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A STUDY THE TECHNICAL PERFORMANCE OF POWER SECTOR IN TAMIL NADU, DURING THE YEAR 1986-87 TO 2013-14

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Abstract
The researcher has made an attempt to study the Technical performance of power sector in Tamilnadu. Technical efficiency in generation in general is determined by plant availability, which in turn is determined by forced outages, by plant load factor (PLF), as also by auxiliary consumption. Considerations of plant availability factor and PLF are usually associated with analyses of technical efficiency only of thermal power plants.

1.1 Introduction

The researcher has made an attempt to study the Technical performance of power sector in Tamilnadu. Technical efficiency in generation in general is determined by plant availability, which in turn is determined by forced outages, by plant load factor (PLF), as also by auxiliary consumption. Considerations of plant availability factor and PLF are usually associated with analyses of technical efficiency only of thermal power plants.

Forced Outage Rate

Forced outages occur when a unit is thrown out of service due to unexpected causes such as breakdown, equipment malfunction etc, and are usually of a random nature. These outages generally be all on the operation side in generators, boilers, turbines, and their auxiliaries. There are also electrical and mechanical forced outages, due to the poor quality of fuel, wet coal being supplied, and lack of timely and proper maintenance practices that cause. Grid system faults, which are always avoidable. Units are also shut down at times for planned preventive maintenance, intended to ensure their proper running conditions, and also due to lack of adequate system load and of water in reservoir in the case of hydro plants. Hydro plants are generally expected to be much less prone to forced outages than thermal plants and their availability is expected to be open always and at maximum subject to firm power capacity constraints.

The details about the forced outage rate of thermal power stations in the first period under study are given in Table 1.1

Table 1.1: Forced Outage Rate of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1986-87	35.70	8.70	--	84.50	25.51
1987-88	23.90	5.70	--	54.60	19.82
1988-89	40.60	16.30	--	44.50	29.24
1989-90	30.40	16.70	--	42.00	23.58
1990-91	32.90	22.80	--	44.40	30.70
1991-92	40.10	25.71	--	47.38	36.10
1992-93	31.34	21.00	--	32.57	28.46
1993-94	35.50	19.53	--	19.43	30.80
1994-95	27.74	26.26	--	18.90	23.92
1995-96	27.15	12.75	--	12.79	15.53
1996-97	32.80	15.40	16.15	12.90	19.95
1997-98	29.90	4.80	12.90	16.77	21.17

Source: Statistics at a Glance, TNEB, Various years.

It is noticed from Table 1.1 that the forced outage rate of Ennore thermal station was high at both the periods. It was decreased from 35.70 per cent in the year 1986-87 to 29.90 per cent in the year 1997-98. In the first period forced outage rate of Tuticorin thermal station fluctuated between 15 to 25 percent. The forced outage rate in Tuticorin and Mettur thermal stations also fluctuated during the study period. The forced outage rate in all thermal stations was 25.51 per cent in 1987-88 and it was decreased to 21.17 per cent in the year 1997-98.

Table 1.2 presents the details about the forced outage rate of thermal power stations in the second period under study.

Table 1.2: Forced Outage Rate of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1998-99	34.40	24.40	16.69	19.74	22.96
1999-00	49.20	16.60	9.63	10.74	21.55
2000-01	71.20	12.10	11.58	7.52	25.60
2001-02	52.20	10.90	6.36	9.19	19.70
2002-03	36.70	10.24	11.58	7.15	16.42
2003-04	54.50	12.60	13.84	9.00	22.50
2004-05	54.60	9.90	24.81	7.23	24.10
2005-06	75.38	13.50	24.24	9.51	30.67
2006-07	60.21	17.52	21.69	10.22	25.47
2007-08	57.45	14.33	27.33	11.15	18.36
2008-09	58.14	18.00	20.47	17.33	13.90
2009-10	57.36	12.33	19.24	14.65	17.34
2010-11	65.22	16.22	21.39	13.36	18.35
2011-12	56.00	19.78	17.33	18.66	21.89
2012-13	45.36	16.89	19.63	15.47	23.05
2013-14	59.14	18.33	20.17	10.39	22.39

Source: Statistics at a Glance, TNEB, Various years.

