THE POWER PROBLEM

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"Free Enterprise was born with man and shall survive as long as man survives."

—A. D. Shroff

1899-1965

Founder-President

Forum of Free Enterprise

THE POWER PROBLEM IN INDIA

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In the context of the relatively longer period taken by all developed countries in accelerating the growth of electrical power in their respective countries, the achievements in India hitherto, reached in a relatively short period of 30 years after independence, must at the outset, be called quite impressive, even after accepting that the base level of usage of electricity in 1950s was very low.

With the exception of a few private generating agencies like TATAS, Ahmedabad Elec. Co., C.E.S.C. etc. all the expansions in the power utility field have been channelised through individual State Electricity Boards (constituted under Elec. Supply Act, 1948), the Central Electricity Authority and its fore-runners, the Atomic Power Authority and the recently established National Thermal and Hydro Power Corporations. All State Boards have completed 25 years of their existence and can be stated to have "come of age."

The installed capacity in 1950 was a mere 1,700 MW, whereas by the end of 1978-79 it has been increased 16 times, to about 26,000 MW. Power generation in the same period had increased from 5 Billion Units to over 100 Billion units—an increase of 20 times.

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* The author is a former Technical Member of the Maharashtra State Electricity Board. This text is based on a lecture delivered by him under the auspices of the Forum of Free Enterprise in Bombay on 8th August 1979.

The KWHR/KW per KW installed, which is presently reckoned as the best possible index of the usage of installed capacity which was around 3,000 KWHR/KW in 1950, is presently around 4,000 KWHR/KW, thereby indicating a better usage of the installed capacities by about 33%.

In the immediate post-independence years, the country was installing Generating Sets of the order of 10 to 20 MW and that too imported ones. A set of the order of 50 to 60 MW was an exception. This picture has radically changed since about 1962. The first Turbo Generating manufacturing plant in the country was established at Bhopal in 1962. Later on additional plants were also installed and were subsequently merged in BHEL, a Governmental Agency, manufacturing not only Thermal Generating plants and equipment, steam and Hydro generating sets, and a host of other equipments required for Power Utilities field. India had also made an early start in the then newly opened field of harnessing nuclear energy for production of power. The country is presently manufacturing almost all of its requirements of Hydro Turbines and Generating Sets, Nuclear Power plants but also Steam Turbo Generating sets and Boilers of capacities ranging from 100-200 MW and is poised for manufacturing similar plants for 500 MW Turbo Generator Sets and Boilers. The first imported 500 MW set is presently under installation at Trombay, which is expected to be precursor to be a number of similar sized indigenously manufactured sets in the next decade.

Besides meeting most of the requirements of Power plants and equipment within the country, BHEL has also earned a good name in the export field and the prospects of securing additional orders appear to be extremely good.

While major transmission voltages adopted in 1950s were of the order of only 100 KV, a few 400 KV EHV transmission sections have already been commissioned in the country and more are under installation.

A major thrust is also in hand in respect of energising the rural community including electrification of agricultural

pumps, lift irrigation pumps etc. which have enabled the country to increase food production within the country whereby self sufficiency in this field has also been possible. Over 250,000 villages have been electrified in the country.

One would have ordinarily expected that India having become self-sufficient in the 1970s in producing all its electrical plant and equipment, including sophisticated high pressure thermal sets and boilers, hydro-electric equipment for all high and low head installations, nuclear power plants as well as key industries like Coal, Railways and others having been nationalised and the power sector being given a very high priority, next only to defence, a solid foundation would have been by now laid, whereby power shortage situations would have been a thing of the past.

In the context of the overall shortage situation available things have apparently not gone the way they should have and one must examine the causes of the present unavoidable situation. One obvious explanation is that it has not been possible to raise adequate resources for pumping them in the essential and vital key sectors such as Power, Coal, Cement, Steel and Railways. The inadequacy of allocations for the power sector in particular becomes immediately noticeable from table I.

It is readily seen from Table I that up to 5th Five Year Plan period, even after spending a total amount of Rs. 33,600 million as against original provision of Rs. 28,440 million, the actual increase in installed capacity was only 16.57 MKW as against anticipated increase of 26.03 MKW. In other words even after spending extra 11% money the shortfall in the capacity realised is as high as 57%. The picture in the 5th Five Year Plan is by no means different, since as against the increase of 16.55 MKW expected in the plan, the actual increase is only 12.75%.

It is seen that experiences gained during the couple of years following the worldwide oil crisis in the years 1973-74 when for the first time, shortage conditions were experienced,

TABLE 1.

