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MANPOWER OPTIMIZATION - EXPERIENCE OF

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Brought out by

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Manpower Optimization in NHPC

1. THE BACKGROUND

National Hydroelectric Power Corporation Limited (NHPC), A Govt. of India Enterprise, was incorporated in the year 1975 with an objective to plan, promote and organise an integrated and efficient development of hydroelectric power in all aspects. Later on NHPC expanded its objects to include other sources of energy like Geothermal, Tidal, Wind etc. Since its inception in 1975, NHPC has grown to become one of the largest organisation in the field of hydro power development in the country. With its present capabilities, NHPC can undertake all activities from concept to commissioning of Hydroelectric Projects.

At present, NHPC is a schedule 'A' Enterprise of the Govt. of India with an authorised share capital of Rs. 1,50,000 million. With an investment base of over Rs. 2,22,000 million, NHPC is among the top ten companies in the country in terms of investment.

Initially, on incorporation, NHPC took over the execution of Salal Stage-I, Bairasiul and Loktak Hydro-electric Projects from Central Hydroelectric Projects Control Board. Since then, it has executed 10 projects with an installed capacity of 3755 MW on ownership basis including projects taken up in joint venture. NHPC has also executed 3 projects with an installed capacity of 79.35 MW on turnkey basis. Two of these projects have been commissioned in neighbouring countries i.e. Nepal and Bhutan.

Presently NHPC is engaged in the construction of eleven projects aggregating to a total installed capacity of 5623 MW including 520 MW under implementation by NHDC (Narmada Hydro-electric Development Corp.). NHPC has planned to add 2480 MW during the 10th Plan period and 7707 MW during 11th Plan period and it is planned to add over 15,000 MW of hydropower capacity by the end of 12th plan (year 2017). More information related to operating stations, ongoing projects and other information about NHPC, is available at the company's website www.nhpcindia.com

Present manpower strength of NHPC is approx. 13200 and in order to have optimum manning at operating hydro-electric power stations and projects, NHPC has been continuously trying. In the subsequent pages, this endeavour has been illustrated, for the purpose of serving as a reference document for others. The aspect of optimization of manpower has been covered in three broad sections; optimization of man-power at operating stations and of construction stage projects and future strategies.

2. MANPOWER AT OPERATING POWER STATIONS

2.1 Constraints

The requirement of manpower for a particular Power Station depends, to a large extent upon the following major parameters:

- Number of Machines / Units installed, irrespective of capacity.
- Location factor i.e. distances between Power House & Dam, as it may be a deciding factor for construction of colony, Hospitals / dispensaries / clubs etc.
- Extent of Remoteness, as it may be a deciding factor for level of outsourcing some of the indirect activities.

What makes it difficult to assess the manpower requirement with respect to capacity (MW) of the station is the fact that every machine / unit requires a dedicated crew with fixed skill mix, irrespective of unit size. Therefore if unit capacity is higher, the Men/MW ratio will be lower and the vice-versa. Thus for manpower estimation exercise should be independent of linkages to capacity.

2.2 Norms

For projection of manpower for hydro stations in the country Nation Power Plan has estimated a norm of 2.43 men/mw for VIII plan and 2.00 men/mw for IX Plan. Fixation of Norm for X Plan is currently under process of finalization for which the primary data is being collected from various organizations.

2.3 Estimation of Manpower

The Manpower Estimation Exercise takes into account and mainly dwells upon following parameters:

- CEA guidelines
- Job profile
- Organization Structure
- Outsourcing
- O&M expenses provided by CERC

Over a period of time, various workshops were conducted at various power stations for the said objectives aimed at evolving trend setter HR practice in the corporation, job profile and specification were prepared with an eye an efficient manpower planning, productivity enhancement well defined sphere of functions and responsibilities. The process of development of Job Profile evolved around standardization in term of number of department and evolving Manpower Norms as reflected in Table-1.

TABLE-1

Description	Manpower Norms	Remarks
Station Head Sectt.	24	Manpower for technical service, Health services & Vigilance
Civil Engineering Department	60	Dam / Water conductor system, Disaster & Reservoir Management, Land Management, infra structure, Civil / Contractors, Hydro Mechanical.
Power Engineering Department	141	Power House Operation, P/H Maintenance, Instrumentation, Communications, Elect., maintenance of colony, materials & transport mgmt., Fire & Safety.
Human Resource Department	24	Establishment, Recruitment, Industrial Relation, Administration, Training & Development, Public Relation, Rajbhasha & Law.
Finance Department	19	Salary, Banking, Stores & PSL and Compilation
TOTAL	268	

Note: Details regarding job profile, organization structure available in Job Profile handbook of NHPC.

Moreover, manpower requirement may vary either on higher or lower side depending upon the no. of location / distances, level of outsourcing, adoption of latest technology etc.

As to the outsourcing, the following activities of Power Station are generally outsourced:

- Security
- Running & maintenance of Guest house, canteens, field hostels
- Housekeeping
- Major maintenance of equipment
- Vehicles except those of station Head, VIP, Fire tender, Ambulances etc.
- Other unskilled activities

2.4 O&M Expenses

This is the main guiding factor for estimation of manpower for a particular Power Station. O&M expenses provided by CERC are 1.5% of the capital cost of the project including expenses towards employees remuneration, Repair & Maintenance of machines and Administrative expenses. In most of the Power Stations the actual O&M expenses are exceeding the expenses provided by CERC. Main culprit for this is expenditure on account of manpower which is about 80 to 121% of the expenses provided by CERC thus leaving little scope for incurring expenses for R&M of machines & administration. In a sense Additional O&M expenses are direct loss to the company.

2.5 Examination & Methodology

The O&M expenses provided by CERC constitutes the following type of expenditures:

- Repair & Maintenance of machines
- Employee remuneration
- Administration expenses

However, the employee remuneration being so high, there is hardly any space left for other expenses. It is pertinent to mention that CERC approves expenditure in lump sum @ 1.5% of the capital cost of the project without any distinction of percentage share of R&M of machines, employee remuneration and administrative expenses. Thus it is imperative that some kind of internal benchmarking is evolved to keep a tab on exorbitant employee remuneration which is eating into organizational profitability.

2.5.1 Internal Benchmarking

Corporate Industrial Engineering Group, NHPC has thoroughly examined the entire issue in the perspective of CERC O&M expenditure, Job profiling. Manpower Study, employee remuneration expenses etc.

After the through scrutiny, the power stations / upcoming projects have been classified into 4 types based on installed capacity. This is done to figure out Av. Cost / MW at market prices as indicated in Table-2.

TABLE-2

Capacity Range (MW)	Av. Cost / Installed Capacity [Rs Cr. / MW]
Up to 100	9.9
101-200	6.60
201 - 350	6.30
351 – 500	5.50
Above 500	5.00

The optimum manpower has been estimated. Parameters i.e. job profile, on the basis of various level of outsourcing which is as follows:

TABLE-3

Capacity (MW)	Estimated Nos.
Upto 100	150
101 - 200	260
200 - 350	325
351 - 550	390
500 & above	475

Taking the manpower cost @ Rs. 3.5 lacs per employee; the employee remuneration expenses have been calculated. Based on av. Cost / MW for select project / Power station from each classified category, the benchmarks have been evolved for employee remuneration as % of CERC O&M expenditure.

The following table-4 elucidates the methodology:

TABLE-4

Capacity Range (MW)	Select Capacity (MW)	Av. Cost / MW (Rs. Cr.)	Capital Cost (Rs Cr)	Assuming CERC Expenditure @ 1.5% of capital cost (Rs. Cr.)	Manpower as per evolved norms (nos.)	Man/MW Ratio	Employee remuneration as per evolved norms @ Rs. 3.5 lacs p.a. per employee (Rs. Cr.)	Employee remuneration as % of CERC (proposed Norms)
Up to 100	60	9.90	600	9.00	150	2.50	5.25	58.33
101 to 200	180	6.60	1188	17.82	260	1.44	9.10	51.07
201 to 350	280	6.30	1764	26.46	325	1.16	11.38	42.99
351-500	480	5.50	2640	39.60	390	.78	13.65	34.5
500 & above	690	5.00	3450	51.75	475	.69	16.63	32.13

Thus we may fix employee remuneration as percentage to CERC.

O&M expenses is indicated in Table-5


TABLE-5

Capacity Range (MW)	Proposed Norms (Rs. Cr.)
Up to 100	5.25
101 to 200	9.10
201 to 350	11.38
351-500	13.65
500 & above	16.63

2.5.2 Manning at Dhauliganga Hydroelectric Power Station

The estimation of manpower requirement of Dhauliganga Hydro-electric Power Station has been done as per the above. In the subsequent pages (6-12), the manning structure of the departments of Dhauliganga HES has been illustrated.

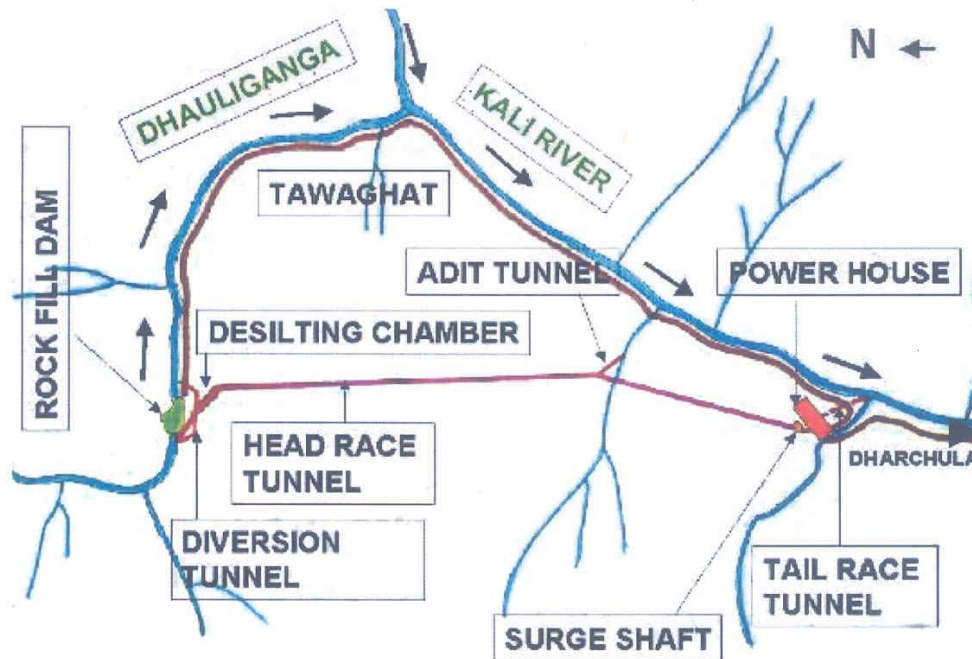
DHAULIGANGA POWER STATION



Generation Profile
Layout Plan

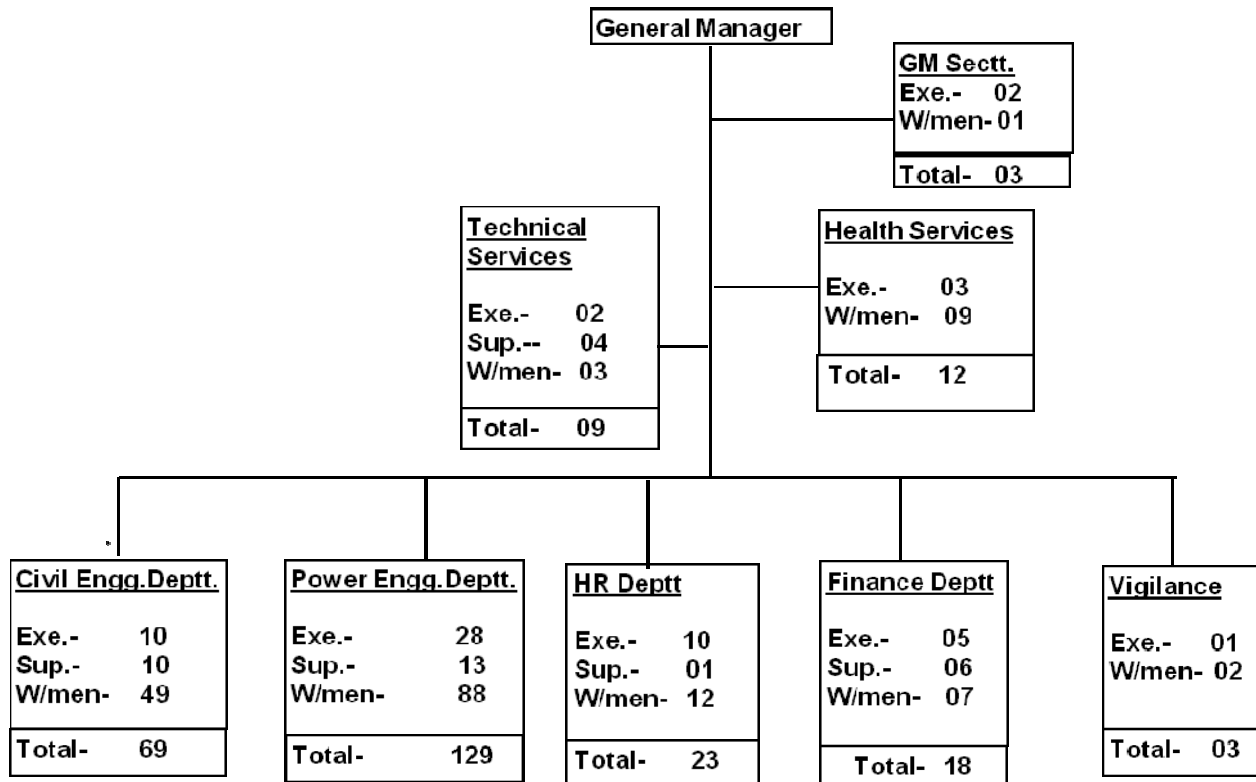
SALIENT FEATURES	
Location	Distt. Pithoragarh in Uttranchal.
Approach	Nearest Airport - Pithoragarh, Nearest Rail Head - Bareilly.
Capacity	4x70 MW
Annual Generation	1134 MUs
Latest Estimated Cost	Rs.1578.31 Crores (Aug '99 exchange rate level)
Beneficiary States	Uttranchal, U.P., Delhi, H.P., Punjab, Chandigarh, J&K, Haryana & Rajasthan.
Year of Commissioning	2005

