

**Report of the Committee**  
**on**  
**Manpower, Certification and Incentives**  
**for**  
**System Operation**  
**and**  
**Ring fencing Load Despatch Centres**



**Ministry of Power**  
**Government of India**  
**August 2008**

## **Foreword**

The electric “Power System” is a complex technical system with diverse stakeholders. These include generating utilities, transmission utilities, distribution companies, consumers, manufacturers, market intermediaries, academic institutions, technologists, economists, financial institutions, planners, administrators, government authorities, regulatory bodies and many others. Decisions may involve considerable formal and informal interaction with stakeholders making the power system operation a multidisciplinary task. This calls for an overall understanding of all related areas in addition to the technical aspects.

Effective grid management requires handling of different but related sets of flows that are critical for optimization of energy resources at the national level. These are the flow of energy across the grid, the exchange of information about power flows and the status of elements it moves across and the flow of money between producers, marketers, transmission owners, buyers and others. ‘Load Despatch Centres’ (LDCs) play an essential role in managing and improving all the three. Thus, ‘load despatching’ is an overarching; distinct and specialized activity.

In accordance with Section 3 of the Electricity Act, 2003, the Government of India notified the National Electricity Policy for the development of the Power System. The spirit of the Act is to ensure independence for System Operation. Under the reform process pursued by the Government of India, the Electricity Supply Industry (ESI) in India is developing at a fast pace. The committee perceives “load despatching” in the 21st century as a ‘mission critical activity’ for uninterrupted and reliable power supply; a ‘facilitator’ for an efficient electricity market; an “optimizer” of precious power generating resources; an ‘instrument’ for equitable and fair use of the available transmission infrastructure and an

‘indispensable link’ between the managers, administrators, planners and regulators on one end and the physical system on the other end. LDCs would also play a major role in facilitation and deployment of renewable energy sources and consider minimizing emission despatch as an objective function. Thus strengthening of Load Despatch Centres in India would yield substantial gains to all stakeholders.

In the rapidly changing scenario, the credibility of the ESI in India is in large measure in the hands of the System Operators at the Load Despatch Centres. They have to be neutral, fair, transparent, and accountable in discharging their duties. The factors that influence the performance at the LDC are the external business environment, internal work environment, clarity of goals, operating aids to perform, motivation to perform and skills and knowledge of the individuals. Strategic interventions in all the above would enhance the performance of the Load Despatch Centres.

The committee constituted by the Government of India went into the details of the functioning of ‘Load Despatch Centres’ and has arrived at its recommendations in this report. All efforts need to be made to create an environment where the Load Despatch Centres have functional autonomy, independent and sustainable revenue streams and are adequately staffed with people having the right skills, equipment and incentives to deliver.



**(Gireesh B. Pradhan)**

**Chairman of the Committee**

New Delhi

## Acknowledgement

The Committee would like to place on record the co-operation extended by the State Governments and the inputs given by the State Electricity Regulatory Commissions (SERCs).


The participation of engineers at State Load Despatch Centres, Regional Load Despatch Centres and National Load Despatch Centre in the survey has been a very valuable input for this report.

The contributions of volunteers from Regional Load Despatch Centres who helped in conducting the survey in a very short time and the efforts made by Shri S.R. Narasimhan and Shri Vivek Pandey in preparation of the report are sincerely acknowledged.

Lastly, the Committee would like to place on record the motivation provided by the Ministry of Power, Government of India on this key issue of Power System Operation in India.

  
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## List of Acronyms

<b>ABT</b>	Availability Based Tariff
<b>ATC</b>	Air Traffic Controller
<b>ATM</b>	Air Traffic Management
<b>BBMB</b>	Bhakra Beas Management Board
<b>CAPEX</b>	Capital Expenditure
<b>CEA</b>	Central Electricity Authority
<b>CERC</b>	Central Electricity Regulatory Commission
<b>CTU</b>	Central Transmission Utility
<b>DVC</b>	Damodar Valley Corporation
<b>EMS</b>	Energy Management System
<b>ERC</b>	Electricity Regulatory Commission
<b>ESI</b>	Electricity Supply Industry
<b>HVDC</b>	High Voltage Direct Current
<b>IEGC</b>	Indian Electricity Grid Code
<b>IPP</b>	Independent Power Producer
<b>ISGS</b>	Inter State Generating Stations
<b>ISO</b>	Independent System Operator, International Standards Organization
<b>ISTS</b>	Inter State Transmission System
<b>IT</b>	Information Technology
<b>LDC</b>	Load Despatch Centre
<b>NEP</b>	National Electricity Policy
<b>NERC</b>	North American Electric Reliability Corporation
<b>NLDC</b>	National Load Despatch Centre
<b>NPTI</b>	National Power Training Institute
<b>PX</b>	Power Exchange
<b>REB</b>	Regional Electricity Board
<b>RLDC</b>	Regional Load Despatch Centre
<b>RPC</b>	Regional Power Committee
<b>SA</b>	Situational Awareness
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>SEB</b>	State Electricity Board
<b>SERC</b>	State Electricity Regulatory Commission
<b>SLDC</b>	State Load Despatch Centre
<b>SOPs</b>	Standard Operating Procedures
<b>SPC</b>	State Power Committee
<b>STU</b>	State Transmission Utility
<b>TSO</b>	Transmission System Operator
<b>ULDC</b>	Unified Load Despatch and Communication

# **Chapter-1**

## **Introduction**

### **1.1 Formation of the Committee**

The important role of System Operators in Load Despatch Centres and the need for capacity building was highlighted during the interactive session organized by the Ministry of Power on 5<sup>th</sup> November 2007 with the Forum of Regulators and the State Governments (Copy of the minutes is at Annex-I). The Ministry of Power sought suggestions from the State Electricity Regulatory Commissions (SERCs) and the state utilities on these issues. Suggestions received are summarised at Annex-II. Thereafter, the Ministry of Power, constituted a committee vide order no. 6/2/2008-Trans dated 04<sup>th</sup> February 2008 to examine issues relating to manpower, certification and incentives for the personnel employed on System Operation at various levels and also for ring-fencing the Load Despatch Centres to ensure their functional autonomy and give recommendations. The committee comprised the following:

#### **Chairman**

Shri Gireesh B. Pradhan, Addl. Secretary, MoP

#### **Members**

Shri V. Ramakrishna, Member (PS), CEA

Smt. R. Chatterjee, CMD, Andhra Pradesh TransCo.

Shri A. K. Sachan, M.D. Lower Assam Electricity Distribution Co. Limited

Shri Yaduvendra Mathur, Secretary (Power), Rajasthan

Shri S.K. Soonee, ED (System Operation), POWERGRID

Shri Shyam Wadhera, Director (Projects), PFC

Shri Lokesh Chandra, Director (Trans), MoP    Member Secretary

The order issued by the Ministry of Power is enclosed as Annex-III.

## **1.2 Approach adopted by the committee**

Three meetings of the committee members were convened in New Delhi- first on 15<sup>th</sup> April 2008, second on 15<sup>th</sup> May 2008 and third on 11<sup>th</sup> August 2008. Based on the initial discussions among the members, an Approach Paper on “Enabling effective and efficient Load Despatch Centres in India through functional autonomy and authority, certified manpower and appropriate incentivization” was developed. The paper is at Annex-IV. A literature survey was also done to gather international experience on the issues referred to the committee. A list of these references is at Annex-V.

Two members of the committee (Shri Lokesh Chandra and Shri S.K. Soonee) visited the office of the Executive Director, Air Traffic Management, Airport Authority of India at Rajiv Gandhi Bhawan, Safdarjung Airport, New Delhi on 17<sup>th</sup> July 2008. Subsequently on 08<sup>th</sup> August 2008, the above members visited the Delhi Air Traffic Control Centre at the Indira Gandhi International Airport. These visits were undertaken because of the somewhat analogous working of the Air Traffic Management and the Power System Operation, both of which are “mission critical activities”. The committee members tried to understand the selection, training, and incentive scheme for Air Traffic Controllers employed for Air Traffic Management. A report of the information gathered is at Annex-VI.

Thereafter a survey of LDCs in the state/regional/ national level was carried out with the help of a questionnaire to assess the infrastructure available, profile of the personnel employed and the operating practices adopted. The questionnaire administered and the analysis of the responses received is enclosed as Annex-VII. The draft report of the Committee was discussed and finalised in the third meeting held at New Delhi.

## **Chapter-2**

### **Role of Load Despatch Centres in India**

#### **2.1 Introduction**

Electrical load<sup>1</sup> dispatching started in India ever since interconnected systems began to operate within the state power systems. However, their functioning gained prominence in 1964 when the Regional Electricity Boards (REBs)<sup>2</sup> were constituted through a resolution of the Ministry of Power. The term “Load Despatch Centre” was explicitly mentioned in the statute for the first time in the 1991 amendments to the Electricity Supply Act 1948. Later the 1998 amendments to the Electricity Supply Act 1948 designated Load Despatch Centres as apex bodies to ensure integrated operation of the power system within their area of jurisdiction. The same status is given to these bodies under the Electricity Act 2003. Thus, the LDCs now have the status of statutory bodies in India. The chronology of developments in the statute in respect of LDCs and the statutory functions of these centres are enclosed at Annex-VIII.

#### **2.2 Load Despatch Centres in India**

In 1947, the Indian power system consisted of small isolated systems. Gradually the systems around urban and industrial areas grew into full-fledged State (provincial) power systems. In 1964, the concept of development of the power system on a regional basis was formulated. In order to coordinate the activities in power system operation between and within the state system, control centres were set up at the regional levels and at the state level.

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<sup>1</sup> Electrical demand is better known as “load” in the power system parlance

<sup>2</sup> The REBs found a mention in the Electricity Supply Act 1948 in the 1991 amendments. REBs have been reconstituted. They are now known as Regional Power Committees (RPCs).

The control centres in the state came to be known as the State Load Despatch Centres (SLDCs) and the control centres at the regional level as the Regional Load Despatch Centres (RLDCs). The Electricity Act 2003 has also envisaged a National Load Despatch Centre (NLDC), which shall become fully operational in the near future.

Presently the power system in the country is demarcated into five regional grids and all the states and union territories in India fall into one of these regional grids. The RLDCs are located at Kolkata, Shillong, New Delhi, Mumbai and Bangalore. The NLDC is located at New Delhi. The State Load Despatch Centres are located in the state capitals. Sikkim and the Union Territories of Chandigarh, Daman & Diu, Dadra & Nagar Haveli, Andaman & Nicobar and Lakshdweep have limited facilities for operation of the power system within their jurisdiction.

The Bhakra Beas Management Board (BBMB) has a separate control centre at Chandigarh that coordinates water releases and dispatch of hydro power from the stations of Bhakra, Dehar, Pong, Ganguwal and Kotla that are jointly owned by Punjab, Haryana, Rajasthan and Himachal Pradesh. A few interstate lines between these states that form a part of the Inter State Transmission System are also operated and maintained by the BBMB. Likewise the Damodar Valley Corporation (DVC) has a well-defined control area in the Eastern Region (covering portions of West Bengal, Jharkhand and Bihar) with its own generation, transmission and distribution system to meet its load. DVC has a separate control centre at Maithon in Jharkhand.

Thus there are **thirty-three SLDCs** including the DVC and the BBMB control centres, **five RLDCs** and **one NLDC** in India. The addresses of LDC websites (wherever available) is compiled as Annex-XIV.

## **2.3 Functions carried out by the Load Despatch Centres in India**

The functions of Power System Operators in the Electricity Supply Industry in India has been evolving with the integration of power systems, increase in electrical energy demand, growth in the economy and changes in technology, regulations, market design, administration and management of the power system.

### **2.3.1 Load Despatch Centres as System Operators**

Classical System Operation involves operational planning, protection coordination, designing of safety net, assessment of transfer capability, generation/transmission facility outage coordination, frequency control, voltage control, issuing switching instructions, managing congestion in the transmission system, setting power order of HVDC stations, arming and disarming of System Protection Schemes, restoration of equipment post disturbances, grid disturbance analysis and such related activities for ensuring reliability of the power system.

Precision and timing are vital in System Operation as a minor technical snag or a seemingly innocuous human error may lead to human casualty, equipment damage and/or blackout within seconds, resulting in severe social, economic and political implications. Thus, “Situational Awareness” (SA), presence of mind, fast decision-making and prompt action is essential for preventing supply interruptions or loss of resource optimization opportunities.

Over the years, the complexity in System Operation has increased due to increase in system size, increase in the number of stakeholders and growing demand for electrical energy. Further, new threats in the form of



cyber terrorism, sabotage, natural calamities have now emerged. In future, the challenges before the System Operators would increase with the introduction of Distributed Generation (DG), increased sources of renewable energy etc. Future grids are expected to be “Intelligent Grids” with self-healing properties and tomorrow’s operator would be designing and operating such grids. These developments would lead to a significant increase in the challenges to be faced by system operators in the 21<sup>st</sup> century. Reliability of the electricity grids is the prime responsibility of the LDCs.

