# CHAPTER-III

## 3 Review on the Operational performance and functioning of Namrup Thermal Power Station of Assam State Electricity Board (ASEB).

## Highlights:

**Cost of generation per unit increased from 82 paise in 1996-1997 to 127 paise in 2000-2001 due to excess consumption of natural gas, excess auxiliary consumption and low Plant Load Factor (PLF).**

**(Paragraph 3.4.2)**

**Against the target of 2350 MU during 1996-1997 to 2000-2001 the station could generate only 1933.83 MU of power leading to shortfall of 416.17 MU valued at Rs.27.71 crore.**

**(Paragraph 3.4.3)**

**None of the generating units (except Unit 2 and 3) could achieve the Standard Plant Load Factor (PLF) in any of the years during 1996-1997 to 2000-2001. Lower PLF resulted in loss of generation of 1459.46 MU during the above period.**

**(Paragraph 3.4.4)**

**Generating units remained shut down for 2154 days on 10 occasions from November 1996 to June 2000; this resulted in loss of generation of 404.17 MU valued at Rs.27.70 crore.**

**(Paragraph 3.4.5.2)**

**Usage of higher heat rate compared to designed heat rate resulted in excess consumption of 119.54 MSCM of gas valuing Rs.14.10 crore at landed cost.**

**(Paragraph 3.5)**

**The higher rate of auxiliary consumption resulted in loss of 18.23 MU valued at Rs.1.95 crore.**

**(Paragraph 3.6)**

**Contracting a higher quantity of gas for transportation compared to actual allocation per day resulted in extra expenditure of Rs.3.09 crore towards minimum demand charges.**

**(Paragraph 3.7.3)**

**The Board incurred avoidable expenditure of Rs.3.14 crore due to keeping of imported materials at bonded warehouse and exchange rate fluctuation.**

**(Paragraph 3.8)**

## 3.1 Introduction

**Board has to import power due to decline in its own generation**

Assam State Electricity Board was deficient in generation of power compared to demand for the same. The gap between demand and own generation was bridged by import of power from outside the state, which ranged between 1393.69 MU in 1996-1997 to 2306.29 MU in 2000-2001. The rise in import of power was due to decline in Board's own generation from 1331.73 MU to 934.96 MU during the period. Under the circumstances economic and efficient operation of existing generating units had assumed great importance.

The Namrup Thermal Power Station (NTPS) is one of the four thermal power-generating stations (gas-based) of Assam State Electricity Board (ASEB). It has six generating units with a total installed capacity of 133.50 MW. The generating units comprise of three gas turbine units (Units 1,2 and 3) of 23 MW capacities each, one gas turbine unit (Unit 4), one gas fired steam turbine unit (Unit 5) and one waste-heat recovery plant (Unit 6) having capacity of 12.50 MW, 30 MW and 22 MW respectively. These units were commissioned between April 1965 and March 1985.

## 3.2 Organisational set-up

The Member (Technical) is in charge of generation at Board level and is assisted by the Chief Engineer (Generation) at Headquarters. The Senior Power Station Superintendent (SPSS) of the station is in charge of day-to-day operation of the station and he is assisted by one Power Station Superintendent (PSS) and 6 (six) Executive Engineers.

## 3.3 Scope of audit

The performance and functioning of Namrup Thermal Power Station during the period from 1996-1997 to 2000-2001 and other related transactions were reviewed in Audit during November-December 2001 and the findings are discussed in the succeeding paragraphs.

## 3.4 Operational performance

### *3.4.1 Life span of generating units*

The 3x23 MW units (Unit No. 1, 2 and 3) were designed, manufactured and commissioned by M/s Westinghouse, Canada in April 1965. The 12.50 MW Westinghouse make unit (Unit No.4) was originally purchased for Chandrapur Thermal Power Station of the Board from where it was brought to Namrup and commissioned in March 1976. Unit No.5 (30 MW) and Unit No.6 (22 MW) were designed, manufactured and commissioned by M/s Bharat Heavy Electricals Limited (BHEL) in April 1976 and March 1985 respectively.

The Unit No.6 (22 MW) is a Waste Heat Recovery Unit with three boilers connected to mother units (Unit No. 1, 2 and 3).

**Unit I to 5 exceeded their fair life span**

Neither the manufacturer nor the Board has assessed the expected life of the generating units. It was however, seen that15 years for plant and machinery for gas plant and twenty-five years for Waste Heat Recovery Plant. As against this, the three 3x23 MW units have completed a life of 37 years, Unit No.4 and Unit No.5 have completed a life of 26 years each, Unit No.6 has completed a life of 17 years as on 31 March 2002. Thus, all the generating units (except Unit No.6) have exceeded their fair life span.

The Board was, however, carrying out renovation and modernization works from time to time to maintain the efficiency of the generating units and one such scheme taken up during the 9$^{th}$ Plan with a loan of Rs.30.30 crore from Power Finance Corporation Limited was still (March 2002) under execution.

In spite of this, the capacity utilisation was less leading to higher cost of generation as discussed in succeeding paragraphs.