CHART SHOWING EXPENDITURE AND SHORTFALL IN TARGETS (ALL INDIA)

Period	Expenses in Million Rupees		Installation capacity in MKW		Shortfall in percentage
	Provision	Actuals	Anticipated increase	Actual increase	
1st 5 Year Plan 1951-56	—	1050	1.30	1.10	15.4%
2nd 5 Year Plan 1956-61	2350	2500	3.50	2.25	35.7%
3rd 5 Year Plan 1961-66	7120	7739	7.04	4.52	35.8%
Plan Holiday 1966-69	6430	6762	5.43	4.12	24.1%
4th 5 Year Plan 1969-74	12540	15550	9.26	4.58	50%
5th 5 Year Plan 1974-76 :					
Generation	33240	47590	16.55*	12.75ϕ	25%ϕ
Distribution	16340				
Rural Electrification	12320	24220			
	61900*	71810			

* Provision for **whole** of 5th Draft plan.

ϕ Actuals in first two years.

though in relatively smaller magnitude in Maharashtra as well as a few other States in the country, have been allowed to be forgotten in succeeding years, when we had continuously a spell of 3/4 years of good monsoon, when the comfortable hydro resources arising out of these good monsoon years in a way created a complacent situation and all concerned overlooked a rather disquieting feature which was steadily appearing on the scene on an year to year basis by way of coal production in the country not keeping pace with the rising requirements of Public Utilities, Railways and other Industrial Sectors. Coupled with this, there were also transport limitations for carriage of coal becoming increasingly more and more predominant, the combined effect of which in turn was to make the situation more and more unmanageable. The efforts being made throughout the world for taking all possible energy saving and energy conserving measures have also not been fully appreciated in our country and we have failed to take any real and effective steps in developing the non-conventional but ever recurring fields of energy, such as Hydel power, Tidal and wind power and also the solar power (which is incidentally available in India in greater abundance).

Since the disposition of hydro sources were not uniformly distributed in the country and thinking that the conventional fuel resources, viz., coal were available in plenty and also fairly well distributed, an over-emphasis was placed on development of thermal generating capacity and over 10,000 MW of thermal capacity was added in the entire country. All the same, the vital input required for operating the thermal stations viz. coal, has been seen to have suffered tremendously. In spite of the total annual coal production having increased from 35 million tonnes in 1951 to over 100 million tonnes in 1978, we have on a number of occasions in the recent past seen situations when major thermal stations in the country were having coal stocks low enough to put their daily generation targets in complete jeopardy.

While the universal practice advocated in the early 1950s and 1960s was to keep stocks of coal of 3 months' require-

ments, progressively these levels by usage were reduced upto 2 and even 1 month. It was a common experience in the years 1972-73 onwards to see that in the pre-monsoon period when due to low lake levels at Hydel stations maximum thermal generation had to be resorted to, coal stocks were reduced to even lower levels and out of sheer necessity a new line of thinking was promulgated that the station away from coal mines need to have about 3/4 weeks' stock only, whereas pithead stations can afford to have 15 days stock and this process continued practically every year thereafter including the present 1976-79 period, viz., that for all deficiencies experienced by Electricity Boards in respect of maintaining adequate stocks of coal at Thermal Power Stations, Railways were blaming coal mines for inadequate stocks at loading points as well as low production in some of the collieries, whereas the Coal authorities in turn were complaining of inadequate wagon allotment for movement of **coal.** Both authorities in turn were pointing fingers at each other and no accurate picture of the actual situation was available to Electricity Boards, although both the Railways and Coal authorities were also simultaneously blaming Electricity Boards for inadequacy of power supplies.

A very quick and brief analysis of the present day shortage situations existing over very large areas of the country and the extent and magnitude of shortage conditions on an year-to-year basis would readily reveal that, by and large, it is a pure and simple case of lost opportunities. This would be obvious from the following broad analysis of different factors which have contributed to the adverse situations of today.

The present stage of development of power field in the country has been primarily occasioned through the establishment of Electricity Boards in each State, set up under the Electricity Supply Act, 1948, who were supposed to be primarily responsible not only for the generation of electricity but also for transmission and distribution thereof, throughout the length and breadth of the State. They were entrusted with the task of not only meeting the total electrical require-

ments of various sectors but also were enjoined to acquire existing generating and transmitting licences on termination of the period of licences under prevailing market conditions, and were expected to manage their system operations on a "No profit—No loss" basis. The Central Government could also initiate appropriate Generating and Transmitting system projects in the Central territories as well as those extending over 2/3 States. Obviously while enough thought had been given by the early planners and enactors to devise an almost foolproof system in respect of machinery for development of electricity there have been some major deficiencies which have led to the existing shortage situation.