### **2.3.2 Load Despatch Centres as Market Operators**

Market Operation involves generation resource scheduling, managing renewable energy sources, providing common and equal information access to all market players, facilitating open access, seams management, metering system design, meter data collection, validation and processing, energy accounting and settlement, calculation of losses, pool account administration, market surveillance, analysis and other related activities. These functions gained prominence subsequent to the structural changes in sector and introduction of new market mechanisms such as the Availability Based Tariff (ABT), Open Access and Power trading. The LDCs of tomorrow would need to implement new market mechanisms that complement reliability.

The complexity in market operation is already increasing due to an increase in the number of market players, evolving market mechanism and increased sophistication in market design. With growing commercial consciousness among the market players, market related activities and tasks, which were formerly done in an offline mode, have now become a time-constrained activity and moved into the online operation control centre. Moreover, as a “Market Operator”, the LDCs have to discharge their duties in a non-discriminatory and transparent manner.

### **2.3.3 LDCs as an agent for achieving economy & efficiency**

Achieving economy and efficiency in the operation of the power system is an important function of the LDCs. These services are delivered by facilitating sharing of national resources, merit order operation of generating stations, energy portfolio management, reactive power management, congestion management, transmission loss optimization and smooth operation of the settlement system. Considering the volume and geographical spread of the electricity market in India as well as the prevailing diversity in fuel, capacity, technology, weather, demand, system availability etc., there is a huge scope for optimization of energy resources within the available tools and mechanisms. Empowered System Operators with access to real-time and archived power system data can cause huge savings in the overall operation cost by timely interventions in real-time. The benefit of these savings would be shared across the board and may ultimately help in reducing the cost of energy delivered to the consumers.

The System Operators can cause huge savings in fuel charges as well as transmission losses. The savings in total fuel charges would be realized by reduction in the average cost of generation through merit order generation. The System Operators would achieve merit order generation through proper scheduling and operation in real-time. The savings because of reduced transmission losses would be realized by timely and coordinated actions for proper transmission network management, switching in of reactive control devices and reactive/active support from generators. Only focused attention towards these aspects by LDCs would give the desired results.

#### **2.3.4 LDCs as a change agent in the ongoing reforms in ESI**

India is passing through a phase of rapid economic growth. The reforms in the Indian power sector have resulted in the unbundling of the vertically integrated utilities, increasing number of market players with different goals and interests and increased competition among them. These changes have brought about greater focus and cost awareness within the utilities and a consequential increase in the pressure to use the physical system closer to its limits.

The physical System Operation in general has not changed, but there is a shift of tasks and duties leading to new requirements for the System Operators. Likewise, energy trading is not new in the electricity industry, but it is now carried out via the market involving the entry of market players. There is thus a greater stress on transparency and fairness in System Operation. Being at the nerve centre of the power sector the LDCs are the key to further reforms in the power sector. They have to facilitate open access in the transmission and distribution system to create a vibrant and competitive electricity market.

In the ESI, the Load Despatch Centres also act as the agencies that execute the regulatory orders. Thus, the success of reform initiatives in the power sector would depend on the right interpretation and implementation of the same by the LDCs. For example, the implementation of ABT, Open Access and Power Exchange at the interstate level has been possible due to the proactive participation of RLDCs. Similar success can be achieved at the state level through a proactive role of SLDCs.

### **2.3.5 LDCs for feedback to policy makers, regulators & planners**

In the changed scenario, the administrators, electricity regulators and power system planners have to take substantial inputs from the system operator to arrive at the right decisions in the interest of the ESI. The LDCs comprehend the activities in the industry and provide necessary insights and information as desired by these bodies. While doing so they have to articulate their views fearlessly and without any biases before these bodies. The LDCs interact with the stakeholders on a day-to-day basis and therefore they act as an important link between the stakeholders and the regulatory agencies. LDCs observe and analyse the response of the market participants in the marketplace. Since the LDCs are in touch with both ends of the spectrum, their feedback to the regulator is important.

## **2.4 Conclusion**

The rapidly changing scenario in the power sector has resulted in changes in the role of LDCs at all levels. Further, it is essential that the industry has confidence on the competence of the System Operators and their conduct is above suspicion. This is all the more important especially with the rapidly growing economy, international interconnections and increasing participation of private players through Ultra Mega Power Projects (UMPPs), Power Exchanges (PXs) and other market mechanisms. System Operation needs to be recognized and nurtured as a distinct faculty within the ESI and the LDCs must be provided with an enabling environment to help them to deliver the desired results.



## **Chapter-3**

### **Manpower and Incentives**

#### **3.1 Manpower requirement**

The Load Despatch Centres have to function round-the-clock with suitably skilled manpower for System Operation, Market Operation, research, analysis, regulatory affairs, logistics (system data acquisition, Energy Management, communication, IT systems) and other establishment services to carry out the functions discussed in Section 2.3 of this report.

A literature survey and a reality check of all the LDCs with the help of a survey were done to assess the manpower requirements. Considering the prevailing work load and the likely responsibilities that will arise in the future, an assessment of the staffing requirement for a typical LDC has been made and is placed at Annex-IX. The committee perceives the LDC as an executive oriented body with people predominantly from the field of Electrical Engineering supported by other faculties such as Electronics Engineering, Information Technology etc. Further, additional persons with Commerce, Economics, Humanities and Legal background would also be required to look after financial and legal aspects. It would be seen that on an average 60 to 70 skilled executives might be required in a typical LDC.

The manpower requirements may vary depending upon the size of the power system under the jurisdiction of LDCs. For example, larger states such as Uttar Pradesh and Maharashtra require several Area Load Despatch Centres (ALDCs) to assist the SLDC. The number of persons required in these states for load despatching would be higher. Likewise, the requirement in SLDCs of union territories and smaller states would be lower. Table-1 gives the summary of the typical distribution of persons at various managerial levels.

**Table 1: Management levels in a typical LDC**

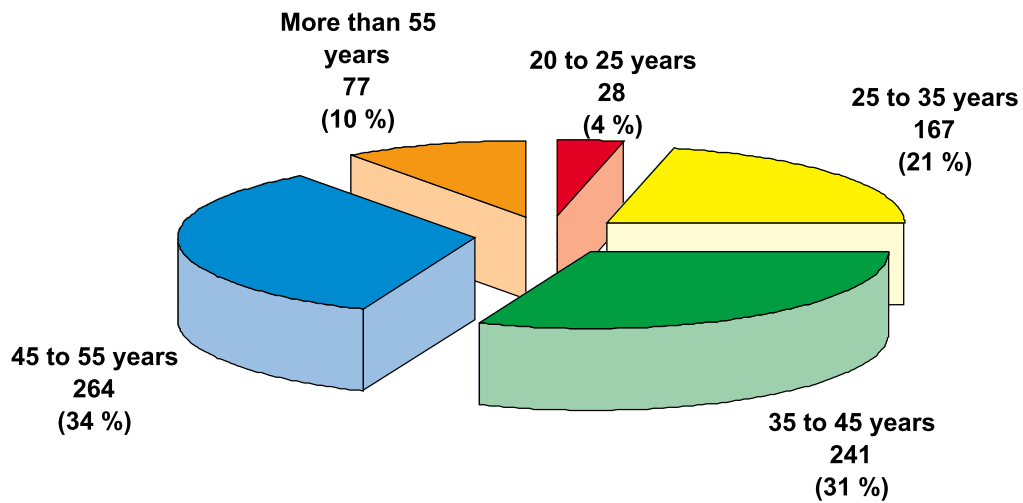
<b>S No.</b>	<b>Management level</b>	<b>Number of persons</b>	<b>(%)</b>
1.	Top	05	7 %
2.	Middle	13	19 %
3.	Lower	49	74%
4.	<b>Total</b>	<b>67</b>	<b>100%</b>

### **3.2 Present manpower strength and profile of manpower at LDCs**

The present strength of executives in LDCs at all levels in India is in the range of 1200. Considering an average requirement of executives in a typical LDC (as discussed above), the total skilled professional required for thirty-nine (39) LDCs all across the country would be in the range of say 2350 to 2750.

A survey of all LDCs in India was conducted to assess the profile of personnel employed in LDCs. The detailed survey report is enclosed at Annex-VII. The survey reveals that nearly 44 % of executives posted at LDCs in India are above 45 years of age [Fig. 1]. These executives would be due for retirement in the next 10-15 years. The committee therefore recommends that LDCs should have a plan for regular recruitment to have adequate and suitably trained staff at these centres at all times.

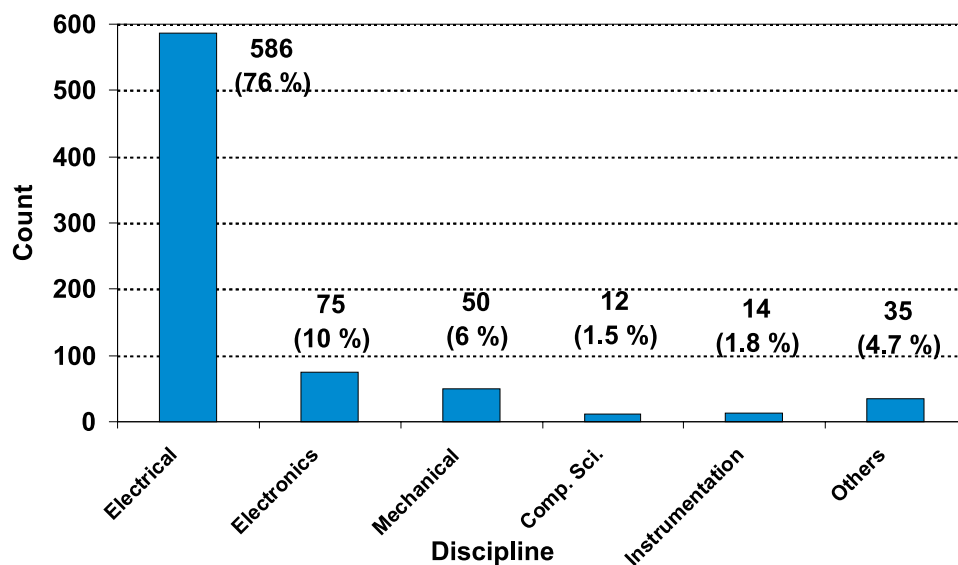
**Figure 1: Age profile of LDC personnel**



[Total respondents: 777]

The survey also reveals that presently more than 75 % of executives at LDCs are from Electrical Engineering discipline [Fig 2]. This is encouraging as power system operation is the core activity of the LDCs. Efforts must be made to retain this strength and supplement the same with interdisciplinary learning and development.

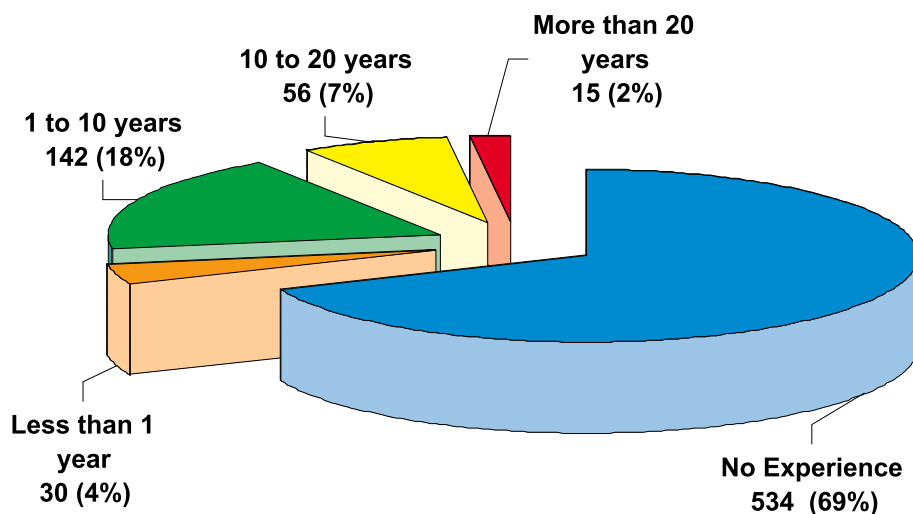
**Figure 2: Basic discipline of personnel at LDCs**



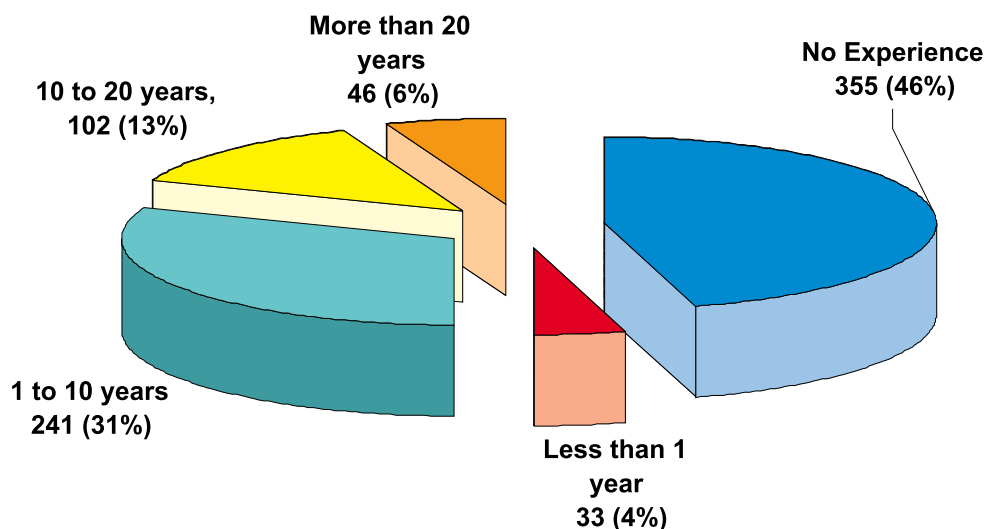


Efficient load despatching also requires a deep understanding of generation, transmission and distribution technology. Out of the 777 persons surveyed in LDCs all over India, 534 (69%) have no experience in generation [Fig. 3] while 355 (46 %) have no experience in T & D [Fig. 4]. The committee recommends that this weakness may be addressed either by induction of people with suitable experience in these areas or by suitable exposure through medium term / long term training programmes.