It was noticed during Audit that no life extension scheme was planned/executed by the Board and the units were not de-rated till March 2002.

### *3.4.2 Cost of generation*

***3.4.2.1*** The cost per unit of generation at station bus-bar during 1996-1997 to 2000-2001 is tabulated as under:

| Particulars | 1996-1997 | | 1997-1998 | | 1998-1999 | | 1999-2000 | | 2000-2001 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TC* | UC(P)& | TC | UC(P) | TC | UC(P) | TC | UC(P) | TC | UC(P) |
| **A. Variable cost** (i) Cost of natural gas | 1,368.38 | 34 | 1,240.10 | 42 | 1,827.25 | 50 | 1,955.95 | 59 | 3,274.77 | 71 |
| **(ii) Chemicals and Lubricants** | 10.76 | 01 | 4.35 | - | 14.57 | 01 | 4.50 | - | 14.24 | 01 |
| **Total (A)** | **1,379.14** | **35** | **1,244.45** | **42** | **1,841.82** | **51** | **1,960.45** | **59** | **3,289.01** | **72** |
| **B. Fixed cost** (i)Transmission charges of gas@ | 186.96 | 05 | 190.32 | 7 | 201.35 | 05 | 211.18 | 07 | 225.20 | 05 |
| **(ii) Employee cost** | 585.33 | 14 | 609.01 | 21 | 661.07 | 18 | 782.90 | 23 | 880.12 | 19 |
| **(iii) Interest on capital** | 683.75 | 17 | 705.36 | 24 | 880.48 | 24 | 875.64 | 27 | 876.12 | 19 |
| **(iv) Depreciation** | 358.60 | 09 | 351.44 | 12 | 363.65 | 10 | 458.40 | 14 | 462.12 | 10 |
| **(v) Other costs** | 80.27 | 02 | 100.77 | 03 | 145.34 | 04 | 87.40 | 03 | 77.33 | 02 |
| **Total (B)** | **1,894.91** | **47** | **1,956.90** | **67** | **2,251.89** | **61** | **2,415.52** | **74** | 2,520.89 | **55** |
| **Total cost** | **3,274.05** | **82** | **3,201.35** | **109** | **4,093.71** | **112** | **4,375.97** | **133** | **5,809.90** | **127** |
| **Net generation (MU)** | **404.94** | | **291.53** | | **366.01** | | **328.95** | | **455.59** | |

**Cost of generation per unit increased from 82 to 127 paise over 5 years**

It would be seen from above that total unit cost of generation increased from 82 paise in 1996-1997 to 127 paise in 2000-2001. The increase in cost by 45 paise was mainly due to (i) excess consumption of natural gas, (ii) excess auxiliary consumption and (iii) low plant load factor.

***3.4.2.2*** In this connection it may be pointed out that the increase in fixed cost component of generation varied from 16 paise to 35 paise per unit due to shortfall in actual gross generation compared to generation at 58 *per cent* load factor as shown below:

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* TC= Total cost in Rupees in lakh.

& UC (P)= Unit cost in paise.

@ Transmission charges of gas were subject to minimum guaranteed off-take and hence treated as fixed cost component.

| | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 |
|---|---|---|---|---|---|
| **(i) Total fixed cost (Rupees in lakh)** | 1894.91 | 1956.90 | 2251.89 | 2415.52 | 2520.89 |
| **(ii) Actual gross generation (MU)** | 424.65 | 308.50 | 383.76 | 341.22 | 475.81 |
| **(iii) Generation at 58 per cent PLF (MU)** | 678.29 | 678.29 | 678.29 | 680.15 | 678.29 |
| **(iv) Fixed cost per unit on actual gross generation (Paise)** | 45 | 63 | 59 | 71 | 53 |
| **(v) Cost per unit on generation at 58 per cent PLF (Paise)** | 28 | 29 | 33 | 36 | 37 |
| **(vi) Difference in cost per unit (Paise)** | 17 | 34 | 26 | 35 | 16 |

### *3.4.3 Shortfall in generation*

**Actual generation fell short of target fixed by the Board**

The station generated a total of 1933.83 MU of power during 1996-1997 to 2000-2001 against a target of 2350 MU fixed by the Board and approved by the Central Electricity Authority. The targets so fixed corresponded to a PLF of 34.20 (1996-97) to 47.03 (2000-01) compared to standard PLF of 58 percent (Para 3.4.4) and hence was fixed on lower side. The station could, however, achieve the target only in 1996-1997 and there was a net shortfall of 416.17 MU valuing Rs.27.71 crore at cost as detailed in the following table:

| Year | Target (MU) | Actual (MU) | Shortfall (MU) | Fixed cost per unit (Rupees) | Total cost of shortfall (Rupees in lakh) |
|---|---|---|---|---|---|
| **1996-1997** | 400.00 | 424.65 | (+) 24.65 | 0.47 | (+) 115.86 |
| **1997-1998** | 520.00 | 308.50 | (-) 211.50 | 0.67 | (-) 1417.05 |
| **1998-1999** | 450.00 | 383.66 | (-) 66.34 | 0.61 | (-) 404.67 |
| **1999-2000** | 430.00 | 341.22 | (-) 88.78 | 0.74 | (-) 656.97 |
| **2000-2001** | 550.00 | 475.80 | (-) 74.20 | 0.55 | (-) 408.10 |
| **Total** | **2350.00** | **1933.83** | **(-) 416.17** | - | **(-) 2770.93** |

Scrutiny in audit revealed that the shortfall was mainly due to longer duration of both planned and forced outages as discussed in Para 3.4.5 and 3.4.6.

