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Development of Thermal Power

By

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HISTORY OF POWER DEVELOPMENT

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At the time of independence on 14th August, 1947, the power position in the Punjab became serious as the Mandi hydro electric power station of 48 MW capacity which was the main source of power and located in the Kangra Valley fell to the lot of India. Thus the Punjab had to depend mainly for their power supply on India.

There were, however, private electricity undertakings at Lahore, Rawalpindi, Multan and other smaller towns, but these were feeding isolated loads in their areas of reticulation.

In the N.W.F. Province, there was the Jabban hydro electric power station of 9.6 MW located on the Upper Swat Canal. In this Province as well, there were private electricity undertakings at Dera Ismail Khan and Bannu having small Diesel generating stations.

In Bahawalpur State, there existed a small Diesel generating station of 318 KW capacity owned by the State.

Soon after independence, the Government of Pakistan took serious note of the delicate power position and planned new power stations in the northern areas.

Work on Rasul hydro electric power station of 22 MW capacity was expedited and the same was completed in 1952. Montgomery steam power station of 6 MW capacity was constructed and completed in 1955. At Lyallpur a steam station of 8 MW capacity was also constructed.

In the N.W.F. Province, the Jabban hydro electric power station was extended by 10 MW and another hydro electric power station of 20 MW capacity was constructed on the Swat Canal at Dargai, downstream of Jabban.

In Bahawalpur State, small Diesel generating stations varying between 200 lKW to 650 KW capacity were set up at Ahmedpur, Rahimyarkhan, Khanpur, Chistian Mandi and Bahawalnagar.

As already stated earlier, these stations were more or less feeding isolated loads and were not running in Parallel except Jabban and Dargai hydro electric stations in the NWF Province.

Integration of the Provinces took place on 14th October,1955, into one Province of West Pakistan. It was then realised that though there was an overall shortage of generating capacity yet the position could be very much improved if the isolated systems could be run in parallel and formed into a grid system as some of these systems like Jabban-Dargai and Montgomery had surplus power.

In January, 1956, the Jabban-Dargai system was paralleled with Rasul hydro electric system and a grid was evolved. Subsequently other generating stations were also connected to the newly evolved grid system.

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Later on, more power stations were constructed, both hydel and thermal. In the north a hydro electric power station was built at Warsak on the Kabul River having four machines each of 40 MW capacity. Almost at the same time a thermal station having two machines of 65 MW capacity each was built at Multan. Simultaneously a grid system comprising of 461 miles of 132 KV double circuit line was built extending from Warsak to Lyallpur connecting major grid stations of Peshawar, Wah, Rawalpindi, Gujranwala, Kala Shah Kaku, Kot Lakhpat; Lyallpur, Ludewala and Daudkhel. The new 132 KV grid system was connected with Multan Thermal Power Station with a 220 KV Transmission Line.

With the construction of Mangla Hydro Electric Power Station having ultimate capacity of 800 MW, Multan Thermal Station extended by another two steam units of 65 MW each, Thermal Station at Faisalabad having two steam units of 66 MW each and eight gas turbines each of 25 MW, Sukkur four steam units each of 12.5 MW, Hyderabad steam units with gas turbine 43 MW, Kotri Gas turbines 130 MW, Warsak Hydel two units of 40 MW each, Quetta steam and gas units of 83 MW, Guddu four steam units of 640 MW and gas turbines of 400 MW, Tarbela Hydel Power Station with ten units each of 175 MW the total generation capacity went upto 4949 MW out of which Thermal generation was 2052 MW. The detail is enclosed at Table-1.

The length of transmission lines of 500 KV, 220 KV, 132 KV & 66 KV constructed upto 30.6.1985 is 19347 KM. The details are at Table-2.

The number of grid stations in service as on 30.6.85 were 457 with total capacity of 14493 MVA. The details are at Table-3.

TABLE-1

INSTALLED CAPACITY AND EFFECTIVE CAPABILITY

(A) — HYDEL (IN M.W.)