**Figure 1: Experience of LDC personnel in Generation**



**Figure 2: Past experience of LDC personnel in Transmission and Distribution**



### **3.3 Attracting and retaining talent at LDC**

The manpower at LDCs has to be a good combination of fresh recruits and experienced professionals. System Operation is an area where long-term commitment is required because substantial time, efforts and resources are required to develop a fresh entrant into a productive asset. Periodic recruitment at the induction level as well as lateral entry of professionals is required. Compensation, service conditions, work environment and the perceived value of the experience gained at the LDCs would greatly influence the availability and retention of talent at the LDCs. The advantages of choosing “System Operation” as a profession have to be tangible and convincing enough to draw young professionals to this area.

Every LDC could tap bright candidates at the college level itself by sponsoring selected students for subsequent induction in LDCs. The Committee strongly recommends that specialised courses focusing on System Operation could be introduced at National Institutes of Technology and Indian Institutes of Technology to develop “System Operation” as a distinct faculty.

### **3.4 Compensation and incentives for LDC personnel**

LDCs operate shared assets that are strategic for the national economy and the society. The economic value of their interventions in the system is substantially high and widely shared among a large number of stakeholders. The services offered by professionals in LDCs are in the nature of knowledge services that demands continuous learning with the evolving system and market design. The compensation structure available to the System Operators at LDCs therefore should encourage specialization

and professionalism. To encourage professional excellence, the committee has recommended the introduction of a certification program for the System Operators. Chapter 4 discusses this aspect in detail.

The World Bank discussion paper titled 'Transmission System Operators...Lessons from the Frontlines' by Beatriz Arizu, William H. Dunn Jr. and Bernard Tenenbaum has emphasized that the professionals working at LDCs have to be compensated handsomely to avoid losing them to other market participants. It states "*...in Latin America government owned TSOs often lose talented people because the TSO is usually limited to paying government level salaries. Market participants are willing and able to pay much higher salaries to individuals who understand grid and market operations.*"

In view of the above, the committee recommends that the monetary compensation, incentives and other benefits available to the LDC personnel are kept significantly higher than the compensation and benefits available to other power industry professionals in the public or private sector. The career progression within the LDCs and the monetary incentives should be linked to the job performance and to the up gradation of skills by way of acquiring of suitable "operator certificates" as discussed subsequently in Chapter 4. The other incentives could include sponsored membership to professional bodies, access to relevant periodicals/reports, sabbaticals for higher studies and opportunities for Professional Engagement (PE) such as attending workshops, conferences both within the country and abroad.

The System Operators are subjected to immense physiological and mental stress. Physiological stress arises from the need to continuously adjust their circadian rhythms to their work schedules. Mental stress in the LDC results primarily from the need to respond to the unforeseen and random

events. The other sources of stress could be time pressure, system alarms, non-compliance of System Operator's instructions by the utilities, shifting quickly from periods of little activity to periods of peak activity, operational protocols, work schedules and skills/capabilities not commensurate with the job requirement. All these aspects have to be suitably addressed by improving the working conditions and work environment. Further, the LDC professionals must have access to facilities such as pick and drop for attending duties in rotating shifts, routine health check up, canteen, recreation and professional counselling.

### **3.5 Work environment and other facilities at LDCs**

The work environment in LDCs is a function of management policy, work culture and the physical infrastructure available at the LDCs. The committee recommends the "confessional approach" towards operator errors so that the Operators feel empowered to take unbiased and courageous decisions especially during system emergencies. Other aspects of the work environment could be taken care of by the physical environment, infrastructure, geographical location of LDC, office layout, hygiene in the premises, seating arrangement, lighting, acoustics, ergonomics, temperature/humidity control, fresh air, availability of power supply back up, house keeping, canteen, library, conference room etc.



## **Chapter- 4**

### **Certification and training of System Operators**

#### **4.1 Need for improving skills and knowledge**

The skills available with the System Operators are determined by the selection criteria applied, the way they are introduced into and trained for their jobs and the opportunities available for skill up-gradation. Presently there is a huge disparity in various LDCs on these aspects. In the rapidly changing scenario, a new look at the operator's competencies is required and a system needs to be developed to ensure that quality service is delivered by the LDCs.

#### **4.2 Rationale for certification of System Operators**

Licensing has been one of the earliest forms of certification in many occupations. Certified Operators have been a pre-requisite in areas involving public health and safety. A permanent driving license is generally valid for 10-15 years and has to be revalidated after this period. Similarly, an elaborate process exists for ensuring that the personnel in the civil aviation industry viz. aircraft pilots, Aircraft Maintenance Engineers (AMEs), cabin crew, Air Traffic Management are competent.

Two members of the committee (Shri Lokesh Chandra and Shri S.K. Soonee) visited the office of the Executive Director, Air Traffic Management, Airport Authority of India at Rajiv Gandhi Bhawan, Ministry of Civil Aviation. Subsequently on 08<sup>th</sup> August 2008, the above members visited the Delhi Air Traffic Control Centre at the Indira Gandhi International Airport. These visits were undertaken because of the somewhat analogous working of

the Air Traffic Management and the Power System Operation both of which are “mission critical activities”. A report of the information gathered is at Annex-VI.

The Air Traffic Controllers have an elaborate procedure for their selection, training and regular assessment. Proficiency checks are carried out to identify deficiencies. Apart from the induction level courses, refresher courses and specialist courses are organized to ensure the proficiency of Air Traffic Controllers. Therefore, in order to strengthen the LDCs the committee recommends that a similar approach could be adopted. In the electricity industry, the Bureau of Energy Efficiency (BEE) conducts examinations for certifying the Energy Auditors and the Energy Managers with the help of the National Productivity Council.

#### **4.3 International practices in system operator certification**

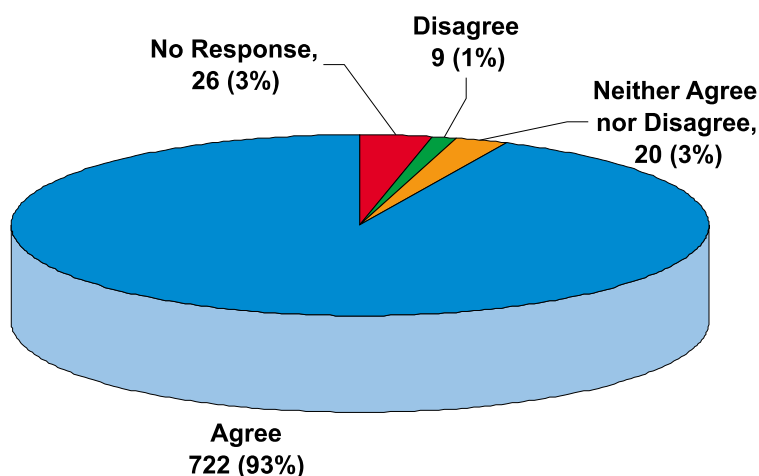
In the area of System Operation, internationally, the North American Electric Reliability Corporation (NERC) has a System Operator Certification Program which provides the framework for the examinations used to obtain initial certification in one of four NERC credentials: Transmission Operator, Balancing and Interchange Operator, Balancing, Interchange and Transmission Operator and Reliability Operator. A System Operator credential is a personal credential issued for successfully passing the NERC System Operator Certification Exam. A written examination is conducted for testing the Operators on their knowledge of NERC operating policies along with the principles of operation of interconnected power systems before the award of the Certification. Such certificates have to be revalidated every three years. Staffing the control centres with such certified Operators is a mandatory requirement in North America. More details are available at [www.nerc.com](http://www.nerc.com) and the practices followed in different countries are enclosed at Annex-X.

#### 4.4 Certification and training for System Operators

In view of the discussions above, the committee is convinced that certification of System Operators is urgently required to ensure the competence of persons engaged in load despatching. The survey of LDCs also reveals that nearly 93% of the respondents at LDCs are of the opinion that certification of System Operators is essential to improve the overall standards in System Operation [Fig. 5]. An approach paper on System Operator Certification is enclosed at Annex-XI.

The committee recommends that within the next one year, all the course material, systems and procedures required for administering a “basic level” of training and certification be developed jointly by the Central Electricity Authority / Central Transmission Utility / State Transmission Utilities / RLDCs and other stakeholders. The Committee also recommends that all LDCs must ensure that all their personnel undergo this basic training and only certified personnel staff the LDCs within two years from the release of this report. Annual Compliance Reports in this respect must be filed by each LDC before the Appropriate Electricity Regulatory Commission. Subsequently advanced level training and certification programme must be introduced.

**Figure 5: Opinion of LDC personnel regarding Certification**





The focus of the certification process has to be on verification of the basic competence of System Operators. During the initial days there may be apprehensions among the System Operators due to fear of failure. Therefore efforts for confidence building in the incumbents could be made with the help of basic training and sample mock tests ahead of time. A “formative evaluation system” with proficiency tests could be used to provide feedback to Operators and recommend remedial study. Ample opportunities to reappear, retake and get certified could be given before adoption of the “summative evaluation” system, wherein the results used to take definitive decisions about the individual as to whether he is competent or not competent to perform the job or whether the individual may be promoted or not promoted could be put in place. The certificate should carry a definite validity with the need for renewal after set periodic intervals. During these intervals, the Operators must be provided training in the relevant areas.

A Central Institute for training the System Operators would be required. To begin with, the National Power Training Institute may be given the responsibility of training. At a later stage an independent institute may be established for the System Operators like the Civil Aviation Training College at Allahabad for the Air Traffic Controllers.

The process of training and certification will involve a high level of investment in resources and manpower. To ensure sufficient seriousness, such programme of training, certification and renewal must involve payment of fees by the applicant. The employer organizations would reimburse these fees.

#### **4.5 Governance and administration of the training and certification process**

Governance of the certification process would include formulation of policies, fee structure, development of rating scales, performance monitoring of the system for operator certification program. Administration of certification program would comprise of maintaining databases, records, and applications, collection of fees, providing reports on the certification related activities, maintaining master files containing certification records, program audits and credits awarded. Written, oral and on-the job tests (real-time or through a training simulator) would have to be conducted with the help of a Central Agency.

To maintain credibility, the training and certification agencies need to be different. However, to begin with, the NPTI may be entrusted with the responsibility of training and certifying System Operators.



## **Chapter- 5**

### **Ring-fencing and Functional Autonomy of Load Despatch Centres**

#### **5.1 Introduction**

The statutory provisions in the law as related to System Operators envisage LDCs as powerful, effective and efficient entities in the electricity industry. However laws have to be interpreted and implemented in letter and spirit to achieve the intent. The experience in implementation of open access in transmission and distribution especially in the state sector has revealed serious concerns regarding the functional autonomy and authority of LDCs.

A variety of organizational models have been suggested for LDCs ranging from a monolith for all LDCs in the country akin to the All India Services, Independent System Operators (ISOs) and the Transmission System Operators (TSO). Functional autonomy would mean taking decisions without being adversely influenced by extraneous issues originating from the Company Management or any of the market players. The Governments and the ERCs need to encourage and support the LDCs in discharging their functions in an impartial manner as apex bodies. Functional autonomy and authority for LDCs could be ensured through

- a) Independent governance structure
- b) Separate accounting
- c) Adequate number of skilled manpower having high ethical standards and driven by altruistic values
- d) Adequate logistics/infrastructure

## **5.2 Funding of Load Despatch Centres**

The funding requirements of the LDCs at the regional level were traditionally met by budgetary allocations from the government. At the state level the respective SEB/ STU funded the LDC. Subsequent to the transfer of RLDCs to POWERGRID (CTU) the expenditure of RLDCs was met by contribution from the state utilities based on an adhoc amount decided by CEA. After amendments to the Electricity (Supply) Act 1948 in 1998, the CERC specified the “fees and charges” payable to RLDCs by the state constituents. Subsequently after the progressive commissioning of the Unified Load Despatch and Communication (ULDC) schemes starting from mid-2002, CERC has directed that the ULDC tariff would also cover the RLDC fees and charges and no separate payment under the latter head was necessary. Further details are enclosed at Annex-XII.