### *3.4.4 Low Plant Load Factor (PLF)*

The details of maximum possible generation at installed capacity, actual generation and corresponding Plant Load Factor achieved in respect of each generating unit for the five years up to 2000-2001 are given in Annexure 12. The position is summarised below:

| Units | Installed capacity (MW) | Year of commissioning | Actual Plant Load Factor | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 |
| **No.1** | 23.00 | April 1965 | 32.60 | 13.64 | 21.92 | 11.55 | 31.53 |
| **No.2** | 23.00 | April 1965 | 60.94 | 65.56 | 44.36 | 55.67 | 64.45 |
| **No.3** | 23.00 | April 1965 | 55.65 | 4.34 | 62.72 | 47.87 | 69.03 |
| **No.4** | 12.50 | March 1976 | 22.65 | 43.13 | 45.36 | 45.71 | 10.49 |
| **No.5** | 30.00 | April 1976 | 29.70 | 30.36 | 19.44 | 3.67 | 30.24 |
| **No.6** | 22.00 | March 1985 | 11.00 | 6.83 | 11.94 | 25.28 | 27.18 |
| **Station** | **133.50** | **-** | **36.31** | **26.38** | **32.81** | **29.10** | **40.69** |

The original project reports of the generating Units were not available and hence the PLF as envisaged in them could not be ascertained. The Station/Board also did not fix any operational norms for the Units. However, the Rajadhyaksha Committee appointed (1980) by the Government of India recommended a standard PLF of 58 *per cent* for thermal power projects. It would be seen from the table that except Units 2 and 3, none of the Units could achieve the standard PLF in any of the five years up to 2000-2001. The overall station PLF varied from 26.38 *per cent* (1997-1998) to 40.69 *per cent* (2000-2001).

The low PLF compared to standard had resulted in a shortfall of 1459.46 MU in generation during 1996-1997 to 2000-2001.

The main reasons for the low PLF as identified in audit were:

(i) Longer duration of both planned and forced outages (Para 3.4.5),

(ii) Actual sustainable capacity of generating units being lower than installed capacity [Para 3.4.6 (ii)] and

(iii) Running of generating units with partial load/no load [Para 3.4.6 (i)].

These aspects have been further discussed in succeeding paragraphs.

### *3.4.5 Low plant availability*

***3.4.5.1*** The details of hours available, hours operated, planned outages, forced outages and relative plant availability in respect of each of the 6 (six) generating units are shown in Annexure 13. The position is summarised in the table below:

| Units | Installed capacity (MW) | Year of commissioning | Plant availability (Percent) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 |
| **No.1** | 23.00 | April 1965 | 60.46 | 31.75 | 33.69 | 16.32 | 74.41 |
| **No.2** | 23.00 | April 1965 | 97.67 | 97.06 | 69.33 | 81.15 | 97.75 |
| **No.3** | 23.00 | April 1965 | 79.55 | 6.51 | 92.59 | 67.49 | 97.56 |
| **No.4** | 12.50 | March 1976 | 42.87 | 83.29 | 93.69 | 87.35 | 22.34 |
| **No.5** | 30.00 | April 1976 | 77.15 | 82.73 | 73.34 | 13.09 | 63.79 |
| **No.6** | 22.00 | March 1985 | 54.39 | 31.85 | 61.64 | 86.60 | 81.52 |
| **Station** | **133.50** | **-** | **68.68** | **55.53** | **70.71** | **58.67** | **72.90** |

**Low plant availability due to longer duration of planned/forced outages**

As per Rajadhyaksha Committee Report, thermal power plants are expected to be available for 80 *per cent* of total available hours. It would be seen from the above table that Unit-1 could not achieve the norm of 80 *per cent* in any of the five years. The norm also could not be achieved by Unit-2 in 1998-1999, Unit-3 in 1996-1997, 1997-98 and 1999-2000, Unit-4 in 1996-97 and 2000-01 and Unit-5 in all the five years except 1997-1998 and Unit-6 during 1996-1997 to 1998-1999. The overall station availability varied from 55.53 *per cent* to 72.90 *per cent* during 1996-1997 to 2000-2001.

The low availability of the generating units was due to longer duration of both planned outages (42213.80 hours) and forced outages (49043.01 hours) representing 16.05 *per cent* and 18.65 *per cent* of total available hours (2,62,944 hours) respectively.