TECHNICAL FEATURES	
■	56 m high concrete faced rock fill dam.
■	6.5 m dia, 5.29 km long head race tunnel.
■	6.5 m dia, 437 m long tail race tunnel.
■	Underground power house containing 4 units of 70 MW each.



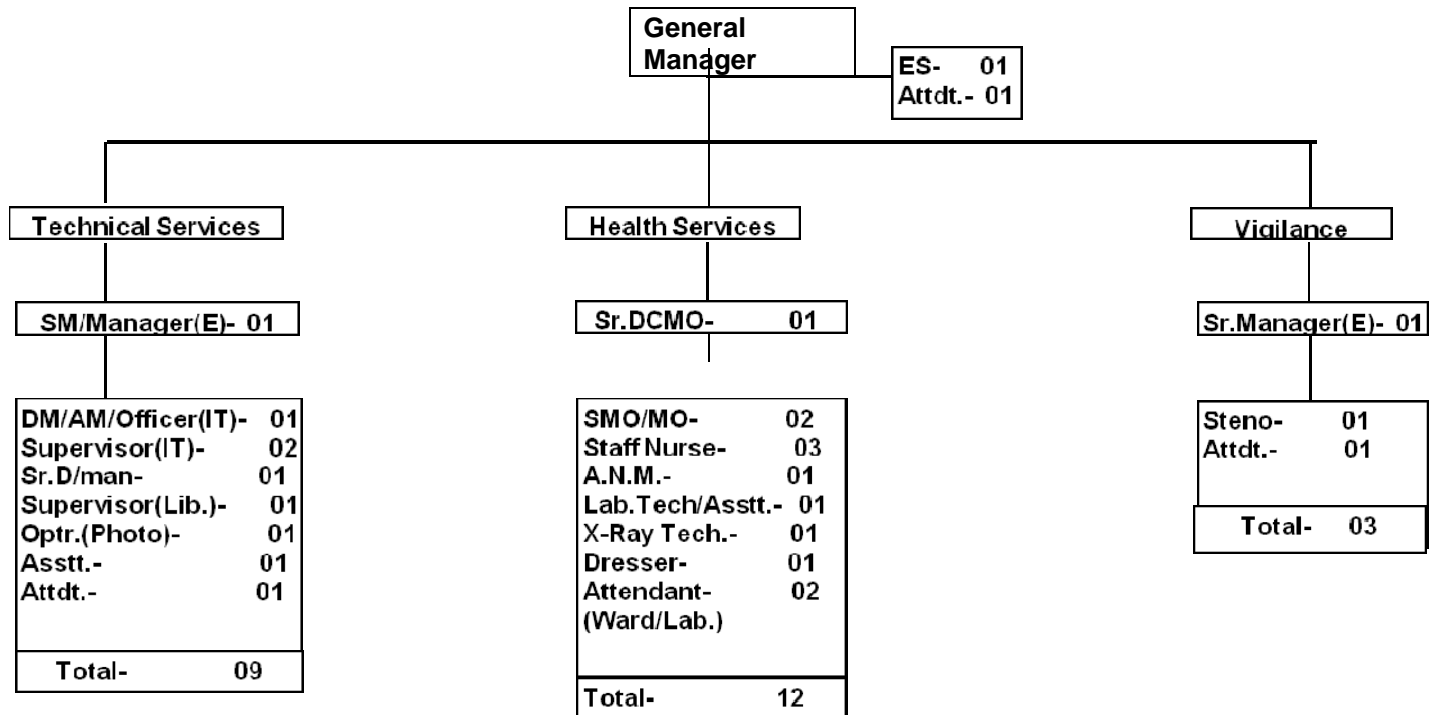


**Organisation Structure for Dhauliganga Power station
(Manpower functional centre wise)**



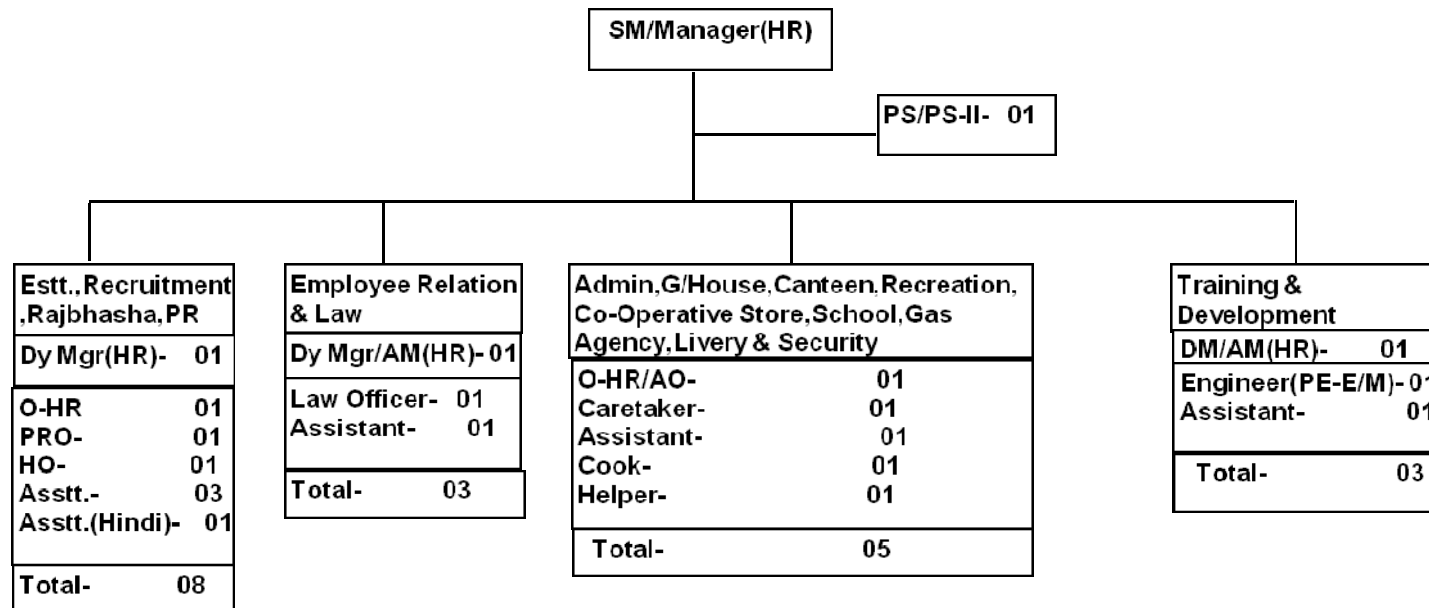


Organisation structure for Dhauliganga Power Station Head Secretariate



Summary:				
	<u>Exe.</u>	<u>Sup.</u>	<u>W/men</u>	<u>Total</u>
No.-	08	04	15	27

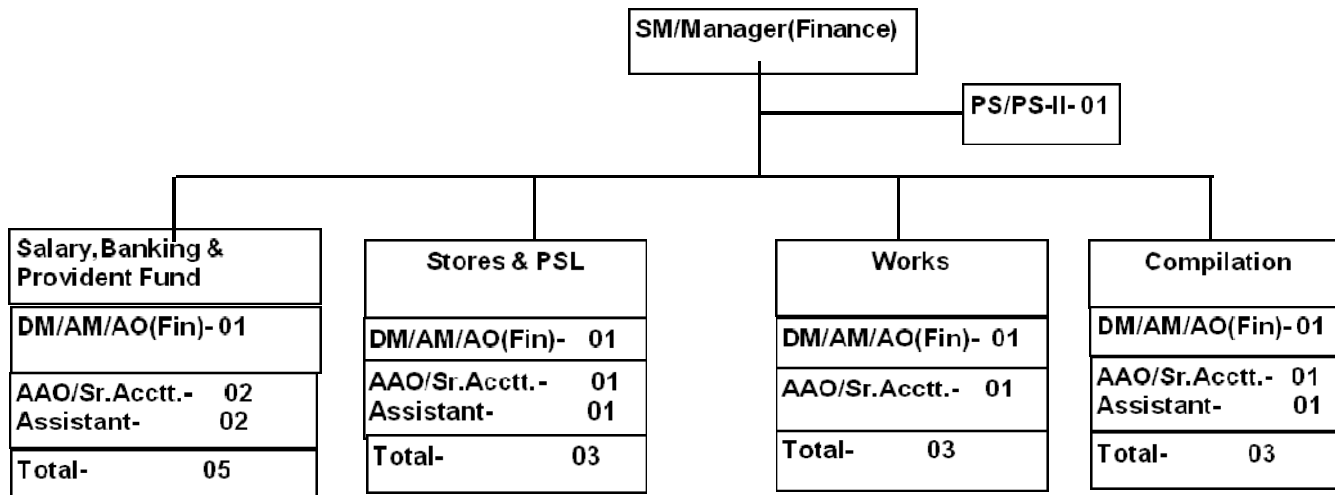
Organisation Structure of HR Deptt at Dhauliganga Power Station



Note: Attendants: 02 nos.