At the SLDC level the situation of funding is rather opaque as the SLDCs are either part of the STU or the vertically integrated SEB with no separate accounting or balance sheet. Only seven out of twenty three SERC websites surveyed in end June 2008 had a separate SERC order specifying SLDC fees and charges (Annex-XIII). To ensure functional autonomy, it is very important to have financial independence.

The Committee recommends that starting 2009-10 all SERCs must ensure separate accounts for the SLDC functions as an immediate first step to ensure ring fencing. For example in Andhra Pradesh, the Andhra Pradesh ERC has issued an elaborate order dated 07<sup>th</sup> March 2007 on SLDC charges for the period 2007-08 and 2008-09.

### 5.2.1 Suggested changes in funding methodology for Load Despatch Centres

Sections 28 (4) and 32 (3) of the Electricity Act 2003 state that LDC may levy and collect such fee and charges from the generating companies or licensees engaged in interstate (for RLDC) and intrastate (for SLDC) transmission of electricity as may be specified by the appropriate commission. However, the Ministry of Power in its Electricity (Removal of Difficulty, sixth order dated 08<sup>th</sup> June 2005) has dropped generating companies from the above section of the Electricity Act. The revised wordings are as under:

*“Levy and collection of fees and charges for using transmission system. -*

*The Regional Load Despatch Centre may levy and collect such fee and charges from the licensees using the inter-state transmission system as may be specified by the Central Commission.*

*The State Load Despatch Centre may levy and collect such fee and charges from the licensees using the intra-state transmission system as may be specified by the State Commission.”*

This Committee recommends that this issue should be reconsidered by the Government in the light of the developments such as Ultra Mega Power Projects (UMPPs), Merchant generators and Independent Power Producers (IPPs), transmission licensees, distribution licensees at state and interstate level, traders involved in long-term sale/purchase. In the reform process it is suggested that all the generating companies, licensees (transmission, distribution and trading) fund the services received from

LDCs in an explicit fashion. This could be in the form of a fixed fee for every generating station or entity scheduled; a fee for every revision in schedule sought and a fee for handling the metering and settlement system.

Incidentally the fees deposited by the above entities while filing tariff petitions before the Regulatory Commissions is a pass through. These are still deposited upfront by the generating companies, licensees (transmission, distribution and trading) with the regulatory commission rather than the Commission charging this directly from the state utilities. Likewise all the market players and transmission licensees fund the RPC secretariat. A similar arrangement is suggested for SLDCs, RLDCs and NLDC. The APERC order on SLDC fees and Charges referred in Section 5.2 above already mandates recovery of these charges from all generating companies, distribution licensees and trading licensees using the intra-State Transmission Network.

### **5.2.2 Business model for Load Despatch Centres**

As mentioned in Section 5.2, the ULDC tariff is expected to cover all the expenses incurred by the RLDCs. It might be appreciated that the ULDC tariff serves a limited purpose of servicing the tangible assets created under the ULDC project viz. Supervisory Control and Data Acquisition System (SCADA), Energy Management System (EMS), the associated communication system as well as the auxiliary services like UPS, DG sets and the air conditioning system. These assets are tools for real time monitoring of the grid. A tool cannot be equated with the indispensable services offered by LDC personnel by interpreting the available information with the help of tacit knowledge and experience acquired over the years. The following services provided by LDCs, distinct from ULDC, are statutory in nature or mandated by ERCs.

- a) Operational Planning and studies related to transfer capability, line shutdowns etc. to ensure reliability, which is a public service.
- b) Real-time operation and responding to emergencies in the grid
- c) Post despatch analysis of operation and tripping; providing inputs to the different sub-committees at the RPC/State Power Committee (SPC) level (it would not be possible for the sub-committees to deliver in the absence of inputs/analysis from LDCs)
- d) Metering and Settlement System
- e) Information dissemination system through periodic reports, exception reports and other grid related data to the stakeholders involving a huge IT infrastructure (different from ULDC infrastructure)
- f) Feedback to planners, policy makers and regulators

To make LDCs financially independent, it is necessary to identify revenue streams, which can strengthen the financial status of LDCs. The business model for LDCs would have to recognize the following three distinct revenue streams, which would all be regulated by the Appropriate Electricity Regulatory Commission.

- a) Fees and charges for system operation
- b) Tariff for decision support system and IT infrastructure (currently only ULDC tariff)



- c) Operating charges for scheduling, metering and settlement for market players. (CERC has already introduced operating charges payable by Open Access customers to LDCs since May 2004)

The above charges may be recovered from all generating companies and licensees using the services of LDCs. In addition LDCs could provide value added services (requested studies, manpower development, detailed reports, access to data archives for a fee etc) on chargeable basis.

### **5.3 Capital Expenditure (CAPEX) plans by Load Despatch Centres**

A significant portion of LDC cost arises because the operations are to be carried out round-the-clock requiring adequate redundancy in resources to tide over contingencies. There is a heavy reliance on information technology with components having high obsolescence rate. A few of the applications (such as SCADA/EMS) are offered by a limited number of vendors and costs are high.

The modernization of LDCs is a continuous process and the ERCs might direct LDCs to submit their CAPEX plans for a rolling five-year period and approve the same after examining its prudence through public hearings. ERCs may examine CAPEX proposal considering a shorter life cycle of 7-10 years for such equipment. As a first step the plan for 2009-12 for all LDCs might be submitted and approved by the respective ERCs by 31st March 2009. SLDCs may take assistance from CTU and RLDCs in preparing such plans.

## 5.4 Separate outlay for Load Despatch Centres

Assuming an annual charges of Rs. 1000 crores for all the LDCs in the country by 2012 and an anticipated annual generation of 1000 Billion units by 2012 the cost of system operation services works out to just 1 paisa per unit. This is very low in comparison to the charges for other services in ESI (Table 2 below) and will further go down with increase in volume as system grows.

**Table 2: Comparison of charges for various services in ESI**

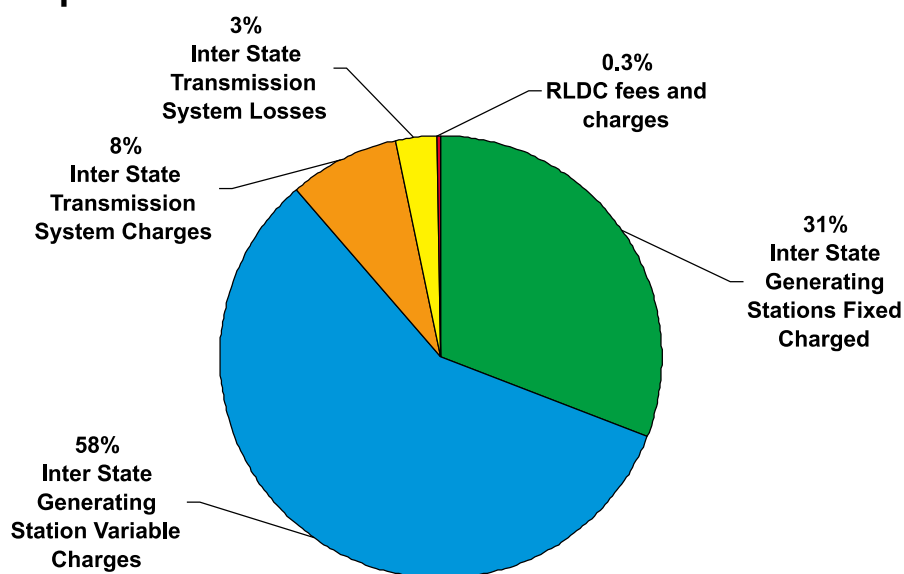
<b>S No.</b>	<b>Services in the ESI</b>	<b>Paise per kWh</b>
1.	Energy charges (for coal fired)	100-200
2.	Energy charges (for RLNG)	500-600
3.	Energy charges (for naptha)	1000-1500
4.	Inter State Transmission (Long term)	10-20
5.	Inter State Transmission (Short term)	3-9
6.	Trading Margin	4
7.	Power Exchange	1

Another way of looking at the leverage that could be realized through System Operation is by way of reducing the operation cost in terms of fuel by merit order. Taking only the Inter State Generating Stations (ISGS) and Inter State Transmission Systems (ISTS) business for 2006-07, it could be seen [ Fig. 6] that fixed cost for generation is around 31 %, fuel cost is around 58 % and transmission cost is 8 %, transmission losses are 3 % whereas the RLDC fees and charges are less than 1%. The percentages would be similar for state level generation and transmission

system. The strengthening of LDCs would help in optimizing the expenses of fuel charges and transmission losses, which are 61 %.

Thus the total value of the services and the consequential savings to the national economy would far exceed the funds that LDCs would have to spend to provide these services. The Committee recommends that LDCs should be made self-reliant in terms of resources and should have separate outlays for efficient functioning.

**Figure 6: Composition of the annual business volume at the regional level**

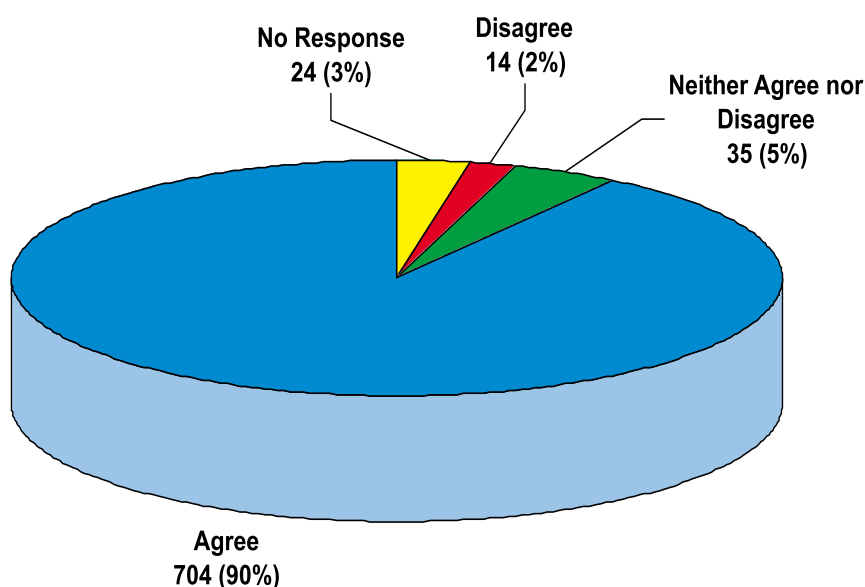


## **5.5 Governance structure**

The LDCs have to ensure that their actions are non-discriminatory, transparent and not influenced by any market player or any other business activity. Sections 28(2), 28(3) (a) and sections 32(2) (a) of the Electricity Act 2003 provide adequate safeguards in respect of scheduling. The decentralized mode of scheduling adopted in our country ensures minimum subjectivity on the part of LDCs the dispatch decisions. The Indian Electricity Grid Code (IEGC) and State Grid Codes issued by CERC and SERCs respectively provide the basic framework for operation and ensure minimum subjectivity in real time operations.

Under Section 37 of the Electricity Act 2003, the Appropriate Government may issue directions to the RLDCs or SLDCs as the case may be. Government could use this provision in a transparent manner for directing the LDCs for taking all such measures as may be necessary for maintaining smooth and stable transmission of supply of electricity. The Appropriate Government must take suitable steps to facilitate the independent functioning of the Load Despatch Centres, in line with the Electricity Act 2003 and the National Electricity Policy.

**Figure 7: Opinion of LDC personnel on importance of ethics in LDC**



At the RLDCs/NLDC level, Government of India has already taken a decision for setting up a wholly owned subsidiary of POWERGRID responsible for the independent System Operation of RLDCs and NLDC to ensure ring-fencing and functional autonomy. A similar arrangement could be replicated at SLDC level. Nevertheless, accounting function separation is an essential first step that must be implemented by 31<sup>st</sup> March 2009. State Governments may consider a separate representative Board structure to be created, which can be entrusted with the responsibility of System Operation.

A 'Forum of Load Despatch Centres' with secretariat functions being provided by National Load Despatch Centre must be established. This Forum could take up issues of common interest and also formulate a Code of Ethics for the LDC personnel.

## **5.6 Systems and procedures at Load Despatch Centres**

With regard to offline systems there is an urgent need to first integrate the online systems and offline systems operating in islanded mode within the same LDC. Subsequently, the systems in different LDCs have to be integrated with each other. This is essential to streamline operations and enhance the productivity of the workforce. Several mundane and routine activities need to be automated to release manpower for deployment in other areas.

The NLDC in consultation with CEA must lay down "Standard Operating Procedures" (SOPs) for the LDCs. Further, the committee recommends that the systems and procedures adopted at each LDC must conform to ISO 9001, ISO 14001, OHSAS 18001 and an Integrated Management Systems (IMS) must be in place. The LDC of tomorrow would need to be certified for its Quality Management, Environmental Management and Occupational Health and Safety Systems. These systems would also help in harmonizing the systems and procedures adopted by all the LDCs in India.