***3.4.5.2*** The details of major shutdowns of the generating units during 1996-1997 to 2000-2001 are given below:

| Unit | Installed capacity (MW) | Period of shutdown | No. of days shutdown | Excess days of shutdown | Loss of generation (MU) at 58% PLF | Fixed cost of generation per unit (Paise) | Loss of generation at cost (Rupees in lakh) |
|---|---|---|---|---|---|---|---|
| **No.1** | 23.00 | 5.11.96 to 27.8.97 | 295 | 87 | 27.85 | 67 | 186.59 |
| | | 4.6.99 to 28.4.2000 | 328 | 136 | 43.54 | 74 | 322.20 |
| **No.2** | 23.00 | 5.1.99 to 4.6.99 | 150 | 60 | 19.21 | 74 | 142.15 |
| **No.3** | 23.00 | 19.4.97 to 25.3.98 | 341 | 208 | 66.59 | 67 | 446.15 |
| | | 12.12.99 to 28.3.2000 | 106 | 90 | 28.81 | 74 | 213.19 |
| **No.4** | 12.50 | 15.5.2000 to 3.2.2001 | 262 | 202 | 35.15 | 55 | 193.32 |
| **No.5** | 30.00 | 10.6.99 to 1.6.2000 | 357 | 285 | 119.02 | 74 | 880.75 |
| **No.6** | 22.00 | 1.4.96 to 28.7.96 | 118 | 61 | 18.68 | 47 | 87.80 |
| | | 29.8.97 to 1.1.98 | 125 | 116 | 35.52 | 67 | 237.98 |
| | | 21.1.99 to 3.4.99 | 72 | 32 | 9.80 | 61 | 59.78 |
| | | **Total** | **2154** | **1277** | **404.17** | | **2769.91** |

The total shutdown of 2154 days included planned shutdown of 412 days and forced shutdown of 1742 days. The forced shutdowns included:

- 208 days (4992 hours) for fault in turbine and another 133 days (3192 hours) for excessive vibration in exciter in Unit 1 (23 MW);

- 208 days (4992 hours), 133 days (3192 hours) and 16 days (384 hours) for non-availability of rotor, heavy vibration and fault in exciter respectively in Unit-3 (23 MW);

- 357 days (8568 hours) for repairs and maintenance in Unit-5 (30 MW);

- 547 days (13128 hours) for non-availability of stores and spares in respect of Unit-1 (223 days), Unit-3 (90 days) and Unit-6 (234 days);

- 81 days (1944 hours) in Unit-6 for other miscellaneous reasons.

**Loss of generation due to excess time taken for overhauling, repair etc.**

The total shutdown of 2154 days included excess time of 1277 days (30,648 hours) taken for overhauling and repair and maintenance work with consequential loss of generation of 404.17 MU valued at Rs.27.70 crore at fixed cost of generation in respective years.

In addition to above, Unit No-1 (23 MW) was shutdown for 212 days from 26 January 1998 to 26 August 1998 and Unit-4 (12.50 MW) remained under shutdown for 199 days from 15 June 1996 to 30 December 1996 due to heavy sparks in exciter unit and non-availability of oil cooler fan blades respectively. Thus, lack of preventive maintenance and failure to keep stock of important spares resulted into loss of generation of 102.50 MU valued at Rs.5.77 crore at fixed cost of generation.

A few illustrative cases of forced outages as analysed in audit are discussed below:

**(i) <u>Non-availability of spare rotor</u>**

The Unit-3 (23 MW) was stopped from 19.04.1997 due to rise of vibration level above permissible limit and was recommissioned on 25 March 1998. The total outages included avoidable outage of 208 days from 27.06.1997 to 21.01.1998 due to non-receipt of new rotor, which was lying in bonded warehouse in Kolkata from 06.03.1997 to 29.12.1997 (Refer Para.3.8.1). The rotor was ultimately received at Namrup on 21 January 1998.

This delay resulted in loss of generation of 66.59 MU (at 58 *per cent* PLF) valuing Rs.4.46 crore at 67 paise per unit being fixed cost of generation during 1997-1998.

**(ii) <u>Delay in procurement of discharge casings</u>**

The Unit-6 (22 MW) was under shutdown from 25.04.1995 due to failure of all the Boiler Feed Pumps. Due to non-availability of required spares, immediate repairs could not be carried out. Against supply orders placed in September 1994, the spares were received in June 1996 and the unit was recommissioned on 28 July 1996. Thus due to inordinate delay in procurement of discharge casings, the unit remained shutdown from 25.04.1995 to 31.05.1996 (402 days) with consequential loss of generation of 83.94 MU (considering actual sustainable capacity of 15 MW and a PLF of *58 per cent*) valued at Rs.3.95 crore at 47 paise per unit being fixed cost of generation during 1996-1997.

**(iii) <u>Delay in procurement of Graphite Packing Rings</u>**

The Unit-6 (22 MW) was brought under shutdown from 21.01.1999 due to heavy leakage of steam through control valve spindle. M/s BHEL, the supplier of the unit suggested on 05.02.1999 to use graphite-packing rings for the control valve. The station requested the Controller of Movements (COM), ASEB, Kolkata on 18 February 1999 to procure the material and despatch the same to the station. Thus, there was a delay of 13 days in initiating the purchase for material valued at Rs.12,500.00 only. The COM, Kolkata procured the materials on 9 March 1999 after a delay of 19 days. The materials were received at site on 26 March 1999 and the unit was recommissioned on 3 April 1999. Thus, there was a delay of 32 days in re-commissioning the unit with consequent loss of generation of 9.80 MU at 58 *per cent* PLF valued at Rs.0.60 crore at 61 paise per unit being fixed cost of generation during 1998-1999.