Summary:				
	<u>Exe.</u>	<u>Sup</u>	<u>W/men</u>	<u>Total</u>
No.	10	01	12	23

Organisation Structure of Finance Deptt. at Dhauliganga Power Station

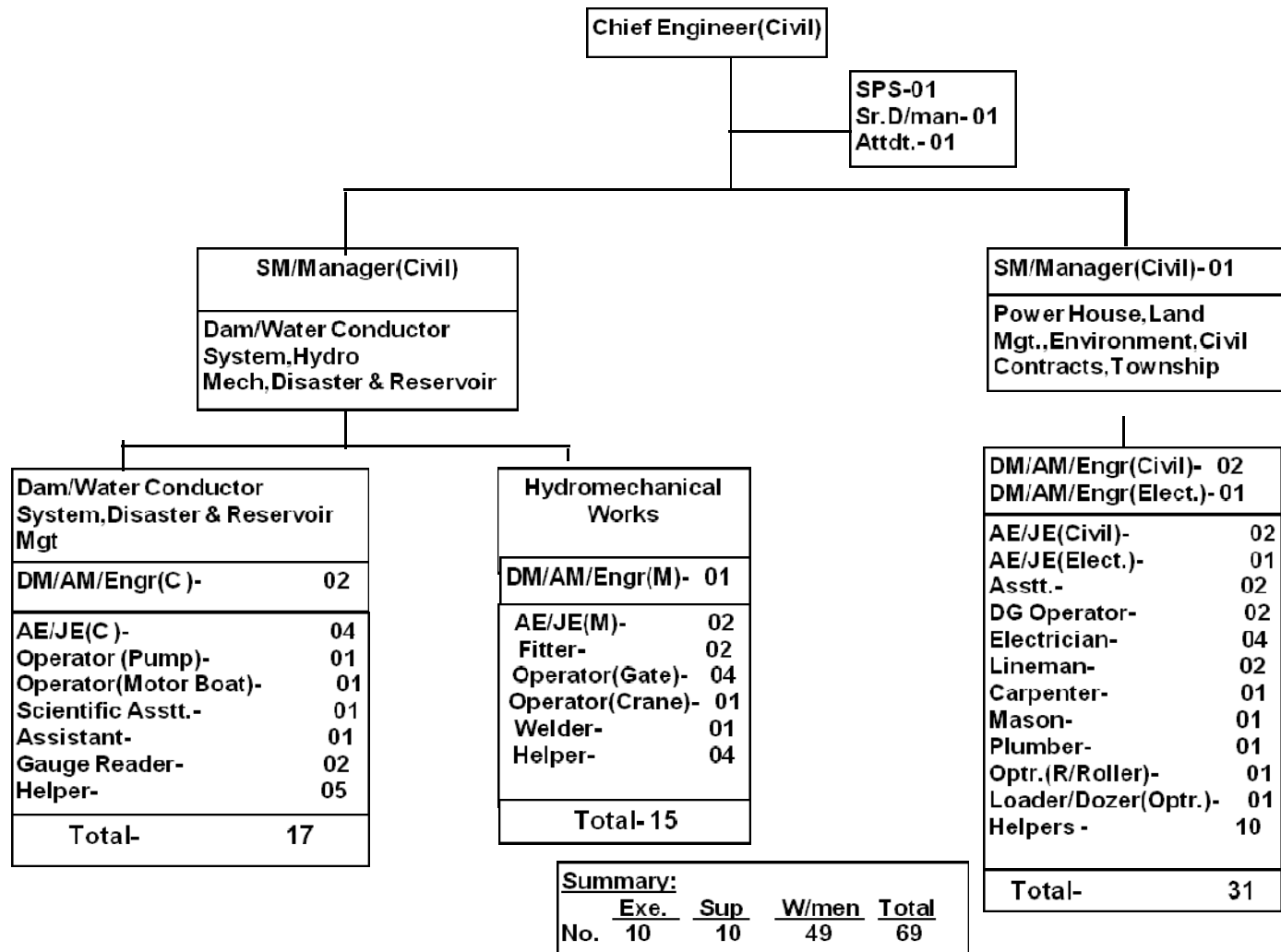


Note: Attendant=02 nos.

Summary:				
	<u>Exe.</u>	<u>Sup.</u>	<u>W/men</u>	<u>Total</u>
No.	05	06	07	18

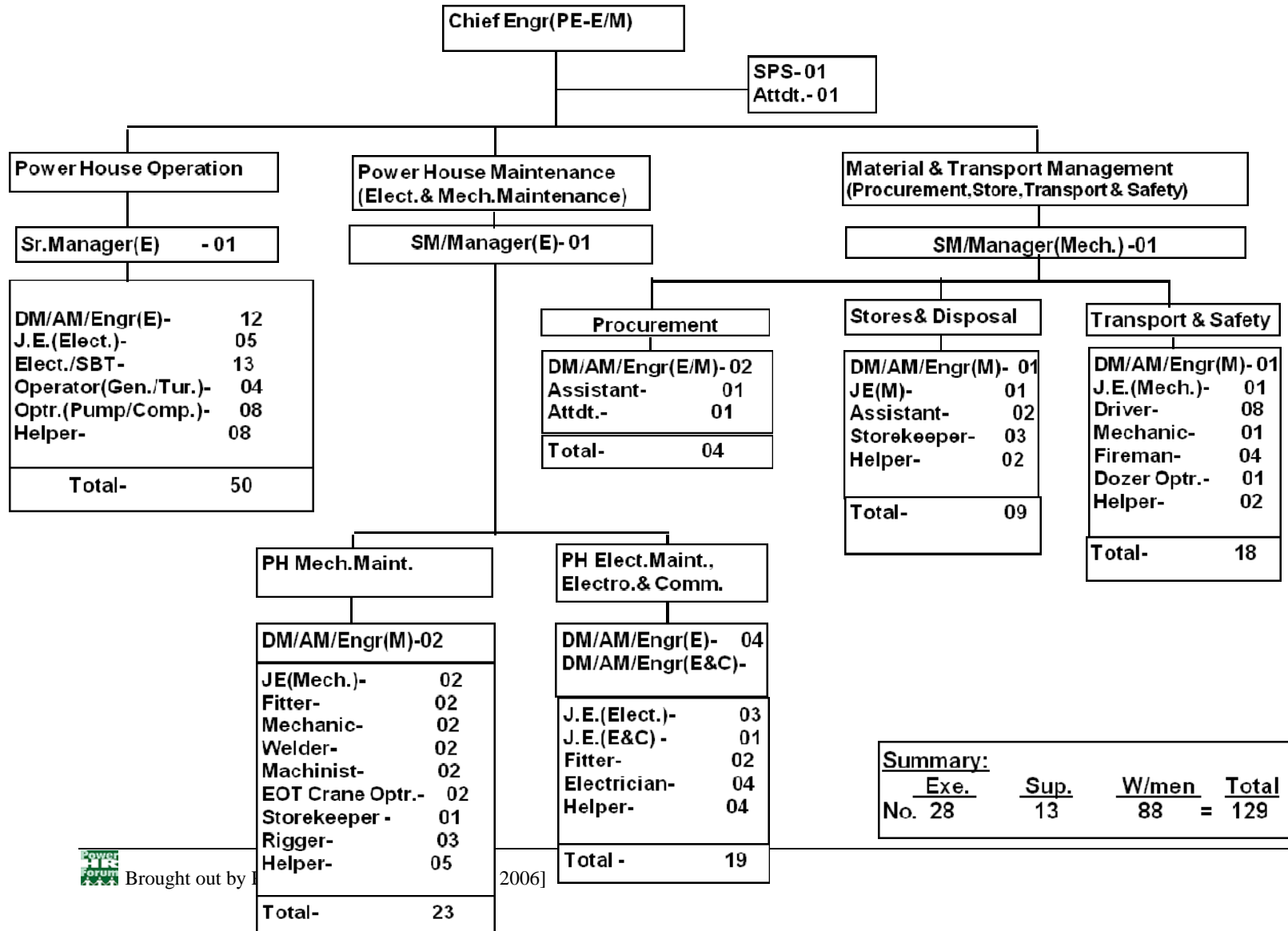


Organisation structure for Civil Engineering Deptt. at Dhauliganga Power Station





Organisation Structure of Power Engrg.Deptt. at Dhaliqanga Power Station





3. MANPOWER AT POWER PROJECTS

3.1 Constraints

The requirement of manpower for a particular project in construction stage depends upon the following major parameters:

- Number of locations i.e. Dam, Power House etc.
- Design features of Project i.e. Type of Power House, length of Tunnel, number of adits etc.
- Mode of Construction i.e. Departmental or package contracting / Turnkey basis.
- Topographical conditions etc.

Like Power Stations it is not feasible to link the manpower requirement with the capacity of Project. A number of organizations including various stage Electricity Boards of the country as well as “Sub Group” set by the Government for a study on Manpower Planning have endeavored to make a detailed study for setting up uniform Manpower norms, however, could not finalize any such norms primarily for the following valid technical reasons:

- Composition of a Hydroelectric Project situated in an arduous and difficult terrain is unique by itself.
- Unlike thermal (Coal based / oil fired) and nuclear counterparts, hydro projects are absolutely non-standard in design and layout.
- Hydro projects are tailor made to suit the site conditions (topography, hydrological situations, geo-technical environment etc.) and Design and Layout of a hydro project has no relation whatsoever with the installed capacity (MW).
- Generating Units of certain capacity can be relatively very small if the head available is high. Therefore, smaller size generating units would naturally require reduced dimensions of Power House Civil Works.
- A very small capacity project can have a long water conductor system passing through a complex topography and geology necessitating considerable civil engineering efforts.
- NHPC is operating mostly in Himalayan region & North East region where geology is highly typical. The kind of geological surprises that we come across make it impossible to think of any norms of Manpower Planning.
- Manpower norms even if existing abroad will have no relevance to Indian conditions in view of a very large gap in technological level, large difference in geo-technical environment and also large variation in social and climatic conditions.
- Items of work undertaken by contract labour differ from project to project. While many of the jobs in projects are done by contract labour, some projects primarily engage departmental manpower whereas some are constructed on turnkey basis under bilateral agreements.

In view of the above, all over the country, manpower deployment at Hydro Construction sites is need based and is decided by experience on case-to-case

basis. Each project has therefore to be considered as a case by itself. As may be appreciated, some projects will have long underground tunnels, some will have surface power channels, in some cases there would be surge tank deep down the hill and in some cases it would not be there at all. Even project modules are at large variance.

3.2 Norms

For projection of manpower for construction hydro station in the country National Power Plan has estimated a norm of 2.75 Man / MW.

TABLE : Man/MW status at our ongoing projects:

Project	Capacity MW	Manpower		Men / MW ration as per	
		Sanction	In-position	Sanction	In-position
Dulhasti	390	743	747	1.90	1.91
Teesta-V	510	535	579	1.04	1.13
Sewa-II	120	247	434	2.05	3.61
Teesta L/D-III	132	164	207	1.24	1.56
Parbati-II	800	766	944	0.95	1.18
Subansiri Lower	2000	465	362	0.23	0.18
Chamera-III	231	278	343	1.20	1.48
Parbati-III	520	304	148	0.58	0.28
Total	4703	3502	3764	0.74	0.80

3.3 Estimation of Manpower

3.3.1 Parameters:

In NHPC perspective, while estimating manpower, the following parameters taken into consideration:

3.3.1.1 Organization Structure

- Number of locations & distances
- Design features of the Project
- Organization structure – Functional Areas
- Job Profile
- Establishment expenses as approved in DPR
- Mode of Construction

3.3.1.2 Functional Areas:

The following functional areas have been identified while estimating the manpower requirement for each of the project :

Construction Works

- Dam & Diversions
- Surge Shaft, Penstock

- Water conductor for system & Reservoir management
- Power House Complex
- Tail Race Tunnel
- Head Race Tunnel
- Geology

Support Services (Technical)

- Planning, Co-ordination & Monitoring
- IT & Communication
- Infrastructure (Roads, buildings, bridges, land acquisition, forest, environment)
- Procurement / Contracts
- Quality Control
- Safety
- Workshops, field repair & maintenance, store, transport

Common Service

- Finance & Accounts (Salary, Suppliers & Contractor bills, Budgetary Control, etc.)
- Personnel & Administration (Recruitment Industrial Relation, Establishment, General Administration, Protocol, Law, Rajbhasha, Public Relation, Training & Development etc.)
- Vigilance (Vigilance activities)

3.3.2 Requirement of Manpower

3.3.2.1 Manpower Norms For Stage-I Projects

Activities:

- Data collection / preparation of application for site clearance by MOEF.
- Establishment of gauge and discharge sites and metrological observatories. Hydrological measurements and Metrological observations will continue till construction of the Project.
- Obtaining the site clearance from MOEF.
- Essential geological exploration for establishing type of dam and its foundation and other civil structures.
- Topographic survey of the project area and detailed survey for the purpose of preliminary layouts of dam, Powerhouse etc.
- Essential temporary infrastructure / access required for carrying out the above works.
- Commencement of EIA & EMP studies.
- Formulation of a pre-feasibility report for assessment of commercial viability of the project.
- Preparation of estimates for Stage-II activities and their submission to CEA.

Time Schedule:

One year from the zero date.

Expenditure:

The Ministry of Power will sanction expenditure up to Rs. 10 crores on survey and investigation and preparation of PFR.

Manpower Requirement:

Executive	Numbers	Supervisors	Numbers
Chief Engineer	1	Civil	3 to 5
Civil Engineer	5 to 7	PE	2
Power Engineers	2	F&A	2
HR	1	Others	2
Finance	1	Total	9 to 11
Geology	2		
Environment	1		
Doctors	1		
Total	14 to 16		
Workmen	25-35		
Grand Total	48-62		

3.3.2.2 Manpower Norms For Stage-II Projects

Activities:

- Essential survey and investigation works comprising the following:
 - Detailed Topographic survey of reservoir area and project area.
 - Procurement of satellite imageries including aerial maps where require.
 - Geo-physical surveys comprising seismic and seismic and resistivity tests etc.
 - Hydro-metrological observations.
 - Collection of silt data and its analysis.
 - Geological exploration comprising surface mapping, drilling, drifting and their logging etc.
 - Construction material survey both qualitative and quantitative.
- Preparation of Detailed Project Report.
- Submission of DPR to CEA and obtaining Techno Economic Clearance from CEA.
- Submission of EIA and EMP to MOEF and obtaining Forest and Environment clearances of the Project.
- Temporary / permanent buildings (residential and non-residential)
- Roads and permanent bridges as may be required for approaching work sites and transportation of heavy equipment.

- Acquisition of land required for the execution of the Project including land. Initiating the process for acquisition of land of the reservoir submergences area.
- Arrangement of construction power.
- Preparation of tender specification and bid documents.
- Submission of PIB Memo / CCEA note.