## **Chapter 6**

### **Recommendations of the Committee**

The Committee examined various aspects of functioning of Load Despatch Centres (LDCs) in India and after detailed deliberations, the Committee views the functions discharged by LDCs as highly specialized and technical. System Operation is a crucial and vital function in the power sector and the force-multiplier effect of this activity must be realized and encouraged by all stakeholders. The recommendations of the Committee for strengthening the Load Despatch Centres in India are as under:

#### **6.1 Recommendation 1**

The Committee recommends that the LDCs should be ring-fenced suitably to ensure their functional autonomy by taking the following steps:

- a) The Appropriate Government should take suitable steps to facilitate independent functioning of the Load Despatch Centres in line with the Electricity Act 2003 and National Electricity Policy. To begin with, the State Governments are urged to create a separate representative board structure for governance of LDCs on the lines of wholly owned subsidiary being created for the independent System Operation of RLDCs and NLDC.
- b) The financial accounts should be separated for all LDCs by 31<sup>st</sup> March 2009 with the appropriate Electricity Regulatory Commissions (ERC) specifying the fees and charges payable.

- c) Capital Expenditure (CAPEX) plans for modernization of all LDCs during 2009-12 should be submitted and the approval of the respective Electricity Regulatory Commission (ERC) should be obtained by 31st March 2009. The Central Transmission Utility (CTU) and Regional Load Despatch Centres (RLDCs) should extend the necessary assistance to SLDCs in this area.
- d) In the next stage, rolling 5-year CAPEX plans should be prepared by each LDC and got approved by the respective ERCs to take care of the system expansion, associated real-time data requirements as well as technological innovations and obsolescence of control centre equipment. ERCs may examine CAPEX proposal considering a shorter life cycle of 7-10 years for such equipment.

## **6.2 Recommendation 2**

For making LDCs financially self-reliant, the Electricity Regulatory Commissions (ERCs) should recognize the three distinct revenue streams:

- a) Fees and charges for system operation
- b) Tariff for decision support system and IT infrastructure (currently only ULDC tariff)
- c) Operating charges for scheduling, metering and settlement for market players.

All Generating Companies and licensees using the services of the LDCs would make all the above payments. In addition the LDCs could provide value added services (studies, manpower development, reports, access to data archives etc), on chargeable basis.

### **6.3 Recommendation 3**

The Committee recommends

- a) Introduction of a system of certification of System Operators by an independent Central body, similar to the system followed in case of Air Traffic Controllers.
- b) Establishment of a Central Institute for training of System Operators. Initially the National Power Training Institute (NPTI) may be entrusted with the responsibility of training and certification.
- c) Within the next one year, all the course material, systems and procedures required for administering a “basic level” of training and certification should be developed.
- d) All LDCs must ensure that all the personnel of LDCs undergo this ‘basic level’ training and certification and only certified personnel staff the LDCs within two years from the release of this report. The appropriate Electricity Regulatory Commissions would be furnished with an Annual Compliance Report of this requirement. Subsequently advanced level training and certification programme must be introduced.



- e) Fresh recruitment at regular intervals for lowering the average age of the work force in the LDCs.
- f) Introduction of suitably designed courses in the Indian Institutes of Technology and National Institutes of Technology for ensuring availability of skilled manpower.
- g) Active collaboration of LDCs with educational institutes for research and development related to Indian power system and electricity market operation.

#### **6.4 Recommendation 4**

The highly specialized and technical nature of LDC function necessitates a suitable compensation structure to attract and retain talent. The Committee recommends

- a) The compensation structure for LDC personnel should be substantially higher than comparable companies in the power sector both in the public as well as private.
- b) Apart from the compensation structure, innovative incentive schemes, such as sabbaticals for higher learning and opportunities for Professional Engagement (PE) in the form of attending seminars/workshops and conferences both in India and abroad must be provided.

- c) Once the certification system is introduced, monetary incentives similar to Air Traffic Controllers can be provided to the System Operators based on their ratings.

## **6.5 Recommendation 5**

For standardizing and harmonizing the LDCs work, the committee recommends

- a) The NLDC in consultation with CEA, would lay down the “Standard Operating Procedures” (SOPs) which would be adopted by the SLDCs. Suitable Quality Standards and an Integrated Management System (IMS) may also be implemented.
- b) A ‘Forum of Load Despatch Centres’ with the secretariat provided by National Load Despatch Centre must be established. This Forum could take up issues of common interest and also formulate a Code of Ethics for the LDC personnel.
- c) At a future date, if all the State Governments agree, an umbrella structure of SLDCs integrated with RLDCs and NLDC may be considered.



# ANNEXES



## **Annex-I**

### **Minutes of the Interactive Session convened by the Ministry of Power on 5<sup>th</sup> November 2007 with the Forum of Regulators and the State Governments.**

#### **List of participants is at Annex-I.**

- 1.0 Welcoming the participants, Secretary (Power) highlighted the critical importance of power sector in economic development of the country and the resolve of the Central Government and the State Governments are expressed in the resolution of the CM's Conference on power sector, to accelerate capacity addition and to make the power sector competitive and financially viable. He said that spirit of the Electricity Act 2003 is to promote competition in the electricity industry. However, the progress towards operationalising open access in transmission and distribution, which is one of the key facilitators for competition, has been slow so far. India is trying to showcase its power sector with a targeted capacity addition of about 80,000 MW in 11<sup>th</sup> Five Year Plan. The private sector is also showing strong interest in the power sector in recent months. Efforts are being made for promoting captive generation and decentralized power generation.
- 1.1 He further added that Maharashtra and Haryana were two states which have taken commendable step by waiving off the cross subsidy surcharge for promoting open access keeping in view the present power shortages in country. Secretary (Power) also said that there have been some improvement in reducing AT&C losses in a number of states, however in quite few but in other states situation was not satisfactory. He emphasized on the need for rationalization of tariff. He made reference to recent judgment of ATE in respect of open access. He indicated that the proposed revised APDRP scheme would aim at sustained performance of reduced losses and a condition for converting a substantial part of the loan to grant.
- 1.2 Recognising the important role of the Electricity Regulatory Commissions in power sector reforms, Ministry of Power is taking number of steps to support capacity building of the staff of the Regulatory Commissions. State Governments are also being impressed upon to create SERC Funds for ensuring financial autonomy to the Commissions. The Forum has also been requested to suggest staffing pattern for the SERCs so that it could be taken up with the State Governments.

**He suggested that there was a need to launch a country-wide website on open access to bring transparency in various charges being levied and also to regularly review the status and action taken on applications received on open access. He requested that Forum of Regulators to take a lead in this regard.**

- 2.0 A presentation was made by the Ministry of Power on implementation of open access. A copy of the presentation is at Annex-II. During the presentation, the participants were requested to indicate if any correction was required in figures relating to cross subsidy and wheeling charges in States given in the presentation.

## **Annex-I**

- 3.0 Shri Bhanu Bhushan, Member, CERC said that there is a need to distinguish the open access for as a choice of power for consumers (which is to be implemented by SERC and there are many issues) from the open access in transmission which was relevant from the point of view of augmenting supply of electricity to grid. He also added that there was a need to fully realize that a captive power plant is captive to its industry and not to a particular state utility. He said that in a number of states, state utilities are treating the captive plant as captive to them and were not allowing open access corridor for power from such captive power plants for transmitting electricity out of the state.
- 4.0 Chairperson, CA said that appropriate technological upgradation and functional autonomy of SLDCs was critical for success of open access and there was a need to continuously review the pendency and decision taken by SLDC on applications for open access.
- 5.0 Chairperson, WBERC complimented the Ministry of Power for organizing the meeting. He said that SERCs are not against open access. The Act envisaged clear role of SERCs. He welcomed the studies done by TERI on tariff orders and by CEA on open access charges and suggested that such studies should be done regularly with realistic assumptions.
- 6.0 Chairpersons, Maharashtra ERC said that the Forum of Regulators had discussed the position paper prepared by Ministry of Power with assistance of CEA on open access. He also made a presentation on behalf of the Forum of Regulators, a copy of which is at Annex-II. He said that SERCs have come out with regulations, which can be reviewed, on petitions being filed. In the present period of shortages, there is no need of additional surcharge. Case by case approval of SERC might not be required for open access. Reduction in cross subsidy surcharge would occur as a part of MYT regime. He said that there are certain issues and opportunities also in introducing open access in period of shortages. On the one hand, the licensee would have to procure more expensive power through trading and supply the same to subsidized consumers but on the other hand, accelerating open access would facilitate overcoming shortages of power. He said that the State Governments had an important role in ensuring separation of transmission business and independence of SLDCs. He emphasized on the need of computing voltage-wise system loss levels in order to avoid lading of I.T. level losses of HT level open access consumers.

The Member APERC said that they have filled an appeal before the Supreme Court against the order of the Appellate Tribunal in Appeal No. 6.0 169. During the discussions, it became clear that Hon'ble Supreme Court has not stayed the judgement of the Tribunal and it stands. Further, it was clarified that obstructing open access was not justified at all when the utilities are failing to supply good and reliable power.

## **Annex-I**

- 7.1 Member, APERC said that the Commission is not against open access and the volume of third party sales in the state is of the order of 600 MW. The power sector in the state is in consolidation stage and the State Government is of the view that burden of subsidy should not increase further. He agreed that proper costing of system support services was required.
- 7.0 The participating SERCs were requested to indicate whether any factual changes were required regarding various open access charges in the position indicated in the presentation. The status of cross subsidy surcharge and the wheeling charges after incorporating the charges indicated by the SERCs is at Annex-IV. During the discussions, it was felt that wheeling charges were high in states of Assam and West Bengal and there was a need to review those charges to make them reasonable. Neither Orissa ERC nor representative of Orissa Government was present in the meeting. However, there was a feedback that interstate open access regime was restrictive in Orissa and power was being bottled up.
- 8.1 On the proposal of UPERC that wheeling charges would be in-kind at the rate of 12% of energy wheeled, Member, CEA said that levying whole of the wheeling charges in-kind did not appear appropriate as wheeling charge should reflect the cost of service and should not be related to the price of electricity being wheeled. CMD, POWERGRID said that the losses and cost of transmission in STU systems should be much less than in the CTU system in view of the shorter distances in case of STUs. Relevant data by POWERGRID on this issue was also circulated in the meeting.
- 8.2 The following additional issues also came up for discussion on open access:
- Member, CEA said that the charges for reduction in contracted demand were still high in many states. It was agreed that the Forum would review the position.
  - Existing PPAs should be honoured and there should be no question of unilateral abandonment of such contracts for open access sale.
  - There was a need to follow best practices for promoting open access. It should be possible to submit applications electronically and normally decision should be taken within one week.
- 8.3 After discussions, it was agreed that a website would be launched by the Forum of Regulators by 1<sup>st</sup> December 2007. The website would make available various charges being levied and permissions required for obtaining open access in different states. The data would be updated every fortnight. The website would be maintained by the CERC Secretariat which is also Secretariat for the Forum. The website may also make available the status of open access applications received in the states, the decision taken and the



## **Annex-I**

pendency status. This would have to be collected from SLDCs. Necessary financial and manpower support for launching and maintaining website would be made available by POWERGRID which is also the CTU.

- 9.0 Member, CERC said that the aspects of scheduling and metering needed special attention in order that open access traffic did not lead to excessive burden on grid management. He said that many other countries have faced difficulties in this regard. CMD, POWERGRID also added that the grid management and training to SLDC staff should be given adequate attention. Chairperson, Maharashtra MERC said that intrastate balancing was already in place in the state and the same can be studied. Chairperson, Gujarat ERC said that they have also started a framework for this purpose on experimental basis. Member, APERC said that the state was already having significant volume of third party sales.
- 9.1 After discussions, it was decided to constitute a Task Force which would be headed by Shri Bhanu Bhushan, Member, CERC and would have following as Members:
- i) Chairperson, Maharashtra ERC
  - ii) Chairperson, Gujarat ERC
  - iii) Chairperson, Andhra Pradesh ERC
  - iv) Secretary (Energy), Rajasthan
  - v) Secretary (Energy), Haryana
  - vi) Secretary (Energy), Chhattisgarh
  - vii) Shri S.K. Soonee, ED, POWERGRID

The Task Force would examine various issues relating to scheduling, metering and settlement of intrastate open access transactions and would give its recommendations by 31<sup>st</sup> December 2007.

- 10.0 In-depth discussions were held on the issue of upgrading and ring-fencing SLDCs, Secretary (Power) said that to ensure that open access is granted in transparent and non-discriminatory manner, SLDCs have to act independently. There was also need to incentivise SLDC personnel.
- 10.1 Member, CERC said that system operation required long term commitment and a cadre of system operators would be preferable than deputationists. Globally, system operation is with transmission utility it restructuring have been done otherwise system operation

## **Annex-I**

functions as an independent entity. He added that if the restructured entities are Government owned then ensuring independence of SLDC becomes more critical. Chairperson, CEA added that regular monitoring of decisions taken on applications for open access would facilitate assessment of independence of SLDCs.