It is inferred from Table 1.2 that the forced outage rate of North Chennai thermal station was around 12 percent. In the second period in last two years it increased to 24.24 percent. In Mettur thermal power station forced outage rate was more in the first period and it declined in the second period to 9.51 percent in 2005-06 and increased to 10.39 per cent in 2013-14. The forced outage rate of all thermal stations was above 20 percent in both periods. From 2003-04 to 2005-06 the forced outage rate increased to 30.67 percent. This was due to supply of poor coal. Forced outage rate of thermal station in general was around 20 percent.

Plant Availability

Plant availability factor is defined as unity less planned maintenance rate (PMR) less forced outage rate (FOR); i.e., availability = 1- (PMR+ FOR) [2]. If the forced outage rate was higher the available capacity will be low.

The details about the plant availability of thermal power stations in the first period under study are given in Table 1.3

Table 1.3: Plant Availability of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1986-87	64.30	80.30	--	15.50	74.49
1987-88	76.10	80.00	--	45.40	80.18
1988-89	71.80	83.70	--	54.40	70.76
1989-90	69.60	83.30	--	58.00	76.42
1990-91	67.10	77.20	--	55.60	69.30
1991-92	59.90	74.29	--	52.62	63.90
1992-93	68.66	79.00	--	67.43	71.54
1993-94	64.50	80.47	--	80.57	69.92
1994-95	72.26	73.28	--	81.10	76.08
1995-96	72.85	87.25	--	87.21	84.47
1996-97	67.20	84.60	83.85	87.10	82.50
1997-98	70.10	81.10	87.10	83.83	81.50

Source: Statistics at a Glance, TNEB 1986-87, Various Years.

It is shown from Table 1.3 that the plant availability of Ennore, Tuticorin and Mettur thermal stations were 64.30 per cent, 80.30 per cent and 15.50 per cent respectively in the year 1986-87 and it was increased to 70.10 per cent, 81.10 per cent and 83.33 per cent in the year 1997-98 respectively. In the first period the plant availability of all thermal stations was 74.49 per cent in the year 1986-87 and it was increased to 81.50 per cent in the year 1998-99.

Table 1.4 presents the details about the plant availability of thermal power stations in the second period under study.

Table 1.4: Plant Availability of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1998-99	65.60	75.60	83.31	80.26	77.04
1999-00	50.80	83.40	90.37	89.26	78.45
2000-01	28.80	87.90	88.42	92.47	74.40
2001-02	47.80	89.13	93.65	90.81	81.10
2002-03	63.30	89.76	88.46	92.85	83.58
2003-04	45.50	87.40	86.16	91.00	77.55
2004-05	45.40	90.10	75.19	92.77	75.90
2005-06	24.66	86.40	75.88	90.37	69.33
2006-07	30.47	84.25	78.69	88.36	70.45
2007-08	34.12	87.00	71.36	74.14	72.75
2008-09	28.39	79.25	78.78	78.94	71.69
2009-10	24.78	81.36	80.25	80.14	78.78
2010-11	37.00	88.33	81.97	84.36	75.68
2011-12	28.99	87.87	79.24	87.39	80.14
2012-13	24.33	80.71	82.96	90.14	79.47
2013-14	32.97	79.41	80.78	91.47	82.78

Source: Statistics at a Glance, TNEB, Various years.

It is observed from Table 1.4 that the plant availability of Ennore, Tuticorin, North Chennai and Mettur thermal power stations was 65.60 per cent, 75.60 per cent, 83.31 per cent and 80.36 per cent in the year 1998-99 and it was 32.97 per cent, 79.41 per cent, 80.78 per cent and 91.47 per cent in year 2013-14. In the year 1998-99 the plant availability in all thermal stations was 77.04 per cent and it was 82.78 per cent in the year 2013-14. Plant availability of thermal stations in general was above 65 percent in both the periods. This shows that plant availability of thermal stations was efficient.

