

Constitution of a State level
Advisory Committee to identify
operation and maintenance problems
of power stations.

Government of Gujarat,
Industries, Mines and Power Department,
Resolution No. GKB-1181/7341/K-1,
Sachivalaya, Gandhinagar,
Dated the 31st December, 1981.

RESOLUTION :

There have been frequent forced outages of varying durations in the various power stations of the Gujarat Electricity Board and Ahmedabad Electricity Company Ltd. in Gujarat. These unscheduled outages result in emergency load control measures and load shedding in rural areas adversely affecting the industry and agriculture. Looking to the gravity of the situation arising out of such frequent unscheduled outages, the question of appointment of an ad hoc Committee to examine the practices of operation and maintenance of the indigenous sets was under consideration of the Government of Gujarat for some time. Government is now pleased to constitute a State Level Study Committee for identifying the problems and difficulties and to suggest remedial measures for prevention of such unscheduled outages. The composition, functions and tenure of the Committee shall be as under

(A) Composition of the Committee :

1. Dr. S. Varadarajan, Chairman, Chairman of the
Engineers India Limited. Committee.
2. Shri Ajay Chingabhai,
Ahmedabad Textile Mills Assn.
3. Shri Arvind Buch,
Textile Labour Association.
4. Shri Chimanbhai Mehta,
INTUC
5. Shri K.N. Shenoy, Managing Director,
Hindustan Brown Boveri, Baroda.
6. Shri L.G. Sane, Consultant
7. Dr. J.K. Satia, Professor of System
Engineering, IIM.
8. Shri M.V. Rao, General Supdt.
Trombay Power Station.
9. Shri G.C. Jain, GM,
Renukoot Power Station, Mirzapur.

- | | | |
|-----|---|-----------------|
| 10. | Shri Manharlal G. Patel
President, Gujarat Small
Industries Federation. | Member |
| 11. | Shri Darbari Sheth, M.D.
Tata Chemicals, Bombay House,
Bombay. | " |
| 12. | Shri Dalsukhbhai Patel, M.L.A. | " |
| 13. | Shri R. Basu Member (Adn.)
GEB, Baroda. | Mem. Secretary. |
- (B) Status and functions:-

The Committee shall have the status of a State Level Committee. The members will work in honorary capacity. The Committee will examine and submit a report to the State Government on the following matters:-

- (i) whether the present practices of operation and maintenance of the indigenous sets are proper and adequate; and whether these are in accordance with the best power Engineering standards and practices;
- ii. whether correct operating procedures are laid down and are followed for shut-down and start-up of the power plants and for meeting the emergency conditions arising out of load fluctuations;
- (iii) whether the instrumentation and practices concerning water chemistry are adequate for short-term and long term protection of the power plant equipments;
- (iv) whether an adequate and effective system exists in the various power stations for identifying and analysing the trippings of the power plant; If such analysis is being done, whether follow up action is adequate and effective to avoid recurrences;
- (v) whether the training and retraining programmes of various categories of Engineers and other technical staff are adequate and to determine whether any changes are required in the training programme, prescribed levels of qualifications experience and competence for proper and effective discharge of their duties;
- (vi) whether the maintenance of the power stations is properly organised on soundlines; and whether preventive maintenance programmes are organized on an adequate scientific basis;
- (vii) to review the rehabilitation programme undertaken on these sets, its adequacy, the timelines of the progress and the results, if any of the measures already completed;

(viii) whether the control of functions, delegation of responsibility, accountability within the power stations and the management reporting system is adequate and proper.

Whenever necessary, the Committee will suggest suitable remedial measures.

(C) The tenure of the Committee will be 4 months. The Committee will meet periodically.

(D) The headquarters of the Committee will be Baroda. It may however, hold meetings at the power stations or any other places within Gujarat at the discretion of the Chairman.

(E) Member Secretary.

Member (Administration) Gujarat Electricity Board will be the Member Secretary of the Committee.

(F) The Committee will submit its report within four months.

2. The expenditure on T.A.D.A. etc. of the non-official members will be regulated according to Section-I of Rule I-6, in Section-I of Appendix XI, II of BCSR Vol. II.

3. Government is also pleased to direct that the expenditure on TA/DA of members should initially be met by the GEB and subsequently Government should reimburse the expenditure to the GEB.

4. This issues with the concurrence of the Finance Department dated 31st Dec. 1981, on this department file of even number.

By order and in the name of the Governor of Gujarat,

B. J. DETTAWAL
Deputy Secretary to the Govt. of Gujarat,
Industries, Mines and Power Department.

To

The Accountant General, Gujarat, Ahmedabad/Rajkot.

The Pay and Accounts Officer, Gandhinagar.

The Finance Department/F.A. IMED.

The General Administration Department (Planning).

The Secretary, Labour, Social Welfare and Tribal Development Department.

The P.S. to Secretary (M.P) IMED.

P.S. to C.M.

All Members of the Committee (by letter).

"J" Branch IMED.

STATE LEVEL ADVISORY COMMITTEE APPOINTED BY THE GOVERNMENT OF GUJARAT TO IDENTIFY OPERATION & MAINTENANCE PROBLEMS OF POWER STATIONS IN GUJARAT. (VARADARAJAN COMMITTEE)

Phones:63481/82/83/84/85
Telex :Vidyut Brd-264
Gram :GUJELBOARD

C/o.Gujarat Electricity Board
Head Office, Race Course
Baroda 390 007.

Ref.No.TRG:AAJ-15;563

Date: 23 August, 1982

To:

1. Shri Ajay Chimanbhai
President
Ahmedabad Textile Mills' Association
PB No.4056, Navrangpura
Ahmedabad-380009 - By Special Messenger.
2. Shri Arvindbhai Buch
President
Textile Labour Association
Gandhi Majoor Sevalaya
PB No.110, Bhadra
Ahmedabad 380 001 - By Special Messenger.
3. Shri Chimanbhai Mehta
E-2, First Floor
Firdaus Flats,Khanpur
Ahmedabad-380001 - By Special Messenger.
4. Shri KN Shenoy
Managing Director
Hindustan Brown Boveri Ltd
PO Maneja
Baroda - By Special Messenger.
5. Shri LJ Sane
Consultant
1084, Dharampeth Extn.,
NAGPUR - 440 010
(Maharashtra) - By Regd.A.D Post.
6. Dr. J.K.Satia
Prof. of Systems Engineering
Indian Institute of Management
Vastrapur
Ahmedabad 380 015 - By Special Messenger.
7. Shri MV Rao
Chief Superintendent
Trombay Power Station
Tata Electric Companies
Bombay 400 074 - Through Angadia.

contd....2

8. Shri GC Jain
General Manager - By Regd.A.D
Renusagar Power Co. Ltd Post.
PO Renusagar, Dist.Mirzapur
Pin: 231 218 (U.P)
9. Shri Manharlal G. Patel - By Special
President Messenger.
Gujarat Small Ind.Federation
Gun House, Salapas Road
Ahmedabad 380001
10. Shri Darbari S.Seth - Through
Dy.Chairman & MD Angadia.
Tata Chemicals Limited
Bombay House, Fort
24 Homi Mody Street
Bombay 400 023
11. Shri Dalsukhbhai Patel - By Special
Leader of the Opposition Messenger.
Gujarat Vidhan Sabha
Gandhinagar 382 617

Dear Member,

Sub : Draft Report of our Committee.

I am sending herewith a copy of the above draft Report which is going to be discussed at our next meeting due to be held at Delhi on 30 August 1982 in the Board Room of M/s Engineers India Limited for which a separate intimation by Telegram has already been sent to you.

You are requested to examine the draft report, and send us in advance, and also bring with you for the Delhi meeting, your written comments in duplicate. You are requested to quote the paragraph number of the draft report to which your comments apply, for easy and quick reference.

I am also sending herewith copies of the following correspondence exchanged by us with BHEL:

1. Shri KL Puri's DO No.BHE/PDH/60 dt.12-7-82 to Dr.Varadarajan.
2. Dr.Varadarajan's letter dated 11-8-82 to Shri KL Puri;&
3. My letter dated 20 August 1982 to Shri BS.Samat, Director (TPG),BHEL.

Yours sincerely,

(R. BASU)
MEMBER-SECRETARY

cwcs to:

Dr.S.Varadarajan,Chairman & MD
Engineers India Ltd.,
PTI Building,4 Sansad Marg
NEW DELHI-110001

Encls: as above.

- COPY -

BHARAT HEAVY ELECTRICALS LIMITED

K.L. PURI,
Chairman and
Managing Director

DO No. BHE/PDH/60
D/ 12th July, 1982

My dear Dr. Varadarajan,

This has reference to your D.O. Letters dated 26/5/82 and 22/6/82 regarding deliberations of the State Level Advisory Committee appointed by the Government of Gujarat for identifying the problems in the O&M of the power stations of Gujarat and the very fruitful discussions that I and my colleagues in BHEL had with your self and other Members of the Committee in Board Room on 1/7/1982.

I am enclosing the gist of discussions we had regarding the problems faced by GEB. The points raised by the Committee are being examined in detail and I would like to assure you that all assistance will be extended to GEB by BHEL.

With kind regards,

Yours sincerely,

Sd/-
(K.L. PURI)

Dr. S. Varadarajan,
Chairman & Managing Director,
Engineers India Limited,
PTI Building,
Parliament Street,
NEW DELHI-110-001

ENCL: as above.

Gist of discussions held on 1/7/82
between BHEL and State Level Advisory
Committee appointed by Government of
Gujarat.

1. Interaction with G.E.B.

The question of better interaction with GEB to ensure that in the projects under execution and also in future projects, cordial relationship between GEB and BHEL exists was discussed in detail.

BHEL stands by its commitment to render the best of service to the customers and it shall do the best that is possible to ensure that proper interaction is restored between BHEL and GEB.

To restore confidence of GEB in our equipment and services, it was suggested by us that a complete project may be handed over to us on turn-key basis with stipulation of penalty and acceptance as was done in the case of Tripoli and BHEL could prove its capability in such a project.

2. Problems in BHEL equipment

The problems in the BHEL supplied equipment in GEB power stations were discussed in general. It was stated by us that BHEL was a member of the Task Force set up with GEB for analysing the problems and suggesting rectifications. The last deliberations of the Committee took place in December '81 and most of the issues were settled. Shri D. Narasimhan, Deputy General Manager who was BHEL's representative in the Task Force is again nominated for the same purpose and he along with Shri B.K. Patel, Chief Engineer, GEB will go over the technical points and suggest solutions.

A meeting was held later in the Projects Division of Thermal Projects Group in which the Technical Members of the Committee discussed the problems with our Technical Experts and a consensus on the methods of tackling the problem was reached.

3. C&I Deficiencies.

Regarding your observation that the C&I area is not functioning well, although principally it is ILK's problem, yet we agree to interact with GEB and ILK for evolving solutions to the problems in the C&I area.

4. Spares.

The progress made by BHEL in supplying spares to power stations was brought out. It was emphasised by BHEL

that in the last two years the value of the spares supplied to the different power stations has gone up from Rs. 50 crores to Rs. 110 crores. However, it is necessary that the power stations should plan their spares procurement, as supply of spares at short notice, especially, for imported and long lead items is not possible. In spite of our proposal to CEA for allotting money to maintain a pool of spares no funds have yet been allocated and as such it is not possible for BHEL, on its own, to stock spares to cater for emergency requirements. However, BHEL is prepared to send officers dealing with spares management in the Company to the different power stations to assist GEB in planning and ordering of spares.

It was also agreed that we will critically examine each specific complaint of high pricing and make revision if warranted. A set of catalogues of spares in which prices are held firm for one year was also shown to the Members of the Committee.

5. Reliability of design Quality of equipment

Regarding the charge that sometimes equipment of unproven design are supplied, BHEL may reiterate that all the designs are proven designs of collaborators and in case some of them have not proven their reliability, it was mainly on account of Indian conditions being different from those prevailing in the countries of original manufacture. BHEL however is always taking necessary steps to ensure that the defective equipments are corrected.

Regarding PA fans, it was mentioned by us that the impellers in the first set of PA fans which gave some problems at a number of earlier commissioned stations, are being replaced with impellers of lower weight and the same are expected to give more reliable service.

6. Availability of drawings

Regarding availability of drawings for manufacture of spares, BHEL's stand is that only spares of low technology could be manufactured outside BHEL works. Drawings of such components would be supplied to GEB as and when requested.

- COPY -

STATE LEVEL ADVISORY COMMITTEE
APPOINTED BY THE GOVT.OF GUJARAT
TO IDENTIFY OPERATION & MAINTENANCE
PROBLEMS OF POWER STATIONS
IN GUJARAT.

Phone: 63481/82/83/84/
85.

Telex: Vidyut Brd-264
Gram : GUJELBOARD

CHAIRMAN:

Dr. S. Varadarajan
Chairman & MD
Engineers India Ltd.
P.I.I. Building,
4, Sansad Marg,
New Delhi:110001,

C/O: Gujarat Electricity Board, Head
Office, Vidyut
Bhavan, Race Course,
BARODA-390-007.

Ref. No.

Date: 11 August'82.

MEMBER-SECRETARY:

R. Basu, I.A.S.
Member (Admn.),
Gujarat Electricity Board,
Baroda-390007.

Dear Shri Puri,

I thank you for your letter (D.O. No.BHE/PDH/60) dated 12 July, 1982 regarding the discussions the members of the State Level Advisory Committee of the Government of Gujarat had with you and your colleagues on 1 July, 1982 and for the copy of the gist of discussions which you had kindly prepared. I am circulating copies of your letter and attachment to all Members of the Committee.

I am heartened by your assurance that all assistance will be extended by BHEL to the power generating units in Gujarat.

You were good enough to inform us on 1 July, 1982 that you would arrange to send to me,detailed information on the points listed in my letters to you dated 26 May and 22 June, 1982. May I request you to arrange for the information to be sent at an early date so that it could be taken note of in the Report which the Committee plans to finalise shortly.

With kind regards,

Yours sincerely,
Sd/-
(S. Varadarajan)

To
Shri K.L. Puri,
Chairman and Managing Director,
B.H.E.L. 18-20, Kasturba Gandhi Marg,
NEW DELHI-110-001.

Copy to Mr. R. Basu, G.E.B. - Enclosed please find 10
spare copies of this letter for circulation to members.

- COPY -

STATE LEVEL ADVISORY COMMITTEE
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CHAIRMAN:

Dr. S. Varadarajan
Chairman & MD
Engineers India Ltd.
P.I.I. Building,
4, Sansad Marg,
New Delhi: 110-001

C/o: Gujarat Electricity
Board, Head Office,
Vidyut Bhavan, Race
Course, BARODA-390007.

Ref: No.
Date: 20 August 1982.

MEMBER SECRETARY:

R. Basu, I.A.S.
Member (Admn.)
Gujarat Electricity Board,
Baroda-390-007.

Dear Shri Samat,

Kindly recall our telephonic conversation yesterday on the subject of BHEL's response to the points raised by the Varadarajan Committee and communicated to Shri K.L. Puri in Dr. Varadarajan's letters dated 26 May and 22 June, 1982. You had indicated that gist of discussions held on 1 July, 1982 had already been sent to Dr. Varadarajan and no further information was required to be sent by BHEL. I had explained to you that unless a detailed response to the points raised by the Committee was received, the Committee would have to finalise the report on the basis of the points made by GEB alone and this would not be in the interest of BHEL. I also drew attention to Dr. Varadarajan's letter to Shri Puri dated 11 August, 1982 in which he had asked for the information.