### **10.2 The following state-wise views emerged:**

- i) Maharashtra ERC said that STU should be separated.
- ii) Karnataka ERC said that SLDC was part of TRANSCO and its independence was seriously questionable in view of the fact that transmission utility and distribution companies have common management.
- iii) In Kerala, it is functioning as part of SEB.
- iv) In West Bengal, SLDC is part of STU and have an independent Board. They plan to have a separate SLDC in long term.
- v) APERC said that SLDC should be separate ideally but for the time being, it could be a ring-fenced entity.
- vi) Rajasthan and Assam said that SLDC is functioning in STU satisfactorily.
- vii) Bihar said that SLDC is presently with BSEB but it should be an independent body.
- viii) Chhattisgarh said that SLDC would be independent after restructuring of CSEB.
- ix) Gujarat ERC said that significant change in attitude of SLDC personnel was required.
- x) HPERC said that SLDC is facing problem of staffing.
- xi) Haryana said that SLDC is functioning within STU but independently. There was a system of special pay to SLDC personnel.
- xii) MPERC said that SLDC was functioning with STU but the personnel required more capacity building.
- xiii) Jharkhand ERC said that functioning of SLDC was not satisfactory and even the energy accounting for JSEB was not done properly. Secretary (Energy), Jharkhand said that SLDC would be made independent after the restructuring of SEB which is expected shortly.
- xiv) Punjab said that there was a serious manpower problem in SLDC. It should be a part of STU.
- xv) Meghalaya said that they would deal with the issue after restructuring of SEB.

## **Annex-I**

- 10.3 JS (Trans.), Ministry of Power said that SLDC be ring-fenced with a non-executive chairman, independent board and staff can be taken on deputation. CMD, POWERGRID suggested that there was a requirement of building a nationwide cadre of system operators.
- 10.4 Summarising the discussions on SLDCs, Secretary (Power) said that the system operation was a specialized function and accordingly cadre building was required. Monitoring of SLDCs by SERCs would be useful to check whether they are functioning independently. NPTI could arrange training for system operators. There was also need for certification system for qualified system operators. Special pay and financial incentives based on open access facilitation were also required to have adequate attraction for personnel in SLDCs.
- 10.5 It was agreed to constitute a committee consisting of Shri Ashok Kumar Khurana, Additional Secretary, Ministry of Power to examine various issues relating to manpower, certification and incentives for personnel for system operation at various levels and also for ring-fencing the load dispatch centers to ensure their functional autonomy and give recommendations. Representatives of CEA and CTU could be co-opted in the Committee. The Committee would give its report within one month.
- 11.0 Secretary (Power) suggested that there was a need to develop franchisees in medium size towns, new townships and large towns where there was a serious problems of power shortages, with a view to improve distribution of electricity. This could be a viable alternative to privatization. To sum up, following decisions were taken:
- i) Launching a website on open access by the Forum of Regulators by 1<sup>st</sup> December 2007 (Para 8.3)
  - ii) Constituting a Task Force which would be headed by Shri Bhanu Bhushan, Member, CERC for examining issues related to scheduling metering and balancing of intrastate open access transactions (Para 9.1)
  - iii) Constituting a committee consisting of Shri Ashok Kumar Khurana, Additional Secretary, Ministry of Power for examining issues relating to staffing and autonomy of Load Despatch Centres (Para 10.5).
- 12.0 The meeting ended with the vote of thanks to the chair. On behalf of Forum, Chairperson, WBERC thanked the Ministry of Power for organizing the meeting and assured full support of the Regulatory Commissions for power sector reforms.

## Annex-I

### Annexure-1

Interactive Session of Forum of Electricity Regulators—Dated 5<sup>th</sup> Nov., 07

Sl.No.	Name (S/Shri)	Organisation
1.	Anil Razdan, Secretary	Ministry of Power
2.	Anil Kumar, Addl. Secretary	Ministry of Power
3.	Ashok K. Khurana, Addl. Secretary	Ministry of Power
4.	G.B. Pradhan, Joint Secretary	Ministry of Power
5.	Jayant Kawale, Joint Secretary	Ministry of Power
6.	V.P. Joy, Joint Secretary	Ministry of Power
7.	Alok Kumar, Director	Ministry of Power
8.	Rakesh Nath, Chairman	Central Electricity Authority
9	Sunil Verma, Member	Central Electricity Authority
10	V.S. Verma	Central Electricity Authority
11	Bhanu Bhushan, Member	Central Electricity Regulatory Authority
	<b>Public Sector Undertakings</b>	
12.	Dr. R.P. Singh, CMD	Power Grid Corpn. Ltd.
13.	V.K. Garg, CMD	Power Finance Corpn.
14	Asim Barman, Chairman	DVC
15	S.K. Soonee, Ex. Director	POWERGRID
	State Governments	
16	Pulak Dev. Pr. Secretary	Govt. of Arunachal Pradesh
17	Rajesh Gupta, Secretary (Energy)	Govt. of Bihar
18	Vivek Dhand, Pr. Secretary (Energy)	Govt. of Chhattisgarh
19	V.L. Joshi, Pr. Secretary (Energy)	Govt. of Gujarat
20	Ashok Lavasa Pr. Secretary (Power)	Govt. of Haryana
21	Shrikant Baldi, Secretary (Power)	Govt. of Himachal Pradesh
22	Adiya Swarup, Secretary (Energy)	Govt. of Jharkhand
23	K.K. Vijaya Kumar, Secretary (E)	Govt. of Kerala
24	B.K. Dev Verma, Pr. Secretary (Power)	Govt. of Meghalaya
25	K. Lal Nghinglora, Secy, (Power)	Govt. of Mizoram
26	K. Guite, ACE	Govt. of Mizoram
27	Harish Ahuja, Dy. Secretary (Power)	NCT of Delhi
28	Rana Jodhbir Jung, OSD	Govt. of Tripura
29	Sunil Mitra Pr. Secretary (P)	Govt. of West Bengal

## Annex-I

State Electricity Regulatory Commission		
30.	J.P. Saikia, Chairperson	Assam ERC
31.	Surinder Pal, Member	Assam ERC
32.	Geeta Gouri, Dir. (Tariff)	APERC
33.	G. Subbarao, Chairman	Bihar ERC
34.	S.K. Jayaswal, Member	
35.	B.K. Halder	
36	S.K. Mitra	Chhattisgarh ERC
37	Y.Khanna, chairman	Himachal Pradesh ERC
38	S.K.F. Kujur, Chairman	Jharkhand, SERC
39	K.B. Pillai, Chairman	J&K SERC
40	K.P. Pandey, Chairman	Kerala ERC
41	C. Balakrishnan, Chairman	Karnataka State ERC
42	B. Chatterjee, Chairman	Haryana ERC
43	Dr. J.L. Bose, Chairman	MPERC
44	Pramod Deo, Chairman	Maharashtra ERC
45	Shri Vinay Kohi, Chairman	Meghalaya State ERC
46	S.S. Pall, Member	PSERC
47	K.L. Vyas, Member	Rajasthan ERC
48	B. Jeyaraman, Member	T.N. ERC
49	V. Elango	T.N. ERC
50	Vijay Kumar, Chairman	UPERC
51	R.D. Gupta, Member	UPERC
52	S.N. Ghosh, Chairman	WBERC
53	S.R. Sethi, director	Delhi Transco Ltd.
54	Ajay B. Pandey, MD	MSEDCL
55	Y.K. Raizada, Dir. (Tech.)	RUVN
56	Pranab K. Das, MS, Power & MD	HVPN
57	Shiv Raj Singh	Chhattisgarh SEB
58	Manoj Dey, Member	- do -
59	S.B. Khyalia	GUVNL

## Annex-II

### Suggestions by the SERCs and the State Utilities on Load Despatch Centres

#### 1. Role of Load Despatch Centres

	Comments / Suggestions
<b>AssamERC</b>	"SLDCs play a very significant allocative role in ensuring optimum utilization of available power, avoiding congestion and ensuring reliability a role which will become more important as the distribution activity will be open to players other than the present entities also..."
<b>Maharashtra ERC</b>	"It is beyond doubt that the state and regional power grids are bound to become more complex in the near future and system operation and control will be critical in the process."
<b>Madhya Pradesh ERC</b>	"SLDC functions are more complex than those of RLDC as SLDC is responsible for intrastate as well as interstate matters of ABT, open access, scheduling and energy accounting and regulatory affairs at central as well as state level. Further SLDC shall have to deal with new challenges like Power Exchange at National as well as State level in near future."

#### 2. Manpower and desired skills at Load Despatch Centres

	Comments / Suggestions
<b>Assam ERC</b>	"a specialized cadre service be created for load despatch function with certain additional incentives. Till creation of such specialized cadre service, the existing system on deputation from parent department may continue..."
<b>Maharashtra ERC</b>	"Most of the personnel at LDC would be technical or Techno commercial persons""...the basic requirement of the LDC employee, even at the entry level is to have prior operational experience in Generation or transmission of power system..."the personnel need to communicate effectively and understand the technical communication impacted to them through information, indicating instruments, and any other contemporary audio-visual systems used in power systems"

#### 3. Certification of System Operators

	Comments / Suggestions
<b>Maharashtra ERC</b>	"LDCs shall have to be managed by qualified Certificate holders, as system operators are to operate the integrated grid in real time"
<b>Maharashtra Transco</b>	"There should be training and certification authority for manning the LDC and personnel to be posted in SLDCs"

## Annex-II

### 4. Training of System Operators

	Comments / Suggestions
<b>Maharashtra ERC</b>	"To develop indigenous capabilities in manpower of LDC, training programs is suggested." "Refresher courses would need to be organized in various disciplines and for personnel at different levels, with reference to latest developments in technology and experience in operations of LDC."
<b>Madhya Pradesh ERC</b>	"Tailor-made detailed training programme have to be developed so as to achieve the professional competency and efficiency in the working of the Load Despatch Centres."
<b>Maharashtra Transco</b>	"SLDC staff should have exposure to National/ International practices in line with ISOs and TSOs abroad."

### 5. Incentives for LDC personnel

<b>Maharashtra ERC</b>	"Short term incentives- job rotation, effective practicing of the Appraisal system, giving exposure and opportunity to represent LDC at various platforms of power system coordination and planning." "Long-term incentives can be imparted only through limitless vertical buoyancy in the power sector for the eligible person." "It is essential to provide conduits and channels to ensure such movements."
<b>Madhya Pradesh ERC</b>	"Some incentive scheme may also be made applicable to Load Despatch staff engaged for system operation, scheduling, energy accounting, system support etc."
<b>Maharashtra Transco</b>	"...time scale promotions, providing performance based incentive etc."

### 6. Ring-fencing and Functional Autonomy of Load Despatch Centres

	Comments / Suggestions
<b>Maharashtra ERC</b>	Ring-fencing can come through financial autonomy to shoulder its capital and revenue expenditure independently; administrative and HR autonomy; technical freedom to give decisions regarding issues pertaining to Protection coordination, Outage planning, Outage availing and system strengthening; Responsibility to undertake Commercial settlement of imbalance pool." "there is no need to ring-fence the personnel manpower of the body...total insulation from the rest of the power system is neither possible nor advisable, as it would restrict boundaries for innovativeness and managerial abilities..."
<b>Maharashtra Transco</b>	"SLDC should function under the hierarchy of RLDC & NLDC and shall be functionally independent as an apex body in its area of jurisdiction."

## Annex-II

<b>Madhya Pradesh ERC</b>	“Ways should be formulated and steps should be taken to insulate Load Despatch Centres by restricting / limiting the flow of their cash to its parent company””bringing the whole Load Despatching responsibilities under one umbrella, right from Sub-LDC up to NLDC by establishing a Government company for operating the NLDC... and making the RLDCs/SLDCs its subsidiary companies.””payment of RLDC/SLDC fee and charges through irrevocable LC and inclusions of provisions for heavy penalties for non-payment by licensees.”
<b>Assam ERC</b>	“Independent identity should be established by separating them from the transmission company.””Unbundling of the SLDC costs from the transmission network are a high priority””Accounting of SLDC has to be bifurcated from that of the transmission company”





## **Annex-III**

No. 6/2/2008-Trans  
Government of India  
Ministry of Power

....

Shram Shakti Bhawan, Rafi Marg,  
New Delhi, the 4<sup>th</sup> February, 2008

### **ORDER**

A Committee is constituted to examine issues relating to manpower, certification and incentives for the personnel employed on system operation at various levels and also for ring-fencing the load dispatch centres to ensure their functional autonomy and give recommendations with the following composition:

- |   |   |                  |
|---|---|------------------|
| 1. Shri Gireesh B. Pradhan, Addl. Secretary, MoP                              | - | Chairman         |
| 2. Shri V. Ramakrishna, Member (PS), CEA                                      | - | Member           |
| 3. Smt. R. Chatterjee, CMD, Andhra Pradesh Trans.Co.-                         |   |                  |
| 4. Shri A.K. Sachan, M.D. Lower Assam Electricity<br>Distribution Co .Limited | - | Member           |
| 5. Shri Yaduvendra Mathur, Secretary (Power), Rajasthan                       | - | Member           |
| 6. Shri S.K. Soonie, ED (System Operation), PGCIL                             | - | Member           |
| 7. Shri Shyam Wadhera, Director (Projects), PFC                               | - | Member           |
| 8. Shri Lokesh Chandra, Director (Trans), MOP                                 | - | Member Secretary |

The Committee shall submit its report within a period of 45 days from the date of its constitution.