One factor is the failure to modify Electricity supply Act (1948) to keep pace with the requirements of Public Utilities so as to enable them to keep one step ahead of the Industrial and other allied requirements. A number of deficiencies have come to notice during the operation of the Electricity Supply Act over the last 30 years, by way of the constitution of Board, Members' tenure, specific role to be played by Electricity Consultative Council, their dependence on State Government for allocation of funds for implementing new projects, their inability to have any equity in the Board's working and to have market borrowings directly as also their inability to work on specified "No profit—No loss" basis under pressures from Governmental and Political authorities, and their consequent inability to raise adequate internal resources for financing of new projects, similar to the practice available with major industrial sectors. In short, there has been over-emphasis on the part to be played by Electricity Boards in respect of developing the relatively underdeveloped and backward areas of the State rather than to meet additional Generating and Transmission projects to satisfy rising needs of the State.

Even though the need for changing Electricity Supply Act has been fully accepted in all quarters, apparently, nothing worthwhile is yet forthcoming by way of actual changes in the Act. It is now high time that Government of India and the States jointly sit together and evolve a

workable pattern of modifications to the Electricity Supply Act.

Another factor is the practice adopted by different States in the appointment of Chairmen and members of their Electricity Boards which has not been uniform. While some States have appointed technical persons as Chairmen, others have appointed administrative personnel from their respective state cadres. The duration of the tenure of the Board has also varied from 2 to even 5 years. Not all these variations can be stated to have been eminently viable or suitable to the actual needs of creating a sense of dynamism that is required for tackling the ever increasing and complex problems of the Board, particularly in the direction of establishing an all-India Electric Grid network, creating a state of self-sufficiency in power and efficient running and management of the respective power systems.

The third factor is inter-State river water disputes. It is now well known that while the tremendous hydro potential available in the country has been largely investigated and accepted, a number of River Valley Projects involving generation of large quantum of power have not yet been taken up for implementation on account of no agreement having been reached between the concerned States with regard to share of the waters, the Agencies who would execute the projects and the sharing of the power generated. The Narmada River Valley Project involving 3 States of Gujarat, Maharashtra and Madhya Pradesh is a case in point.

The fourth factor was the stopping of imports. After its inception BHEL and AVB have gone in for indigenous manufacture of Steam Generating Boilers and Turbo Generating plant for the Thermal, Hydel and Nuclear schemes. They went in for production of sets of 30, 50/60, 100/120 and 200 MW capacities in rapid succession in the period 1962-73, without consolidating the position gained. On the advice of these Agencies, the Government of India took a rather distorted view of the requirements and imposed a total ban on import of plant and machinery for new projects from overseas countries, assuming a state of self-sufficiency

having been reached within the country by then. This step was obviously wrong, as has been proved in the years 1975-79, when the combined effort of BHEL and AVB have not produced adequate Generating Plants to satisfy all the needs of the country. Recently definite imports for captive generating plant have been permitted and this is going to be a pattern for future also.

The total ban on imports around 1973-74 was also understandable in the context of the specific recommendations of the Tiwari Committee appointed for determining specific areas where imports should be permitted, the extent of such imports etc. Had the Government acted on the specific recommendations of this Committee, the present day shortage situations would not have arisen, since about 3,000 to 4,000 MW Generating plants equipment would have been imported from outside and commissioned and that too at considerably lower cost than what is presently required, after the enormous inflationary trends experienced in between.

Valuable technical and operational experience would have also been available not only to the Utilities but also to BHEL and a proper sound base would have been available for future expansion in the power field, based on indigenous technology and with indigenous plant and equipment.

The decision in respect of size of Thermal set taken up for indigenous production as well as voltage level adopted for transmission for a vast country like India with relatively low density that were taken up at different times were also wrong decisions. While the country was needing sets of 100 MW capacity, BHEL chose to produce sets of 30/60 MW and when the country needed sets of 220 MW or even 330 MW capacity, BHEL went in for production of 100/120 MW capacity; when the country was needing 500 KV and higher voltage transmission system, a wrong decision was taken to go in for manufacture of plant and equipment suitable for only 400 KV transmission.

If only a correct decision had been available in the past at appropriate time, the entire power picture in the

country would have been totally different, since with the same physical effort and time, almost double generating capacity would have been available along with appropriate transmission facilities.

The various Electricity Board authorities in the country have on many occasions complained about the nonsequential and delayed deliveries of major plant and equipment—boilers and TG sets—but apart from these, the quality of the plant and equipment supplied has not been upto the mark. On very many occasions newly erected and commissioned plants have had to be shut down to rectify certain obvious design drawbacks and deficiencies. The case of Ennore, Patratu, Kothagudam and the recently commissioned Tuticorin plant are cases in point. Obviously BHEL must pay serious attention to these aspects to enable the utilities to run their system on a trouble free basis.