Plant Load Factor

Load factor is generally defined as the ratio of average load to maximum (or peak) load. Extended thus to a generating unit, plant load factor then refers to the ratio of the actual generation of that plant to its maximum possible generation during the period (one year). Even if the plant is available with a high probability, it may have at times to be shut down due to lack of adequate system load (reserve shut down), and hence the actual generation of the plant may fall short of availability. Plant load factor is then defined in this vein also as availability less reserve shut down rate. Thus the difference between availability and plant load factor represents a safety margin, buffer, or reserve margin, with a demand-cushioning effect. A plant load factor very close to availability might be misconstrued as reflecting better capacity utilization; such over-exertion, however would definitely tell upon the life of the plant, and increase its 'down' chances. Hence, along with a higher availability, an adequately high reserve margin also is desirably sought for. Plant load factor also is influenced by factors like age of the generating plant, quality of coal, and its timely and adequate availability, shortcomings in energy evacuation, and equipment deficiencies.

The details about the plant load factor of thermal power stations in the first period under study are given in Table 1.5.

Table 1.5: Plant Load Factor of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1986-87	48.50	76.10	--	3.80	64.70
1987-88	57.44	77.30	--	25.00	68.70
1988-89	46.10	82.00	--	41.00	66.70
1989-90	44.30	80.10	--	42.60	64.30
1990-91	51.00	71.40	--	44.30	58.30
1991-92	47.55	70.60	--	48.80	55.70
1992-93	52.06	76.00	--	64.15	65.19
1993-94	46.90	76.04	--	76.38	63.23
1994-95	54.60	68.26	--	75.98	68.41
1995-96	53.48	84.52	--	80.53	77.12
1996-97	43.22	79.50	63.38	80.53	71.48
1997-98	48.80	70.10	61.82	73.93	67.96

Source: Statistics at a Glance, TNEB, Various years.

It is evident from Table 1.5 that plant load factor of Ennore thermal power station was around 50 percent and around 70 per cent in Tuticorin thermal power station in the first period. In the year 1986-87 the plant load factor for all the thermal power

stations was 64.70 per cent and it was 67.96 per cent in the year 1998-99. Mettur thermal power station's plant load factor was 3.8 percent in 1986-87 and increased to 73.93 percent at end of the first period.

Table 1.6 furnishes the details about the plant load factors of thermal power stations in Tamil Nadu during the second period under study.

Table 1.6: Plant Load Factor Of Thermal Power Stations (in percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1998-99	45.60	71.70	66.62	68.60	65.62
1999-00	32.80	80.80	78.26	78.42	72.29
2000-01	19.10	86.30	78.91	87.27	74.81
2001-02	29.20	88.12	84.71	86.92	78.13
2002-03	44.19	89.07	79.85	91.56	81.02
2003-04	32.00	87.63	78.57	91.28	78.31
2004-05	31.00	88.90	71.00	90.85	76.89
2005-06	15.23	83.40	72.50	88.59	72.24
2006-07	16.47	79.14	70.28	90.14	73.98
2007-08	27.89	81.36	72.78	87.15	78.14
2008-09	49.17	85.35	86.52	87.78	80.80
2009-10	38.05	77.91	87.43	86.85	76.42
2010-11	35.44	77.30	81.74	82.42	73.36
2011-12	22.61	85.60	84.81	92.77	77.90
2012-13	18.67	90.00	81.98	84.26	77.94
2013-14	20.14	89.47	82.17	87.14	80.36

Source: Statistics at a Glance, TNEB, Various years.

In the second period the plant load factor of Mettur thermal station increased to 90 percent. Plant load factor of overall thermal power station was above 70 percent in both the periods. In the second period it was reduced below 50 percent and reached 15.23 percent in 2005-06 in Ennore thermal power stations. In the first period the plant load factor of Tuticorin thermal power station was around 70 percent and it increased to 89.07 percent (in 2002-03) and 89.47 per cent (2013-14) in the second period. Plant load factor of Tuticorin thermal power station was not affected in both the periods.

It should also be pointed out that the Ennore power plant in general is much older than other thermal stations. The state of maintenance of this unit also remains very poor. Side by side the introduction of new vintage plants of higher technical efficiency, proper and timely maintenance of plants to ensure their healthy life also is indispensable. It has been recognized that in many cases investment in long-term rehabilitation and empowering of old plants fructify more promisingly than in installing new generation capacity.