### *3.4.6 Low Plant utilisation*

Based on standard PLF of 58 *per cent* (Refer Para 3.4.4) and availability at 80 *per cent* (Refer Para 3.4.5), the standard plant utilisation factor works out to 72.50 *per cent*. As against this norm the actual utilisation factor of the station was between 47.47 per cent (1998-99) and 54.07 per cent (1999-2000) as per details in Annexure 14.

It would be seen from Annexure 14 that none of the Units could achieve the standard in any of the years during 1996-1997 to 2000-2001. While Units-1 to 3 commissioned in April 1965 recorded average utilisation of 55.02 *per cent*, 65.69 *per cent* and 69.21 *per cent* respectively, the Units-4 to 6 commissioned subsequently in March/April 1976 and March 1985 recorded average utilisation of 50.46 *per cent*, 35.42 *per cent* and 21.12 *per cent* respectively mainly due to the fact that the sustainable capacity of these units was lower than their installed capacity as discussed further in succeeding sub-Para (ii).

The main reasons for the low utilisation of available capacity, as analysed in audit were as follows:

### (i) Running of units with partial load/without load

**Units were run on partial load due to reasons largely controllable**

The station (along with Lakwa Thermal Power Station) caters to the regional loads of Tinsukia and Dibrugarh Districts of Assam through the Upper Assam grid of the Board. Hence during off-peak period, the units were run either with partial load or without load in the absence of sufficient system demand. Apart from this, units were also run on partial load due to (i) low gas pressure (ii) requirement of uniform gas drawal during 24 hours (iii) Grid restrictions and (iv) other technical reasons such as vibration level beyond permissible limit etc. which were largely controllable and indicated management failure to take timely remedial action. The problem of low gas pressure could be solved by installing required compressors. Grid restriction and excessive vibration could be controlled by increasing transmission capacity and proper maintenance.

During 1996-1997 to 2000-2001, the units were run for a total of 1441.40 hours without load, which was categorised as running hours though no electricity was generated. The station also received gas at low pressure (below 215 P.S.I[@]) for a total of 713 hours. However, the effect of such low pressure on generation had not been quantified by the station authority.

**Non-availability of spares in stores resulted in loss of generation**

The load in respect of Unit-1 (23 MW) was restricted to 10 MW only from 27 August 1997 to 6 January 1998 (132 days) due to damage of a gasket at the generator. The damaged gasket could not be replaced immediately which resulted in draining out of Hydrogen from the generator and the generator had to be run with air only. The gasket was not available at store and had to be imported from Canada. Had the gasket been kept in store, the time lost in importing the same could have been avoided. Due to non-availability of spare gasket there was loss of generation of 22.99 MU (13 MW X 2439 Running hours X 72.50 *per cent*) valuing Rs.1.54 crore at 67 paise per unit being the fixed cost of generation during 1997-1998.

### (ii) Reduced capacity of generating units

The details of maximum and minimum loads in MW achieved by each generating units during 1996-1997 to 2000-2001 are as tabulated below:

| Year | Unit-1 (23 MW) | | Unit-2 (23 MW) | | Unit-3 (23 MW) | | Unit-4 (12.50 MW) | | Unit-5 (30 MW) | | Unit-6 (22 MW) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| **1996-97** | 22.2 | 3.5 | 23.0 | 4.0 | 23.0 | 4.0 | 11.0 | 2.0 | 20.5 | 3.0 | 7.3 | 2.0 |
| **1997-98** | 22.5 | 3.0 | 23.0 | 4.0 | 23.0 | 6.0 | 12.0 | 1.0 | 19.2 | 2.5 | 7.5 | 2.0 |
| **1998-99** | 23.0 | 4.0 | 23.0 | 5.0 | 23.0 | 3.5 | 11.0 | 2.0 | 15.5 | 2.5 | 10.5 | 1.5 |
| **1999-00** | 23.0 | 4.0 | 23.0 | 4.0 | 23.0 | 2.8 | 11.5 | 1.8 | 16.5 | 2.0 | 13.0 | 1.5 |
| **2000-01** | 18.0 | 2.5 | 23.0 | 5.0 | 23.0 | 7.0 | 11.0 | 2.8 | 21.0 | 4.0 | 13.5 | 2.0 |

[@] PSI=Pounds per square inch.

It would be seen from the above table that out of 6 (six) units, three units (Unit 4, 5 and 6) could not attain their installed capacity in any of the five years. Unit-1 could not attain its full capacity in three years 1996-1997, 1997-1998 and 2000-2001. The maximum and minimum loads with which the units were operated clearly indicate that all the units were running with partial loads, which resulted in low utilisation of the units.