Time Schedule:

Eighteen (18) months.

Expenditure:

Proposal costing Rs. 20 crores and more will require FM's approval. Cost over Rs. 50 crores will require the approval of the cabinet / CCEA.

Manpower Requirement:

Executive	Numbers	Supervisors	Numbers
Head of Project	1	Civil	5 to 7
Civil Engineer	10 to 15	PE	3 to 4
Power Engineers	3 to 5	Finance	2
HR	1	Admn.	1
Finance	1	Research	1
Geology	2	Total	13 to 16
Environment	1		
Doctors	2		
Total	21 to 28		
Workmen	50-60		
Grand Total	84-104		

Establishment Expenses:

The more rational solution is to estimate manpower for a construction project in correlation with approved establishment charges as incorporated in Detailed Project Report (DPR) of the project and which is generally 5% to 7% of the (I Works-B land) of cost estimate of the Project.

The Central Water Commission provides this limit. If we exceed the establishment charges it directly affects the profitability of the Corporation due to cost over run.

3.3.2.3 Manpower Norms For Stage-III Projects

Activities:

- Tendering and awards of works.
- Actual construction.

EXECUTIVES:

Discipline	Upto 100 MW	101-300 MW	301-500 MW	501 & above
Civil	15	25	30	35
Electrical	4	6	7	10
Mechanical	3	4	5	5
HR	3	4	4	4
Finance	4	5	5	5
Medical	2	4	4	4
IT&C	1	1	1	1
E&C	1	1	1	1
PR	0	1	1	1
Hindi	1	1	1	1
Research	1	2	2	2
Geo/Geophy.	2	2	3	3
Env.	1	1	1	1
Total	38	57	65	73

SUPERVISORS:

Discipline	Upto 100 MW	101-300 MW	301-500 MW	501 & above
Civil	6	10	12	15
Electrical	2	4	5	7
Mechanical	2	1	2	3
Finance	3	5	5	6
IT&C	1	2	2	3
E&C	1	2	2	2
Supervisors (Civil,PE,office)	6	10	11	16
Total	21	34	39	52

WORKMEN:

Discipline	Upto 100 MW	101-300 MW	301-500 MW	501 & above
Technician	41	48	51	56
Office based staff	20	34	39	39
Utilities	15	18	20	20
Unskilled	35	47	51	59
HEM operators / Drivers	14	16	18	22
Paramedical	10	12	13	13
Total	135	175	192	209

- Technician: Electrician, Fitter, Welder, Mechanic, SBT, Lineman etc.
- Office Based Staff: Assistants, Stenos & others ministerial staff
- Utilities: Pump, Compressors, Generators, etc.
- Unskilled: Helpers, Beldar, Attendant, Security Guard, Safaiwala, etc.
- HEM Drivers, Operators: Dozer, Dumpers, Shovel etc.

4. FUTURE STRATEGIES

4.1 External Benchmarking

Industrial Engineering Group has also collected data from other organizations:

Capacity (MW)	Range of Men-MW Ratio in similar organizations	NHPC	Comparative in other organization
Upto 100	1.92 to 3.52	3.52	Tata Hydro : 1.92
101 to 200	4.47 to 7.00	4.47	Andhra Pradesh : 7.00
201 to 300	0.59 to 4.23	1.79	Tata Hydro :0.59
301 to 500	0.66 to 5.01	.69	Maharashtra : 0.66
501 to 750	0.53 to 0.41	1.28	Maharashtra : 0.53

4.2 Surplus Manpower & Planned Interventions for Optimization:

4.2.1 Redeployment:

Planned Redeployment to other ongoing project has been identified as effective strategy to deal with surplus manpower problem. The benefits of the same are:

- Limits of CERC O&M expenditure.
- Job profiling Rationale.
- Optimum Manpower Requirement / Utilization.
- Staggering Employee remuneration expenses.
- Profitability of Corporation.

4.2.2 Separation

Implementation of voluntary separation schemes may also help significantly for reduction of surplus manpower.

4.2.3 Ban on Recruitment

4.2.4 Multi-skilling & Job enrichment

4.3 Interventions Identified For Upgrading Surplus / Obsolete Manpower:

The trend of manpower requirement over and above the existing strength for the Xth & XIth plan for workmen in various categories is as follows:

(i) **Critical trades in which requirement is increasing substantially over and above the existing strength:**

Discipline	2005	2006	2007	2008	2009	2010	2011	2012
Electrician / SBT	16	43	116	134	172	269	293	445
Operator (Pump / Comp.)	-13	3	11	17	29	42	50	75
Machinist	7	13	18	20	23	27	29	38
Welder	-10	10	12	20	23	24	25	13
EOT Crane Operator	13	13	21	21	25	35	37	53
Operator (Gen / Tur.)	22	37	59	59	65	85	90	121
HEM Operator	-1	27	35	35	30	19	18	-7
Operator (Photo)	22	22	22	22	22	22	23	23
Scientific Asstt. / Gauge Reader	-4	24	25	24	26	25	25	25
Plumber	3	15	11	18	15	10	10	1

(ii) **Critical trades in which requirement is decreasing substantially over and above the existing strength:**

Discipline	2005	2006	2007	2008	2009	2010	2011	2012
Assistant	- 263	-109	-153	-73	-77	-144	-149	-260
Storekeeper	-49	-13	-32	-17	-17	-36	-44	-71
Fitter	-154	-145	-139	-135	-132	-127	-118	-85
Mechanic	-115	-101	-109	-103	-109	-113	-114	-128
Helper / Beldar / Attendant	-809	-570	-639	-517	-514	-605	-626	-814
Cook	-34	-34	-38	-37	-39	-45	-44	-51
Carpenter	-49	-39	-43	-38	-43	-47	-43	-46

The intervention envisages

- No Recruitment.
- Gaps be filled through training, job enrichment & multi-skilling as reflected below:

(i) **Electrician:**

Providing 52 weeks training in Electrician trade at NPTI / ITI to Helpers / Beldars upto the age of 40 years who possess 8th and above qualifications.

- (ii) **Welder:**
Providing training in Welder trade from NPTI or Larsen & Toubro training centre to Helpers / Beldars (less than 40 years of age) possessing qualification of 8th and above.
- (iii) **Machinist:**
Providing training to Helpers possessing minimum of 8th qualification from ITI Ropar or any other ITI or NPTI.
- (iv) **Operator (Pump / Compressor), Operator Gate:**
The existing Mechanic to be given responsibility for operation of Pump & Compressors / Gates. Familiarization programmes can be arranged through FSUs of manufacturers.
- (v) **EOT Crane Operator:**
Drivers up to the age of 45 years to be given responsibility of EOT crane operation. Familiarization programmes can be arranged through FSUs of manufacturers.
- (vi) **Scientific Assistant / Gauge Readers:**
Existing Assistants or Work Assistants (who are excess to the requirement) having matric or 8th with Science background to be utilized for these jobs.
- (vii) **Plumber / Operator (Photostat):**
The jobs of above categories to be outsourced.
- (viii) **Operator (Generator / Turbine):**
Turbine Operation is an automated operation i.e. computerized or push button start which an electrician can easily perform. However the requirement is of operation Diesel Generating sets for which Mechanics can be given responsibility. If needed, training may be provided from reputed manufacturer of DG sets i.e. Kirlosker Cummins, Sulzer etc.

4.4 **Outsourcing:**

As to the outsourcing, the following activities of Power Station are generally outsourced:

- Security
- Running & Maintenance of Guest House canteens, field hostels
- Housekeeping
- Major maintenance of equipment
- Other unskilled activities
- Vehicles except those of station Head, VIP, Fire tender, Ambulance, etc.

An example of saving which can be accrued through hiring of vehicles is depicted below:

Feasibility Analysis for Jeeps

S.No.	Description	Unit	Per Month	Per Annum
1.	Wages of Driver	Rs.	22000	264000
2.	10% of Wages of one Mechanic & Helper	Rs.	2200	264000
3.	Consumption of Diesel (assumption 60 km / day)	Litre	180	2160
4.	Expenditure towards Diesel (assuming diesel rate at Rs. 30 km/day)	Rs.	5400	64800
5.	Expenditure towards insurance	Rs.	1000	12000
6.	Spare Parts, Tyres etc. (2 tyres per day)	Rs.	000	12000
7.	Servicing	Rs.	500	6000
8.	Interest on capital (assuming 8% p.a. on Rs. 5 Lakh)	Rs.	3333	39996
9.	Depreciation (10%)	Rs.	4000	48000
	Grand Total	Rs.	39613	475356
10.	Add 10% on account of spillages		4500	5200
	Grand Total	Rs.	4413	480556
11.	Expenses if hired through outside	Rs.	21000	252000
12.	Saving per Jeep	Rs.	23113	228556

Manpower Optimization in NTPC

1. THE BACKGROUND

NTPC Limited (NTPC; www.ntpc.co.in), a public sector company, was incorporated in the Nov 1975 to accelerate power development in the country. Initially, a wholly owned company of the Government of India, at present the GoI holds 89.5% of the total equity shares of the company and the balance 10.5% is held by FIIs, Domestic Banks, Public and others. Within a span of 30 years, NTPC has emerged as a truly national power company, generating over 27 % of the power generated in India, with power generating facilities in all the major regions of the country. The present total installed capacity of NTPC is 24249 MW and it plans to become 40,000 MW by end of 2012 and 66000 MW company by 2017.

NTPC's core business is engineering, construction and operation of power generating plants and also providing consultancy to power utilities in India and abroad. NTPC has set new benchmarks for the power industry both in the area of power plant construction and operations. It is providing power at the cheapest average tariff in the country. With its experience and expertise in the power sector, NTPC is extending consultancy services to various organisations in the power business. NTPC is presently commissioning and operating Thermal, Gas and Hydro Power Plants. Major diversifications which have recently been taken place are backward integration (i.e. in the area of coal mining) and forward integration (i.e. Distribution of Power supply). In future also NTPC is planning to enter in new areas like LNG, Hydro Carbon, Nuclear etc.

Initially, NTPC stood for National Thermal Power Corporation Ltd. and the name was changed to only “NTPC Limited”, to reflect the present diverse operations and future plan to enter into all areas of power generation including coal mining, oil and gas exploration.

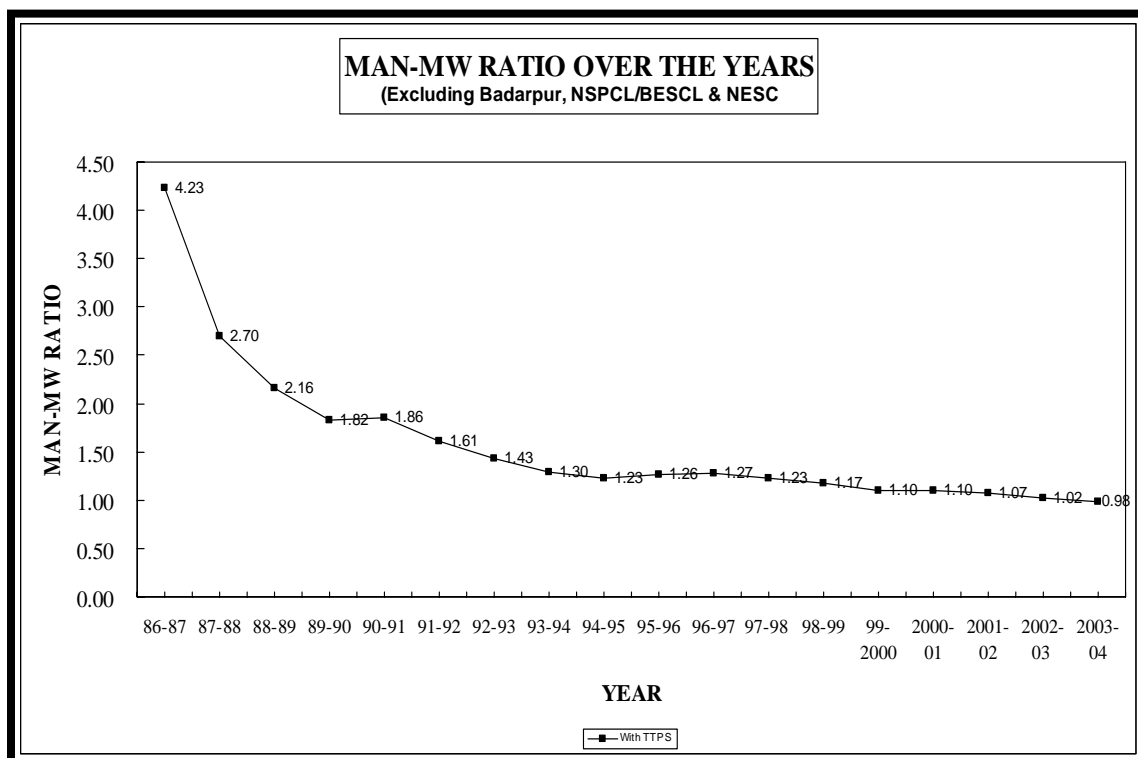
Recognising its excellent performance and vast potential, Government of the India has identified NTPC as one of the jewels of Public Sector ‘Navratnas’- a potential global giant.