(Lokesh Chandra)  
Director (Trans)  
Tel : 2371 5250

Copy to:

1. Officer concerned.
2. Chief Secretary, Govt. of Andhra Pradesh, Assam and Rajasthan.
3. Chairperson, CEA, New Delhi.
4. CMD, PGCIL, Gurgaon.
5. CMD, PFC, New Delhi.
6. Director (R&R), Ministry of Power.



## **Annex-IV**

### **Approach Paper on**

### **‘Enabling effective and efficient Load Despatch Centres in India through functional autonomy and authority, certified manpower and appropriate incentivization’**

#### **1.0 Introduction**

The Electricity Supply Industry (ESI) worldwide is changing from the classical technically driven operation towards a commercially customer oriented business. India is also aggressively pursuing reforms in the power sector that has resulted into unbundling of the vertically integrated utilities, increasing number of markets players with different goals and interests and increased competition among them. These changes have brought about greater focus and cost awareness within utilities and a consequential increase in the pressure to use the physical system closer to its limits.

In the changed scenario it is essential that the industry has confidence on the competence of the system operators and their conduct is considered beyond reproach. This is all the more important especially with international interconnections and increasing participation of private players through Ultra Mega Power Projects (UMPPs), Power Exchange (PX) and other market mechanisms. System operation needs to be recognized and nurtured as a distinct faculty within the ESI. An enabling environment must be created for system operators to deliver.

#### **2.0 Functions of Load Despatch Centres in India**

In India System Operation is better known as **Load Despatching** and the place from where it is carried out are known as Load Despatch Centres (LDCs). As a function it has been carried out in India ever since interconnected systems began to operate within the state power systems however the function gained prominence in 1964 when Regional Electricity Boards were constituted through a resolution of the Ministry of Power. The REBs found a mention in the Electricity Supply Act 1948 only in the 1991 amendments. Presently there are five Regional LDCs (RLDCs) and more than 25 State LDCs (SLDCs) in India. An LDC at the National level is also expected to come up in near future. These LDCs came into explicit existence for the first time in the 1998 amendments to the Electricity Supply Act 1948.

Electricity Act 2003 has designated RLDC as apex body to ensure integrated operation of the power system in the concerned region [Section 28 (1)] and SLDC as apex body to ensure integrated operation of the power system in a State. Section 28 (3) of the Electricity Act 2003 says, *“The Regional Load Despatch Centre shall-*

- (a) *be responsible for optimum scheduling and despatch of electricity within the region, in accordance with the contracts entered into with the licensees or the generating companies operating in the region;*

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- (b) monitor grid operations;
- (c) keep accounts of the quantity of electricity transmitted through the regional grid;
- (d) exercise supervision and control over the inter-State transmission system; and
- (e) *be responsible for carrying out real time operations for grid control and despatch of electricity within the region through secure and economic operation of the regional grid in accordance with the Grid Standards and the Grid Code.*

Section 32 (2) of the Electricity Act 2003 says, “*The State Load Despatch Centre shall –*

- (a) *be responsible for optimum scheduling and despatch of electricity within a State, in accordance with the contracts entered into with the licensees or the generating companies operating in that State;*
- (b) *monitor grid operations;*
- (c) *keep accounts of the quantity of electricity transmitted through the State grid;*
- (d) *exercise supervision and control over the intra-state transmission system; and*
- (e) *be responsible for carrying out real time operations for grid control and despatch of electricity within the State through secure and economic operation of the State grid in accordance with the Grid Standards and the State Grid Code.*”

Section 26 (1) of the Electricity Act 2003 says, “*The Central Government may establish a Centre at the national level, to be known as the National Load Despatch Centre for optimum scheduling and despatch of electricity among the Regional Load Despatch Centres*”.

As per the resolution of the Ministry of Power notification dated 2<sup>nd</sup> March 2005, the main functions of NLDC are:

- a) *Supervision over the Regional Load Dispatch Centres.*
- b) *Scheduling and dispatch of electricity over the inter-regional links in accordance with grid standards specified by the authority and grid code specified by Central Commission in coordination with Regional Load Dispatch Centres.*
- c) *Coordination with Regional Load Dispatch Centres for achieving maximum economy and efficiency in the operation of National Grid.*
- d) *Monitoring of operations and grid security of the National Grid.*
- e) *Supervision and control over the inter-regional links as may be required for ensuring stability of the power system under its control.*
- f) *Coordination with Regional Power Committees for regional outage schedule in the national perspective to ensure optimal utilization of power resources.*

## **Annex-IV**

- g) Coordination with Regional Load Dispatch Centres for the energy accounting of inter-regional exchange of power.*
- h) Coordination for restoration of synchronous operation of national grid with Regional Load Dispatch Centres.*
- i) Coordination for trans-national exchange of power.*
- j) Providing operational feedback for national grid planning to the Authority and Central Transmission Utility.*
- k) Levy and collection of such fee and charges from the generating companies or licensees involved in the power system, as may be specified by the Central Commission.*
- l) Dissemination of information relating to operations of transmission system in accordance with directions or regulations issued by Central Government from time to time.*

The LDCs in India started off with only a telephone/hotline communication system and a frequency meter. It was operational only during the daytime and acted mainly as an information centre. Slowly, state systems got connected and the control centres started operating 24 x 7. They had rudimentary Data Acquisition Systems. Market operations really kicked off after the formation of Central Generating Companies and commissioning of first of these power plants in the early eighties.

Since 1998, Electricity Regulatory Commissions (ERCs) have started getting established in each state and the role of LDCs has enhanced considerably with introduction of new Market Mechanisms such as the Availability Based Tariff (ABT) and Open Access in transmission. The LDCs were overnight required to operate the entire Metering and Settlement System including operation of the Pool Accounts. Handling such a large volume of data in respect of scheduling and metering was possible only through the use of Information Technology (IT) and growth of the INTERNET. The RLDCs and some SLDCs could manage the entire arrangement in paperless mode. The twenty first century saw the commissioning of sophisticated Energy Management Systems (EMS) at all the LDCs in the country. Many interconnections of large grids in the country took place this century and the spiralling growth in the economy as well as the power sector has pitch forked the LDCs centre stage. LDCs are now being viewed as the key to further reforms in the power sector.

### **3.0 Performance of LDCs and the skill sets required now**

There is a significant shift in the operator of the twentieth century and the twenty first century. The primary function of LDCs remain that of ensuring reliability of the electricity grids but with the large interconnections, vulnerability has increased and new threat perception in the form of cyber security, sabotage, natural calamities etc. have become important.

## **Annex-IV**

Conventional EMS technologies remain (with a high obsolescence rate necessitating a life cycle approach) but they have to be supplemented with synchrophasor technology, Wide Area Measurement Systems (WAMS), System Protection Schemes (SPS) and newer visualization techniques. Situational Awareness (SA) at LDCs has become the key to efficacy. The future grids are expected to be Intelligent Grids with self healing properties and tomorrow's operator would be designing and operating such grids.

Reliable operation of electricity grids was traditionally considered a public service. Market Operations constitute the private trade between electricity players and the LDCs had to facilitate the same through the Market Information System. Another vital component of Market Operations, but seldom realized, is administering the entire Metering and Settlement System, including Operation of Pool Accounts. In the last five years, the RLDCs have handled over Rs. 25,000 crores through the Regional Pool Accounts in a dispute free manner. Strong domain knowledge, meticulousness and ability to handle large volumes of data using Information Technology (IT) are the key to success of Market Operations.

System Operation and Market Operation were initially thought to be water tight compartments. This is no longer the case. Rather the mantra now is 'Markets must complement reliability' and has given way to the System Operators operating a full fledged ancillary services market covering imbalances, primary, secondary and tertiary response, black start facilities, reactive power supply etc. Convergence has occurred between the EMS and the Market Management Systems (MMS). Managing Open Access and network congestion is now through the results derived from the EMS and communicated to the market players (Locational Marginal Prices or LMP, loss allocation and transmission pricing).

Another aspect that needs to be appreciated is that in a scenario of markets complementing reliability, the system planner as well as the regulator has to take a lot of inputs from the system operator to arrive at the right decisions which help in growth of the ESI. The LDCs have to articulate their views fearlessly and without any biases before these bodies which calls for an entirely different skill sets. Distributed Generation (DG), emission reduction, Clean Development Mechanism (CDM) and the NegaWatt (NW) industry would also significantly affect the way we operate and the system operator of tomorrow has to be aware and prepare for these changes.

It would be seen from all the above that the earlier skill sets for LDC personnel would no longer be adequate for the operator of the 21<sup>st</sup> century.

The system operator has to ensure operation of the power system with security, reliability, economy and efficiency. This requires an in-depth understanding of not only the technical aspects of system operation but also the market mechanisms and the institutional & legal framework. Thus besides the fundamental engineering knowledge of power systems, system operators need to be well conversant with all domains with which they interface. This would include inter alia- generation, transmission, distribution, protection,

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communication and information technology as well as legal, regulatory, contractual, commercial, managerial, economic, social and political aspects. Further, the establishment of the market place requires transparency in decision-making and equitability in actions. This demands personal integrity and ethical standards of the highest order from the system operators. These issues have been very well documented in the United Nations Report titled “Multi dimensional Issues in International Electric Power Grid Interconnections” (2005 & 2006).

### 4.0 Attracting talent, development and retaining the same at LDCs

The first step of **attracting talent** is very important. The total skilled professional asset base of LDCs all across the country would be in the range of 1500-2000. The LDCs would have to compete for manpower with other sunrise sectors as well as within the power sector. Talent could either be freshmen from college or lateral entry of qualified personnel from power or other sectors. The compensation and the service conditions of the system operators need to be commensurate with the responsibilities handled by them in the economy. Even if the monetary benefits are not comparable to the best, it should be suitably compensated by prestige and recognition by the industry. The above initiatives coupled with stable postings at control centres (most are located in cities which provide opportunity for acquiring higher professional qualifications) would generate the necessary pull for attracting a good talent pool to choose from.

**Development of LDC personnel** is the next step. Freshmen recruited from college need to be put through all the elements of the value chain involved in electricity viz. generation, transmission and distribution during the training period. The training institutes such as NPTI might be actively involved in designing a comprehensive training module for LDCs right from induction level as well as refresher courses. CIGRE WG 39.03 report titled **Certification and Competency Evaluation of System Operators** indicates a growing interest worldwide on the certification of system operators. The reasons for the same are grouped in two categories – “on the one hand the increased accountability of operating organizations in the deregulated environment, and on the other hand the general business trend towards the use of measurement based approaches in performance management.”

**Operator certification is a structured approach** to achieve this. It is already in place in several countries. Even in India this approach has been adopted for all mission critical activities like medical, Air Traffic Controllers and Aircraft Pilots. The Bureau of Energy Efficiency is also adopting a similar approach for developing certified Energy Managers and Energy Auditors similar to Chartered Accountants. The issues involved here are **(a) Certification Cycle (b) Maintaining Active Certification (c) Re-Certification (d) Re-activating Expired Certification (e) Continuing Professional Development (CPD) (f) Course Design**

Considering the diversity of expertise required in LDCs, expecting a single individual to have proficiency in every area would be unrealistic. Therefore pooling of expertise and



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effective **knowledge management** are indispensable to achieve the desired objective. The working environment would be a function of market architecture, organizational structure (Regulator driven) and working culture (driven by management policies and team members). **Mentoring** of young engineers by experienced seniors at Control Centres would be another effective step. The **operating aids** would be a function of the technological advancement in control, instrumentation and Information technology. Motivation would be driven by management policies, incentive structure and personal traits. The educational background, working experience and the grooming within the organization, would drive knowledge and skills of the system operators.

**Adequate opportunities for higher learning, Professional Engagement (PE) opportunities through participation in seminars/conferences both in India and overseas, career progression with opportunities for deputation to other LDCs/ERCs/Multilateral institutions etc. and job satisfaction would ensure retention of talent.** Incentive schemes have to be innovative and encouraging. Thus the road map to effective system operation would have to suitably address each of the above dimensions comprehensively.

### 5.0 Logistics required for LDCs functioning

The Integrated Energy Policy 2006 states that for achieving a GDP growth of 9%, the electrical energy requirement would go up by 3.7 times of 2006-07 level by 2021-22. (Table 2.6, Page 21 of the document). This indicates the sheer volume of expansion in generation, transmission and distribution facilities that would be required. CEA had arranged a conference in July 2007 regarding inputs that would be required to sustain such expansion. Their report titled 'Key inputs for accelerated development of Indian power sector-11<sup>th</sup> Plan and beyond' focuses more on generation, transmission and distribution system. LDCs have not been studied closely. This could possibly be on account of the low scale of operations involved (less than 1% of manpower and financial budget). Nevertheless, the LDC operations would be greatly affected on account of this massive expansion.

Real time data availability at LDCs is vital for their effective operation. A centralized arrangement had hitherto been in vogue for bringing real time data from power station/sub-stations to LDCs. Rapid expansion of the system would render such a centralized system ineffective. All new power stations and substations must now arrange to bring real time data to the LDCs. The arrangement at LDCs needs to be only a 'plug-and-play' type. This is the key to effective operation of LDCs. Else the new installations would not be on the radar screens of LDCs and would impede the latter's functioning.