In this connection the following further observations are also made:

The actual sustainable capacity of Unit No: 4, 5 and 6 were lower than their respective installed capacity as shown below:

**Reduction in installed capacity due to design deficiency**

| Unit | Installed capacity (MW) | Sustainable capacity (MW) | Remarks |
|---|---|---|---|
| **Unit-4** | 12.50 | 10.00 | Due to problems relating to Air filtration system and starting Diesel engine from September 1997. |
| **Unit-5** | 30.00 | 21.00 | Since commissioning of the unit, Gas flow quantum reaches Gas regulating valve capacity at 21 MW. |
| **Unit-6** | 22.00 | 14.50 | Due to design deficiency in boiler by-pass damper, output restricted to 15 MW only since commissioning of the unit. |

The Chief Engineer (Generation) of the Board requested (July 2002) the Central Electricity Authority to de-rate Unit-5 and 6 to 21 MW and 14.50 MW respectively. The required approval had not yet (September 2002) been received.

De-rating of installed capacity would result in higher PLF and plant utilisation factor, without any increase in generation. This in turn will have impact on tariff fixation, effect of which could not be quantified in Audit.

## 3.5. Excess consumption of natural gas

The designed heat-rate per unit generation was 3986.64 K.Cal in respect of Unit-1, 2 and 3, 4032.00 K.Cal in respect of Unit-4 and 3454.00 K.Cal in respect of Unit-5. Unit-6 is a waste-heat recovery plant and hence did not require direct fuel. As against this, the actual heat rate per unit of generation during 1996-1997 to 2000-2001 was as follows:

| Particulars | | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 |
|---|---|---|---|---|---|---|
| **(i)** | **Actual generation (MU)** **Unit-1 to 4** | 325.40 | 215.55 | 309.56 | 282.70 | 343.96 |
| | **Unit-5** | 78.05 | 79.78 | 51.09 | 9.66 | 79.46 |
| | | **403.45** | **295.33** | **360.65** | **292.36** | **423.42** |
| **(ii)** | **Heat consumed** [(i)] **(M.K.Cal)**[(ii)] **Units-1, 2,3,4** | 14,96,878 | 9,93,403 | 13,86,095 | 12,80,081 | 16,31,795 |
| | **Unit-5** | 2,98,828 | 3,21,312 | 2,11,142 | 39,403 | 3,08,361 |
| | | **17,95,706** | **13,14,715** | **15,97,237** | **13,19,484** | **19,40,156** |
| **(iii)** | **Actual heat rate (K.Cal)**[(iii)] **Units-1, 2,3,4** | 4,600 | 4,609 | 4,478 | 4,528 | 4,744 |
| | **Unit-5** | 3,829 | 4,027 | 4,133 | 4,079 | 3,881 |

It would be seen from above that actual heat rate was higher compared to design heat rate in respect of all units. As a result of this, the station consumed 10,40,829 MK.Cal of heat energy in excess which was equivalent to 119.54 MSCM of gas valuing Rs.14.10 crore at landed cost as detailed in Annexure 15.

The excess consumption of gas was attributable to running of the units without load/with partial load.

## 3.6. Higher auxiliary consumption and consequent loss

The requirement of auxiliary consumption in respect of each unit was assessed by audit on the basis of aggregate ratings of auxiliary equipments of each unit as detailed below:

| Units | Installed capacity (KW) | Aggregate ratings of auxiliaries (KW) | Standard rate of auxiliary consumption (*Per cent*) |
|---|---|---|---|
| **No-1, 2,3 and 4** | 81,500 | 2,281.66 | 2.80 |
| **No.5** | 30,000 | 1,928.55 | 6.43 |
| **No.6** | 22,000 | 1,116.76 | 5.07 |

[(i)] Consumption of gas by Units- 1 to 4 not available separately and hence heat consumed by the unit was not available.
[(ii)] M.K.Cal= Million Kilo Calories.
[(iii)] K. Cal= Kilo Calories.

As against the above standard rates of auxiliary consumption, the percentage of actual auxiliary consumption during 1996-1997 to 2000-20001 were as under:

| | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 |
|---|---|---|---|---|---|
| *(P e r c e n t)* | | | | | |
| **Unit-1, 2,3,4** | 2.91 | 2.66 | 2.41 | 1.28 | 6.71 |
| **Unit-5** | 12.03 | 14.06 | 18.73 | 14.49 | 9.11 |
| **Unit-6** | 3.96 | 0.15 | 2.74 | 12.20 | 11.97 |

It would be seen from above table that auxiliary consumption in respect of Units-1 to 4 was very high in 2000-2001 compared to preceding four years. Auxiliary consumption in respect of Unit-5 varied from 9.11 *per cent* to 18.73 *per cent* compared to actual requirement at 6.43 *per cent*. Similarly, auxiliary consumption in respect of Unit-6 in 1999-2000 and 2000-2001 recorded sharp increase and stood at 12.20 *per cent* and 11.97 *per cent* respectively.

As analysed in audit, the higher rate of consumption in respect of Unit-5 was due to running of service water pumps (115.50 KW) from auxiliary transformer and partial load operation of the units during 1996-1997 to 2000-2001. The reasons for increase in consumption in respect of Unit-6 (22 MW) during 1999-2000 and 2000-2001 could not be ascertained in audit due to non-availability of required information.