As the Committee is to finalise its report before the end of this month, I will be grateful if any response by BHEL to the points raised is sent immediately.

With kind regards,

Yours sincerely,

Sd/-
(R. BASU)

Shri B.S. Samat,
Director (TPG),
Bharat Heavy Electricals Limited,
18-20, Kasturba Gandhi Marg,
Hindustan Times House,
NEW DELHI-110-001.

DRAFT REPORT

OF

THE STATE LEVEL ADVISORY COMMITTEE APPOINTED BY
THE GOVERNMENT OF GUJARAT TO IDENTIFY OPERATION &
MAINTENANCE PROBLEMS OF POWERSTATIONS IN GUJARAT.

VOLUME - I

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VOLUMES II & III CONSIST OF APPENDICES.

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Chapter I

INTRODUCTION

1.1.0 Background of the Power Situation

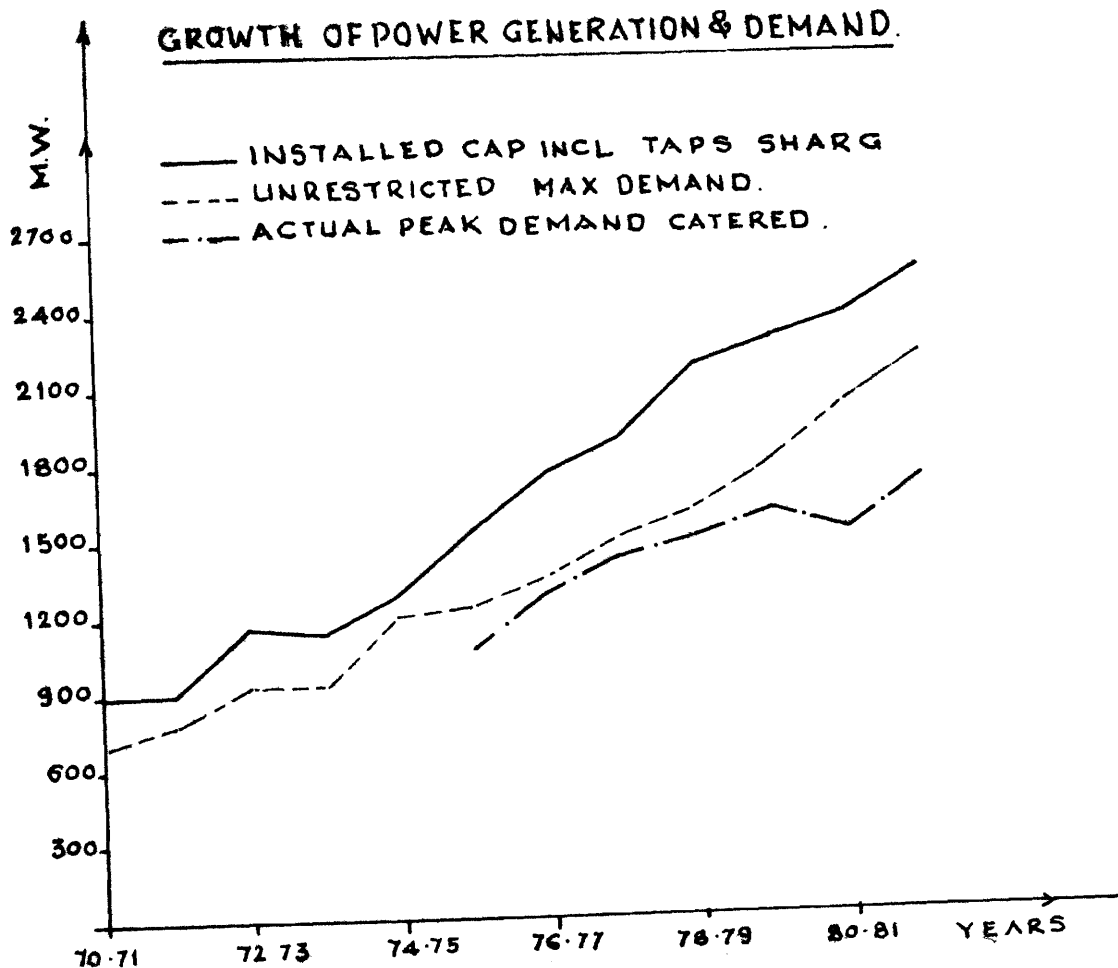
1.1.1 Gujarat has over the last two decades, experienced a very high rate of industrialisation and has emerged as the second most industrialised state in the country. In the field of agriculture too, the use of electric pumpsets for lift irrigation has been growing at a phenomenal rate. As a consequence, the demand for electric power has been growing at a compound rate of 10 per cent per annum. Installed generating capacity has also been growing at a similar rate, though delays in commissioning of new units have resulted in some setback in 1981-82.

Table-I

Particulars	1960-61	1980-81
Installed Capacity	315	2384
Electrified villages	716	12760
Max. Demand (MW) GEB.	-	1798
Total No. of consumers served by GEB	140781	2402930
Industrial consumers	6074	103473
Total sales of power (KWH x 10)	441	6517
Units consumed per capita	52	235
Energy sales by GEB Million units (LT & HT Industrial)	224	3324.5
No. of wells energised.	5401	202853

1.1.2 An important qualitative change that has been taking place during this period is that all new capacity added has been of indigenously manufactured generating units supplied by M/s B.H.E.L., These are the 110 MW unit of A.E. Company, two 120 MW units at Gandhinagar and two 120 MW units, and two 200 MW units at Ukai Thermal Station of GEB. These units now constitute around 50% of the total installed generating capacity in the State.

1.1.3 The graph below indicates the growth of power generation and demand between 1970-71 and 1981-82. The gap between the maximum unrestricted demand and the actual peak demand catered to by the Gujarat System has been growing steadily.



- 1.1.4 Apart from the incapacity of the system to cater to the peak demand on a regular basis, frequent forced outages (Table II) of varying durations have been resulting in emergency load control measures and load shedding in rural areas adversely affecting both industry and agriculture.

Table II Forced Outages

Station	Year	No.	Duration Hours
Ukai	1979-80	139	4633
	1980-81	94	16898
	1981-82 (9 months)	61	5572
Gandhinagar	1979-80	36	578
	1980-81	41	706
	1981-82 (9 months)	32	4745
A.E. Co.	1979-80	-	799
D. Station →	1980-81	-	609
	1981-82 (9 months)	-	131

- 1.1.5 A comparison (Table III) of the Plant availability factors of G.E.B's Ukai, Gandhinagar & Dhuvaran T.P.Ss with the Tata Power Station at Trombay over the period 1977-78 to 1981-82 reveal clearly that the imported generation equipment at Dhuvaran and Trombay have superior performance in terms of Plant availability. The performance of the Dhuvaran T.P.S. compares favourably with Tata's Trombay

T.P.S. (Both using imported equipment), indicating the inherent capacity of a public sector organisation to perform as well as a private sector unit.

Table III Plant Availability Factors.

	1977- 1978	1978- 1979	1979- 1980	1980- 1981	1981- 1982
<u>GEB</u>					
Ukai	52	70	79	54	56
G'nagar	54	79	81	81	61
Dhuvaran	84	89	70	95	89
<u>A.E. Co.</u>					
Sabarmati 'D' Stn.	NC	NC	60	79	71
<u>Tatas</u>					
Trombay	81	88	85	78	86

$$\text{Availability factor (\%)} = \frac{\text{No. of hours unit was available for generation during the year}}{8760} \times 100$$

1.2.0 Constitution of the Committee.

The Government of Gujarat therefore decided to constitute this State Level Study Committee for examining the practices of operation and maintenance of the indigenous sets in order to identify the problems and difficulties and suggest remedial measures for prevention of such unscheduled outages.

1.2.1 The terms of reference of the Committee are in paragraph (B) of the Govt. Resolution No. GEB-1181/7341/K.1 dt. 31.12.81 (Appendix 1) and inter alia cover the following matters:-

- (1) Operations & maintenance practices and procedures
- (2) Instrumentation
- (3) Outage analysis
- (4) Training
- (5) Organisation of maintenance esp. preventive maintenance.
- (6) Rehabilitation programme undertaken by GEB
- (7) Control of functions, delegation of responsibility accountability within power stations, and management reporting system.

1.2.2 The Committee was composed of the following.

1. Dr. S. Varadarajan - Chairman
2. Shri Dalsukhbhai Patel
3. Dr. JK Satia
4. Shri Darbari S Seth
5. Shri Arvind Buch
6. Shri Manharlal G. Patel
7. Shri KN Shenay
8. Shri Chimanbhai Mehta
9. Shri GC Jain
10. Shri LJ Sane
11. Shri MV Rao
12. Shri Ajay Chimanbhai
13. Shri R. Basu, Member-Secretary.

1.3.0 Proceedings of the Committee.

1.3.1 The Committee met for the first time on 30.1.82 and adopted rules for the conduct of business Appendix - 2

1.3.2 The Committee also noted that both GEB and A.E. Co. enjoyed a very high reputation in the power industry, and in terms of such indices of performance as the Plant Availability and factor and Plant load factor (Table-IV below) were among the top few public utilities in the country. The purpose of the Committee was not therefore to find fault with either of these organisations, but rather to study the problems being faced by them and suggest measures for improvement of their overall performance.

Table IV

	Plant availability factor %	Plant load factor %
	1981-82	1981-82
Gujarat	75	54.7
Maharashtra	73	52.9
Madhyapradesh	67	49.9
Andhrapradesh	67	46.8
Tamilnadu	67	48.1
West Bengal	70	40.5

1.3.3 The Committee considered the terms of reference outlined in the Govt. Resolution cited earlier, and decided that in order to subserve its principal objective of making recommendations for improvement of Plant availability and performance, it may examine and make recommendations

in areas not strictly covered in the terms of reference, but which in the opinion of the Committee were essential for arriving at comprehensive solutions to specific problems.

1.3.4 Shri Arvind Buch, Member of the Committee desired that the Committee also take a look at the Transmission and Distribution side of the Board's working, since he felt that matters such as T & D losses & the implementation of power cuts and loadshedding in rural areas deserved the Committee's concern. However, the Committee felt that this would unduly expand the scope of the Committee's work besides being out of its terms of reference.

1.3.5 In keeping with this broad policy, the Committee has reviewed the Operations and Maintenance Practices in Power Stations, identified major problem areas, and made appropriate recommendations. It has also examined the management/organisational structure of the Board and its Power Stations as also the question of Human Resources management; both crucial issues for an organisation growing at a such phenomenal pace. The recommendations in respect of these two areas are therefore made with a view to enable the Board to respond to future needs.

1.4.0 Methodology

1.4.1 In order to elicit information on matters of concern to the Committee, it was decided to frame a set of questionnaires for unit-wise, station-wise and organisation-wise information. In response, both G.E.B and the A.E.Co.

furnished voluminous replies which were extremely useful to the Committee. Separate questionnaires were also prepared by members Shri G.C. Jain and Shri Dalsukhbhai Patel. Replies to these were also scrutinised by the Committee.

- 1.4.2 The Committee, recognising that written replies alone are seldom adequate for a study of the nature entrusted to the committee, invited both the Chairman, G.E.B and the Chief Executive, A.E. Co. to make oral presentations to supplement the written replies to the questionnaire. These presentations are summarised in the minutes of discussion at Appendix-3.
- 1.4.3 The Committee also undertook visits to the Gandhinagar, Ukai and Ahmedabad power stations using indigenous sets. To compare the performance and practices of these with imported sets visits were also paid to the Dhuvaran T.P.S. of the G.E.B and the Trombay T.P.S. of the Tata Power Co. in Maharashtra. During these visits and subsequent visits by a sub-committee of the main committee, opportunity was taken for discussing a variety of problems with the local engineers.
- 1.4.4 Since a number of problems faced in the operation of indigenous sets were attributed to design deficiencies and poor after-sales service by M/s BHEL, a meeting was also arranged on 1.7.82 at New Delhi with Shri K.L. Puri, Chairman of BHEL to hear his views on the subject. The minutes of the meeting are at Appendix-6.

1.5.0 Structure of the Report.

- 1.5.1 A review of operations and maintenance practices is made in Chapter II of this report. Recommendations of earlier Committees like the Kulkarni Committee, the VGB Committee and more recently the Rajadhyaksha Committee are examined with reference to the actual practices obtaining.
- 1.5.2 Chapters III and IV cover the major problem areas identified by the Committee - (1) Design and reliability in respect of equipment supplied by BHEL (2) Instrumentation (3) Spare Parts management (4) Coal quality and (5) Rehabilitation programme undertaken by G.E.B.
- 1.5.3 The entire question of Human Resources management is discussed in Chapter V covering such matters as manpower requirements and availability of engineers; quality of senior managers; recruitment, promotion and appraisal policies, training; industrial relations.
- 1.5.4 Chapter VI deals with the organisational structure and changes needed therein. Matters like functional control, delegation of powers, have also been discussed here. A section of the chapter has also been devoted to certain financial questions which came to the notice of the Committee during its study.
- 1.5.5 Recommendations have been made by the Committee in the body of the Report. However, all important recommendations have been summarised in a separate Chapter VII which also incorporates the Committee's views on the outlook for the future,

Chapter II

REVIEW OF OPERATING AND MAINTENANCE PRACTICES

2.1.0 Introduction.

2.1.1 The ability to utilise generating capacity depends largely upon observance of proper operating and maintenance practices. The Committee found a considerable variation in the practices followed at different power power stations. The availability of sets at Gandhinagar, Ukai, and A.E. Co. power stations has also varied considerably between units and over the years. (Table I).

Table-I Availability of Sets in %

	1977- 78	1978-1979- 79	1979- 80	1980- 81	1981- 82
Ukai-I	51	82	87	65	73
Ukai-II	52	81	67	34	61
Ukai-III	-	-	66	77	35
Ukai-IV	-	-	53	37	81
Gandhinagar-I	64	68	89	93	48
Gandhinagar-II	44	64	75	62	88.
A.E. Co. 'D' Station	-	22	69	78	71

2.2.0 Commissioning Experience.

2.2.1 The Committee noted that most of the sets were commissioned when the installation of instrumentation for proper operation were not complete. It was reported that control loops such as coal-air mixture temperature controls, heater level controls, etc, were not installed at the time of commissioning. In some cases even the air conditioning

of the control room had not been done at the time of commissioning of the sets. The quality of assistance available from BHEL at the time of commissioning varied and depended on the quality of BHEL personnel posted from time to time. The documentation available at the time of commissioning in the form of check lists and manuals were inadequate and did not reflect the benefits of commissioning experiences elsewhere in the country.

2.2.2 Instrumentation was usually completed within periods ranging from 6 months to 2 years from the date of commissioning. However as mentioned later, many of the instruments and controls are not working at all or are unreliable even today.

2.2.3 The commissioning problems accounted for a much lower level of generation during the first year of operation of the sets. Both Ukai and Gandhinagar reported availability factors of 52 and 54 per cent respectively during the first year. A.E. Co's 'D' Station had an A.F. of only 22% in its first year of operation.