To meet the growing demand of the company, optimization of manpower is done on a continuous basis with utmost care. In the following sections, the result of NTPC’s optimization of manpower, is described, to serve as a reference document.

2. PRESENT MAN-POWER SITUATION

The current manpower strength of NTPC is 23,858 detailed as under:

• Manpower posted in NTPC	21,766
• Manpower posted in JVs/Subsidiaries	442
• Manpower posted to Badarpur (managed by NTPC)	1650
Total	23,858



3. MANNING OF OPERATING POWER STATIONS

3.1 Manpower Norms

The factors affecting the manpower requirement for an operating thermal power station depends on the followings factors:

- Type of the Unit
- Size of the Unit
- Level of automation
- Off-site facilities
- Plant Layout
- Control Room Locations
- Level of out-source

From the beginning, all out efforts have been made in NTPC to improve the Man-MW ratio on a continuous basis. Some of the tools and techniques used for optimization of manpower are given under:

- i) Review by internal Committees (Experts)
- ii) Review by consultants
- iii) Internal Bench Marking
- iv) External/International Bench Marking
- v) Development of manpower module/norms for different activities.
- vi) Out-sourcing of non-core/maintenance activities
- vii) Multi-skilling of existing employees
- viii) Re-deployment/skill-upgradation of surplus to expansion projects

The manpower deployment have also been reviewed from time to time by consultants and internal committees as under:

- i) Sh. RN Ghosh, Consultant during 1989-90
- ii) Sh. RP Mungra, Consultant during 1995-96
- iii) Committee of Sr. Executives (Experts)-I during 2002-03
- iv) Committee of Sr. Executives (Experts)-II-continuing
- v) National Productivity Council (NPC) study on executive manpower requirement at Corp.Centre and Regional Head Quarters (RHQs)– continuing.

3.2 Manpower Pattern

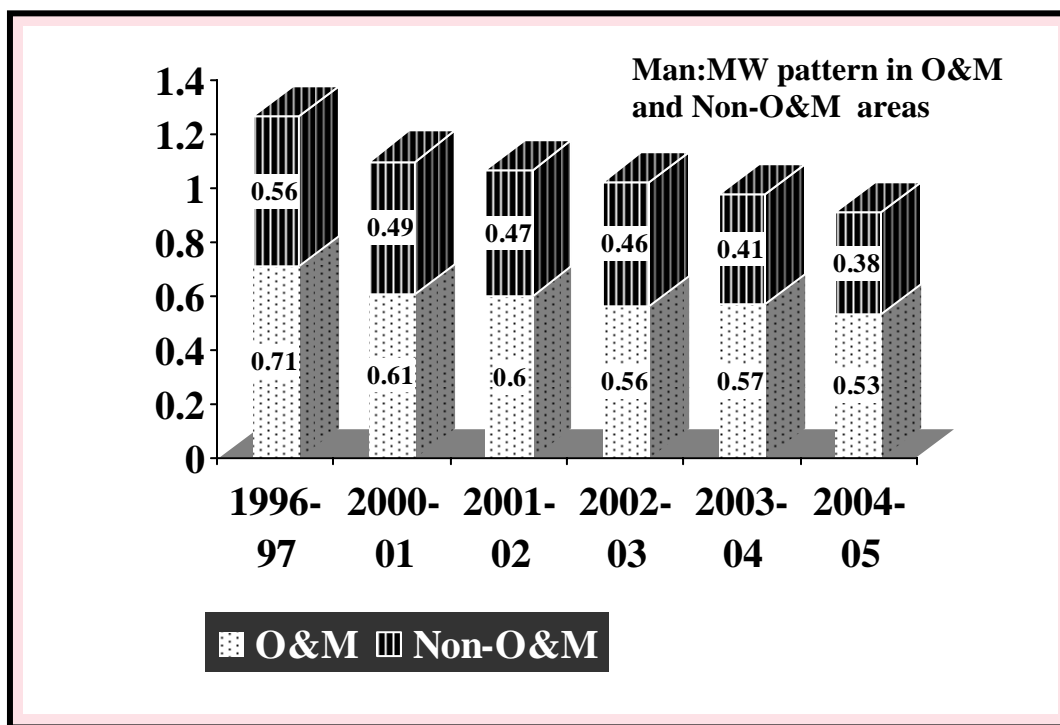
NTPC is presently operating both coal based and gas based power stations. The Man:MW ratio for various coal based power plants ranges from 0.37 to 2.60 and for gas based power plant ranges from 0.14 to 0.58. The present deployment is based on the recommendations of these consultants/committees.

Project	Units	Manpower	Man-MW
Singrauli (coal based)	5x200+2x500 = 2000 MW	1791	0.90
Simhadri (coal based)	2x500 = 1000 MW	541	0.54
Jhanor Gandhar (Gas based)	3x131+255 MW = 648 MW	198	0.31
Sipat (upcoming coal based project)	3x660+2x500 = 2980 MW	1078	0.36

On an average, the Man-MW ratio has been reduced from 3.70 in 1991-92 to 0.91 in 2004-05 as given below:

MAN-MW Ratio & Generation per Employee over the years

Year	Man-MW ratio	Generation (MU/employee)
1991-92	1.61	3.70
1996-97	1.27	4.63
2001-02	1.07	6.26
2002-03	1.02	6.58
2003-04	0.98	7.11
2004-05	0.91	7.43



The figures in Table and graph, are excluding NTPC managed power station at Delhi namely, Badarpur Thermal Power Station and Balco Captive Power Station at Korba, MP and JVs/ Subsidiaries

The capacity addition in the past has also been done without any addition in non-executive manpower. The manpower cost justified the present level of work. However, all efforts are still being made to further rationalize the manpower and it is likely that Man-MW ratio will be reduced further in the years to come. NTPC is aiming to reduce Man-MW ratio to 0.87 by the end of 2006-07 and to 0.60 by the end of 2011-12.

3.3 International Benchmarks

The international bench mark for Man:MW ratio for operating coal based thermal power stations is 0.13. However, this figure is applicable for the “Operational aspect (main plant)” of the power stations. In contrast to the practices abroad, in India, the manning pattern is quite different.

Present Man-MW ratio of NTPC’s best managed power station is very close to international standards if various practices adopted at these power stations are discounted, for which in NTPC the manpower is provided. The various activities which are not reflected in the Man-MW ratio of international power producers vis-à-vis the practices in NTPC are as under:

- i) The regular manpower is mainly posted in the operation function of a power plant.
- ii) Even in some of the power stations like Drax Power of UK, the entire coal handling plant is out sourced.
- iii) The transportation of coal is generally done by external agencies.
- iv) All maintenance activities are out-sourced
- v) Mature vendors are readily available at door step to meet any exigency/emergency.
- vi) The spares are maintained by the agencies doing maintenance activities.
- vii) There is no hospital set up at these power stations
- viii) There is no dedicated township in the power station.
- ix) There is not much manpower in the service function departments.
- x) Good quality of coal with very less ash content.
- xi) Non-existence of functions like township, R&R, Hindi/Rajbhasha, Law etc. which are specific to Indian conditions.

If a function wise comparison is made between power stations abroad and those of NTPC stations, the results are very encouraging and it even surpass the international standards. The following tabulation shows the Man”MW ratio of few NTPC stations, where the manning at main-plant is considered only, as per international practice.

Talcher Kaniha:	0.12
Rihand :	0.12
Simhadri :	0.15
Ramagundam :	0.18
Vindhyachal :	0.23
Singrauli :	0.23

4. MANNING OF PROJECTS

The deployment of manpower during construction phase has also been optimized progressively. The phase/activity wise manpower for a typical 3 x 660 MW coal based power project is given below.

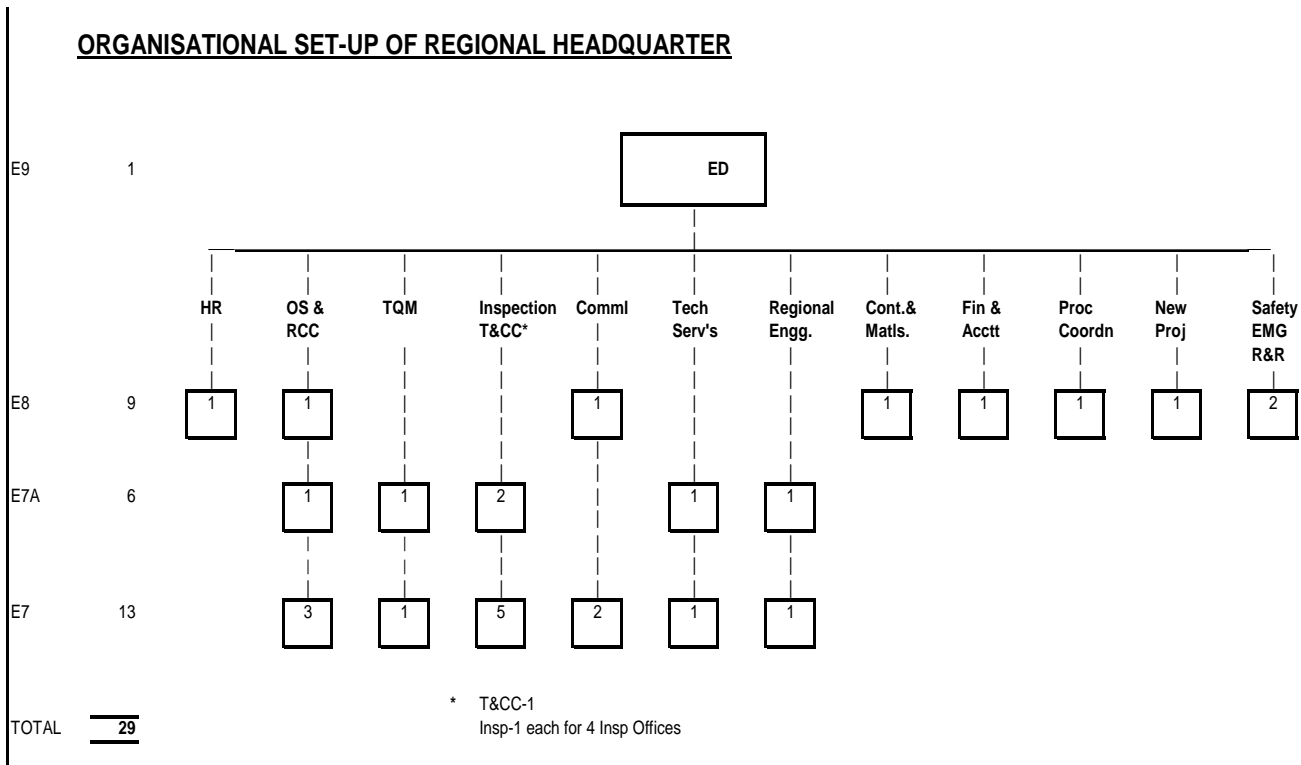
Stage of Project	Executive	Non-executive	Total
Pre-investment approval	13	-	13
Between investment approval and start of boiler erection	62	15	77
Between start of boiler erection and drum lifting	80	15	95
Between Drum lifting and Trial Operation (Peak manpower)	92	34	126
Between Trial Operation and warranty completion	37	-	37
Between warranty period and contract closing	14	-	14