As at present, with the only exception of M/s. AVB, who are producing only steam generating plant and equipment, rest of the manufacture for steam generating sets, hydel sets and nuclear power plants is solely restricted to one public sector agency—BHEL. BHEL have been known to adopt for a long time a "know-all" approach to their production programme, technical designs adopted and the manner of manufacture and delivery of plant and equipment required at various Power Stations in the country.

What is surprising, however, is that in spite of the above experiences, we still continue to proceed on the same familiar but inadequate pattern, without learning from the past experience. Accepting the need for further technical collaboration with leading manufacturers in the world while undertaking manufacturing of the bigger size sets to be installed at the Pithead Thermal Stations, after protracted correspondence a decision was available to have a tie-up with a German firm and these decisions were taken even at the highest governmental level. As has been reported in the papers all these well thought out decisions have not found favour in certain quarters and the entire agreement which

has been the result of almost 5/6 years protracted discussions has been recently allowed to go to waste.

The Chakravarty Committee in 1974 had clearly opined that their analysis had established beyond any reasonable doubt that coal should be considered primary source of energy to the country, and that the coal resources represents the most valuable and reliable source to the economy, even in spite of quality of indigenous coal being poor and the deposits being uneven in geographical dispersal. In spite of such clear direction, the actual efforts by the nationalised coal industry in developing new coal mines and producing coal equal to the total needs of the country for power sectors, Railways and other industrial sectors have been woefully miserable to meet the needs of the situation. It is now proverbial to say that inadequate production of coal and that too of inferior quality has not only reduced generation of power of different Thermal Stations in the country on a number of occasions, but also that it has in turn affected the running of the trains, production of steel, cement and a number of other essential commodities as well.

It is further surprising that after 5 years and a number of hikes in oil prices and political changes on the domestic front, the new fuel policy committee constituted by Energy Ministry had recently concluded that too much dependence should not be placed on thermal generation in future and that hydro electric potential should be exploited to the full and greater stress placed on non-commercial source of energy like forests, dry dumps, and agricultural wastes.

Had the emphasis on hydro electric power been allowed to be maintained at the same level as it was in late 1960, tremendous hydro potential would have been by now, harnessed in different parts of the country, which could have been then usefully utilised by different Utilities for meeting their rising needs.

Another area, where obvious shortcomings have been noticed, is in respect of linkages of coal from respective mines to specific power stations, especially those far away

from the coalfields. In spite of voluminous and excellent spadework done in the past few years in this direction, in actual practice the linkages specified are not being adhered to and are radically altered from time to time, in times of perpetual shortages now being experienced, thereby leading to complete disruption of the railway transport system and in turn aggravating the situation still further.

It is by now well known that Indian coal is not of good quality and it is imperative that this fact is recognised by the boiler manufacturers in the country and new designs are evolved for consuming available low quality coal, without much wear and tear of the boiler components. Too many times, it has happened that this inferior coal has produced devastating results in the existing boilers throughout the country which have been basically designed on burning superior coal, especially in the case of the stations situated far away from the coal fields. There have been occasions when the boiler plant at certain power stations away from the coal fields, which was imported and designed to burn coal of 5200k.cal/kg and above and with ash content of around 20/25% only, had in actuality to accept coal of as low as 3600 kcal/kg and 35/40% ash content.

Practically all coal consuming sectors, viz. Power, Steel, Cement, Railways, are reportedly expressing their dissatisfaction with quality of coal that is being supplied to them. Things have gone from bad to worse and no remedial situation appears likely in the near future. The plant and equipment is therefore taking a heavier toll in respect of quicker wear and tear. Very little attention is presently being given to this aspect by the nationalised Coal Sector, although one constantly hears talk of improvement.

The supply of right type of coal and in appropriate quantity to the Thermal Power Stations is perhaps the biggest factor contributing to the serious power shortage being experienced in the country.

Apart from the inadequacy of coal required for Thermal Power Stations, shortage of railway wagons is also a

material factor for low level of stocks. It is an equally common experience that at critical periods when the Power Stations are crying for coal, the railways have pleaded their inability to move coal on account of shortage of wagons. The railway wagon production programme is also not adequate for producing all the wagons required for the country, and this has hampered not only the power production programme, but also very directly the collieries production programme and indirectly the targetted productions of the cement and steel industries and further indirectly affected the entire economic growth of this country.

In spite of considerable deliberations and decisions arrived at in this field, no standard layout has yet been evolved for Thermal Set of any size and it is common practice to see every individual authority has its own ideas about the layout they think best and insist that this is adopted elsewhere. This indirectly has delayed design and manufacture as also installation of these sets and delayed pace of quickening development of electrification to that extent, sometimes by as much as even 6 months to one year. It is high time that the country accepts the need for evolving well drawn out universally acceptable standard layout for Thermal Set installations and adheres to it for a period of at least 5 or 10 years, if not more.