2.3.0 Operating and Maintenance Practices.

2.3.1 A considerable amount of data on operating conditions is recorded at intervals of either one hour or four hours. Sequential event recorders however are not installed at any of the stations. As many of the instruments are not reliable, some of the data on operating conditions is inaccurate. While recommendations for improving instrumentation are made elsewhere (Ch. IV), it is suggested that one

instrument technician should be available in each shift and he should report to the shift charge engineer. He could identify the instruments which are not functioning whenever a discrepancy is noticed. This would improve the reliability of measurements.

- 2.3.2 Many automatic controls are operated manually which is not a good operating practice. The unreliability of measurements due to defective instruments and non-functioning controls have led to this practice. Once instruments and controls are functioning properly (Ch. IV) this practice should be checked.
- 2.3.3 The Committee found that while a lot of data on operating conditions is collected, it is not analysed. The amount of data and the routineness of operations naturally lead to such neglect. Only when some problems occur, this data is examined. The Committee recommends that a small computer should be made available at each station which can be used to process this data. It should be programmed to collect data at the control room, analyse the same, produce warning signals and prepare a summary report of each day's conditions for distribution among plant personnel.
- 2.3.4 The Committee also examined the record of operating conditions over a specified period. It concluded that within the limitations introduced by design, instrumentation, spares and quality of coal, which are discussed in Chapters III & IV, proper operating procedures were being followed.

- 2.3.5 An annual schedule of preventive maintenance is prepared but the power stations are not able to adhere to this schedule because of frequent unscheduled outages. Some of the pending maintenance tasks are performed during such unscheduled outages. The sets, by and large, are made available when scheduled for maintenance. At times, shortages of spare parts has resulted in a delay in the maintenance schedule. But the spares position is now improving.
- 2.3.6 The suppliers of equipments have given only general guidelines on maintenance. However G.E.B. prepares its own maintenance schedules based on past experience.
- 2.3.7 The targets for completion of maintenance works are set, but because of unexpected repairs or other difficulties, they are usually delayed. As against the norm of 4 weeks for boiler overhaul, and 80 days for turbogenerator overhaul, the recent experience in G.E.B. has been 30 to 40 days for boilers and 115 to 125 days for turbogenerators. The delays are due to several reasons. Poor finish of the bolts are said to cause delays in opening up the sets. When unexpected problems arise, the BHEL personnel at site being too junior have to refer problems to their head office and delays result. Incorrect or inadequate clearances and warping due to manufacturing defect or operations at uneven temperatures result in additional problems. Even where the capacity of sets are identical, many parts are not interchangeable and considerable time is taken in modification of such parts.

- 2.3.8 A maintenance information centre at each power station is being set up. It has a record of past maintenance for each piece of equipment. Once sufficient information on maintenance is accumulated and analysed, it would result in better predictability of need for maintenance and for spare parts. So far the information centres have been working for only a few months and hence the Committee was unable to assess its functioning.
- 2.3.9 Maintenance costing is done on the basis of past experience. The scheduled maintenance work is costed on the basis of estimated cost of spare parts. The maintenance staff are usually part of the regular staff and may or may not be costed separately. The estimates for cost of unscheduled outages are based on past experience.
- 2.3.10 The Plant layouts do not always facilitate maintenance. For instance, the layout of oil piping at Gandhinagar and of H.P. heater, BF pumps, CE pumps, economiser and superheater at Ukai have made maintenance difficult. The Committee suggests that these aspects are kept in mind when new power station layouts are designed.
- 2.4.0 Review of implementation of earlier committee recommendations.
- 2.4.1 Several committees have examined the problems of maintenance of thermal sets, in particular the Kulkarni Committee Report (1975), the VGB Committee Report (1977) and Rajadhyaksha Committee Report (1980). In addition to its own independent evaluation, this committee also reviewed the progress made by GEB in the implementation of these earlier recommendations. The findings were as follows:

2.4.2 The Kulkarni Committee (1975) made several recommendations for modernisation of maintenance measures in large thermal stations. Their major recommendations are summarised in the report of Rajdhyaaksha Committee and the progress against each of these recommendations are discussed below.

- a. A co-ordinated schedule of overhaul of units in the system should be drawn up at the beginning of the year in consultation with the State/Regional load despatch station and the specialised maintenance agencies in the system. 4.37(1)

This recommendation has been implemented, only minor delays in carrying out scheduled maintenance activities are experienced.

- b. Meticulous and detailed planning of scheduled maintenance will enable substantial improvement in the speed and efficiency of maintenance. 4.37(2)

In G.E.B. the time taken for scheduled maintenance is considerably above the norm. Although informally several expediting actions are taken by engineers in charge of maintenance, opportunities exist for further reduction in down time. The norms generally suggested were discussed in

2.3.7. A time and motion study of scheduled outages should be commissioned to identify possibilities for reducing the down time by allocating more resources in the form of man power and equipment. The results of this study as well as previous experience should be used to prepare plans for scheduled maintenance.

- c. Only those essential items of work which cannot be done while the unit is running should be included in the maintenance programme. 4.37(3)

This practice is usually followed.

- d. Detailed planning of the maintenance work should be taken up far in advance of the actual scheduled unit shut-down. 4.37(4)

The maintenance work is planned in advance. However, a list of spare parts required or likely to be required was not available. Consequently some spare parts have to be purchased after the unit is opened. It is preferable to plan for availability of spare parts even though they may not be required for each overhaul. It is suggested that a list of spare parts consumed during each overhaul be maintained and compiled to predict the spare parts requirements for the future. G.E.B. may also take steps to share this information with other stations in the country on a reciprocal basis.

- e. All the activities should be carefully assessed and put in the form of a PERT Chart to be able to plan and control the activities properly. 4.37(5)

This is done.

- f. The work must be organised in two full shifts using the third shift for preparatory work for the ensuing day and for completion of routine work, which does not require much skill. 4.37(6)

Two shifts are used. Some preparatory work is at times carried out in the third shift.

- g. A group of a minimum of 4 engineers including the leader of the team and one engineer for the boiler, one for the turbine and one for the electrical and instrumentation should be exclusively put on the planning and execution of maintenance works. 4.37(7)

No man power is allocated exclusively for planning and execution of maintenance work.

- h. Advance action should be taken to assess and procure spare parts, manpower and materials required for maintenance sufficiently in advance, so that they are all available at site before the unit is taken down for maintenance. 4.37(8)

Advance action is usually taken.

- i. Continuous round-the-clock supervision by higher level personnel should be provided. 4.37(9)

Only one shift supervision by higher level personnel is available.

- . Modern tools and appliances should be used to ensure speedy and high quality of work. 4.37(10)

Although some tools have been acquired, considerable modernisation of tools and appliances is required; in particular the following equipments are needed; pneumatic and hydraulic wrenches, electric trollies for material movement lifting tools and tackles, electric hoists and pneumatic grinders. This Committee recommends their early procurement.

- k. Persons in charge of executing maintenance works should enjoy adequate powers to enable decisions to be taken on the spot to keep the activities going as per schedule. 4.37(11)

The powers of the station chiefs are somewhat limited.

This point has been discussed elsewhere in the report (Ch.IV)

- l. Management must take conscious steps to motivate and involve its staff in achieving the objectives. 4.37(12)

Although steps have been taken to motivate and involve the staff more and continuing efforts are needed in this respect. GEB should work out the necessary actions required. One suggestion is that a small discretionary fund should be made available to the station chief for grant of group incentives for completion of work in time and of good quality.

2.4.3 The VGB Committee had drawn attention to the very poor water quality and neglect of water chemistry. The Committee found no serious problems regarding water chemistry. However there is a carry over problem which has resulted in deposits on turbine blades at Ukai. The problem of carry over is largely due to defective boiler drum internals and malfunctioning controls. (Refer Section 4.2)

2.4.4 The Rajadhyaksha Committee also made several recommendations and these are reviewed below.

- a. On the basis of decisions taken at the 10th conference of power Ministers and Chairman, SEBs, BHEL produced a manual for preventive maintenance along the lines prepared for Badarpur and circulated it to the utilities. There has however been no feed back information from states on the results achieved after implementation of the maintenance procedures recommended. The committee would suggest that follow up action in this matter be taken up by the CEA, as it evaluates the efficacy of the manual and to bring out such modifications or additions as are seen to be necessary on the basis of practical experiences. 4.43

No complete manuals for overhauls are at present available. Such manuals are also not being prepared by BHEL. The committee recommends that GEB should commission preparation of such manuals. It is understood that NTPC has recently developed some manuals. A consultant may be hired to prepare a manual based upon this and other information available.

- b. Boards must establish independent internal multi-disciplinary audit groups reporting directly to the General Manager/Chief Executive of the Plant to report independently on the quality and comprehensiveness of the planned maintenance operations. 4.44

No independent groups have been established. It is suggested that a technical service group both at stations and

at head office may be formed. The details of the functions of such a group are listed in para 2.6.1.

- c. The annual maintenance of modern power plants including all the instruments and auxiliaries, is becoming an increasingly complex task technically and the creation of specialised task forces, which are given rigorous training in maintenance systems requires urgent attention. Each station should have a group of such specialised persons who could be deployed on annual overhauls, preventive maintenance and on forced outage repairs. Depending upon the size of the Board's Operations, expensive equipment or special tools required to attend to major break down and repairs can be held in a central place either in the State or the region and used by stations as required. 4.45

The committee feels that a special maintenance task force should be created to take care of scheduled maintenance. Experienced personnel from different stations may be used to constitute such a task force. This task force should be headed by a Superintending Engineer and may consist of about 7 to 10 engineers. Although the personnel of the task force may be distributed among various stations for their permanent place of posting, it is expected that they will work together as a team for any scheduled maintenance task.

- d. Although there are many common problems faced by thermal stations the opportunities for engineers, supervisors, specialists and skilled workmen to learn from each other are very limited. It is recommended that CEA arrange for exchange of visits between personnel of power stations having similar equipment and common problems of, say coal quality, and also organise seminar on various aspects of plant maintenance. The Committee also observes that reports on subjects which are of direct relevance and interest to shop floor supervisory technical personnel do not reach them. Such reports should receive the widest possible circulation amongst the technical officers of the power industry. 4.46.

It is recommended that GEB work out a regular plan for staff visits to similar power stations elsewhere. When the officials return from visits, their findings should be shared among all concerned personnel at the power station through the newsletter recommended elsewhere.

- 2.4.5 The most important action required is to shift gradually from crisis based maintenance to a planned system of maintenance. A variety of managerial steps are required to bring about such a shift. First the targets set for availability of sets should be realistic. Secondly, a running list should be maintained for maintenance tasks and actions to upgrade the performance of boiler, turbine and especially instrumentation systems. Finally, when a set in any particular quarter has exceeded its targetted availability, it should be given a scheduled outage to perform such maintenance tasks. Over a period of time, this would result in a better balance between scheduled and unscheduled outages and a reduction in the total length of outages.

2.5.0 Outage analysis

- 2.5.1 The analysis of the causes of outages is difficult for several reasons, as listed below. Some of the instruments are not working and therefore reliable measurements may not be available. Sequential event recorders are not installed and instead the data is logged every four hours. It is difficult therefore to reconstruct the history of operating conditions when the outage occurs. The usual data recorded on water, gas condition and coal analysis may not be sufficient to diagnose the real causes of pro-

blems. If some incorrect operating procedures are followed, it is difficult to identify them. Because of fear of reprisals these are not usually brought to notice and therefore corrective actions are not possible. Finally many of the erosion problems are caused over a long term by operating conditions which are not ideal.

2.5.2 The outage analysis committees have been formed at the power stations. These committees have been meeting regularly. The outage analysis committee at Gandhinagar found that the major cause of trippings were due to furnace draft fluctuations and surge of oil pressure. At Ukai, besides the major problems for turbines, leaks in economiser, waterwall and superheater tubes have resulted in problems. The deliberations of the outage committees should be carefully recorded and widely circulated within and outside the particular power station.

2.5.3 The laboratories at these power stations are insufficiently equipped compared to those of other established undertakings. The capability for corrosion and metallurgical analysis is also inadequate. Steps should be taken to upgrade the laboratory, testing equipment and personnel.

2.6.0 Organisation of maintenance

2.6.1 The operation and maintenance functions have been merged at each power station and they are usually subgrouped under various specialisations such as mechanical and electrical. A separate maintenance group is not formed. While there may be some advantages in separating the maintenance

function from operations, the close interrelationship between the two in the case of power stations suggests that they may be organisationally integrated. However, it is suggested that a technical services group be set up at each power station to carry out independent audit of the maintenance function and to provide specialist assistance. The functions of such a technical service group are listed below.

- a. establish short and long term standards of performance.
- b. coordinate plans for operation and maintenance of power sets,
- c. identify likely areas of problems and their likely solutions,
- d. estimate costs,
- e. hire and liaise with suitable consultants,
- f. technical updating, and
- g. operate investigative laboratory.

The technical services group at head office should support the operations of such groups at various power stations.

- 2.6.2 The Committee appreciated the excellent house-keeping at GEB's Power Stations especially the Gandhinagar TPS. In comparison, AE Company's 110 MW Unit was not kept as clean as it should be.

Chapter III

DESIGN AND RELIABILITY OF EQUIPMENT

3.1.0 Introduction

3.1.1 The imported sets at Dhuvaran have performed better than the indigenous sets both at Ukai and Gandhinagar as seen by the following table..:

Table I - Availability factor 1977-78 to 1981-82

Year	Tata	Dhuvaran		Ukai	Gandhi-nagar
		Stage I	Stage II		
1977-78	78*	95.45	76.0	51.5	54.0
1978-79	89	83.25	94.5	81.5	66.0
1979-80	85	98.38	81.5	40.0	53.5
1980-81	78	94.48	94.0	53.0	77.5
1981-82	86	95.00	89.0	62.0	68.0

*The figure is based on data for 7 months
(Sep 77 - Mar 78)

3.1.2 Some of the shortcomings in operations of indigenous sets are a result of design and manufacturing defects and inadequate after sales service by BHEL in terms of assistance in solution of problems and supply of spare parts.

3.2.0 Design and Fabrication Defects Identified by GEB

3.2.1 GEB has identified several instances where the availability of the units remain poor due to lack of quality control at fabrication stage and due to poor design. The major points are listed below.

3.2.2 Drum Internals of 120MW Ukai units 1&2: The drum internals of 120MW units of Ukai boilers are not properly designed and therefore heavy carry-over is taking place. This has resulted in failure of 2 HP Rotors. This point was taken up with BHEL from the very beginning. Recently they had agreed to modify the design and also to provide secondary scrubbers and accordingly the work has been completed in Ukai Unit II. The effectiveness of the modified design will only be known after recommissioning of Unit II at Ukai. It may be mentioned here that GEB has no carry-over problem in 200MW units at Ukai and also in 120MW units at Gandhinagar, where the operating staff and also quality of water chemistry is identical.

3.2.3 Frequent trouble of Primary Air Fan in 200MW units: Heavy vibrations are experienced in Primary Air Fans of 200MW units at Ukai. Earlier GEB used to repair them by some patch work at site on recommendations of BHEL. Last year some modifications were carried out for which impellers were sent to Trichy Workshop of BHEL. Even after modification, the performance has not improved. Now they have suggested further modification stating that they will be supplying a hybrid design for the impeller. Thus, trial and error methods are used by BHEL instead of supplying proven design. GEB is doubtful about the performance even of the proposed hybrid design.