Sr. No.	Name of Power Station	Date of Commissioning		No. and capacity of Units	Total Installed Capacity	Effective Capability	
						Maximum	Minimum
1.	Tarbela	May	1977	2x175			
		June	1977	1x175			
		July	1977	1x175			
		Aug.	1982	1x175	1750	2000	750
		Oct.	1982	1x175			
		Dec.	1982	1x175			
		Feb.	1985	1x175			
		May.	1985	1x175			
2.	Mangla	July	1967	2x100			
		March	1968	1x100			
		June	1969	1x100	800	920	400
		Dec.	1973	1x100			
		March	1974	1x100			
		June	1981	2x100			
3.	Warsak	May	1960	2x40			
		June	1960	1x40	240	240	80
		July	1960	1x40			
		March	1981	2x40			
				Sub Total :	2790		
4.	Dargai	April	1954	4x5	20		
5.	Malakand		1938	3x3.2	20		
			1951	2x5			
6.	Rasul	May	1951	2x11	22		
7.	Chichoki	May	1959	1x4.4			
	Mallian	June	1959	1x4.4	13	70	40
		Aug.	1959	1x4.4			
8.	Shadiwal	June	1961	2x6.75	13		
9.	Nandipur	March	1963	3x4.6	14		
10.	Kurram Garhi	Feb.	1958	4x1	4		
11.	Renala		1925	5x0.22	1		
				Sub Total:	107	(Small Hydels)	
				TOTAL HYDEL :	2897	3230.	1270

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(B) THERMAL

(IN M.W.)

Sr. No.	Name of Power Station	Date of Commissioning	No. and Capacity of Units	Total Installed Capacity	Effective Capability
1.	Multan Steam	June 1960	2x65	260	240
		Dec. 1963	2x65		
2.	Faisalabad Steam	June 1967	1x66	132	120
		Nov. 1967	1x66		
3.	Faisalabad	March 1975	2x25		
	Gas Turbines	June 1975	2x25		
		Sept. 1975	1x25	200	195
		Oct. 1975	2x25		
		Nov. 1975	1x25		
4.	Shahdara Gas	Aug. 1966	2x13.25	85	70
	Turbines	Oct. 1969	4x14.75		
5.	Guddu Steam	March 1974	1x110		
		Oct. 1974	1x110	430	400
		Dec. 1980	1x210		
6.	Sukkur Steam	March 1965	2x12.5	50	40
		April 1967	2x12.5		
7.	Hyderabad Steam	May 1960	2x7.5		
	(Gas Turbine		1x5.7		
	Auxiliary)	June 1965	1x8	43	30
			1x15		
8.	Kotri Gas Turbines	Feb. 1970	1x15		
		Apr. 1970	1x15		
		Dec. 1978	2x25	130	121
		May 1981	2x25		
9.	Quetta (Steam)	Sept. 1964	2x7.5		
	Gas Turbines	May 1972	1x7.5		
		June 1973	1x12.25	95	75
		Jan. 1975	1x25		
		Nov. 1984	1x35		
10.	REPCO (Takenover) Steam	May 1981	1x1.5 1x2.0 1x2.28 1x3.30	9	9
11.	MESCO (Takenover) Steam	May 1981	2x10	20	20
		Sub : Total	Thermal	1454	1320
		TOTAL Thermal + HYDEL		4351 MW	

TABLE-2

LENGTH OF TRANSMISSION AS ON 30.6.1985

(Kilometer)

VOLTAGE	PUNJAB	SIND	N.W.F.P.	BALUCHISTAN	TOTAL
500 KV	849	438	–		1287
220 KV	954	250	76	152	1432
132 KV	5004	2163	1061	1011	9239
66 KV	4901	1329	896	263	7389
TOTAL:	11708	4180	2033	1426	19347

TABLE-3

IN SERVICE GRID STATIONS AS ON 30.6.1985

	500 KV*		220 KV**		132 KV		66 KV		33 KV		TOTAL	
	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity
PUNJAB	1	900	6	2213	148	5211	125	1584	–	–	280	9908
SIND	–	–	2	450	48	1092	31	924	–	5	81	2471
N.W.F.P.	–	–	1	346	27	751	38	397	–	–	66	1494
BALUCHISTAN	–	–	1	173	17	325	11	109	1	13	30	620
TOTAL	1	900	10	3182	240	7379	205	3014	1	18	457	14493

* Gatti (Faisalabad)

** Burhan, Faisalabad (Jaranwala Road), Fisalabad (Nishatabad) Ghakkar, Kalashah Kaku, Lahore (New Kot Lakhpat), Mardan, Sibbi, Dadu and Jamshoro.

NECESSITY OF THERMAL GENERATION

Our power generation is hydel oriented. It is more economical as compared to thermal generation. Two main sources of hydel power are Mangla and Tarbela.. They were built under Indus Water Treaty. They are meant primarly to provide replacement of Irrigation water, originally available from Ravi, Beas and Sutlaj Rivers. The operation of these dams is subject to the irrigation requirements which over ride power consideration. As such the power capability position becomes critical in end December and January when severe restrictions are imposed on the release of water from the two reservoirs as a result of reduced irrigation demands. From February onwards the restrictions become less severe but even then the releases allowed are far less than what is required for utilizing the available power capability. This situation continues. right through till end of March. There is a brief period of respite, before the summer months of May and June when generating capability of Tarbela Power Station gets drastically reduced as a result of depletion of the reservoir, which drops to its minimum generation level in these months. This seasonal reduction in hydel generation output lowers the firm capability of the country by about 50% and Load Shedding is the obvious result, Load shedding is not only a social inconvenience but it also lowers the Industrial and Agricultural output and ultimately effect the economy of the country.