The Sub-Committee appointed by Government of India for considering whether Construction Agencies are adequate for execution of all Thermal and Hydel projects in the country has come out with specific recommendations about the inadequacy in this regard in certain sectors. Some of these recommendations are themselves somewhat questionable but what is surprising is that even then Government of India has not yet taken any positive action on these recommendations. Needless to say that if such a situation continues any longer, there would be extreme dearth of well organised, reliable and efficient construction agencies and the entire enlarged programme for subsequent plans would get nullified. This situation deserves highest attention by Government and the appropriate agencies.

It is common practice to see that appropriate decisions on tenders received are not taken within the normal advertised validity period of the tender of say 3/4 months. Occasionally, such decisions are taken after a lapse of 8 months or even more than one year and these delays are invariably in respect of major tenders whereby the entire project gets delayed by corresponding periods.

One of the primary reasons for such delays is non-availability of standard set of commercial terms and conditions for these tenders. Even though considerable work has been done on standardising these, it has not been universally adopted as yet. Too much emphasis has also been laid on the concept of levying penalties in case of default by individual contractors, which by and large, has always remained an academic discussion and in actual practice, no penalties worth the name have been levied. As an alternative to this concept of levy of penalties, concept of payment of bonus on timely completion of work and additional incentives for earlier completion of work needs to be adopted, which it is felt, would considerably help streamlining and quickening construction schedules.

In the last 15-20 years, emphasis has been readily given on extending rural electrification network in the remote corners of the respective States, so as to enable increase of food production and setting up Cottage Industries. While this has already given substantial direct and indirect benefits to the country, more than due attention is paid to this activity of the respective Utilities and in the process, the Electricity Boards have had to suffer on two accounts, viz., low quality of service rendered by them in rural areas as well as their respective economies getting vitiated in the process. The transmission losses are continuing to increase in the context of low load density available in the rural areas, the subtransmission network has not developed according to the needs of the situation, the Utilities are not able to maintain strict supervision on the commercial aspects of the rural distribution and in the process get unnecessary bad name to themselves. It is high time that Rural Electrification Sector gets a fresh look to correct the above obvious

deficiencies which will indirectly help in better and efficient service to all concerned.

While the country had taken an early start in the newly available nuclear power field and it was expected that in about 10/20 years, at least 20% of the power generated would be available from these sources, the actual development of nuclear power sector has not kept pace with the requirements. There is hardly any well defined programme chalked out for setting up additional stations, especially in the context of worldwide apprehensions with regard to the possibility of nuclear proliferation, on which there is a great nationwide debate going on in U.S. and other countries. This source is therefore perhaps not contributing any substantial proportion to the total power requirements.

A number of inter-state, inter-connecting tie-lines have been set up with a view to enable 2 neighbouring states to exchange surplus power with each other in times of emergencies. There has been hardly any worthwhile exchange of power on some of these lines, primarily in the absence of a well defined national commercial policy with regard to tariff applicable in different conditions.

Under political pressures and in order to spread development of electricity in the far-off rural areas various Electricity Boards have not been allowed to raise their tariffs appropriately to enable them to operate their individual systems of "No profit—No loss" basis as stipulated under the Electricity Supply Act. The different State Electricity Boards are also not allowed to raise any equity capital for themselves, and they are made to depend entirely on Governmental loans as well as Public borrowings through the National Institutions such as R.E.C., L.I.C. etc. It is no wonder therefore that very few State Electricity Boards are today making any profit, but are in fact making serious losses and are a drain on Government Exchequer.

Against the reasonably expected target of 6,000 KWHR/KW installed, at Thermal Power Stations the all India average is merely 4,000 to 4,500 KWHR/KW.

Part of this deficiency can easily be traced to poor maintenance apart from other causes such as shortage of coal etc. There have been a number of instances when major Thermal Power Stations in these areas in spite of having 4 to 6 sets with a total capacity of 400 to 500 MW, on individual occasions not even 1 MW was being generated from these stations.

A number of Electricity Boards are complaining of inadequate suitably qualified technical personnel for manning Power Stations. This in turn speaks poorly of their individual capacity to set up Training Centres within their own organisation or to avail of training facilities set up by the Centre in different parts of the country. The plant and equipment installed is taking a very serious toll on account of their being manned by inadequately experienced personnel to handle the ever increasing complex situations arising on day-to-day basis.

A number of Electricity Boards have also been required to handle strike situations extending over prolonged periods

There has been no uniform guidelines set out by Government of India for meeting peak time and energy shortage situations in different parts of the country in different seasons.