- 3.2.4 Drum level control: BHEL have given several different instructions for maintaining drum levels. This has also resulted in heavy carry-over and on occasion the level suggested was so low that there was starvation and boiler tubes failed due to overheating. A copy of BHEL's letter is included in Appendix-12 which shows that the instructions were revised many times.
- 3.2.5 Flame failure tripping: The flame failure trip-outs have been far too frequent especially on 200MW units and once the unit trips it takes 12-16 hours before it can be re-synchronized. This is causing heavy load shedding during the period of such tripping.
- 3.2.6 Wedges of Rotor: The wedges of generator rotor of 120MW sets have been getting displaced. This causes choking up of ventilating holes and imbalance which ultimately results in severe vibration. This may be due to poor quality of material and workmanship in assembly. The repairs of such defects is time consuming and reduces availability of the unit.
- 3.2.7 Wedges of Stator: The wedges of Stator of 120MW units get loose whenever it is taken out for overhaul. This defect has not been found in imported units.
- 3.2.8 Tube Puncture: There have been frequent tube failures in 120MW and 200MW units. This may be either due to bad material or poor quality control or poor design. After commissioning, the number of tube failures

to date have been 47 in Ukai unit 1, 34 in Ukai unit 2, 11 in Ukai unit 3 and 12 in Ukai unit 4.

- 3.2.9 Flue gas velocity: It appears that the flue gas velocity may be higher than design norms especially when the ash percentage in the coal is high compared to the coal in other countries. This gives rise to heavy erosion on the external surface of economiser and superheater tubes.
- 3.2.10 Soot blowers and coal feeder: The soot blowers are of such design that they go out of order frequently and the coal feeder is of such design that it feeds the coal erratically.
- 3.2.11 CIES Valves: The design of CIES valves in 120MW units is such that even after the defect is attended at BHEL's Bhopal Works, they are found to be passing heavily. So far no satisfactory solution has been found.
- 3.2.12 Governor failure: The operation of the governor on 120MW unit 1 at Gandhinagar is not satisfactory. It has a hunting characteristic which is unsafe. In fact one of the reasons for damage of HP Rotor at Gandhinagar may have been the unsatisfactory operation of the governor.

- 3.2.13 Failure of strainer of control valve: The strainer of control valve of 200MW unit has failed and the pieces were suspected to have gone inside the cylinder. It was therefore necessary to open out the machine which remained out of service for more than six weeks. On checking, it was found that the strainer was shorter in length and therefore this trouble had occurred. On checking the strainers of other control valves it was found that they were also short and had different dimensions.
- 3.2.14 Leakage of oil from exciter gear box of 120MW units: There is leakage of oil from exciter gear box in 120MW unit 1 at Ukai. During the last overhaul, the sealing rings were replaced but after some time the oil started leaking again. This is resulting in rotor earthfault in the unit. It also increases the fire hazard.
- 3.2.15 Erratic behaviour of HP Thrust oil pressure: In 120MW units, the behaviour of HP thrust oil pressure is erratic. Many a times the alarm sounds causing anxiety and the unit has to be shutdown to check the thrust wear. The system of thrust wear indication is not reliable.
- 3.2.16 Passing and leaking of valves: The valves in general are of very poor design and either the bonnet joint fails or a hole develops in the body or seats are

getting erroded. It is necessary to stop the unit very frequently to attend to such defects.

- 3.2.17 Gland sealing steam temperature: As per recommendation of BHEL, when 200MW units were commissioned, the gland sealing steam temperature was maintained between 120° to 150°C. After sometime different instructions were given by BHEL and now it is recommended that temperature should be maintained between 180°C to 200°C. The frequent modification of instructions causes the operations staff to get confused.
- 3.2.18 Auxiliary steam temperature and pressure control: The actuators of auxiliary steam temperature and pressure control could not be commissioned in 200MW units. BHEL had intimated GEB that the manufacture of this type of actuator was discontinued as they have become obsolete. GEB now has to make some alternative arrangements.
- 3.2.19 Breaking of piston rings of Control Valves: The piston ring of the control valve gives way and the control valve get stuck. This is very dangerous.
- 3.2.20 Vacuum problem: In 200MW units, two ejectors are required to be run continuously. Thus, no standby is available.
- 3.2.21 Sticking of diaphragm liner of LP top cover: In 200MW unit III, the diaphragm liner was stuck up and a manhole had to be cut in the top cover to detach

this liner. Nearly 2 weeks were wasted in finding a solution. This is because proper clearance while fitting were not maintained by the manufacturer.

3.3.0 Rajadhyaksha Committee Observations

3.3.1 The growth of BHEL has been so rapid that an adequate number of experienced personnel may not have been available to evaluate changes in design and in materials used and to resolve problems once a unit starts operations. Inadequate competitive pressure has also resulted in deterioration in the after sales service. BHEL does not have the organisation to adequately monitor the results of changes in design or in manufacturing processes or in materials used. Comprehensive manuals for operations or maintenance are not provided to the customers. Proper drawings and instructions for maintenance of equipment some times are not available. Pressure for early commissioning of sets results in inadequate testing and instrumentation at the time of commissioning. There is no system of guaranteed performance test of the power generating sets after initial stabilisation. This point was made by both GEB and A E Co. in their presentations to the Committee.

3.3.2 The Rajadhyaksha Committee (1980) has made several recommendations in this regard which are reproduced here for convenient reference:

- a The Committee recommends the setting up of a formal consultative machinery comprising senior representatives of the various concerned agencies viz. the manufacturers, consultants/designers and the users to ensure that the experience gained from the units in operation is regularly fed back and incorporated into the design and manufacture of the new units. Such a consultative machinery should function preferably under the Chairmanship of Member (Thermal) of CEA. 4.28
- b The long felt demand that manufacturers should provide comprehensive instruction manuals for erection, operation and maintenance to the station staff should be met expeditiously. These should be prepared for different levels of operating staff so that operators and mechanics, supervisors, junior and senior officers are clear about what functions they are expected to perform. 4.29
- c The Committee would like to emphasise that manufacturers must give the highest priority to the manufacture of spares and even let the regular output be curtailed if necessary. The CEA should, through its operations wing, ensure that SEBs place orders sufficiently in advance for them to be built into the manufacturer's production programme and should monitor their production. 4.50

3.4.0 Discussion with Chairman BHEL.

3.4.1 The Committee held discussions with the Chairman and other senior officials of BHEL on 1-7-1982 in New Delhi. The minutes of the meeting are given at Appendix-6. The major points discussed and the comments by Chairman BHEL were as follows:

- 3.4.2 The BHEL Chairman mentioned that the boilers constructed under Czechoslovakian collaboration which were supplied for Ukai Stage I had experienced several difficulties. The earlier 210 MW sets also had experienced difficulties in operations under Indian conditions. Some of these units were supplied in Ukai stage II. The new 210 MW sets, however, were operating well everywhere.
- 3.4.3 The BHEL Chairman reviewed the monthly performance of the BHEL supplied sets in Gujarat. He said that on several occasions, the monthly availability of each of these sets had been nearly 100 per cent. So the need was to continuously maintain conditions similar to those in which the sets performed well. For this purpose cooperation between GEB and BHEL is necessary.
- 3.4.4 GEB on its part should ensure that (a) instrumentation and controls are working properly; (b) the staff is trained and posted about 9 months in advance of commissioning in case of new power stations; (c) proper conditions should be assured at the time of erection, and (d) spare parts management should be strengthened. The Committee has reviewed commissioning procedures, instrumentation and controls, and spare parts management elsewhere in the report.

3.4.5 BHEL on its part has already taken the following actions:

(a) Spare parts production has doubled in two years and is likely to increase further, (b) A catalogue of spare parts with prices and delivery schedules has been prepared and printed and (c) Appropriate changes are continuously being made to incorporate the learning acquired through operating experiences in India; some examples of such modifications are fans, dampers and coal mills.

3.4.6 The issue of bent rotors was discussed. BHEL engineers felt that the major reasons were inadequate or incorrect operating conditions, water chemistry, water induction in turbine, instruments being unreliable or not working and auto controls not working. There was some difference of opinion between GEB and BHEL engineers. GEB engineers felt that the problems were due to design defects in some of the equipment, which has taken a long time to rectify. Although, as remarked earlier, it is difficult to assign a single cause for an unscheduled outage, it does appear that if all instruments and controls were working satisfactorily secondary damage to equipment resulting in long forced outages could have been prevented.

3.4.7 Chairman BHEL gave the Committee a translated version of the report of Mr A V Makhnovski, specialist from USSR who had stayed at the Ukai thermal power station

from November 1981 to May 1982 at the instance of GEB. The full text of the report is reproduced in the Appendix -9. This report largely corroborates the Committee's own findings.

3.4.8 At the end of the discussions, the Chairman BHEL agreed to take the following steps.

- a) review all outstanding orders for spare parts and provide commitments to delivery by agreed dates
- b) set up a group to review all instrumentation and controls in Ukai and Gandhinagar and furnish recommendations for their rehabilitations
- c) set up a joint team to review the problems brought out by GEB as shown in Appendix-11

3.4.9 In general BHEL offered its help in terms of making suitable personnel available in response to articulated GEB needs and resolve all problems. To strengthen coordination between BHEL and GEB on an ongoing basis, BHEL offered to post a mutually acceptable person with support staff and adequate powers to maintain liaison on all matters with GEB.

3.5.0 Action to be taken by GEB.

3.5.1 GEB should prepare itself adequately to cope with the difficulties arising out of indigenisation. Several steps could have been taken by GEB to prepare itself

better in this regard. Systematic efforts through visits and sharing of experiences with power stations in other States having similar sets were not made. It has not developed a strong in-house quality assurance capability. Adequate manuals were not prepared. Concerted efforts were not made to acquire detailed drawings and specifications of parts. In general, the amount of technical information and knowledge required were not developed.

3.5.2 The following recommendations are made in this regard:

- a) GEB should work out a definite procedure for inspection during various stages of manufacture. It is understood that such a programme has been included in the NTPC contracts with BHEL where the conditions of the World Bank Loan required it. The same programme could be adopted by the Board. Such inspection could be carried out preferably by the Board's own personnel; - if necessary, the assistance of a consultancy organisation could be used.
- b) The subcontracted material usually arrives at the where it is inspected. Various components are also matched at that time. The pressure for early commissioning usually results in some compromises

in quality and make shift arrangement in case of defects. GEB should develop strong in-house quality assurance capability for such materials.

- c) A guaranteed performance test under well-specified conditions should be included in the contract agreement with BHEL. Such a test would ensure that the sets are stabilised to work under specified conditions and that they are able to operate at the specified performance level.
- d) Consultants should be hired to monitor the complex relationship between the various contractors and should be fully accountable to the Board. At present Tata Consulting Engineers have been employed by GEB, but the accountability aspect needs to be examined further by GEB.
- e) GEB should acquire detailed drawings and specifications, operation and maintenance manuals, details of manufacturing processes and metallurgical analysis of parts, if necessary by hiring special personnel for this purpose. This should be done as a one-time major exercise first for all existing equipments. Subsequently, only updating would be required.
- f) GEB should review the standards specified by BHEL for various accessories and test them for the required performance once they are commissioned.

g) Operations and maintenance personnel should have close liaison with the project team during erection and commissioning of the plant. During the construction phase, operations and maintenance should have staff to ensure quality control of the erection work.

3.5.3 In addition to the above, GEB should cooperate with and follow-up the actions to be taken by BHEL which are mentioned in paras 3.4.8 and 3.4.9.

3.5.4 The Ahmedabad Electricity Company had reported to the Committee that their 110MW set which has a different design from the 120MW sets of GEB had now stabilised and they had no serious problems of design and reliability of equipment. However many of the recommendations made above will be of assistance to the Company in improving performance further.

Chapter IV

OTHER PROBLEM AREAS

4.1.0 Analysis of outages

4.1.1 Power Stations are complex systems and it is difficult to pinpoint exactly the causes of problems as usually a number of interrelated factors play their part. As the following table shows, there are a number of reasons for unscheduled outages.

Table I - Unscheduled outages by equipment.

Ukai and Gandhinagar (since date of commissioning)

Cause	No. of outages	Hours	% Total
Boiler	332	19669	49.63
Turbine	115	8639	21.84
Condenser	41	455	1.15
Auxiliaries	78	7828	19.75
Electrical	134	2578	6.75
Fuel handling	8	41	0.10
Others	46	310	0.78

Most of the outages are accounted for by the problems in boilers. The forced outages in turbo-generators have been fewer but have been of much longer duration.

4.1.2 A E Co. has submitted a list of forced outages yearwise since commissioning. This is at Appendix 20 It is noticed that most outages are of short duration and the overall availability of the set does not vary very much from year to year.

- 4.1.3 Table II shows the number of forced outages by their duration in different years. Of the total duration of outage, 54 percent were accounted for by outages of less than 7 days, 32 percent by outages of duration varying between 7 to 30 days and the remaining 14 percent by outages of longer duration.

Table II - Unscheduled outages by duration

Ukai and Gandhinagar (since commissioning)

Period of outage	No.	Total Hrs down time	Percent of total
Upto 24 Hrs	453	5436	14.20
1-7 days	191	15280	39.90
7-30 days	42	12180	31.80
Above 30 days	6	5400	14.10
Total:	692	38296	100.00

- 4.1.4 Thus the causes of forced outages and their duration vary considerably. It is therefore necessary to consider a number of factors leading to forced outages and remedy them. Chapters II and III have discussed operations and maintenance practices and the design and reliability of equipment respectively. Principally, the Committee feels that the following other areas need attention:

- a) Instrumentation and Control
- b) Spare parts management
- c) Quality of coal.

4.2.0 Instrumentation and Controls

- 4.2.1 Several deficiencies were noted in the instrumentation and Control systems of both Ukai and Gandhinagar power stations. At A E Co.'s 'B' station the situation was somewhat better, but they also had problems regarding availability of spares due to obsolescence. The Committee had requested Shri U K Ray of Tata Chemicals, Mithapur to make a detailed study of the instrumentation and control system at Ukai and his report is at Appendix- 7. The deficiencies noted have resulted and would continue to result in frequent trippings, inefficient operations, reduction in the life of equipment and may have led to ignoring some precautionary measures because of lack of faith in measurements by operating personnel. Many factors have resulted in these weaknesses, as described below.
- 4.2.2 Several design defects exist. In many cases improper measurement or control signals have been selected. At times, improper selection of ranges for instruments have resulted in imprecise measurements within the normal range of operations. The mounting of some instruments was also found improper. The auto combustion controls are not working and are operated manually. Improper range selection and measurement signals, coupled with manual control has resulted in on-off operation rather than smooth proportionate control of

air pressure. Inaccurate temperature measurements have led to poor control of the air-fuel flow. Many of these difficulties can be attributed to the supplier (ILK), but the responsibility of GEB and its consulting engineers to correctly evaluate the design cannot be denied.

4.2.3 Electronic controls were adopted in Ukai and Gandhinagar. GEB personnel who had experience only on pneumatic controls at Dhuvaran were not adequately trained for the new technology. Besides, the electronic type of controls allow use of computers and data acquisition system. But this feature was not exploited. Lack of spares has resulted in important instruments such as those for continuous measurement and indication of dissolved oxygen in boiler feed water, not working. Some of the equipment has become obsolete and ILK is not able to supply spares for these. While commissioning unit 4 in Ukai, the running spares of other units were used and were not replaced.