5. MANPOWER OPTIMISATION STRATEGIES

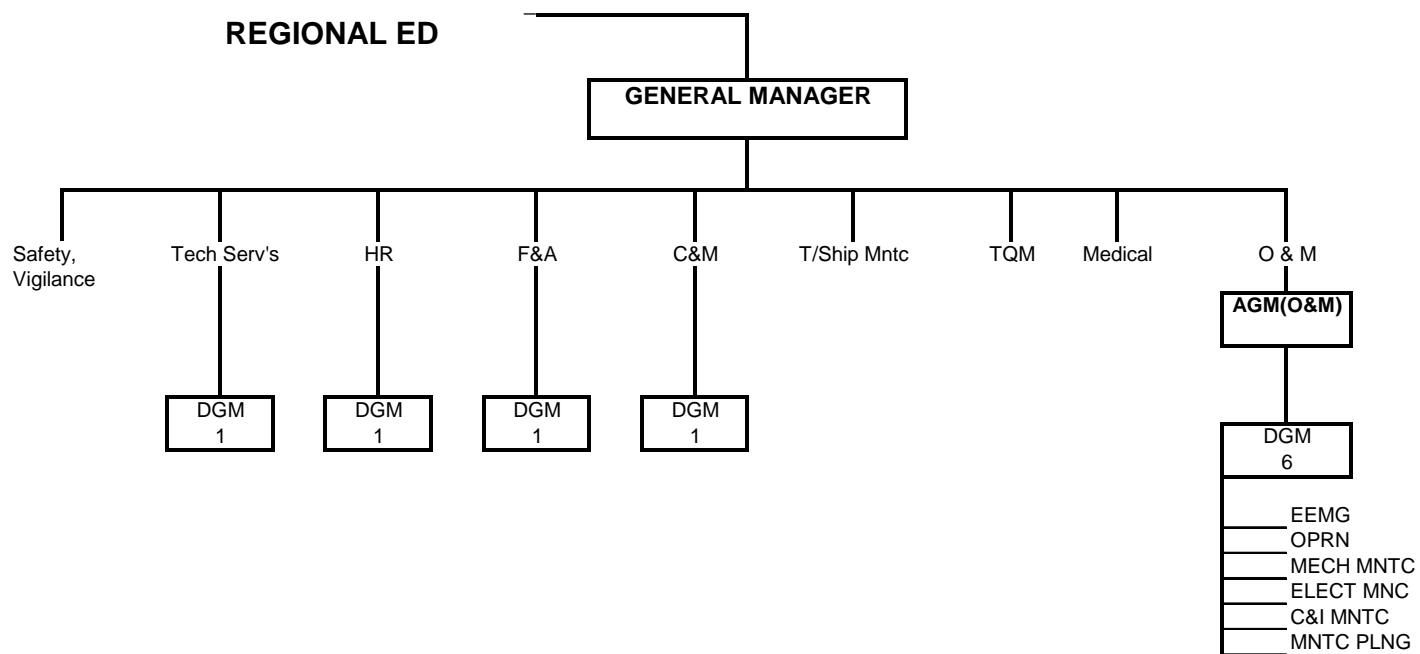
Given below are few factors which are being considered, through which it is possible to bring manpower requirement progressively down.

- i) High capacity unit (Capacity up to 800 MW)
- ii) Out Sourcing of all maintenance activities.
- iii) Significant reduction in unskilled workforce.
- iv) Outsourcing of non-core activities.
- v) Elimination of supervisory cadre.
- vi) Rationalization of control room manning & other manning points in operation.
- vii) Unification of control room.
- viii) High degree of computerization in service functions, reduction in clerical and secretarial staff.
- ix) Significant reduction in non-O&M staff.
- x) Redeployment of surplus staff to newer units.
- xi) Skill Up-gradation of existing staff and their multiskilling

ANNEXURES

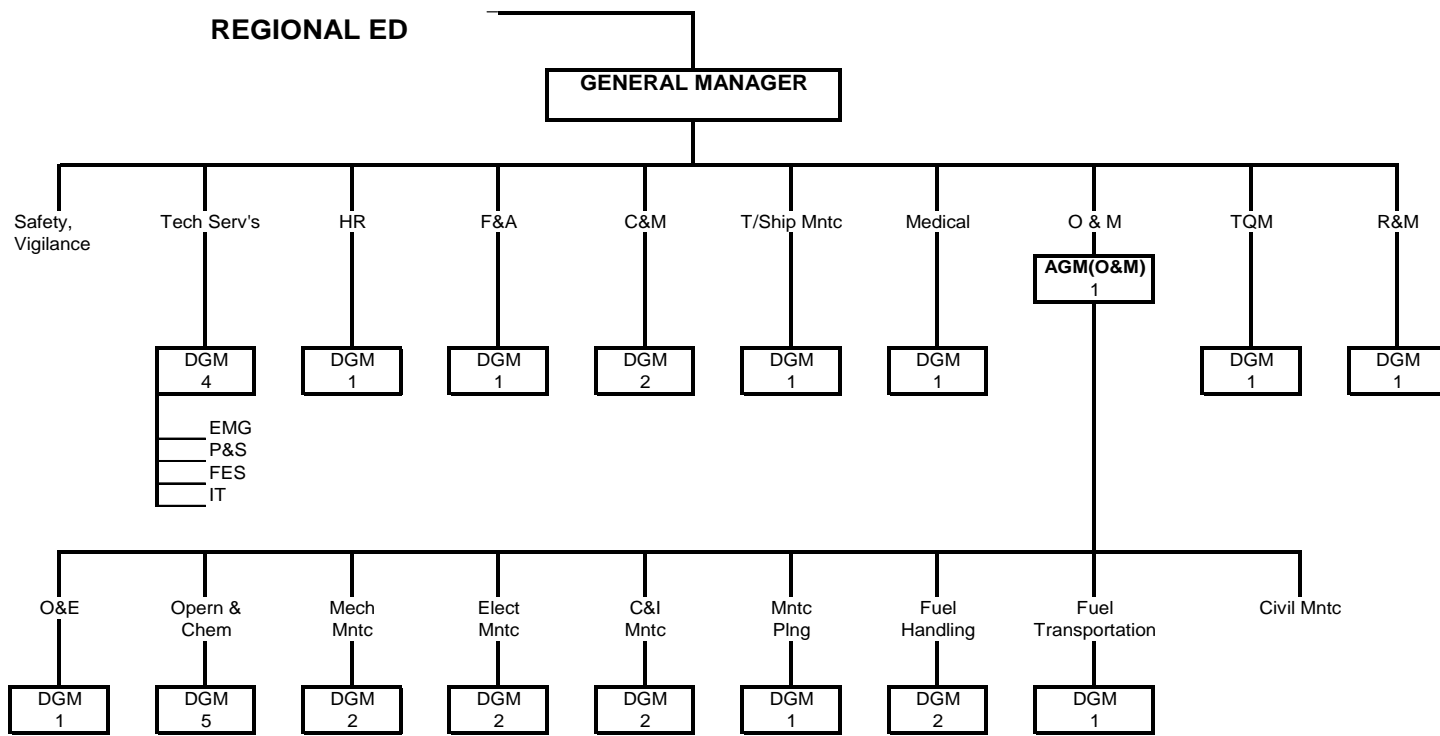


ORGANISATIONAL SET-UP FOR A TYPICAL GAS STATION



GM	:	1
AGM	:	1
DGM	:	10
TOTAL	:	<u>12</u>

ORGANISATIONAL SET-UP FOR A TYPICAL STPP



GM	:	1
AGM	:	1
DGM	:	28
TOTAL	:	30

Manpower Optimization in POWERGRID

1. THE BACKGROUND

Power Grid Corporation of India Ltd (POWERGRID, www.powergridindia.com) was incorporated in October 1989 as a transmission utility by taking over of transmission networks along with the associated manpower of various Central Power Utilities during the period 1991 to 1994. POWERGRID was formed to bring about development in the transmission sector and undertake the responsibility of building a National Grid. The mandate during establishing POWERGRID was to "establish and operate Regional and National Power Grids to facilitate transfer of power within and across the Regions with reliability, security and economy on sound commercial principles". The POWER GRID has been statutorily acknowledged as Central National Transmission Utility of the country. It operates more than 50,000 circuit kilometer of transmission lines, 82 sub stations handling about 47,000 MVA with more than 99 % availability.

Manpower absorbed in POWERGRID ranged from Public Sector Enterprises to pure Govt. Departments and some of them possessing experience in the generation units of Thermal and Hydro Power Plants rather than in transmission systems. Further, out of total employees absorbed approximately 60% were workmen, bulk of whom were non-technical staff like drivers, attendants, assistants, guards and other support staff for whom there was little work in the highly technology driven organization.

This unique fact posed an unique challenge to POWERGRID and in the following sections, the result of manpower man-power planning and optimization is illustrated.

2. MANPOWER PLANNING AT POWERGRID

Finding the right man for the right job and developing him in to an effective team member is an important element of organizational success. Human resource is an important corporate asset and the overall performance of organizations depends upon the way it is put to use. In order to realize organizational objectives, it is essential to have a manpower plan. With this approach, POWERGRID believes that to be successful in every sphere of HR function, thereby leading to organizational success, optimization of manpower is foremost and key factor.

Manpower planning and budgeting in POWERGRID has three stage processes. It not only draws a company wide manpower requirement covering different levels

and functions but also prepares action plan & links itself with organizational development and other sub-systems of HR.

Stage-I: It starts with assessment of workload. The basic input for assessing workload is company's strategic business plan that spells out existing projects, its expansion plan and upcoming projects. Furthermore work schedules and financial allocations for individual projects also form the core of estimating annual workload.

Stage – II : This stage starts with comparison of work load Vs manning norms thereby giving the requirement for different functions, locations, etc. POWERGRID has evolved well-defined manning norms separately for Transmission Lines & Sub-station operation & maintenance, TL & Sub-station construction and Regional offices. With expansion of business in Telecom, APDRP, Distribution Management, Rural Electrification, Sub-transmission, etc. we have also developed our norms for new business areas. With technology advancement, manning norms for HVDC sub stations & norms for automated sub stations are also developed.

Stage- III : Input for this stage is inventory of available manpower with us. In order to ensure that the whole exercise is not restricted only to head counting, skill and expertise of individual vis-à-vis requirement of organization is also taken into account. This also gives an opportunity to the individual for his development and growth. The competence gaps between the requirement and available becomes one of the major developmental input for HRD. Based on this analysis, annual recruitment and developmental plan is envisaged. Outcome of this analysis is also used as input for other sub systems of HR like promotions, placements, job rotation, etc.

Manpower plans in POWERGRID are made on long term (around 5 years) and short term (annual) basis. Long-term manpower plan is subject to revision in case of major change in assumptions like major policy change, change in Govt. guidelines, etc. Manpower plan is an integral part of the overall corporate plan and reflects the broad thinking of management about manpower needs in the organization.

To complete the above process successfully, evolving manpower norms and its continuous review is critical. Optimum manpower depends upon the effective manning norms and the way it is being developed.

3. DEVELOPMENT OF MANPOWER NORMS

At the time of formation, manpower norms of NTPC were adopted. Subsequently, “National Productivity Council” (NPC) was engaged in the year 1994 and manpower study was conducted with an aim to stimulate and promote productivity consciousness. In the study manning norms for construction and O&M were worked out after assessing various parameters like transmission line length, terrain, sub-station operation, sub-station maintenance etc.

Manpower Study was done in systematic manner based on a number of factors such as

- Technological trends
- Ongoing and immediate future projects/ operations and
- Operation schedule
- Employee turnover
- Absenteeism rate
- Current skill inventory
- Separations
- Productivity levels.

After carrying out detailed study NPC recommended new manning norms in the year 1994.

In order to be competitive in the industry continuous review of plan ensures its successful execution. With this view, an international consultant Cooper and Lybrand (C&L) conducted systems audit to review policy, procedures & systems. As a part of the study C&L gave emphasis on organization structure, systems and processes. C&L recommended more autonomy to Regions and change in organization structure. Some of the recommendations given by C&L are presented below.

- Recommended Region operating as semi-autonomous Division headed by ED & three GMs respectively for three core processes as Construction, O&M and Commercial.
- To separate Operation & Maintenance and Construction Activities in Regions
- Recommended more autonomous structure for Sub-stations. DGM heading S/S under operation directly reporting to General Manager (O&M) and same for construction.
- Three Core functions for S/S as Operation, Maintenance (TL & S/s) and five supporting functions as Safety, Finance, HR Admin, Stores, Town Maintenance and Civil works.
- To outsource some of the specialized and repetitive jobs/activities.