The higher rate of auxiliary consumption reduced the availability of power for sale by 18.23 MU valuing Rs.1.95 crore at cost during 1996-1997 to 2000-2001.

## 3.7. Weak procurement system of Natural gas and extra/avoidable expenditure towards minimum demand charges

All the generating units of the station (except the waste-heat recovery unit of 22 MW) are designed to run using natural gas as fuel. The maximum requirement of gas on the basis of designed heat-rate with a standard calorific value of 10,000 K.Cal per SCM, worked out to 1.03 MSCM per day. Considering 80 per cent of installed capacity being available for generation at any point of time, the gas requirement worked out to 0.824 MSCM per day. As against this, M/s Oil India Limited (M/s OIL) had allocated (10 May 1994) 0.665 MSCMD of gas to the station. The quantity of gas allocated by the Gas Linkage Committee, Ministry of Petroleum and Natural Gas, Government of India was not available on records. Evacuation of gas from OIL's wells is facilitated through pipelines owned by M/s Assam Gas Company Limited.

Further scrutiny revealed the following:

### *3.7.1 Absence of formal gas supply agreement*

**Uninterrupted supply of gas at required pressure not ensured**

Although the station is a gas-based thermal power station and had already completed more than 35 years of operation, there was no formal agreement with M/s OIL for supply of natural gas. During 1996-97 to 2000-01, the generating units received gas at low pressure for a total of 713 hours. The corresponding loss in generation and potential revenue could not be quantified in audit. The generating units also remained shutdown for a total of 1944.89 hours due to non-availability of fuel resulting in loss of generation of 43.57 MU valued at Rs.12.24 crore at actual rate of realisation in respective years. Thus, the station failed to ensure uninterrupted supplies of gas and supply at required pressure besides being unable to claim any compensation from M/s OIL on account of interruption in supplies and supply of gas at low pressure.

### *3.7.2 Absence of cross checking of quantity and calorific value of gas*

The quantity of gas delivered by M/s AGCL at station in-take point is measured by meters installed by it. The station has not yet installed any meter of their own to cross check the volume recorded by M/s AGCL's meter.

**Board has no system of cross checking the volume of gas received**

The sale price of gas as charged by M/s OIL are based on actual calorific value of gas as intimated by M/s OIL from time to time. The station does not have any system to cross check the actual calorific values of gas consumed by it although a lower calorific value increases the quantum of gas consumption and also results into running of units at partial loads.

### *3.7.3 Extra expenditure towards minimum demand charges*

The Board entered into an agreement with M/s AGCL (a State PSU) on 20 February 1998 for transportation of 0.798535 MSCM[*] of gas per day by pipeline from M/s OIL's off-take point at Duliajan to the station in-take point at Namrup. The agreement was valid with retrospective effect from 1 January 1985 to 31 December 2000. Similar agreement for the subsequent period had not yet (November 2001) been finalised.

Clause 5.01 of the agreement provided for payment of transmission charges (TC) of gas from April 1990 onwards on the basis of (i) actual quantity or (ii) the minimum demand volume (MDV) equivalent to 85 per cent of daily booked quantity of 0.798535 MSCM whichever is higher. The MDV per day

[*] MSCM= Million Standard Cubic Metre.

thus worked out to 0.678755 MSCM corresponding to annual MDV of 247.745 MSCM (248.424 MSCM for a leap-year)

It was observed in audit that in a bilateral meeting held on 3 June 1987, M/s OIL had agreed to allocate 0.798535 MSCM of gas to the station. As the station could not draw the allocated quantity, M/s OIL had reduced the allocation to 0.5812 MSCM. However, at the intervention of Minister of Power, Government of Assam, M/s OIL allocated 0.665 MSCMD[***] of gas to the station on 10 May 1994. This corresponded to an allocation of 242.725 MSCM per year.

**Agreement for transportation of higher quantity of gas compared to allocation resulted in extra expenditure on account of minimum demand charge**

Scrutiny of gas transmission bills for the period from 1990-1991 to 2000-2001 further revealed that the annual consumption of gas by the station varied from 118.982 MSCM (1991-1992) to 225.311 MSCM (2000-2001) corresponding to daily average consumption of 0.3251 MSCM to 0.6173 MSCM respectively.

Though the company was allocated 0.665 MSCM of gas per day in May 1994, it entered into an agreement in February 1998 for transport of 0.798535 MSCM per day. This had resulted in extra expenditure of Rs.3.09 crore (Rs.1941.28 lakh-Rs.1632.24 lakh) towards minimum demand charges during 1990-1991 to 2000-2001 as per details given in Annexure 16.

## 3.8. Avoidable expenditure towards import of capital equipments/spares

***3.8.1*** The first four gas-based units (Units 1 to 4) were supplied and erected by M/s Westinghouse, Canada. The Board, therefore, imports various capital equipments and spares for repairs and maintenance of these units from M/s Westinghouse at manufacturer's listed prices, which included 8 per cent Indian agent's commission payable to M/s Escorts Limited, New Delhi. The ordered items are generally shipped to the Controller of Movements, Assam State Electricity Board (ASEB) at Kolkata who clears them from the Dock on payment of Excise Duty and transports the same to the station at Namrup.