4.2.4 Currently the instrumentation function at GEB is considerably downgraded, both organisationally and technically. The interface between engineers in charge of operations and those in instrumentation is weak. There is also no exchange of ideas and information between project personnel and operation staff on instrumentation. This function needs to be considerably strengthened.

- 4.2.5 The weaknesses in instrumentation and control systems have led to problems in operation of the generating sets. To illustrate, the automatic steam temperature controls are not working and temperatures are regulated manually. The resulting variation in temperature may lead to problems such as tube fatigue. Unusual tripping on account of furnace draft is a problem in Ukai No IV because of leakage at air heater and continuous oscillation of the actual furnace draft. It may also affect the life and operations of the boiler. As many of the instruments are unreliable or are not working, the operating personnel have lost their faith in the measurement system and consequently may be operating the plant without adequate attention to plant safety.
- 4.2.6 Several steps are needed immediately to improve functioning of instrumentation and control systems. A competent agency should be entrusted with the job of identifying detailed rehabilitation needs and then implementing the rehabilitation programme. Chairman BHEL has agreed to set up a group to do this and GEB should not miss the opportunity.
- 4.2.7 It was represented to the Committee that major rehabilitation work on instrumentation cannot be taken up because of the long outages required. However it should be possible to break up the various elements of the

the rehabilitation programme so that some work can be done during scheduled and forced outages. In fact considerable work could have been done on instrumentation during the recent long outages both at Ukai and Gandhinagar.

- 4.2.8 Precautions need to be taken at each stage - design, commissioning, maintenance and technical audit - to avoid future problems. GEB should have senior instrumentation engineers or experts to evaluate the design at the time of selection and ordering. The Project and Planning Department should have an instrumentation cell with personnel of requisite capability. Qualified instrumentation engineers and specialists are also required to maintain the system. The technical services group at the Head Office should have sufficient competence in instrumentation to carry out technical audit as well as provide specialist advisory assistance to power station personnel in instrumentation and control.

4.3.0 Spare Parts Management.

- 4.3.1 The major difficulty in availability of spare parts is the inability of BHEL, ILK and other suppliers of proprietary items to deliver spares in time. Adequate priority is not assigned to the manufacture of spare parts. Therefore, lead times of 36 months and more are quoted. Sometimes the equipment is classified as obsolete and the spares are not available at all.

- 4.3.2 The response to non-availability of spares varies according to the situation. Often BHEL or other suppliers respond more quickly when the unit is down. Some parts are repaired which would normally have been replaced had new parts been available. At times inferior parts manufactured by local manufacturers are substituted. As a last resort, the unit is sometimes operated without properly functioning equipment.
- 4.3.3 These responses seem to have been adequate and it was reported to the Committee that shortages of spares did not result in an increase in duration of either scheduled or forced outages. The Committee however felt that the shortage of spare parts and the responses outlined above have resulted in a need for more frequent replacements and consequent outages; it also implies inefficient operation of the plant.
- 4.3.4 GEB lacks a suitable spare parts management system at power stations and needs to considerably strengthen their current procedures for management of spares. A E Co. being a single location power utility, has a better system for spare parts management and the Committee does not see any need for change at present.
- 4.3.5 While the Committee has not evolved the needed system in detail a task that GEB should undertake and hire a consultant for this purpose if necessary, the following

elements would be needed for setting up the system - creating a responsible organisation for procurement of spares, improved information systems, and adequate technical support to ensure good quality of parts.

- 4.3.6 The organisational responsibility and availability of information are fragmented. The current procedure for procurement of spare parts is as follows. Each technical section responsible for operation/maintenance prepares the list of needed spare parts for the next year by June of the current year. Whenever lead times are longer than a year, the needs are estimated even earlier. By September, the requirements for the next year are finalised. Of about 2500 spare parts maintained at the power station, about a hundred are procured centrally by the Head Office and the rest are procured by the station itself though sanctions may be necessary from Head Office even for such purchases depending on the value. The procurement action is initiated by the technical personnel responsible for indenting and procurement. The technical section estimates the need but does not have sufficient access to either procurement or stores information. They have their own informal record-keeping system for this purpose. The stores maintains only the stock information and have no information on outstanding orders or promised delivery dates. The technical section

responsible for procurement has information available only on indents. It does not have information on current stock position or likely future needs. This organisation needs to be strengthened by unifying the responsibility in one department, of helping technical section estimate the demand, of procurement action and of maintaining inventories based on well-designed inventory control procedures.

- 4.3.7 The Head Office also needs to delagate more powers to stations for purchase of spares. Currently the financial limits at power stations for local enquiry, limited tender inquiry and general tenders are Rs.5000/-, Rs.15,000/- and Rs.300,000/- respectively. These limits were fixed about seven years ago and need to be revised now. The Committee recommends that a list of proprietary items be prepared and the power station chief be allowed to order these items as required but subject to budgetary limits. The limit for local inquiry should be raised to Rs.20,000/- and for limited tender inquiry to Rs.30,000/-. The general tender limits would be automatically enhanced when the post of Accounts Officer is upgraded as recommended elsewhere in this report. Where repetitive jobs or supplies are required, annual rate contracts should be fixed and then powers for indenting delegated. The Committee also recommends that GEB could introduce a system of

prequalification of tenderers. When this is done, the powers for limited tender inquiry could also be enhanced.

4.3.8 GEB has already started computerisation of its inventory records at Head Office. The Committee recommends similar action at the power station level using mini computers. Meanwhile a cardex system could be introduced for spare parts inventory control. The inventory of spares needs careful monitoring to ensure that the level of inventory is at a level just adequate to offer reasonable service levels for scheduled and unscheduled outages.

4.3.9 An incoming materials inspection activity under the Technical Services Group at the power stations should be organised with adequate testing facilities for carrying out inspection of all parts procured. Where inspections have to be conducted at suppliers' works, inspections could be entrusted to reputed organisations on contract basis.

4.4.0 Coal Quality.

4.4.1 The poor quality of coal as measured by its low calorific value, high ash content and presence of large stones and other foreign objects continue to result in poor performance of the units. Here again, A E Co. is less affected than GEB because of linkage with older coal mines. It results in heavy wear and tear of coal mills and frequent stoppage to remove foreign objects. Since the boilers

are not designed for such a high ash content, difficulties are created in the auto controls of the boiler firing.

- 4.4.2 These difficulties are wellknown and have been discussed in detail by the Rajadhyaksha Committee. In particular, GEB should implement the recommendations mentioned in paras 4.86, 4.87 and 4.88 of the Committee Report for handling coal of poorer quality.
- 4.4.3 GEB has already implemented an incentive scheme with collieries where incentive are given depending upon the quality of coal.
- 4.4.4 It seems that Washeries at pit heads are quite expensive and require action on the part of Collieries. Meanwhile a low level of technology for removing impurities at power stations needs to be developed. For this purpose GEB should have a R & D project with a budget of Rs. 10 lakhs approx. to develop low cost technology for removing non-magnetic or para magnetic impurities from the coal.
- 4.4.5 The capacity of coal mills needs to be suitably increased to handle the required amount of coal of lower calorific value and to provide for increased downtime of the mills due to poor quality of coal.
- 4.5.0 Rehabilitation Programme undertaken by GEB on indigenous sets.
- 4.5.1 The Committee had called for information on the rehabilitation programme undertaken by GEB. The details of the renovation jobs identified and the action taken

thereon till 31-3-1982 are in Appendix- 4.

- 4.5.2 The Committee found that a number of jobs have been completed, but in some cases e.g. E P availability, oil leakage from exciter gearbox, leakage of oil in BFP motor in Ukai units I & II; CIES valve passing, isolating valves of feed control valves passing, unsatisfactory working of EPs in Gandhinagar units I & II; damper leakages, vacuum problem in ~~condenser~~ in Ukai units III & IV; the defects still persist. In some other cases, the jobs have not been completed because parts have not been received from BHEL. In the case of valves GEB has had to import these, and replacement of old valves is proceeding gradually.
- 4.5.3 The Committee also felt that rehabilitation of the instrumentation and control systems had not received due attention in the programme drawn up by GEB and only a very few items of work on instruments/controls have been taken up. The Committee has considered this separately earlier in this chapter and recommended a complete review of the instrumentation and control systems so that a rehabilitation programme can be drawn up.
- 4.5.4 The Committee observed that on the whole, the implementation of the rehabilitation programme on the 210MW units at Ukai has made better progress with more satisfactory results than on the 120MW units. A number of serious problems remain and these have been discussed in Chapter III.

Chapter V

HUMAN RESOURCES MANAGEMENT

5.1.0 Introduction.

5.1.1 Having considered the problems identified in respect of machinery and materials, the Committee turned its attention on an equally important area affecting power station performance - viz - human resources. The availability of trained manpower in the right numbers and at the right time depends largely on the advance planning done by the organisation.

5.1.2 GEB has made some projections of its future requirements of engineers based on existing staffing norms and expansion plans (Appendix-10). However, at present, recruitment is still being done on the basis of existing and likely vacancies during the year at the level of only Junior Engineer or Deputy Engineer. The Committee recommends the setting up of a manpower planning cell with close linkages with the training department so that categorywise, specialisation-wise requirements of manpower are estimated and their training requirements identified. This cell should also develop an information system to support the total personnel function.

5.2.0 Requirement Availability and Quality of Personnel at Power Stations.

5.2.1 The requirements of GEB power stations in terms of sanctioned strength, actual availability and vacancies are

indicated below:

Table-I (Ukai, Dhuvaran, Gandhinagar Power Station)

Category	Sanctioned Strength	No.in posi- tion	Vacancies
J.E.	105	96	9
D.E.	177	171	6
E.E.	72	68	4
S.E.	9	7	2
A.C.E.	3	3	-

Since A.E. Co. has a different structure, comparisons could not be made.

The Committee recognised that some vacancies are always likely to remain on account of transfers, resignations, retirements etc. This figure should not however normally exceed 5% of the total number of posts of each category. Most of the Power Station chiefs complained of shortage of manpower. This complaint apparently arose out of the fact that the ratio between no. of engineers and number of shift positions did not adequately cover the requirements of leave vacancies, training, holidays etc. The Committee learnt however that GEB is now revising this ratio and so no recommendation is made in this regard.

- 5.2.2 GEB has estimated that between 500 and 800 additional Engineers will be required every year in the years 1983-84 - 1990-91 (Appendix-10). Without scrutinizing too closely the basis of these projections, it is possible

to say that the requirement of engineers will far exceed the availability.

- 5.2.3 The numbers of qualified engineers employed per shift in the operation side of power stations in GEB, A.E.Co., & Tata Power Co. are at Appendix-16. It appears that GEB employs a larger number of qualified engineers per shift per unit than either Tatas or A.E. Co.

The Committee therefore recommends that GEB review its staffing patterns to ensure that engineers are only employed on jobs where their training and skills are essential. Secondly, for jobs where formal education in engineering can be dispensed with, GEB could recruit science graduates with the necessary aptitudes, and subject them to post recruitment training.

- 5.2.4 The quality of the technical personnel in the GEB power stations in terms of their qualifications is in Table-II. A.E. Co. have reported that most of their officers are either degree or diploma holders.

Table-II - Qualifications of technical personnel.
(As on 31-3-82)

Station	JE/DE				P.O./Technician		
	Degree	Diploma	Non-Dip.	Total	Dip.	Non-Dip.	Total
G'nagar	35	16	1	52	-	42	42
Ukai	97	38	6	141	9	63	72
Dhuvaran	53	18	4	75	1	83	84

Since the problem of getting qualified personnel to work in remote areas is likely to continue, the Committee recommends that the deficiencies in formal qualifications be rectified through training.

- 5.2.5 The Committee observed that at the higher levels of the power station hierarchy in GEB, engineers with little or no exposure to management training or exposure were being placed in critical management positions. While such persons might be technically competent, the Committee felt that engineers who are holding or are likely to hold important managerial positions should be designated as managers and also given basic training in management concepts. Selection of persons to head power stations should be based more on the administrative and managerial abilities of individuals rather than their technical proficiency alone.

5.3.0 Recruitment.

- 5.3.1 GEB recruits technical personnel of the workmen category at various levels - helper, plant attendant, plant operator etc. Engineers are directly recruited largely as Junior Engineers though qualified plant operators and Technicians are also eligible for promotion as J.Es. 20% of the vacancies at the level of Deputy Engineer are filled up by direct recruitment at any level and all senior posts are filled in by promotion. Campus interviews are held in engineering colleges in Gujarat

for selection of engineers. The Committee recommends that similar campus interviews could be held at some of the IITs and other lead institutions.

5.3.2 For non-technical posts the point of entry is at the Jr. Assistant level. An accounts examination is held to screen employees for the Accounts cadre from among Sr. Assistants. Those who do not qualify for the Accounts cadre continue to get promotions based on seniority on the administrative side to posts such as Head Clerks, Superintendents, Assistant Secretaries etc.

5.3.3 Of late GEB has started some direct recruitment on the Personnel side for posts of Deputy Secretaries and Industrial Relations Officers. The Committee recommends some similar direct recruitment of professionally qualified persons on the Accounts side at the level of Accounts Officer in order to strengthen the finance function.

5.3.4 While technical personnel below J.E level are recruited at the power stations, the J.Es and D.Es are recruited by a Central Selection Committee for all the technical disciplines - viz. Generation, Transmission and Distribution and a common seniority list is maintained. This results in delays in filling up of vacancies of engineers at all levels since engineers on the T&D side are sometimes not willing to move to power stations located in remote areas and, at senior levels, do not have the requisite background or experience. The Committee therefore

recommends that a separate generation cadre be formed for the purposes of both recruitment and promotion.

5.3.5 For selection of engineers at the recruitment stage, GEB employs the interview method. Considering the large number of engineers to be interviewed, the Committee feels that GEB could use some form of objective tests for shortlisting candidates for interview.

5.3.6 In the A.E. Co. no recruitment is done at the Power Station level and all recruitment is centralised. This is possible because it is a single location company.

5.4.0 Training.

5.4.1 GEB has an approved Training Plan involving a capital expenditure of Rs. 135 lakhs and recurring expenditure of Rs. 30 lakhs annually. A staff strength of 112 for manning the training centres is also approved, but most of the personnel have yet to be appointed. A.E. Co. have no In-house training facilities. On-the-job training is imparted and for theoretical inputs facilities of outside training institutions are availed of. Facilities offered by manufacturers for training are also utilised.

5.4.2 For generation training GEB has divided employees into four categories, - (i) Senior Technical Officers consisting of A.C.Es, S.Es, and E.Es. (ii) Engineers (Dy. & Junior Engineers), (iii) Operators and (iv) Technicians. Officers in the first category are sent outside the organisation both in India and abroad for selected

training programmes, Personnel in categories (ii) and (iii) are given training in separate batches at the Board's Ukai Training Centre, and also sent to institutions like PETS, BHEL, CEA, CBIP, PSTI, NTPC, NPC, NITIE, IIM etc. Technicians are trained locally at each Power Station. Particulars of training imparted are in the Appendix-24.