The above recommendation was implemented by the management and in the year 1999-00, Executive Committee reviewed and developed new manpower norms based on C&L recommendations. Again in the year 2002, following the philosophy of continuous review, a reputed HR consultant was appointed to review manpower norms keeping in view the changes in our business model and his recommendations were implemented in 2003-04 after elaborate discussion across levels & functions for its acceptability. A pictorial representation of our manpower norms for Transmission Line and Sub-station O&M (Fig N-1) and construction (Fig N-2) are shown below :

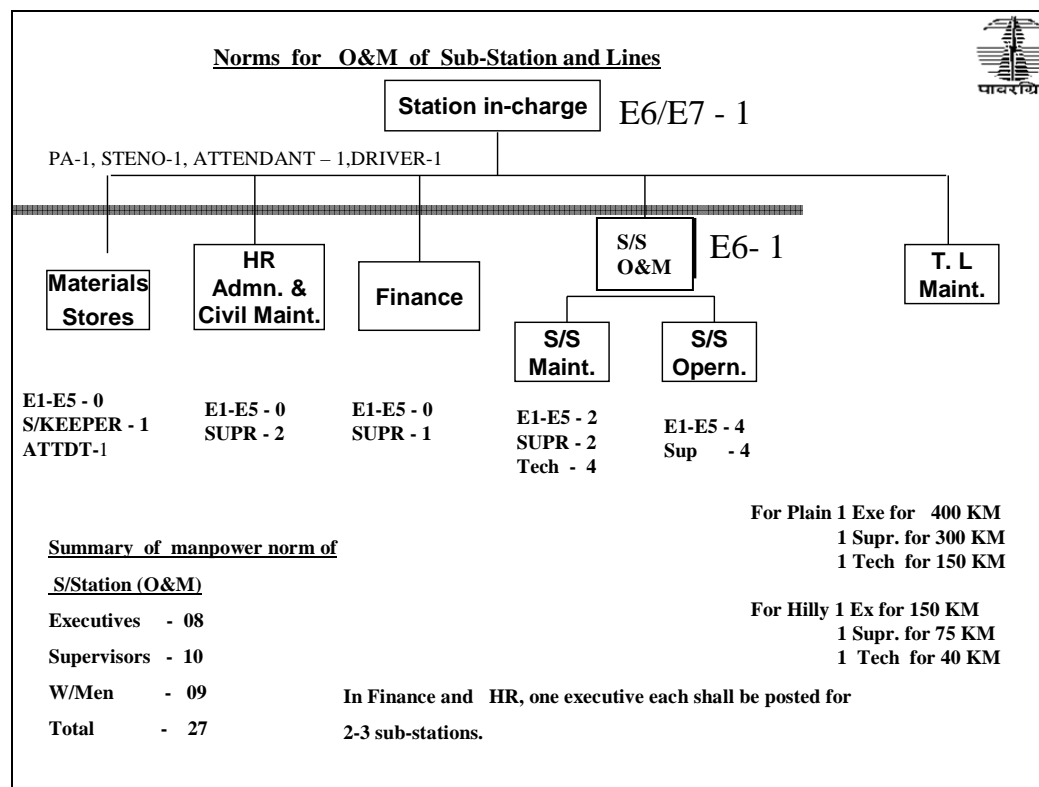


Fig: N-1

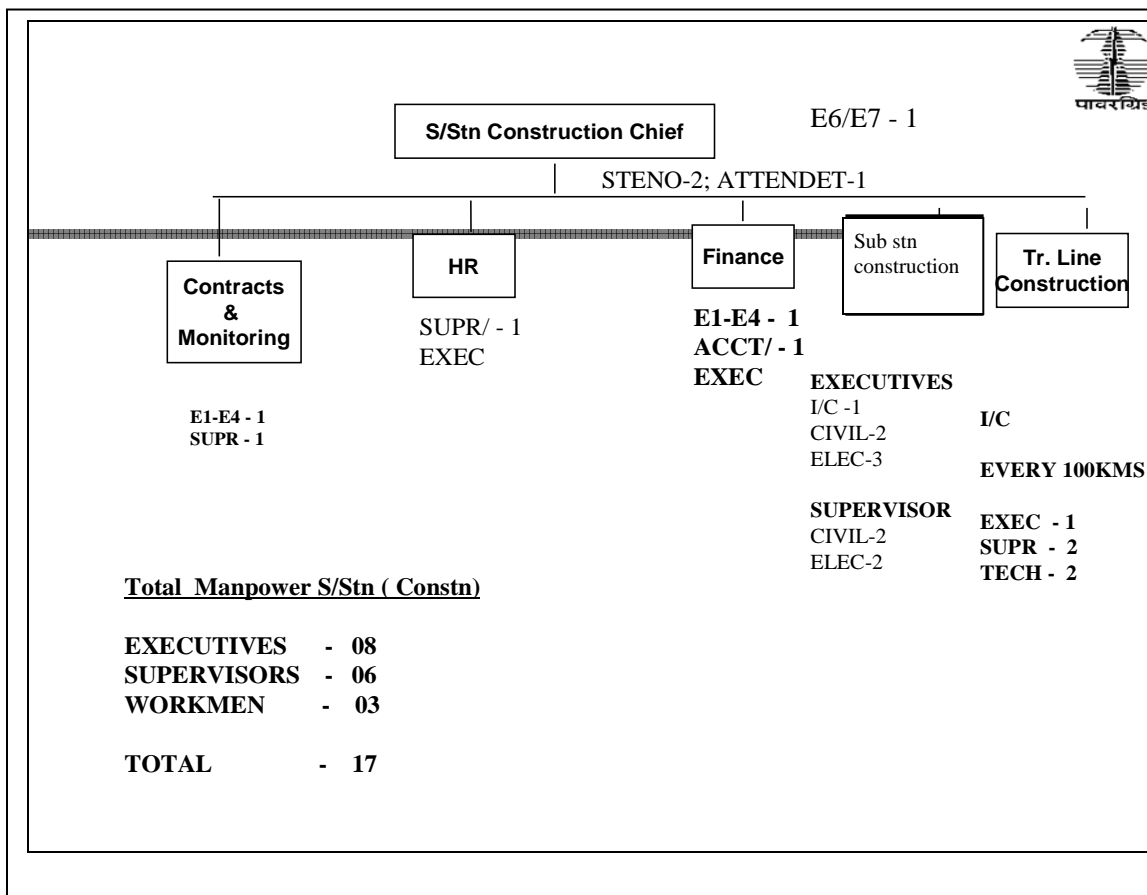


Fig: N-2

Similarly, manpower norms for HVDC sub station & construction and Regional Offices, Regional Load Despatch Centres (RLDCs) are also well defined. Recently with the advent of new technology like automated sub-stations, POWERGRID has revised the norms by reducing staff in operation. Thus, for these remote operated sub-stations under O&M, norm is 19 employees instead of 27.

Our manpower norms are commensurate with the business plans of the organization and its continuous review enabled us to register continuous improvement in productivity. We have also developed manpower norms for our new businesses viz- Telecom, Distribution Management Services & Rural Electrification Consultancy.

Thus, since evolution of our manpower norms, against manning norm of 47 employees/sub-station in the year 1994-95, presently only 27 and at some sub-stations, 19 employees are deployed. Similarly, against initial norm of 55

employees for 1000 km of Transmission Line maintenance (Plain area), present norm is 12-13 employees.

All this was not achieved by serendipity. Management's vision & corporate strategy cascaded down to the lowest level of organizational hierarchy ensured its successful execution thereby leading to the mantra of right man at the right job. Though we have achieved a lot in our endeavor for optimization of manpower there is still lot of scope of improvement and we are on continuous effort for improving it further.

4. TRAINING, RETRAINING & REDEPLOYMENT STRATEGY TO ACHIEVE OPTIMIZATION OF MANPOWER

In the initial years of formation of POWERGRID, amalgamation process brought a pool of expertise from different constituent organization. At the same time it also resulted in huge mismatch, i.e., shortage in skilled areas and surplus in unskilled or non-technical discipline. Amalgamation process brought around 1100 employees in these categories.

The real challenge before POWERGRID was optimal utilization and balanced deployment of these mismatch manpower effectively (Fig.1). POWERGRID **retrained more than 700 unskilled surplus workmen such as Attendants, Drivers, and Security Guards, Assistants and redeployed them as Linemen, sub-station Technicians, Stenographers, etc.** during the period from 1994 to 2003. Innovative methods were developed to establish the trainability, six months long training modules (Fig.2) covering basic education, technical and behavioral inputs, on-the-job, off-the-job capsules, setting up of CEA accredited training institutes in different parts of the country and training evaluation methods. Training & deployment strategy helped in transforming the skill and knowledge texture of the company (Fig.3).

Value audit analysis by chartered accounts proved saving to the tune of Rupees 21 crores on account of this retraining intervention. DFID has recognized it as the best model beneficial to developing countries. Asian Regional Training & development organization (ARTDO) bestowed the 1996 ARTDO Asia Pacific HRD Award on POWERGRID. POWERGRID was also honoured with National HRD Network award, 1998.

Fig 1: Unskilled Work Environment

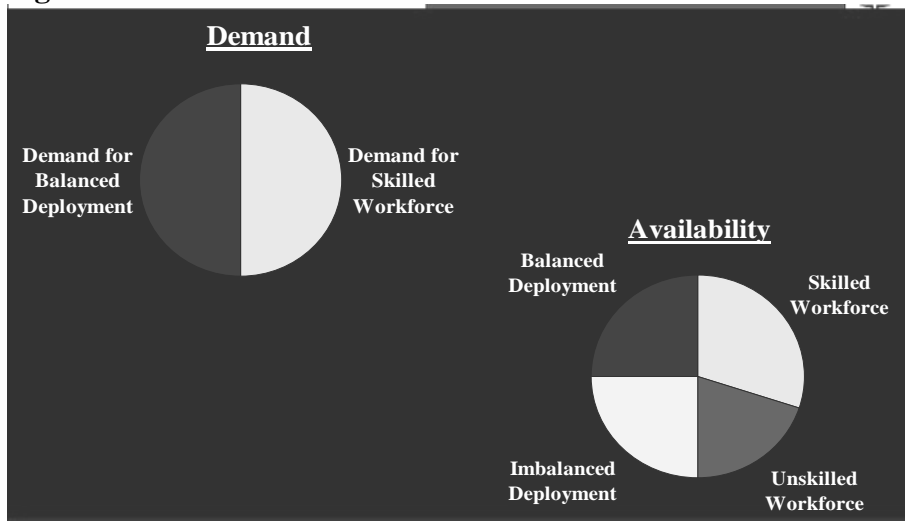


Fig 2 : Skill transformation through Training, retraining and deployment

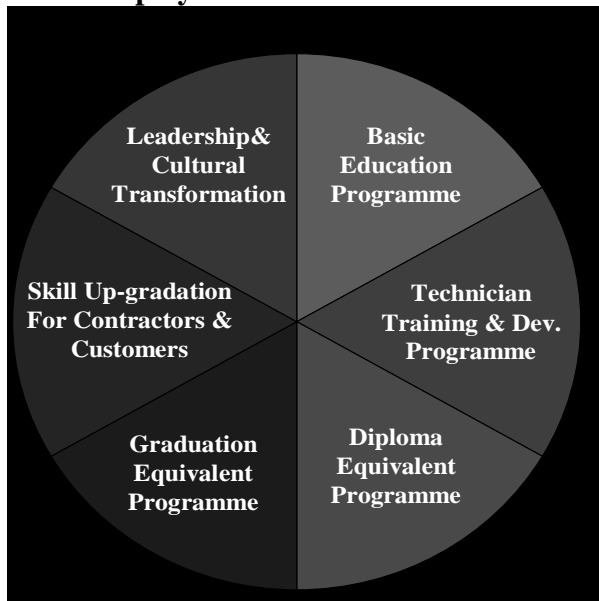


Fig 3 : Training, retraining and deployment for optimization of manpower



Fig: 3

Following interventions were also used by the management for the optimization of manpower.

- Continuous refresher training of non-technical workmen redeployed as technicians.
- Deployment of mismatch / surplus attendants in auxiliary services e.g. dispensary, library, Transit camps, Employee clubs etc.
- Up gradation of jobs / enhancement in Channel of Promotion to match the gap between surplus & deficit areas. For ex- Re designation of Attdts. as Jr. Optr. (Print room/Admn. Services)
- Deployment of designated Security Guards on relevant jobs thereby saving on security expenditure.

5. BUSINESS RESULTS

Today POWERGRID is one of the largest transmission utilities in the world with a significant presence on the global power arena. POWERGRID has excelled in all the areas of its activities: project execution, operations, load dispatch, commercial, finance and human resource. Standards set by POWERGRID in its journey towards forming of national power grid are considered as benchmarks in their own right. One of the key factor to many of these achievements is our unstinted efforts on optimization of manpower through scientific forecasting, well defined manpower norms & their periodical review, balanced deployment & skill transformation through training, re-training & re-deployment. Moreover, all this has been drawn from Strategic Business Plan of the organization. The financials, transmission network, MVA, sub-stations that POWERGRID added in a decade of its existence without adding much manpower. Figure: 4 / 5 and Table: 1.1 are testimony to the record of POWERGRID's achievements. As both the figure and the table illustrate, POWERGRID made a net profit of Rs. 786 crores against Rs. 237 crores and enhanced the turnover from Rupees 634 crores to a stupendous figure of Rupees 2831 crores between the period 1992-93 to 2004-05. Similarly number of sub-stations rose from 42 to 85 and length of transmission lines from 22228 to 50745 in the same period.