Auxiliary Consumption

Auxiliary consumption at generation end eats into the energy available for transmission. Auxiliary consumption in the power station depends upon its layout, operation conditions, atomization, and design of various equipments.

The details about the auxiliary consumption of thermal power stations in the first period under study are given in Table 1.7.

Table 1.7: Auxiliary Consumption of Thermal Power Stations (in Percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1986-87	12.60	7.80	--	25.40	9.30
1987-88	12.50	7.80	--	13.60	9.80
1988-89	12.00	7.40	--	11.00	9.20
1989-90	12.40	7.70	--	9.90	9.30
1990-91	12.20	8.10	--	9.00	9.30
1991-92	12.10	8.10	--	9.00	9.30
1992-93	12.14	8.20	--	8.81	9.11
1993-94	12.74	9.60	--	8.75	9.14
1994-95	12.06	8.17	--	8.53	8.19
1995-96	12.10	7.90	--	8.33	8.63
1996-97	12.45	8.00	8.77	8.27	8.64
1997-98	12.60	8.10	9.91	8.25	8.99

Source: Statistics at a Glance : TNEB, Various Issues

Table 1.7 shows the auxiliary consumption of thermal power stations. Auxiliary consumption of Ennore thermal power station was around 12 percent in the first period and it was around 8 per cent, 9 per cent in Turicorin and Mettur thermal stations. In overall thermal power stations in Tamil Nadu's auxillary consumed was around 9 per cent in the first period.

The details about the auxiliary consumption of thermal power stations in the second period under study are shown in Table 1.8.

Table 1.8: Auxiliary Consumption of Thermal Power Stations (In Percent)

Year	Ennore	Tuticorin	North Chennai	Mettur	Thermal Stations
1998-99	13.30	8.00	9.52	8.95	9.14
1999-00	14.70	7.60	9.33	9.19	8.98
2000-01	15.30	7.60	9.32	8.09	8.46
2001-02	15.60	7.65	8.89	8.01	8.50
2002-03	12.86	7.63	9.21	7.87	8.47
2003-04	13.90	7.80	9.10	7.80	8.48
2004-05	14.80	7.80	9.10	8.30	8.67
2005-06	16.20	8.06	9.42	8.38	8.71
2006-07	15.36	8.01	9.45	8.78	8.79
2007-08	15.74	8.13	9.57	8.74	8.93
2008-09	16.24	7.95	9.74	8.08	9.15
2009-10	14.22	7.48	9.48	7.97	9.28
2010-11	15.78	8.02	9.27	7.89	9.61
2011-12	16.97	7.87	9.97	7.45	8.87
2012-13	16.78	8.12	8.97	8.15	8.56
2013-14	15.45	8.36	9.04	8.47	9.01

Source: Statistics at a Glance : TNEB, Various Issues.

It is observed from Table 1.8 that there was slight increase to 16.2 percent in the second period. Though it was aged station its auxiliary consumption was around 12 percent. Auxiliary consumption of Tuticorin and North chennai was below 10 percent in both periods. Auxiliary consumption of Mettur thermal station was 25.4 percent in 1986-87 and it was declined to 8.38 percent in 2005-06 and it was increased to 8.47 per cent in the year 2013-14. Auxiliary consumption of thermal power station in general was less than 10 percent in both the periods.

Findings

As Ennore is aged plant its forced outage rate was more than other plants. In Tuticorin and North Chennai forced outage rate was around 15 percent. Mettur station forced outage rate was more in 1986-87 and it declined in 2005-06 and it increased to 10.39 per cent in 2013-14. Though Ennore is aged plants its auxiliary consumption is around 15 percent. Auxiliary consumption of Tuticorin and North Chennai was below 10 percent in both periods. Mettur station auxiliary consumption declined step by step from 1998-99 to 2013-14. Except Ennore thermal station in all other thermal power stations plant availability was above 75 percent. Plant load factor of Ennore was below 20 percent but all other thermal stations it was above 70 percent. As the private sector was involved there was no negative impact of the technical factors of power sector.