- 5.4.3 The present training programme for DE/JE and operators has a duration of 3 months. The minimum duration of training stipulated by the CEA under Rule 3 (2A) of the Indian Electricity Rules 1956 is 12 months for new recruits. The Committee therefore recommends that GEB should introduce such 12 month training programmes for new recruits in addition to the current three months programme for engineers and operators already working in power stations. GEB should initiate action to procure the faculty, premises and equipment in order to implement this recommendation.
- 5.4.4 GEB does not have its own simulator for training of operating personnel. A beginning has been made in simulator training by sending batches of operators to the Tata Power Station at Trombay. The Committee recommends that GEB acquire its own simulator for training of operating personnel.
- 5.4.5 It was reported to the Committee that quite often, Power Stations were not able to relieve their employees for undergoing training as substitutes were not available. The Committee recommends that the Board maintain a training

reserve of supernumerary posts so that persons are readily spared and training facilities better utilised.

5.4.6 GEB's training department also suffers as working engineers are not willing to take up positions as faculty members. The Board should consider some incentives to encourage the experienced and professionally competent engineers to seek assignments in the training department. If this is not possible, GEB should select suitable persons from among the retired engineers and re-employ them as faculty members.

5.4.7 GEB has proposals to establish a generation training institute at Wanakbori and a Central Training Institute near Baroda. However, the Committee observed that these proposals are still at the blue print stage. The Committee recommends that GEB expedite work on these two institutes so that they start functioning as early as possible. The Central Institute at Baroda, it was reported, would also conduct management development programmes to upgrade the managerial skills of senior technical and non-technical personnel. The Committee would like to lay stress on this aspect of training which, in its opinion, is crucial to the process of organisational development of GEB.

5.4.8 The Committee also recommends that Management Development Programmes for all officers of the level of S.E. and above be started urgently even before the Institute is established. Faculty could be engaged on contractual terms and

premises could be hired, if necessary.

- 5.4.9 Programmes of training abroad in countries from which the relevant power technology has been imported, should be arranged in an organised manner. The Committee recommends that instead of individual engineers being sent for such programmes, teams of engineers both operations and maintenance should be sent to work in foreign power stations, so that some of the working culture can also be absorbed.

5.5.0 Specialists.

- 5.5.1 The rapid advances in technology have thrown up new needs in terms of specialised knowledge and skills. As discussed elsewhere, GEB does not have a cadre of trained instrument engineers. The Committee felt that this may be an important contributory factor resulting in poor performance of the Instrumentation and Control Systems at both Ukai and Gandhinagar power stations. The Committee therefore recommends that GEB inducts an appropriate number of engineers with instrument or electronics background and constitutes a specialist cadre of instrument engineers. However, lateral entries of suitably qualified personnel at higher levels in the cadre should be allowed.

- 5.5.2 The Committee noted that GEB had already made a beginning by recruiting metallurgists for the power stations. The Committee recommends that these metallurgists be grouped into a cadre with proper promotion opportunities in order to retain them in the organisation. Here also lateral

entry of suitably qualified persons should be allowed.

- 5.5.3 The Committee found that GEB does not have a single position for an economist in the organisation. It is obvious that in such a fast growing industry a number of economic factors have to be considered at the planning stage as well as in matters such as tariff formulation. The Committee recommends that the Board may recruit one economist for the Planning Department and one for the Commercial Department. Alternatively one or two economists could be included in the Management Services Group.

5.6.0 Performance Appraisal and Promotion Policies.

- 5.6.1 The forms used by GEB for performance appraisal were scrutinised by the Committee. These were found to be fairly comprehensive. The Committee was informed that these are at present under review. There is no methodical appraisal reporting system in A.E. Co. Departmental head's observations during the year enables an informal assessment. At the end of a 3 year period the Departmental heads submit and discuss their recommendations with the group executive & final assessment is submitted to the Chief Executive. This is mainly for salary administration

- 5.6.2 The appraisal reporting system in GEB however has a deficiency common to most performance appraisal procedures. Only the immediate line superior writes the appraisal report which is reviewed by the next higher level officer. The Rajyadhyaksha Committee has recommended that at least

three persons one level ~~above~~ should write reports on every officer. While this may not be possible at all levels, this Committee feels that at least in respect of Power Station Chiefs and may be one level below, the line superior's report should be augmented by remarks of the finance and personnel functional heads at Head Office. This would ensure a balanced report on all aspects of the management of the power stations.

5.6.3 In Chapter-VI of this report, a recommendation has been made about a periodic objective review of performance of power stations by a Head Office group. These review reports should also be incorporated in the performance appraisal of the chiefs of power stations.

5.6.4 GEB has been following a policy of promoting engineers according to seniority-cum-merit upto the level of E.E. For posts of S.Es and above, merit is given greater weightage. Promotions to posts of S.Es and above are screened by a Committee of the full-time members and Chairman and then submitted to the full Board for approval. As stated earlier, the Committee recommends that promotions to senior management positions should be based on an objective assessment more of managerial abilities than of technical competence alone. The organisation structure recommended in the next chapter provides sufficient flexibility so that technically competent engineers without managerial talent could get promotions in existing posi-

tions such as technical services etc.

- 5.6.5 The Committee observed that the present promotion policy resulted in all engineers stagnating for long periods as E.E. and S.E. - as long as 15-17 years as E.E. and 9-10 years as S.E. Thus engineers could aspire to head power stations (in the rank of A.C.E.) only when they were on the verge of retirement. The Committee therefore recommends that GEB so re-orient its promotion policy - if necessary by adopting a 'fast track' approach whereby a fixed proportion of engineers at D.E. level could be selected, trained and thereafter given accelerated promotions so as to make them A.C.Es after about 20 years of total service. Those engineers who do not enter this 'fast track' should also be assured of a career upto the level of S.E.

5.7.0 Industrial Relations.

- 5.7.1 GEB has five recognised unions covering employees categorised as workmen under the Industrial Disputes Act, and three recognised Associations of engineers.
- 5.7.2 To cope with the multiplicity of trade unions, the Board has a system of periodic meetings between union representatives and management at the Circle or Power Station level and at the Head Office level where most matters are discussed and resolved. Presidents of the Unions also have meetings with the Chairman of the Board to review important issues not settled at a lower level.

- 5.7.3 GEB has entered into a 5 year settlement with its recognised unions in October 1981 under which substantial monetary benefits accrued to the employees. A similar long-term settlement was also reached with the three associations of engineers in March 1982. There are thus no major disputes between the Board and its employees.
- 5.7.4 During the year 1981 because the earlier Award on wages and working conditions of engineers had expired and the new settlement not yet finalised, Junior and Deputy Engineers at Power Stations had stopped working on the second and fourth Saturdays in line with the practice in other offices of the Board. This caused considerable difficulty in maintenance work, though operations were not affected because JE/DEs in the operations shifts were entitled to overtime. The Committee noted that as part of the new settlement, all engineers will work on all Saturdays on payment of a special compensatory allowance.
- 5.7.5 The A.E. Co. is covered under the Bombay Industrial Relations Act and has only one representative union. The Company had faced some problems in 1979 and 1980. However, they have concluded a long-term settlement with the Union in 1981.

Chapter VI

ORGANISATION STRUCTURE AND FINANCIAL PRACTICES

6.1.0 Introduction.

6.1.1 GEB has grown very rapidly in size and has three major generating stations at present. But its organisational capability to manage the problems associated with size has not been developed correspondingly. As considerable expansion is also planned in the next five years and the number of major generating stations will increase to 6 during the next 10 years, there is a need to develop the requisite organisational and multi-unit management capability. A E Co. does not have the same problems of size or multi-location operations.

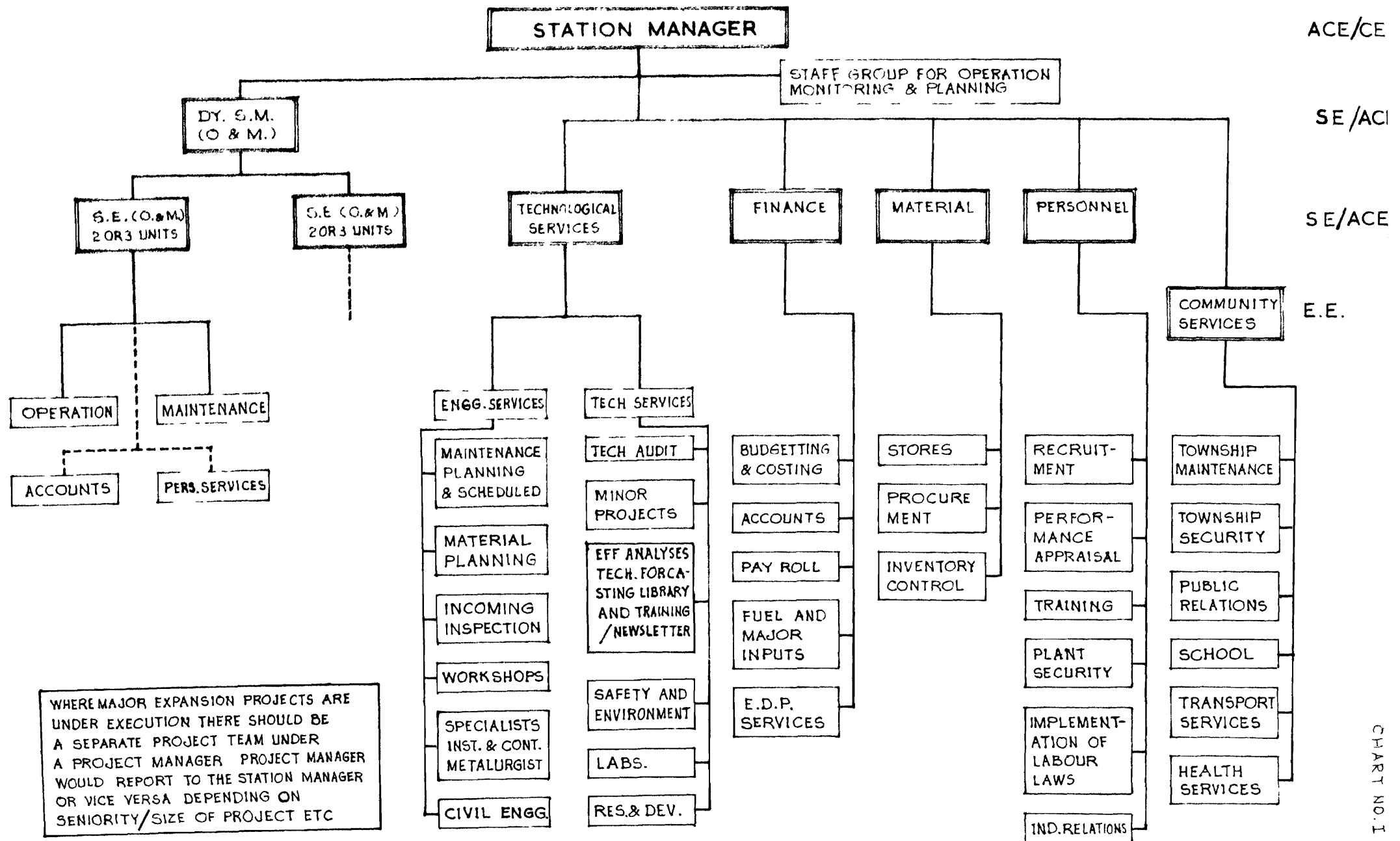
6.1.2 Five major areas require changes - organisation structure to permit sub organisational units generating stations to be cost centres and as self sufficient as possible, greater delegation of financial and administrative powers, improved information processing procedures, strengthening intra-organisational communication by sharing information and strengthening the processes of human resources development.

6.2.0 Changes needed in organisation at power station.

6.2.1 The existing organisation structure of power stations vary. The organisation charts for the stations are given in Appendix- 13.

- 6.2.2 This organisation structure does not permit expansion easily. The stations are dependent upon the Head Office for their personnel, finance and material procurement functions. Further expansion in the numbers of stations would therefore overburden the Head Office. The station chiefs do not have enough autonomy and also, therefore, are not fully responsible for the station performance. It does not have separate personnel for engineering and technical services.
- 6.2.3 The proposed organisation structure for the station is exhibited on Chart No. I.
- 6.2.4 To permit power stations to become self sufficient in managing themselves, the non-technical functions of accounting, personnel and materials management need to be upgraded. There should be one person each of a level equivalent to S.E. responsible for these functions reporting to the chief of the station. These persons will receive functional guidance from their corresponding counterparts at the head office. A separate technological services group needs to be established. A small staff group is needed for daily monitoring of operations and planning for generation of power. The tasks involved in managing the town-ship and community relations need to be separated from those of operating the generating station. These could be placed under an Administrative officer of the level of E.E.

PROPOSED CHART FOR POWER STATION



- 6.2.5 Although the Station Manager is incharge of the station, a management committee consisting of Station Manager, Dy. Station Manager (Operations and maintenance), and persons incharge of technological services, finance, material and personnel should be set up to co-ordinate various activities. It should meet as frequently as needed but at least once a week to discuss specific problems and review performance and action needed in terms of various support services. This should result in a culture of consultative decision making.
- 6.2.6 The proposed management structure for stations will only work if it is supported by appropriate development of human resources, management reporting and performance review system.
- 6.2.7 The SE (O&M) incharge of a group of two or three units (depending on convenience) should also have support in terms of personnel services and accounts, so that each group of units can work as an independent cost sub-centre. The SEs should also be delegated sufficient powers for local purchase of materials required for day-to day maintenance.
- 6.2.8 The personnel need to be interchanged among various functions so that they acquire overall understanding of the operations. The promotion policies and career planning should be such that persons in the age group 40 to 50 become station managers (refer para 5.6.5 also)

Possibilities should be provided to specialists for lateral entry at higher positions. Specific strengths of individuals should be recognised while granting promotions to higher positions or assigning responsibilities for specific jobs.

6.3.0 Performance Review.

6.3.1 The performance review system should consist of the following - daily monitoring of station operations by the station manager, weekly monitoring of support activities by the management committee, a monthly review of overall station performance by the management committee and quarterly review by a Head Office Team (6.3.3). The performance of the station should be judged on the basis of efficient generation at the lowest possible cost for a foreseeable future.

6.3.2 A management information system needs to be developed consisting of management reporting, financial, personnel and materials information systems. The management reporting system should support the performance review system described above. The monthly and quarterly reports should be ready within a week from the end of the month or quarter. The reporting system should also include a qualitative report by the station manager in his own hand discussing highlights of performance, problems faced, difficulties overcome, etc.

6.3.3 The Head Office should have a Board Committee for each station consisting of at least two of the full time Board members and the Chief Engineer (Generation) at the Head Office. This Board Committee should be responsible for quarterly performance review of the station. It should meet at least once a quarter and more frequently if necessary, at the power station. This Committee should have all the powers of the full Board in respect of matters arising out of O&M of the power station. The minutes of the meetings of the Board Committee should be placed before the full Board for information.