Hydel generation being not dependable during low water months i.e. January to June, and to meet with the growing demand for electricity envisaged in future it became imperative for WAPDA to construct thermal power stations due to their short installation time and steady supply throughout the year. Although there are handicaps like development of resources and arrangements of finances, still a number of schemes are presently underway to meet the power shortage. Brief description of ongoing and future thermal projects follows.

1. 210MW STEAM TURBO-SET GUDDU UNIT-4.

The object of this project is to install at Guddu a steam turbo-set unit of 210 MW to provide thermal support to Hydel generation and to meet the rapidly growing demand for power in the country.

The total cost of the project is Rs. 2040/- million with a foreign exchange component of Rs. 716/- million. The contract for the supply, installation, testing and commissioning of 210 MW Steam Turbo-set was awarded to M/s. CMIC of China. The Foreign Exchange cost of the project has been financed by supplier's credit amounting to US$ 48.309 million made available by M/s. CMIC of Peoples Republic of China. The Chinese contractor has expedited the commissioning a little ahead of schedule. The unit started supplying power on trial basis from December,1985 and was put into commercial operation on 4th February, 1986. At present it is running under warranty period.

2. 450MW COMBINED CYCLE POWER STATION GUDDU.

The project includes installation of a 450 MW Combined Cycle Power Plant at Guddu in two phases, 1st phase comprises of 4 Gas Turbines of 100 MW nominal rating each, alongwith 220 KV sub-station facilities. The 2nd phase consists of 2 Steam Turbines of nominal rating 100 MW each. Also included in the project is 20'' diameter about 60 KM gas pipe line from Mari gas field to Guddu, for supply of Mari gas to Guddu Thermal Power Station.

The total cost of the project is Rs. 4450/- million including a foreign exchange component of Rs. 2345/- million. The project is being financed by Asian Development Bank and US-AID jointly to the extent of US$ 140.9 million and US $ 52.0 million respectively.

M/s. General Electric USA was awarded the Contract for supply, erection, testing and commissioning of four gas turbo-sets. While the Contract for supply, erection, testing and commissioning of Power Transformer and 220 KV Switchyard was awarded to M/s. Imperial Construction

Company (Private), Ltd., Lahore Pakistan. The major erection work in Phase-I of gas turbines and 220 KV switch yard has been completed.

The units have been put into commercial operation on the following dates:

PHASE—I

Gas Turbines :	Unit-1	5-1-1986
	Unit-2	15-4-1986
	Unit-3	20-3-1986
	Unit-4	27-4-1986

The work of lying the pipeline was awarded to M/s. Petrocon a Pakistani firm. The construction of the line has also been complted.

PHASE-II

The main objective of the second phase of the project is to utilize the heat from the exhaust gases of the combustion turbines and generate 200 MW power from the same. This will greatly improve the thermal efficiency of the power plant. This technology of combined cycle is being experienced in Pakistan for the first time. The contract of the project, consisting of 4 waste Heat Recovery Boilers and two steam turbo-sets, has been awarded to M/s General Electric U.S.A. on 19.3.1986. The contractor has already mobilized at site. The tentative commissioning date is January, 1988.

3. 400 MW GAS TURBINE POWER STATION KOT ADDU UNITS 1 TO 4.

The project provides for installation of 4 Nos. Gas Turbine-Sets of nominal rating of 100 MW each at Kot Addu alongwith sub-station facilities to give the needed thermal support to hydel oriented generation and to meet the fast increasing demand for power.

The total cost of the project is Rs. 2715/- million including a foreign exchange component of Rs. 1419/- million. The project is being financed jointly by M/s. KFW West Germany and the Italian Government to the extent of DM 108 million and DM 145 million respectively.

The contract for supply, erection, testing and commissioning of gas turbine units 1 and 2 has been awarded to M/s KWU, West Germany and gas turbine units 3 & 4 to M/s GIE/FIAT Joint Venture of Italy. About 90% of the material and equipment of the project has reached at site. The erection and installation of the units is in full swing and the units are expected to be commissioned as per schedule.

The scheduled commissioning dates are as follows:

Unit No. 1 & 3	November 1986
Unit No. 2 & 4	January 1987

4. 400 MW GAS TURBINE POWER STATION EXTENSION KOT ADDU UNITS 5 TO 9

The project involves installation of four gas turbines of approximate nominal rating of 100 MW each, to meet the repidly growing demand for power in the country.