A major contribution in the power generation field by private sector is seen to be extremely difficult in view of the magnitude of resources involved. Various States have acquired individual private generating licensees by enacting special laws or ordinance to enable their acquisition and merger with respective State Electricity Boards. A few exceptions are TELCO, AEC, CESC etc. The only private generation now permitted is through small size captive diesl generating sets to meet stand-by requirements of individual industry. Use of such stand-by sets in times of emergencies has been well accepted but the commercial aspects of such generation are not adequately looked after and individual industries making use of such sets are always required to be at the receiving end. This is not very desirable.

Over and above all the above referred lost opportunities, there is one very major and important contributing factor to the present stage of deficiencies in Power Sector, i.e., the planned methodology adopted for creation of additional capacity in the country.

There are very obvious lacunas and deficiencies in this regard and procedures set down for sanctioning of new projects are lengthy, cumbersome and subject to a series of discussions, scrutiny and audit by the Central Government. There are no in-built provisions for slippages as should be the real case in an important sector like Power sector.

Whither Indian Economy?

All present indications point out that the Indian economic situation will deteriorate further and it is felt that tensions that are inevitably generated in such a situation will aggravate. It appears to be a case of structural retrogression directly attributable to the decline of the planning process.

It is obvious that in the context of the results obtained in the previous plan periods, if one has to reach a state of self-sufficiency in the Sixth Plan period, some very drastic and radical solutions will have to be contemplated and acted upon instead of following the beaten track as hitherto.

1. The Power Sector should be given the highest priority, even higher than Defence, along with equal priority to the coal and railway industry.

2. Establish with immediate effect Central Electricity Generating Board, duly supported by Regional Electricity Boards with executive authority (instead of present Regional Electricity Boards which are merely supervisory type bodies).

The individual State Electricity Boards shall then be left with the responsibility of transmission and distribution

of Electricity received from Central Generating Board within the individual States.

3. Delink the planning for Power Sector from the individual 5 Year Plan periods. In other words, ensure that the planning for new generation schemes shall be on continuous and rolling basis.

4. Ensure that every year minimum requirement of additional Thermal/Hydel/Nuclear power capacity shall be fixed and adequate number of projects are actually sanctioned for implementation taking into account, sufficiently in advance, all relevant aspects to take care of preliminary actions in respect of land surveys etc., as also average implementation periods of such schemes (based on the results of past 5 to 10 years' performance) and, also usual slippages experienced and the fact that new sets get stabilised actually in the 3rd year of operation.

5. Institute a national dialogue to determine the proper Hydro-Thermal-Nuclear mix for Electricity Industry to suit Indian conditions.

6. Harness all Hydel schemes with topmost speed through Central Electricity Generating Board by settling all Inter-State River Water disputes in a definite period of say 5 years, and also implement various local Microhead Hydel schemes to take maximum advantage of such recurring source of energy.

7. The Central Electricity Generating Board shall in turn meet the full requirement of power of individual States at selected points, through existing Electricity Boards who will be responsible for merely transmitting and distributing energy so received to various subcentres in the State as per requirements.

8. Establish with immediate effect additional manufacturing capacity for Thermal/Hydel/Nuclear sets in competition to existing agencies such as BHEL, AVB etc. This

suggestion is even otherwise necessary, in view of the established fact that the existing manufacturing capacity in the country is inadequate to meet with the expected capacity additions in the immediate future.

9. In view of the limited consultancy expertise available in the country, set up additional independent consultancy agency through expertise available in the form of senior, experienced and competent retired engineers of different Electricity Boards.

10. Establish adequate number of additional Construction Agencies to implement the programme set and as per definite time schedules that are expected.

11. Import about 4,000-5,000 MW of Thermal-cum-Hydel generating plant and equipment from world sources and allocate the same to different project centres as per requirements. A definite programme will have to be chalked out for commissioning this capacity in a matter of next 5 years or so and no slippages should be permitted under any circumstances. It would be worthwhile to note that as at present India has extremely favourable foreign exchange reserves available for utilisation.

12. Along with the import of 5,000 MW generating capacity as above, about 25,000 to 30,000 railway wagons for transporting will need to be imported, in a manner similar to import of steel and cement which are in short supply as at present.

13. For meeting the shortfalls in coal production, import for the next 5 years about 10 million T. coal per year from all available sources.

14. Having determined the various locations for installing additional capacity, instead of following the normal process of tender adopted previously, go in for negotiated tenders with reputed construction agencies who can be depended upon for erecting plant and equipment as per

prescribed schedules and on the basis of bonus concept to serve as appropriate incentive for speedy implementation.

15. Define and try out a proper programme for development of new coal mines adjacent to Super Thermal Power Stations being set up in the country and ensure adherence to keep pace with developments of individual Super Thermal Power Stations.