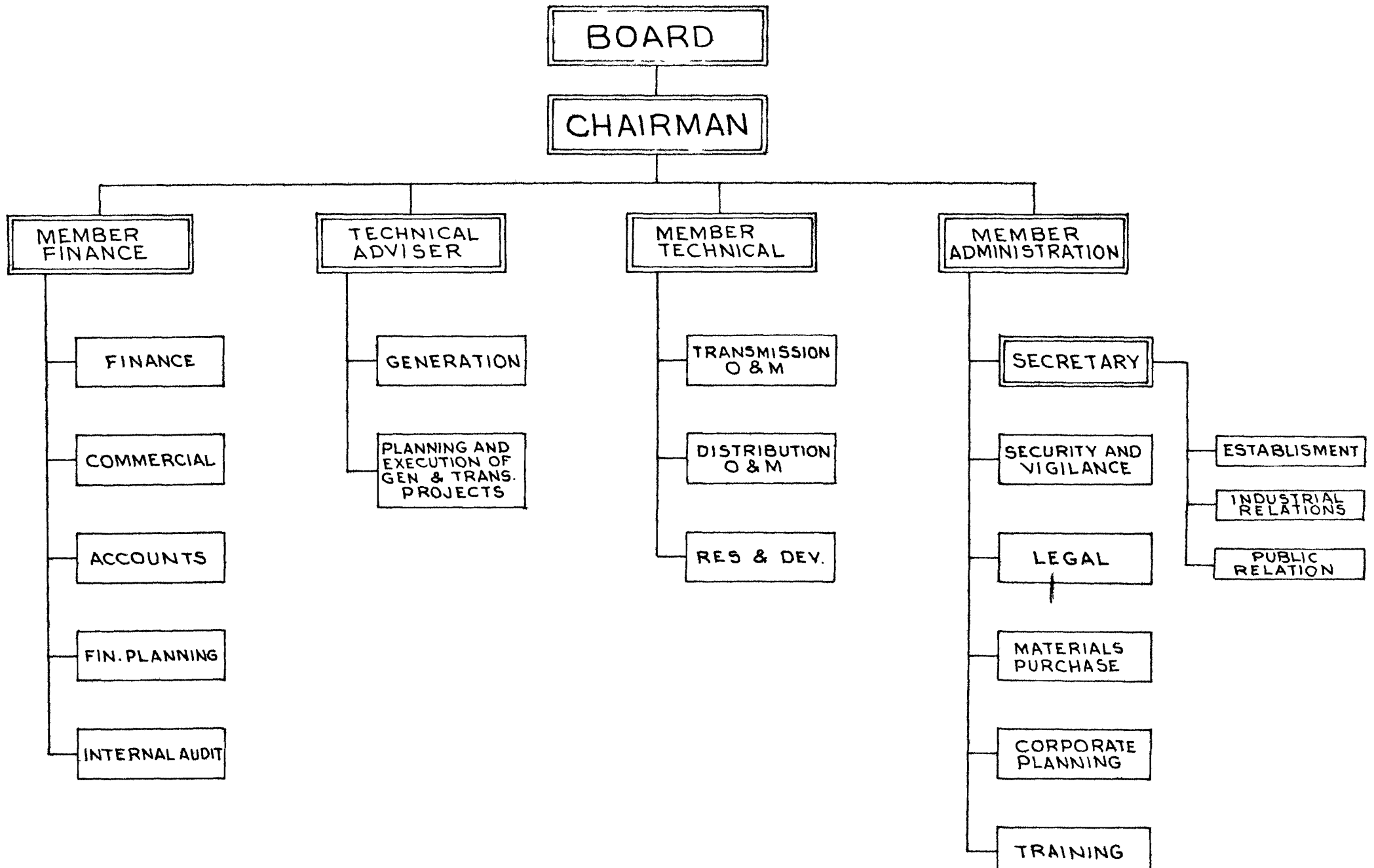
6.4.0 Organisation of the Board.

6.4.1 The existing structure of the Board at Head Office is exhibited on Chart No.2.

6.4.2 The organisation at Head Office should support the station organisation. While the groups for personnel and finance exist at the Head Office, separate groups for technological services need to be established. The MIS function needs to be introduced as a part of the Management Services group. This group would also provide E.D.P. services to all departments. Quality assurance and materials management functions need to be strengthened.

6.4.3 As power generation increases, the distribution function also needs to be strengthened. With the expansion in size and multi-unit-operation, the co-ordination between

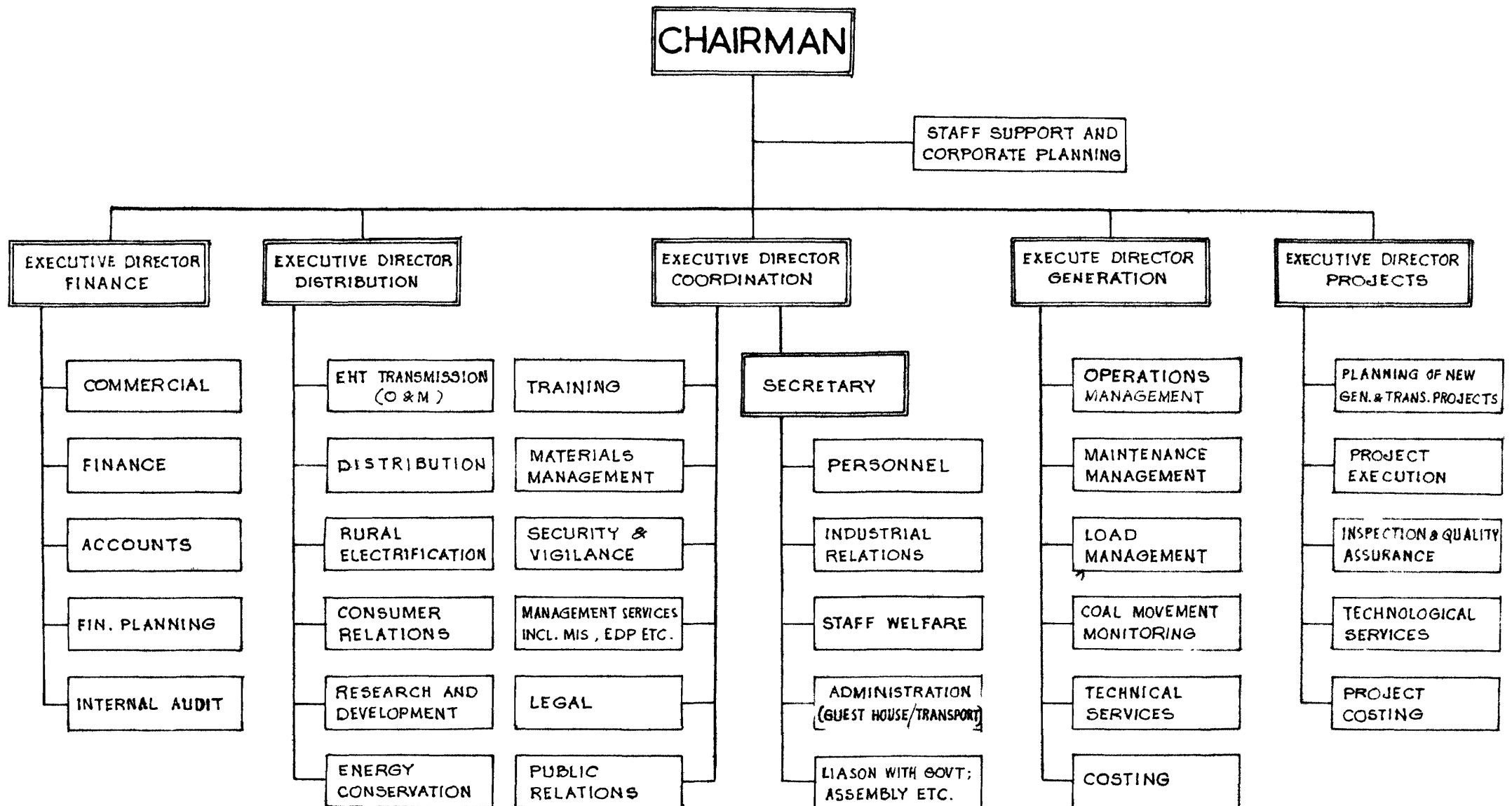
EXISTING STRUCTURE AT HEAD OFFICE



generation, transmission and distribution, projects and technological services needs to be strengthened. Therefore, the Board structure itself needs to be revised somewhat.

- 6.4.4 The proposed organisation structure is at Chart No.III. While the Board may continue to consist of a Chairman, three full time members and three part-time members, the executive organisation of the Board should have five Executive Directors reporting to the Chairman. Three of these Executive Directors would be the full-time members of the Board, while the other two could attend Board meetings as invitees. A small staff group and a corporate planning cell would assist the Chairman in performance review and monitoring.
- 6.4.5 The Management Services Group should have one or two Management graduates, a statistician, an economist and a systems analyst in addition to the E.D.P. section. A Technical Services Group is proposed under the Executive Director (Generation) and a Technological Services Group under the Executive Director (Projects). The former would support the Technical services groups at Power Stations while the latter would be concerned with absorption of new technology related to projects, evaluation of designs of equipments & instrumentation as well as quality assurance for incoming materials for projects.
- 6.4.6 To supplement the formal organisation structure, an informal integrating mechanism like an Executive Committee

PROPOSED EXECUTIVE STRUCTURE OF THE BOARD



consisting of the Chairman and Executive Directors should be set up. This Committee should meet at least once a week and review performance in key areas such as generation, projects, rural electrification, load restrictions, revenue and expenditure as well as inter-departmental co-ordination.

- 6.4.7 In view of the public utility nature of the Board and the need for it to operate on the basis of getting adequate returns from invested resources, the linkages with the consumers and public need to be strengthened. For this purpose, the Government may consider appointment of suitable persons to represent these interests as part-time members on the Board.
- 6.4.8 The Committee would like to stress that the organisational changes proposed should be introduced gradually and only after full discussions at all levels, so that there is no organisational trauma which might render the changes in-effective.
- 6.4.9 There is a need for delegation of financial and administrative powers commensurate with newly defined responsibilities for the station managers. The financial powers of the station manager for works and purchases need to be enhanced as discussed in section 4.3.7. He should have full authority for budgetted amounts and some authority for non-budget expenditure. Some of the financial and administrative powers currently exercised

at the Head Office should be delegated to the stations once the positions of finance and personnel at the station are up-graded accordingly. Finally, the Board Committee should have sufficient powers to decide on most of the station's operational needs.

6.5.0 Information Handling.

6.5.1 Information should be shared as widely as possible. For instance, a small cell should be set up at each station to collect data on operations. The daily report on key performance indicators should be prepared by the next morning and should be distributed to all technical personnel. Similarly other means of sharing information such as technical news-letter, reports of visits to other power plants and informal seminars should be encouraged. Zeroxing and duplicating facilities should be made more widely available. Teleprinter grid for power stations needs to be installed.

6.5.2 GEB has begun the use of computers for its materials management and financial and cash management. The Committee recommends use of micro-processors at the station level for operation, maintenance and administrative purposes. While it should seek professional assistance for designing various systems for use of computers for processing information at station and Head Office level,

the following areas could use computers

- a. Personnel;
- b. Inventories;
- c. Maintenance/outages analysis;
- d. Planning for maintenance;
- e. Daily performance analysis, monitoring of operating parameters;
- f. Financial Management
- g. Costing

6.6.0 Financial practices.

- 6.6.1 The Committee recommends that the budgetary and costing systems and financial practices of the Board should be oriented towards getting adequate returns from invested resources rather than towards only providing services.
- 6.6.2 Currently only fuel accounting is done at each station and other inputs for power generation, staff and spare parts are not costed separately. The committee understands that a costing system has been developed (Appendix-8) to account for cost of generation of power at each station but is not completely implemented because of a lack of cost consciousness among station personnel. This costing system, with appropriate modifications if necessary, should be implemented.
- 6.6.3 Currently maintenance budgets are prepared on an adhoc basis. Therefore, budgetary control of maintenance is almost non-existent. A rational basis for preparing budgets for preventive maintenance needs to be evolved

and used. The cost accounting system in conjunction with the budgetary system should be used to analyse variances.

- 6.6.4 The Committee as a result of its discussions with the Member (Finance), finds that cash provision for spare parts needs to be increased. The finance for spare parts are provided on the basis of actual consumption of spare parts. However, because of long lead times, increase in prices, and the need for partial advance payment to suppliers, the requirements for working capital has increased considerably. The Committee recommends that the State Government ensure that adequate provision on this account is made in GEB's budget.

Chapter VII

SUMMARY OF RECOMMENDATIONS AND OUTLOOK FOR THE FUTURE

7.1.0 Summary of Recommendations.

7.1.1 The recommendations made by this Committee can be found in the text of the Report under the respective chapters. However for ease of reference, these are summarised herebelow.

7.2.0 Review of operating and Maintenance Practices.

7.2.1 Whereas recommendations on instrumentation are made in Chapter IV, the Committee while reviewing operating and maintenance practices, suggested that one instrument technician be provided in each shift reporting to the shift charge engineer. He could identify the instruments which are not functioning whenever discrepancy is noticed -(2.3.1)

7.2.2 Once instruments and controls are functioning properly, the practice of manual operation of automatic controls should be discontinued. - (2.3.2)

7.2.3 The Committee recommends that a small computer should be made available at each power station to process data on operating conditions. It should be programmed to analyse the data, produce warning signals and prepare a summary report of each day's conditions for distribution among plant personnel. (2.3.3)

7.2.4 The Committee suggests that the aspect of ease of maintenance be kept in mind when new power station layouts are designed. - (2.3.10).

7.2.5 A time and motion study of scheduled outages should be commissioned to identify possibilities for reducing

downtime by allocating more resources in the form of manpower and equipment. The results of this study should be used to prepare plans for scheduled maintenance. - (2.4.2 b)

- 7.2.6 It is suggested that a list of consumption of spare parts for each overhaul be compiled to predict spare parts requirements for future overhauls, GEB may share this information with other similar power stations in the country on a reciprocal basis. (2.4.2.d)
- 7.2.7 The Committee recommends early procurement of the following equipment to ensure speed in maintenance tasks: Pneumatic and hydraulic wrenches electric trollies for movement of materials, lifting tools and tackles, electric hoists and pneumatic grinders. (2.4.2.j)
- 7.2.8 The Committee suggests that a small discretionary fund be made available to the Station Managers for grant of group incentives in the form of refreshments or token cash prizes for completion of work in time and of good quality. (2.4.2.1)
- 7.2.9 GEB should commission preparation of comprehensive overhaul manuals on the lines of NTPC. (2.4.4.a)
- 7.2.10 The Committee suggests the creation of technical services groups to report independently on the quality and comprehensiveness of planned maintenance operations. (2.4.4.b) and (2.6.1).
- 7.2.11 The Committee recommends the creation of a special maintenance task force to take care of scheduled maintenance. Experienced personnel from different stations may be used to constitute such a task force under a Superintending

Engineer. Although the personnel may be distributed among various stations for their permanent place of posting, they should work together as a team for any scheduled maintenance task. (2.4.4.c)

7.2.12 GEB should have a regular plan for visits by personnel to similar power stations elsewhere. The reports of officials returning from such visits should be shared among all concerned personnel through a technical newsletter. (2.4.4.d)

7.2.13 The most important action required is to shift from crisis based maintenance to planned maintenance. The steps recommended are: 1. Targets set for availability of sets should be realistic. 2. A running list of maintenance tasks on and action to upgrade the performance of boiler, turbine and especially instrumentation systems be prepared. 3. Whenever a set exceeds its targetted availability during a quarter, it should be allowed a scheduled outage to perform such maintenance or improvement tasks. (2.4.5)

7.2.14 The Committee recommends that the deliberations of the outage committees should be widely circulated within and outside the particular power station. (2.5.2)

7.2.15 The Committee recommends that the laboratories, testing equipment and personnel should be upgraded qualitatively. (2.5.3).

7.3.0 Design and Reliability of Equipment.

7.3.1 The Committee recommends that GEB should work out a definite procedure for inspection during various stages of manufacture of equipment. It was learnt that such a programme is included in NTPC contracts with BHEL.(3.5.2.a).