The total estimated cost of the project is Rs. 3400/- million including a foreign exchange component of Rs. 2000/- million.

Tenders for the supply, erection, testing and commissioning of 4 Gas Turbo-Sets on open financing basis were received and opened on 30-4-1986 and are under evaluation.

The expected commissioning dates of various units of the project are as below:–

Unit No. 5	November,1988
Unit No. 6	December, 1988
Unit No. 7	January ,1989
Unit No. 8	February ,1989

5. 200 MW COMBINED CYCLE POWER STATION KOT ADDU

The project involves installation of the steam turbo-generators of approximate capacity of 100 MW each, alongwith Four Heat Recovery Boilers, which would be operated in conjunction with the Four 100 MW each Combustion Turbines presently under installation at Kot Addu. In addition,construction of a single circuit 220 KV transmission line from Multan to Kot Addu along-with associated sub-station equipment is also included in this project.

The main objective of the present development scheme is to utilise heat from the exhaust gases of the combustion turbines and generate 200 MW power from the same. This will greatly improve the Thermal efficiency of the power plant. The project is included in the sixth Plan Generation Programme. The estimated cost of the project is Rs. 2800/- million with foreign exchange component of Rs. 1408/- million. CDWP has recommended the scheme for approval in its meeting held on 30.3.1986.

A loan agreement for an amount equivalent to US $ 90.00 million has already been signed with World Bank.

The Tender Documents for International bidding will be issued in September 1986, and the project is expected to be operative early in 1989.

6. 3 x 210 MW STEAM POWER STATION EXTENSION MULTAN UNITS 5,6, & 7.

The project comprises of installation of three steam turbo-sets of 210 MW capacity each as an extension to the existing Multan Power Plant.

Executive Committee of National Economic Council (ECNEC), in its meeting held on 15-2-1986, has approved the scheme for an estimated cost of Rs. 8568.00 million including a foreign exchange component of Rs. 3871.44 million.

This project will be constructed with the assistance of Soviet Union. A protocol for credit financing of the Project has already been signed between the Government of Pakistan and U.S.S.R.

The Soviet experts are presently preparing a Detailed Project Report for plant. The units are tentatively scheduled for commissioning as per following programme:

Unit No. 1	October, 1990
Unit No. 2	April, 1991
Unit No. 3	October, 1991

7. OIL FIRED THERMAL POWER PLANT JAMSHORO UNIT NO.1.

The main object of the project is to instal 200/250 MW generating capacity steam turbo-set alongwith 220 KV sub-station facilities at Jamshoro to provide Thermal support to meet the increasing demand for power.

The total cost of the project is estimated at Rs. 3530 million including a foreign exchange component of Rs. 1660 million. The foreign Exchange Cost of the project is being financed through a soft loan extended by the Government of Japan. A loan agreement for Japanese Yen 22 736 billion has already been signed.

Tenders for supply, erection, testing and commissioning of Power Plant equipment and related auxiliaries have been received and an Award will be announced shortly. The unit is scheduled for commissioning in October 1989.

8. JAMSHORO UNITS 2 & 3

During visit of Prime Minister of Pakistan to China, an agreement was signed with the Chinese for installation of two steam units at Jamshoro with a capacity of 210 MW each on negotiation basis. The documents required for negotiations have been handed over to M/s CMEC and their mission is expected to visit Pakistan soon alongwith price package. The contract is expected to be negotiated and signed by the end of 1986. Tentative schedule of commissioning is Dec. 1989 and April,1990.

9. JAMSHORO UNITS 4, 5 & 6

There is a planning of installing three more steam units of capacity 300-400 MW at Jamshoro on Furnace Oil. Possible financing will be for World Bank, USAID and ADB. Feasibility report was prepared by M/s NESPAK and is being assessed by M/s BE CHTEL National Inc. The studies also include lying of fuel pipeline from Karachi to Jamshoro and Jamshoro to Kotri. Two units are expected to be commissioned by end 1990 and third unit by end 1991.

10. FAISALABAD AND KOTRI COMBINED CYCLE PROJECT

Conversion of simple cycle gas turbines at Faisalabad and Kotri to Combined Cycle has been planned and Thermal rehabilitation scheme. 80 MW Steam Units are planned at Faisalabad and 40 MW at Kotri. These are scheduled for commissioning during February, 1990.

11. ADDITIONAL COMBUSTION TURBINES (200 MW)

It is proposed to install two more combustion turbines of 100 MW each in the system by December, 1989 in order to meet projected demand before January, 1990. These units would perform peaking duty. The location of these turbines has yet to be decided, and final recommendations in this respect will be formulated after looking into various factors such as availability and supply of fuel, constraints of the power system, and availability and supply of space etc.