16. Ensure appropriate extensions to existing railway lines, especially appropriate railway sidings to such of the collieries as do not have appropriate railway sidings etc.

17. To supplement efforts of the nationalised Power Industry, promote local captive generation by industries or group of industries and/or co-operatives, either in the form of major diesel capacity or even thermal/hydel sets to serve groups of industries. Similarly, captive generation by coal and railway industry should also be encouraged.

18. It might even be necessary to give attractive incentives to the private industry, through very low interest rate loans. Alternatively, industry should be asked to set aside certain share of the capital expenditure from their project costs for diverting it to the Public Utility for implementing their power additions programme, in return for guaranteed supply in due course for their individual requirements.

19. Instead of serving all remote and inaccessible rural areas in different States through grid power, examine possibility of developing other non-conventional sources such as tidal or wind power, bulb type hydel stations or even solar power, wherever possible, so as to avoid the burden caused by such unbalanced rural development on individual utility systems.

20. Ensure that there is no conflict between industrial and rural sector requirements which is presently seen to be detrimental to both of them in many respects.

21. Adopt standard layouts for plant and equipment in greater extent than has been practised hitherto and ensure strict adherence thereto.

22. Establish within minimum possible time appropriate all-India grid with appropriate inter-connections between major thermal-cum-hydel stations of the country, by transmission lines of voltages higher than 400 KV. Adoption of 750/1,000 KV as next higher step of voltage as also high voltage DC transmission will have to be considered in this respect with immediate effect.

23. Promote free import of improvements in technology available throughout the leading plant manufacturers and utility systems to enable Indian Utility Industry to keep abreast of the world development.

24. Improve quality of end usage equipments such as improved design induction motors etc.

25. Revamp existing State Electricity Boards by making them a set of professional experts with appropriate representations from Industrial and Agricultural Sectors, instead of present practice of appointing administrative personnel or non-official but political personnel as members of such Boards.

26. Take appropriate and urgent steps to train adequate number of technical personnel in the Power sector in view of large expansion programmes.

27. Initiate appropriate incentives for different State Electricity Boards and Power Utilities as well as individual Power Stations to optimise their generation programme so as to exceed even the present targets of 6,000 KWHR/KW through improved plant operation and maintenance methods, as also resorting to various other measures such as staggering of holidays, staggering of recess hours etc. thereby flattening of daily load curves.

28. Resort to maximum number of waste heat recovery methods and systems.

29. Establish full co-ordination between all key sectors, such as Power Utilities, Railways, Coal, Cement, Steel and other authorities as well as major manufacturing units such as BHEL, AVB and others so that the power installation and operation programmes do not suffer as at present and in turn the individual sectors also keep up to their respective targets of production.

30. Increase the allocation for research and development efforts from the present 1.5% to at least 5% and intensify search for alternate sources of energy—solar, geothermal, microhydel, gobargas etc.

31. Immediately set up Power Finance Corporation at national level for financing future generation projects instead of present method of routing approvals and allocations of funds through Planning Commission.

The above suggestions, if immediately implemented, can reasonably improve the unsatisfactory power situation only after 5/7 years, when the first batch of additional generation projects are likely to be commissioned. The immediate outlook during early 1980's therefore appears to be definitely bleak and various effective measures have to be drawn out for meeting shortage situation during the next 5/10 years at least.

II

M. S. PADMANABHAN*

Little over three decades back, when India attained "freedom at midnight", the installed capacity of electric power was about 1,500 megawatts; since then, it has increased to about 26,000 megawatts as on mid 1979. Curiously, when capacity was low in late 40s, there was not much talk of shortage of power, no outcry against 'powerlessness'. But now, no day ever passes without some report, some criticism, some seminar, on the shortage of power; in fact, it has become a crucial issue—more crucial than even food!!

What is this phenomena due to? Has the demand outstripped capacity? OR, is there a mis-match-power available in one area and demand grows in another area and both cannot be linked due to political, administrative and technical reasons? OR, is the utilisation of installed capacity below par? While one should aim at using the capacity for 6,000 hrs. in a year of 8,760 hrs. giving thereby an utilisation factor of little less than 70%, the average had touched 56% though it had slumped down to less than 50% in the last many months.

Out of the three reasons for the Power Problem, the last one, namely, the poor utilisation is the main cause for the

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* The author is a technical director of a private company and was earlier with BHEL as an Executive Director. This text based on a lecture delivered by him under the auspices of the Forum of Free Enterprises in Bombay on 8th August 1979.

present travail— "the villain of the piece". The other two have not contributed massively to the present crisis. Yet, lest they should in the future, they must be foreseen and action taken, in time. The portents are, that demand will rapidly out-pace the supply, creating acute shortage which, in turn, will strangulate the growth of economy in the coming decades.