- 7.3.2 GEB should develop a strong in-house capability for quality assurance for materials arriving at site. (3.5.2.b)
- 7.3.3 A guaranteed performance test under well-specified conditions should be included in the contract agreements with BHEL. (3.5.2.c)
- 7.3.4 The aspect of accountability of consulting engineers appointed by the Board needs to be further examined.(3.5.2.d)
- 7.3.5 The Committee recommends that GEB should acquire detailed drawings and specifications, operations and maintenance manuals, details of manufacturing processes and metallurgical analysis of parts. If necessary, special personnel could be hired for this purpose. (3.5.2.e)
- 7.3.6 Operations and maintenance personnel should have close liaison with the project team and ensure quality control of erection work. (3.5.2.g)
- 7.3.7 The Chairman BHEL had in his meeting with the Committee agreed to take the following steps: a. review outstanding orders for spare parts and provide commitment to deliver by agreed dates.
- b. set up a group to review all instrumentation and controls in Ukai and Gandhinagar and furnish recommendations for their rehabilitation.
- c. Set up a joint team to review problems brought up by GEB (Appendix 11)
- The Committee recommends that GEB should cooperate with and follow up the actions to be taken by BHEL.(3.5.3)

7.3.8 Although it was reported by A.E.Co. that they had no serious difficulties in respect of design and reliability of their 110 MW unit, the recommendations made above would help in improving their performance also (3.5.4)

7.4.0 Other Problem Areas

7.4.1 The Committee felt that the following other areas needed urgent attention:

- a. Instrumentation and control
- b. Spare parts management.
- c. Quality of coal (4.1.3)

7.4.2 The instrumentation function in GEB needs to be strengthened both technically and organisationally. (4.2.4)

7.4.3 The Committee recommends that a competent agency should be entrusted with the job of identifying the rehabilitation needs of the instrumentation and control systems and then implementing the rehabilitation programme. (4.2.6)

7.4.4 The Committee suggested that the proposed rehabilitation of instrumentation and control systems could be broken up so that work can be done during scheduled and forced outages (4.2.7)

7.4.5 The Committee recommends that GEB should have senior instrumentation engineers or experts to evaluate the design at the time of selection or ordering. The Projects Department should have an instrumentation cell in the Technological Services Group with personnel of requisite capability. Qualified instrument engineers and specialists are also required to maintain the system. The Technical Services Group in the generation department should have sufficient

competence to carry out technical audit as well as provide specialist advice to power stations in instrumentation and control. (4.2.8)

7.4.6 The Committee recommends that GEB create an organisation at the power station level responsible for procurement of spares, improved materials information systems, and adequate technical support to ensure good quality of parts. (4.3.4 and 4.3.5)

7.4.7 The Committee felt that this organisation should be strengthened by unifying the responsibility in one department, of materials planning, procurement and inventory control. Inspection of incoming materials should be organised under the Technical Services Group at the Power Stations (4.3.6 and 4.3.9)

7.4.8 The Committee has suggested greater delegation of powers to power stations for purchase of spares. (4.3.7)

7.4.9 The Committee recommends computerisation of inventory records at power stations using small computers. Meanwhile a cardex system could be introduced for inventory control. (4.3.8)

7.4.10 An incoming materials inspection activity should be organised under the Technical Services Group with adequate facilities. For inspection at manufacturer's works, reputed organisations could be entrusted the work on contract basis (4.3.9).

- 7.4.11 The Committee reiterated the recommendations of the Rajadhyaksha Committee mentioned in paras 4.86, 4.87, and 4.88 of that Committee's Report for handling coal of poor quality. (4.4.2)
- 7.4.12 The Committee felt that a low level technology for removing impurities from coal at power stations needs to be developed. For this purpose an R&D project should be initiated. (4.4.4)
- 7.4.13 The capacity of coal mills needs to be suitably increased to handle the required amount of coal of lower calorific value and to provide for increased down time of the mills due to the poor quality of coal. (4.4.5)
- 7.5.0 Human Resources Management.
- 7.5.1 The Committee recommends the setting up of a manpower planning cell with close linkages with the training department so that category-wise, specialisation-wise requirements of manpower are estimated and their training needs identified. This cell should also develop an information system to support the total personnel function. (5.1.2).
- 7.5.2. The Committee recommends that GEB review its staffing patterns to ensure that engineers are only employed on jobs where their training and skills are essential. For jobs where a formal education in engineering could be dispensed with, GEB could recruit science graduates with the necessary aptitudes and subject them to post-recruitment training. (5.2.2)

- 7.5.3 The Committee recommends that deficiencies in formal qualifications of existing personnel be rectified through training. (5.2.3)
- 7.5.4 The Committee felt that engineers who are holding or are likely to hold important managerial positions should be designated as managers and also given basic training in management concepts. Selection of persons to head power stations should be based more on the administrative and managerial abilities of individuals rather than their technical proficiency alone. Separate promotion opportunities for technically proficient engineers should be provided. (5.2.4 & 5.6.4)
- 7.5.5 The Committee recommends direct recruitment of professionally qualified persons on the Accounts side on the lines of the recruitment done by GEB of I.R.Os. and Dy. Secretaries on the personnel side. (5.3.2)
- 7.5.6 The Committee recommends the formation of a separate generation cadre of engineers for the purposes of both recruitment and promotion. (5.3.4)
- 7.5.7 The Committee recommends that GEB should introduce 12 month training programmes for new recruits in addition to the current 3 month programmes for personnel already working in power stations to meet with the CEA stipulations. GEB should take action to procure faculty, premises and equipment to implement this recommendation. (5.4.3)
- 7.5.8 In order to strengthen and facilitate the training function, the Committee also made the following recommendations:

- a. GEB should acquire a simulator for training operators.
(5.4.4)
- b. GEB should maintain a training reserve of supernumerary posts - (5.4.5)
- c. If it is not possible to attract serving engineers to the training department through incentives, GEB should select suitable persons from among retired engineers.
(5.4.6)
- d. GEB should expedite action to establish the generation training Institute at Wanakbori and the Central Institute at Baroda as early as possible. (5.4.7)
- e. Management Development Programmes for all officers of the level of S.E. and above should be started urgently.
(5.4.8)
- f. Foreign training should be organised systematically and groups of engineers sent to work in foreign power stations instead of individuals (5.4.9)

7.5.9 The Committee recommends that GEB inducts an appropriate number of engineers with instrument or electronics background and constitutes a specialist cadre of instrument engineers. (5.5.1)

7.5.10 The Committee recommends that the metallurgists already recruited be grouped into a cadre with proper promotion opportunities in order to retain them. (5.5.2)

7.5.11 The Committee felt that in respect of power station Chiefs and may be one level below, the appraisal report by the line superior should be augmented by remarks of the finance and personnel functional heads at Head Office. (5.6.2)

- 7.5.12 The quarterly performance review by the Head Office group should be suitably incorporated in the performance appraisal of Station Managers. (5.6.3)
- 7.5.13 The Committee recommends that GEB reorient its promotion policy-if necessary by adopting a 'fast track' approach whereby outstanding engineers at D.E. level could be selected, trained and given accelerated promotions so as to make them A.C.Es. after about 20 years of total service. For others promotion up to a level of S.E. should be ensured (5.6.5)
- 7.6.0 Organisation Structure and Financial Practices.
- 7.6.1 The Committee felt that five major areas require changes-organisation structure to permit sub-organisation units; power stations to be cost centres and as self-sufficient as possible, greater delegations of financial and administrative powers, improved information processing procedures, strengthening intra-organisational communication by sharing information and strengthening the processes of human resources development. (6.1.2)
- 7.6.2 The Committee recommends revision of the organisation structure for the power stations and the Board.(6.2.2 & 6.4.4)
- 7.6.3 To permit power stations to become self-sufficient in managing themselves, the Committee recommends that the non-technical functions of accounts, personnel and materials management should be upgraded. Separate technological services group needs to be established. The tasks

involved in managing the township and community relations need to be separated from those of operating the generating station. (6.2.3)

- 7.6.4 The Committee recommends the setting up of a management Committee consisting of the station manager, the Dy. Station Manager (D&M), and persons in charge of technological services, finance, materials and personnel to coordinate activities and build up a culture of consultative decision making. (6.2.3)
- 7.6.5 The Committee recommends establishment of a periodic performance review system. (6.3.1)
- 7.6.6 A management information system covering management reporting, financial, personnel and materials information needs to be developed. (6.3.2)
- 7.6.7 The Committee recommends that GEB should have a Board Committee for each power station consisting of at least two of the full-time members and the C.E. (Generation). This committee should review performance every quarter and have all powers of the full Board in respect of O&M of the power station. The minutes of the meetings of the Board committees should be placed before the full Board. (6.3.3)
- 7.6.8 The MIS function needs to be introduced as a part of the Management Services Group. This group will also include the EDP Services and should consist of one or two management graduates, an economist, statistician and a system analyst (6.4.2 & 6.4.5)

- 7.6.9 The Committee recommends that financial and administrative powers commensurate with the newly-defined responsibilities of power station managers be delegated by the Head Office. The Board Committee should have sufficient powers to decide on most of the stations operational needs.(6.4.9)
- 7.6.10 The Committee recommends that for improving information sharing and processing, the following steps need to be taken:
- a. A daily report on key performance indicators should be circulated to all technical personnel. (6.5.2)
 - b. A technical newsletter should be started.(6.5.2)
 - c. Informal seminars should be arranged.(6.5.2)
 - d. Xeroxing and duplicating facilities should be made more widely available. (6.5.2)
 - e. A teleprinter grid connecting power stations and Head Office should be installed. (6.5.2)
 - f. Computers should be used in following areas:-personnel information, inventories, maintenance/outage analysis; maintenance planning; monitoring of daily performance; financial management, and costing.(6.5.3)
- 7.6.11 The costing system should be implemented and station personnel made more cost conscious. A rational basis for preparing budgets for preventive maintenance needs to be evolved. The cost accounting system with the budgetary system should be used to analyse variances. (6.6.2 & 6.6.3)

7.6.12 The Committee recommends that the State Government should ensure that adequate financial provision is made to enable the Board to place orders for spare parts with long delivery schedules. (6.6.4)

7.7.0 Outlook for the Future

7.7.1 The projections of peak demand for the next ten years and the installed capacity required to meet it are shown in graph on page 89. . The net additions to installed capacity planned during the same period are also shown.

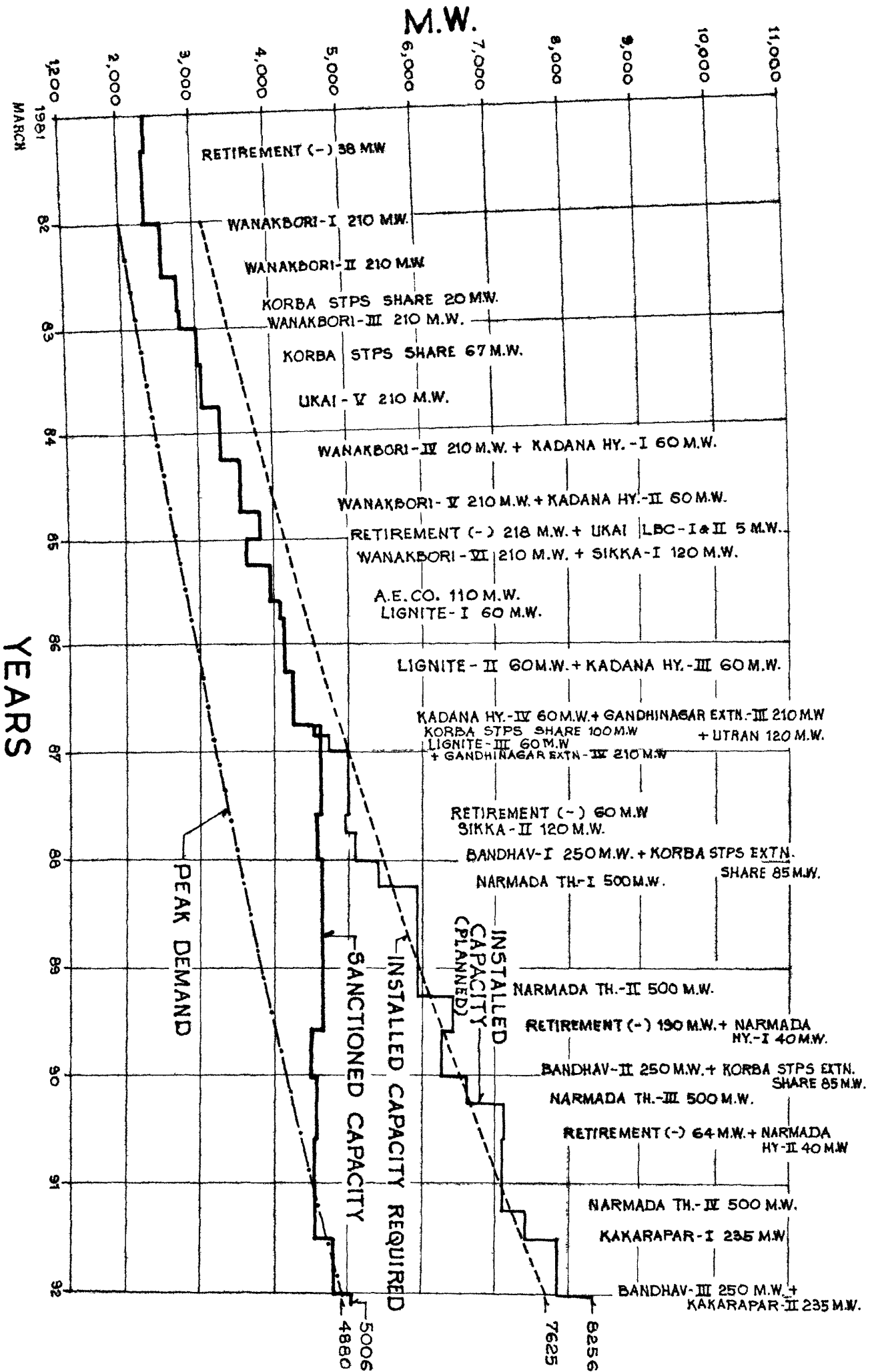
7.7.2 It is apparent that even if all projects are completed as scheduled, the installed capacity in the Gujarat System will be able to cater to the lowest (11th Annual Power Survey) projection of peak demand only after 1988. Considering the likely delays in commissioning/sanction of new projects, it appears inevitable that some load restrictions will have to continue in Gujarat for the foreseeable future.

7.7.3 The immediate objective therefore should be to ensure a stable power supply so that load restrictions do not have to be changed from day to day.

7.7.4 This objective can be achieved only if forced outages are brought down, though the problems associated with fluctuations in peak demand on account of the nature of agricultural operations would largely remain.

7.7.5 The recommendations of this Committee have been made with the objective primarily of reducing forced outages

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in terms both of frequency and of duration. Short-term solutions have been suggested; but in view of the rapid growth of the electricity industry in size and in the complexity of its operations the Committee has made several recommendations of a long-term nature especially on the organisational and human resources aspects.

- 7.7.6 The Committee believes its recommendations will be largely acceptable both to the State Government and the GEB. As the implementation of these recommendations progresses, GEB, which is already one of the foremost electricity boards in the country, will be able to significantly improve its performance and thereby its ability to serve its consumers and the State of Gujarat in the years to come.