Scrutiny of imports of equipments and spares revealed that the Board placed two purchase orders on 28 February 1995 and 5 December 1995 for purchase of one turbine rotor and mandatory spares at F.O.B. price of US $ 28.00 lakh and US $ 37.94 lakh (including 8 *per cent* commission payable to Indian agent) respectively. The purchase orders were placed after obtaining required financial concurrence from the Finance Wing of the Board. However, the ways and means of obtaining the required funds, had not been indicated nor planned.

[***] MSCMD= Million Standard Cubic Meter per day.

**Non-availability of funds for clearing imported items from Port resulted in avoidable expenditure**

It was noticed in audit (December 2001) that when the rotor and mandatory spares arrived at Kolkata Port on 6 March 1997 and 6 June 1997 respectively, the Board failed to arrange necessary funds for clearing these items from the Port and hence it had to keep the same at bonded warehouses at Kolkata for considerable period. This resulted in avoidable expenditure of Rs.3.14 crore towards warehousing & other incidental charges (0.34 crore) and differential charges (Rs.2.80 crore) on account of adverse exchange rate fluctuation as discussed below:

### *(a) Warehousing and other incidental charges*

The consignment containing one turbine rotor and mandatory spares had to be kept in bonded warehouse at Kolkata Port on their arrival in March – June 1997 due to non-availability of required funds for payment of custom duty and cost of rotor.

Due to storing of imported items at Bonded Warehouse instead of transporting the same to the station at Namrup, the Board incurred avoidable expenditure of Rs.33.89 lakh towards warehousing and other incidental charges besides leading to avoidable loss of generation valued at Rs.4.46 crore (Refer Para3.4.5.2 (i) *supra*)

### *(b) Differential charges on account of adverse exchange rate fluctuation*

***(i)*** As per ex-bond Bill of Entry (March 1997), the total F.O.B price of $ 28.00 lakh inclusive of commission payable to M/s Escorts Limited for turbine Rotor was equivalent to Rs.10.10 crore at exchange rate of Rs.36.07 per US dollar. As the Board failed to ensure availability of required funds for payment, it entered into an agreement (2 December 1997) with M/s Sicom Limited. Mumbai for lease finance in respect of the Turbine Rotor. Accordingly M/s Sicom disbursed a total amount of Rs.13.61 crore on 3 December 1997 towards payment of Customs Duty (Rs.2.58 crore) and cost of rotor including agents commission (Rs.11.03 crore) at exchange rate of Rs.39.40 per US dollar. The adverse exchange rate fluctuation during the period of bonding resulted in avoidable expenditure of Rs.0.93 crore.

***(ii)*** Again the total F.O.B price of $ 37.94 lakh inclusive of agent's commission payable to M/s Escorts Limited for mandatory spares was equivalent to Rs.13.64 crore as per ex-bond bill of entry (June 1997) at exchange rate of Rs.35.95 per US dollar. The Board, however, had paid Rs.15.51 crore towards the cost of spares (including agent's commission of Rs.1.25 crore) at exchange rate of Rs.40.88 per US dollar. Thus the Board incurred extra expenditure of Rs.1.87 crore due to exchange rate fluctuations during the period when the spares were lying at bonded warehouse.

Since the above two consignments were lying at bonded warehouse during the entire period of credit (from 7 January 1997 to 2 December 1997 for rotor and from 5 April 1997 to 15 May 1998 for mandatory spares) allowed by the supplier, the Board could not derive any benefit against the extra expenditure of Rs.2.80 crore in above two cases.

## 3.9 Absence of proper stock accounting system

Scrutiny of records relating to stores and stock revealed the following:

(i) As per Accounting Manual of the Board, purchase, transfer, issue and stock of materials were required to be routed through the Material Stock Account. In actual practice however, capital and O&M stores are directly charged to their final heads of accounts by all Divisions (except Civil Division) without routing them through material stock accounts. Financial accounts of the station thus do not disclose any closing stock except those of Civil Division.

(ii) The station did not have any organised store. Stores are received by respective Division/sub-Divisions who maintain their own site stores. Issues of stores are, however, not supported by requisitions and such issues are also not priced and accounted for as the same are charged to final consumption at the initial stage. This shows lack of control over stocks and stores.

## Conclusion

**The shortfall in generation due to low PLF resulted in increase in cost of generation significantly. Avoidable delay in completion of repair and maintenance led to longer duration of shutdown and loss of potential generation. The station also failed to monitor and control excess consumption of fuel and auxiliary power over prescribed norms. The Board failed to finalise gas supply agreement with the suppliers to ensure uninterrupted supplies of natural gas of required quality to the generating station.**

**The Board needs to formulate plans to improve the PLF, minimise the duration of planned and forced outages, ensure maximum plant utilisation, analyse the reasons for higher consumption of fuel and auxiliary consumption over the norms with a view to increase the generation as well as to reduce the unit cost of generation.**