The utilisation depends upon a number of factors.

Low loads at certain hours of the day, or, certain periods of the year lead to lower utilisation. Preventive maintenance and, in certain nuclear power stations, refuelling, necessitate putting the plant out of action for a period which is attempted to be kept to a minimum.

While the above are outcome of deliberate decisions to take the plant 'off the line', there are others which are forced outage. Inadequate or total lack of input—coal or oil in case of thermal and water in case of hydro—has affected continuous operation. So also breakdowns arising out of low quality fuel (e.g. coal with high ash); poorly made plant and machinery; inexperienced operation and maintenance; and at times, negligence and indiscipline.

A reference has been made to preventive maintenance. Over the last three decades, India has acquired generating plants practically from every known manufacturer in the world: it has almost become a museum of power plants. Firstly, they are all ageing and before long, may need extensive overhauling; secondly, need for spare parts. Can the manufacturing units, meet this challenge? The difficulty arises because these units have been established to suit technology of one or other foreign collaborator and unless special efforts are made, this problem may not be readily solved.

Low loads at certain hours of the day will be a fact of life for considerable future. Worse still, total interruption

of load for short duration; and "overcrowding" at certain times resulting in the lowering of frequency—will all be, not, rare exigency, but a normal feature for a long time to come. Do the borrowed designs to which our generation plants are being made, take account of these factors—two shifts and not continuous operation; protracted operation on low loads; hot restart; higher frequency tolerance are some of these factors.

Similar is the case with input—mainly coal. Too frequently complaints have been voiced that high ash content in coal is the main cause for the poor performance of power stations. What has gone wrong? Have the plants themselves been wrongly designed and made OR wrong coal is being used. Perhaps, at the time of ordering the equipments, none knew for certainty as to what coal will be used and what will be its ash content

Yet another possibility has to be kept in view—multi-fuel operation, i.e., coal, oil, or gas. This may become a normal feature since uncertainty of input may persist.

Differences of opinion, becoming almost sensitively controversial, have existed over the strategy of deciding upon the equipments especially the critical generating plants —should the utilities be given facilities to import them from proven and well established sources; or, should they solely depend upon indigenous manufacturers, who have very limited experience in making, though all of them are tied up with good foreign manufacturers as collaborators. Which will be in short-term interest and which, in long-term interest, of the country?

Indigenous manufacturers are all making to borrowed designs, well proven. But the manufacture in a big way started only during the latter half of 60s especially for generating plants. Transfer of technology, its assimilation and development of good expertise/skill have still "many

miles to go" to cause less number of faults at erection, commissioning and operation and thus infuse confidence in the users.

The principal manufacturers of the main plant suffer another handicap. The supporting industries on whom they depend for the material and components are also equally new to these products. If they fumble or grope, the main makers have no better know-how—borrowed or own—to guide them. This problem assumes more serious proportions when auxiliaries (like pumps, small motors, instruments, controls etc.) which are invariably supplied by different sources, start mis-matching.

The plants and equipment that go on the transmission and distribution side, like transformers, switchgears etc. have not given cause for anxiety; in other words, have not contributed to "Power Problem". To a great degree the same is true with generating plants of hydel stations. It is gratifying to note that their manufacture in the country have been successfully established. However, all of them are to borrowed designs of foreign collaborators.

We are still a novice in the game of making and introducing into service the generating plants of thermal stations. Added to this, there had been too rapid an increase or change in the size and type—from 30 MW to 60, 100, 110, 120, 200, 210 and now 500 MW. This has its own problems and will impose a severe strain and challenge to engineers. Perhaps, there is no other option, considering the country's need.

The last two decades of this century are likely to witness a worsening of "power problem" due to acute shortage —demand gallopping at a much faster rate than the supply can cope up with. Augmenting the capacity at a rapid rate is warranted. Decision making and following it up with finding and allocating of resources, is very tedious and

labourious—complicated further by political overtones. Implementing them which includes ordering, designing, making, erecting and commissioning go widely off any reasonably planned schedules. Due to varieties of reasons, manufacturers of both the main and auxiliary/ancilliary plants and equipments are not able to keep to time; nor any organisation to plan, co-ordinate and erect them fast at the sites. Competence, essentially one of management and organisation has to be developed.

With the experience that has been gained, the criticism that has been faced, the new breed of engineers will rise to the occasion and successfully acquit themselves over the years to come.

The views expressed in this booklet are not necessarily the views of the Forum of Free Enterprise

"People must come to accept private enterprise not as a necessary evil, but as an affirmative good".

—**Eugene Black**

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