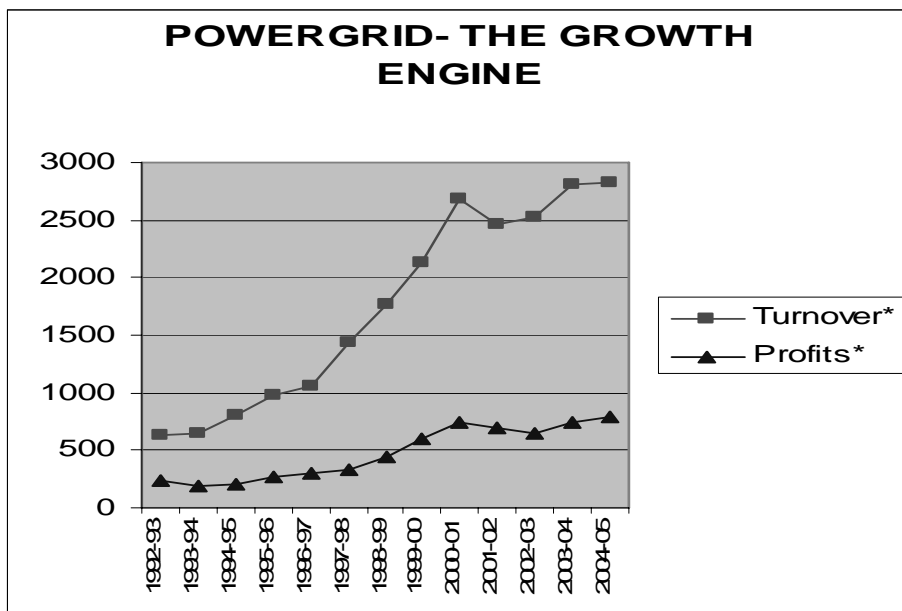


Fig: 4

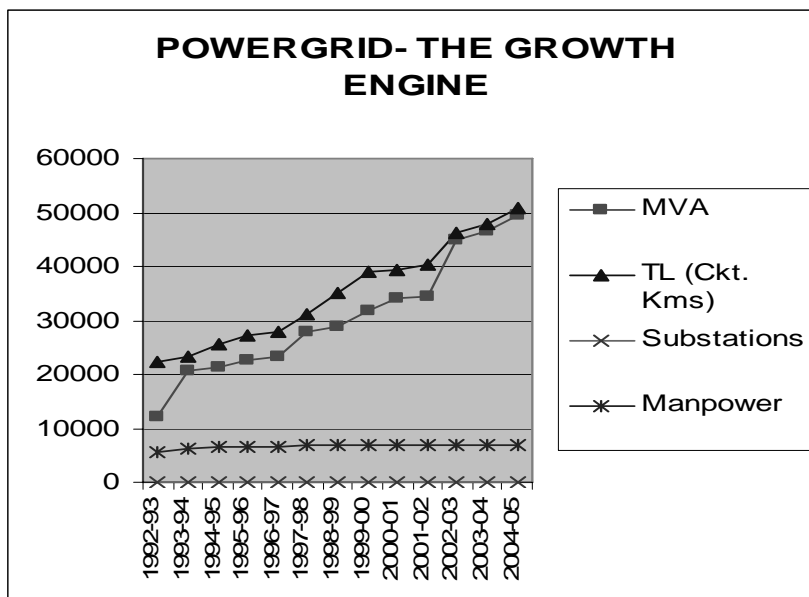


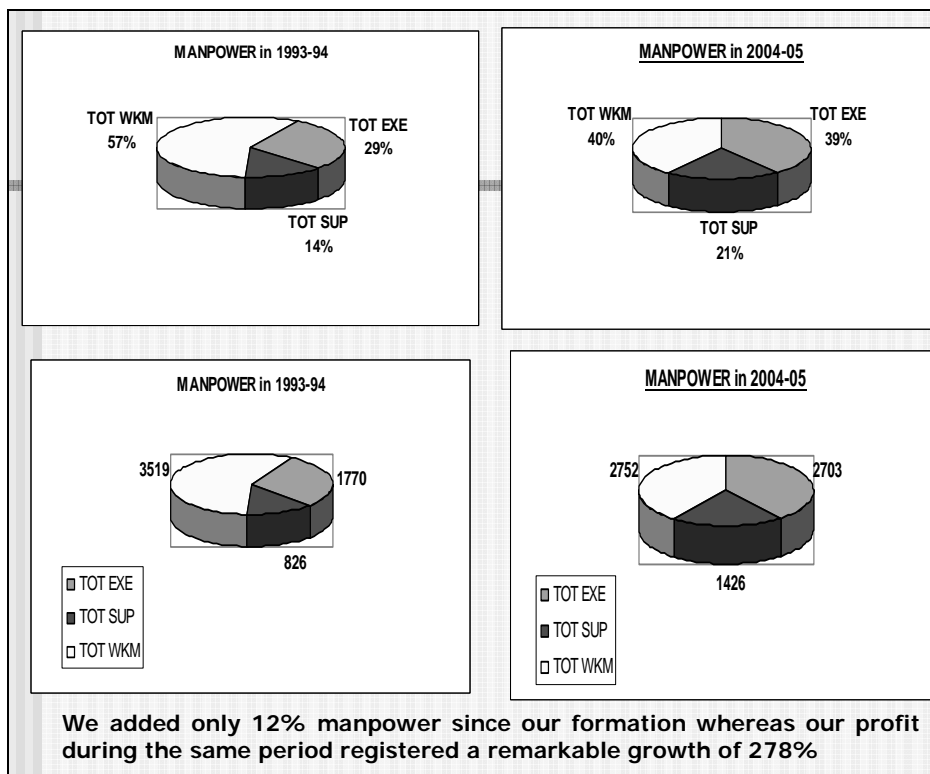
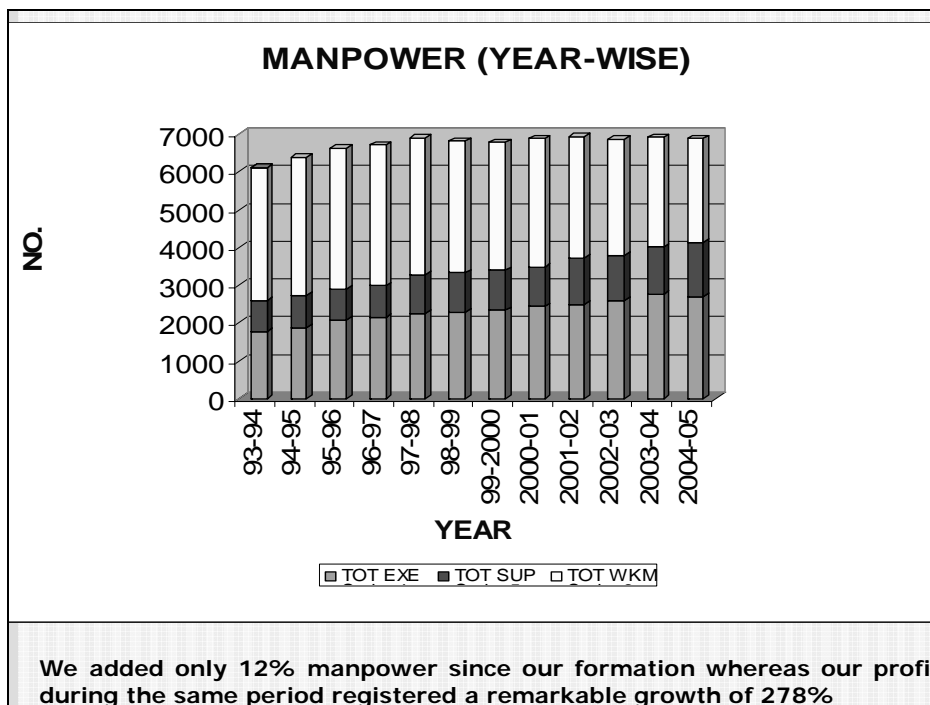
Fig: 5

*Figures in Rs. Crores

Year	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Turnover*	634	649	810	984	1058	1435	1770	2124	2683	2456	2533	2805	2831
Profits*	237	188	208	276	306	337	444	601	743	689	643	748	786
Asset Value*	3521	4229	5067	5492	5582	8096	8851	11450	13261	13777	18943	19876	21930
MVA	12201	20600	21173	22748	23331	27875	28820	31655	33973	34288	44836	46461	49459
TL (Ckt. Kms)	22228	23426	25575	27244	27853	31250	35119	39017	39425	40289	46245	48000	50745
Substations	42	47	50	53	54	55	60	65	67	75	79	82	85
Manpower	5652	6115	6397	6624	6709	6885	6811	6777	6877	6923	6872	6911	6881

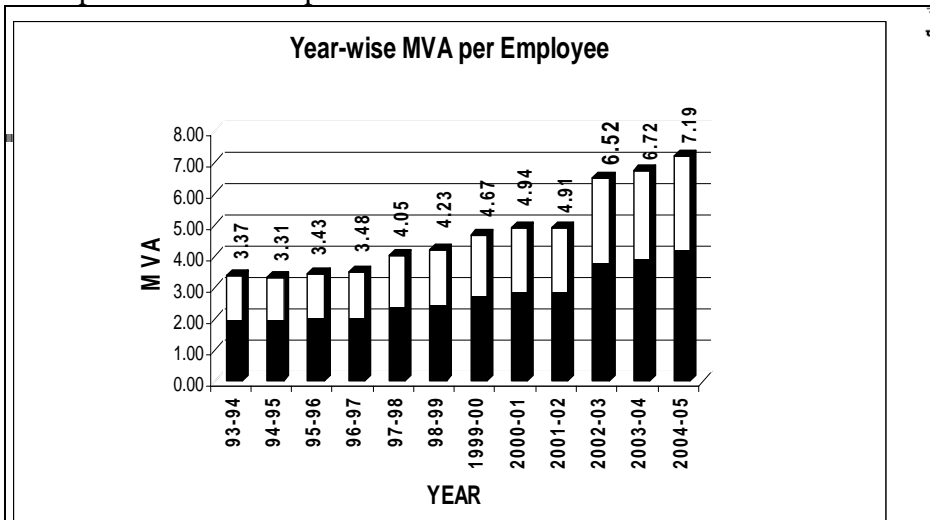
Table : 1.1

Our own benchmarks / indices and continuously strive to improve our performance & productivity has been reflected in the following figures.

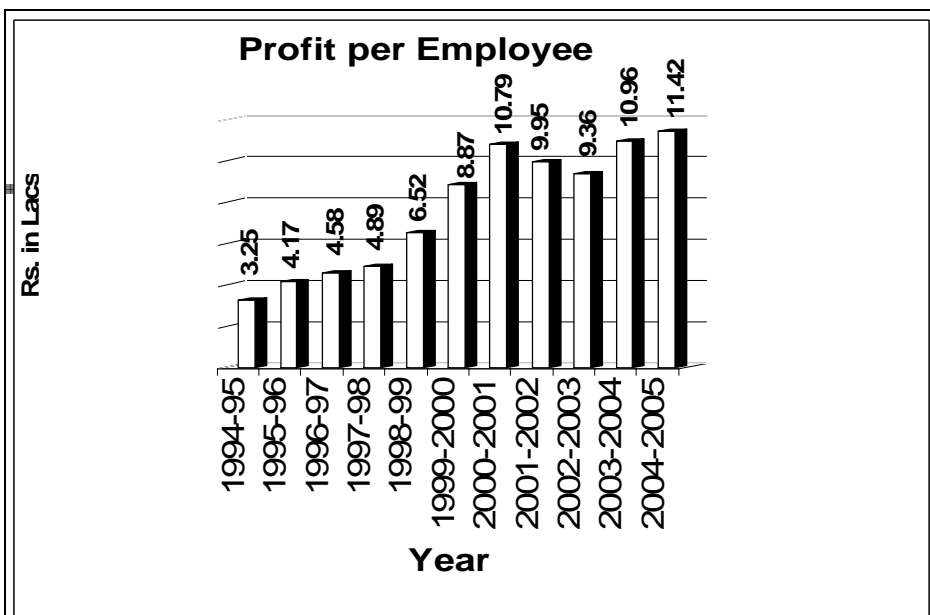


Despite, **more than 300 percent** increase in volume of work due to business expansion POWERGRID has not added even **12 percent** of manpower in last 10-12 years. This is directly attributable to increased performance of highly

motivated employees. Employees are more eager to assume higher responsibilities and seek opportunities to involve themselves with an assignment from conceptualization to implementation.



The ratio of MVA/Employee which was 3.37 in 1993-94 is 7.18 in 2004-05.



Profit/Employee which was Rs. 3.25 lacs in 1994-95 is Rs. 11.42 lacs/Employee in 2004-05. Profit/Employee declined after 2000-01 due to changes in tariff structure by CERC

In the course of journey, POWERGRID has come a long way and optimization of manpower, by evolving/reviewing manpower norms and various HR interventions, became one of the major key factors of success of the organization.