Section 4.10 of the Indian Electricity Grid Code (IEGC) states

*'Reliable and efficient speech and data communication systems shall be provided to facilitate necessary communication and data exchange, and supervision/control of the grid by the RLDC, under normal and abnormal conditions. All agencies shall provide*

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*Systems to telemeter power system parameter such as flow, voltage and status of switches/transformer taps etc. in line with interface requirements and other guideline made available to RLDC / SLDC. The associated communication system to facilitate data flow up to RLDC/SLDC, as the case may be, shall also be established by the concerned agency as specified by CTU in connection agreement. All agencies in coordination with CTU shall provide the required facilities at their respective ends and RLDC / SLDC as specified in the connection agreement.'*

Section 4.12 (a) iii further states as under:

*'All agencies connected to or planning to connect to ISTS would ensure providing of RTU and other communication equipment, as specified by RLDC/SLDC, for sending real-time data to SLDC/RLDC at least before date of commercial operation of the generating stations or sub-station/line being connected to ISTS.'*

These provisions are generally taken for granted and need to be strictly observed as more and more new facilities get commissioned. EMS at LDCs also need to be upgraded and an Asset Management Plan prepared and updated on a continuous basis considering the entire lifecycle. Some of the changes in this field could also be vendor driven and it is important that LDCs have the technical skills to absorb new technology as well as drive technology by specifying new requirements.

Apart from real time data and communication facilities, the LDCs need to have a strong IT infrastructure in place to handle the large volume of data for both System Operation as well as Market Operations. This is a major challenge considering that poorly equipped, non-IT savvy engineers at LDCs had been the norm in the past. Fast obsolescence in the field of IT is another major challenge.

### 6.0 Funding of LDCs

It would be seen from the above sections that the right men and machine combination is necessary for effective LDC operation. All this is not possible without finances. The Business Model of LDCs needs to be finalized. Any funding arrangement for LDCs would need to look at both the capital costs as well as recurring costs. Section 28 (4) and 32(3) provide for the LDCs to collect such fee and charges from the generating companies or licensees engaged in transmission of electricity as may be specified by the Appropriate Commission.

It is desirable that ERCs examine the fund requirement of LDCs in a comprehensive manner and ensure a well equipped, right sized LDC with deliverables and not cost as the criteria. This needs to be discussed threadbare and the right funding arrangement evolved considering all the future activities such as the ancillary services market that the LDCs would administer. In addition to the ULDC tariff, fees and charges another revenue stream is the operating charges levied on Open Access customers. Here it is important to ensure that the amounts so collected are channeled into infrastructure augmentation and development of personnel at LDCs.

## **Annex-IV**

### **7.0 Functional autonomy and authority for LDCs:**

A variety of organizational models have been suggested for LDCs ranging from a monolith for all LDCs in the country akin to the All India Services, Independent System Operators (ISOs) and the Transmission System Operators (TSOs).

Irrespective of the structure, the bottom-line is functional autonomy for the LDC operating personnel. Functional autonomy would mean taking decisions without being adversely influenced by extraneous issues originating from the Company Management. The Governments and the ERCs need to encourage and support the LDCs in discharging their functions in an impartial manner as apex bodies. Functional autonomy and authority for LDCs could be ensured through

- Availability of skilled manpower and logistics/infrastructure
- Motivated personnel having high ethical standards and driven by altruistic values
- An enduring funding plan with no strings attached
- Deliverables the criteria for approving funds
- Stable tenure for operating personnel
- Minimum qualifying requirements/certification for operating personnel
- Clear signal to all stakeholders including other departments in the Company on the apex body stature of SLDCs/RLDC/NLDC

## **Annex-IV**

### **8.0 References**

- [1] United Nations Report titled “Multi dimensional Issues in International Electric Power Grid Interconnections” (2005 & 2006).
- [2] Charles J. Frank and Robert J. Miller, ‘Human Factors Review of Dispatch Control Centres’, IEEE Transactions on Power Apparatus and Systems, Vol PAS-101, No. 6 June 1982
- [3] Hugh Jones, Rolf Knopf, Pasi Lehtonen, Sarah Lutterodt on behalf of Working Group 39.03 ‘39-103, Certification and Competency Evaluation of System Operators’ CIGRE Session 2000
- [4] Steve Allamby, Juan Bogas, Ninel Cukalevski et al, ‘39-104, Operator Performance Requirements and Training Needs in the Commercial Environment’, CIGRE 2000 session
- [5] G. Krost, Steve Allamby, J. Bogas Galvez et al on behalf of WG 39.03, ‘39-102, Impact of Operators’ selection and training on Power System Performance’, CIGRE 1998 session
- [6] NERC, ‘Results of Reliability Issue Survey, Rev 1’, October 24, 2007
- [7] ‘NERC Strategic Plan 2008-2013’, November 2007
- [8] ‘Integrated Energy Policy’, Government of India, Planning Commission, New Delhi, August 2006
- [9] ‘Key inputs for accelerated development of Indian power sector-11<sup>th</sup> Plan and beyond’, Central Electricity Authority, July 2007



## Annex-V

### List of references

- [1]. “*Electricity Act*”, Government of India, June 2003
- [2]. “*National Electricity Policy*”, Government of India, February, 2005
- [3]. “*Indian Electricity Grid Code*”, Central Electricity Regulatory Commission, April 2006
- [4]. “*National Training Policy for the Power Sector*”, Ministry of Power, Government of India, June 2002
- [5]. “*Integrated Energy Policy*”, Government of India, Planning Commission, New Delhi, August 2006
- [6]. “*Key inputs for accelerated development of Indian power sector-11th Plan and beyond*”, Central Electricity Authority, July 2007
- [7]. “*Multi dimensional Issues in International Electric Power Grid Interconnections*”, United Nations Report , 2005 and 2006
- [8]. “*Transmission System Operators-Lessons from the Frontlines*”, Beatriz Arizu, William H. Dunn Jr. and Bernard Tenenbaum, The World Bank Group, June 2002
- [9]. “*Governance and Regulation of Power Pools and System Operators An International Comparison*”, James Barker Jr. Bernard Tenenbaum and Fiona Woolf, Energy, Mining and Telecommunications Department, World Bank, September 1997
- [10]. “*Governance Structure for an Independent System Operator (ISO)*”, William W. Hogan, Carrie Cullen Hitt and Janelle Schmidt, Harvard Electricity Policy Group, June 1996
- [11]. “*Role of the System Operator in the Unbundled and Market Environment*” by K. Malso, V.Renznicek, P. Vejnar, CIGRE 39-204, Session 1998
- [12]. “*Impacts Of Operators’ Selection And Training On Power System Performance*” On Behalf Of WG 39.03: G.Krost, S.Allamby, J.Bogas Galvez, A.Carrano, N.Cukalevski, O.Gjerde, H.Jones, R.Knoepfel, P.Lehtonen, Y.Logeay, S.Lutterodt, Z.Malek, R.Marconato, L.Oroszki, R.Skiold, U.Spanel, D.Szymanski, D.Visser, CIGRE 39-102, Session 1998
- [13]. “*Efficient Teamwork and Interpersonal Communication in Control Centres in the new Power system Environment*” by T.M. Papazoglou, L. Roszki and D. Visser on behalf of WG 39.03, CIGRE 39-101, Session 2000
- [14]. “*Certification and Competency Evaluation of System Operators*” by Hugh Jones, Rolf Knopf, Pasi Lehtonen, Sarah Lutterodt on behalf of Working Group 39.03, CIGRE 39-103- Session 2000

## Annex-V

- [15]. *“Organization and Justification of Power System Operators Training”* by Gerhard Krost, Steve Allamby and Pasi Lehtonen on behalf of WG 39.03, CIGRE 39-102, Session 2000
- [16]. *“Operator Performance Requirements and Training needs In the commercial environment”* by Steve Allamby, Juan Bogas, Ninel Cukalevski, Gilberto Flores, Ole Gjerde, Neso A. Mijuskovic, Udo Spanel, Glenn, Weiss On behalf of WG 39.03, CIGRE 39-104, Session 2000
- [17]. *“The Interaction Between the System Operator and the Market Functions in England and Wales”* by Les Clarke and Mike Lee, CIGRE 39-204, Session 2000
- [18]. *“From Ancillary Services to Reliability Products: A system operator business model”* by J. H la Grange, CIGRE 39-210, Session 2000
- [19]. *“Operator Performance Requirements And Training Needs In The Commercial Environment Steve Allamby”*, Juan Bogas, Ninel Cukalevski, Gilberto Flores, Ole Gjerde, Neso A. Mijuskovic, Udo Spanel?, Glenn Weiss On Behalf Of WG 39.03, CIGRE 39-104, Session 2000
- [20]. *“The Impact of Deregulation and Market Trading on the Requirements for and Future Development of Operator Training Simulators”* by N.Cukalevski, S. Allamby, H.Jones, G. Flores, W De Smet, On behalf of WG 39.03, CIGRE 39-104, Session 2002
- [21]. *“Changes in the Business and Interfaces of System Operators facing Liberalisation and Restructuring”* by Ole Gjerde, Olav B. Fosso, Paul Giesbertz, Les Clarke, Per-Anders Löf, Ben Li, Al DiCaprio, Hubert Lemmens, Chai Ming Mak, Veli-Jukka Pyötsiä, Juan Bogas on the behalf of WG39.05, CIGRE 39-203, Session 2002
- [22]. *“Enhancing System Reliability by Managing Operational Errors in Dispatch Centers”* by Markus Blaettler, Vincent Isoard, Pasi Lethonen, Sarah Lutterodt and Dirk Visser on behalf of Working Group 39.03, CIGRE 39-306, Session 2002
- [23]. *“Consequences of Control Centre Re-Organization for Operators and Their Performance”* by S. Allamby, M. Blaettler, G. Krost, S. Lutterodt, Z. Malek, A. Mendonca De Oliveira, and D. Visser on behalf of WG C2 – 03, CIGRE C-2 303, Session 2004
- [24]. *“Interfaces Between System Operators, Market Operators And Other Market Actors”* by O. Gjerde O.B. Fosso J.C. Bae J. Bogas S.J.N. Cisneiros A. Dicaprio, D. Klaar S. Iwamoto H. Lemmens I. Welch M. Uusitalo On Behalf Of JWG C2/C5-05, Session 2006
- [25]. *“Ergonomics in Control Centre Design for Power System”*, Parmod Kumar, Member, IEEE, V.K. Chandna, and Mini S. Thomas, Senior Member, IEEE, 2006
- [26]. *“Human Factors Review of Dispatch Control Centres”*, Charles J. Frank and Robert J. Miller, IEEE Transactions on Power Apparatus and Systems, Vol PAS-101, No. 6 June 1982

## Annex-V

- [27]. *"Improving Human Performance in the Control Center"*, WG 39.03, G Krost, S. Lutterodt, Y. Logeay, R. Knoepfel, R. Skiold, Electra Number 174, October 1997
- [28]. *"Results of Reliability Issue Survey, Rev 1"*, North American Electricity Reliability Corporation, October 24, 2007
- [29]. *"NERC Strategic Plan 2008-2013"*, North American Electricity Reliability Corporation, November 2007
- [30]. *"Value of Independent Regional Grid Operators"*, ISO/ RTO council, November 2005
- [31]. *"Relevance of Knowledge Management at Power System Operation Control Centres in India"*, Vivek Pandey and K. Momaya, 'Productivity' Journal published by National Productivity Council in April-June 2007 issue, Vol.48, No. 1
- [32]. *"Advanced Load Dispatch for Power Systems- Principles, Practices and Economies"* by E. Mariani and S.S Murthy, Springer ISBN 3-540-76167-5
- [33]. [www.nerc.com](http://www.nerc.com)
- [34]. Websites of Central and State Electricity Regulators in India
- [35]. Websites of Load Despatch Centres in India





## **Annex-VI**

### **Report on the Air Traffic Management Services**

A committee has been constituted by Ministry of Power, Government of India, under the chairmanship of Sh Gireesh B. Pradhan, Addl. Secretary, MoP to examine issues relating to manpower, certification and incentives for the personnel employed in Power System Operation at various levels. There are several other services similar to power system operation but the one, which comes closest, is that of Air Traffic Control. In the aviation industry the role of Air Traffic Controllers play a crucial for ensuring safe landing, take-off and flight of aircrafts in the sky. Since the job involves safety of human lives it has to be delivered with utmost precision. This is similar to the job of a system operator who has to ensure secure, reliable and economic operation of the power system.

In order to gain insight into the way in which the ATC services are organized and to draw ideas that could be implemented in Power System Operation, two members of the committee (Shri. Lokesh Chandra and Shri. S. K. Soonee) visited the office of the Director, Air Traffic Management, Airport Authority of India at Rajiv Gandhi Bhawan, Ministry of Civil Aviation, New Delhi on 17<sup>th</sup> July 2008. Subsequently on 08th August 2008, the above members visited the Air Traffic Control Centre at the Indira Gandhi International Airport in New Delhi. These visits were undertaken because of the somewhat analogous working of the Air Traffic Management and the Power System Operation both of which are “mission critical activities”. The committee members tried to understand the selection, training, and incentive scheme for Air Traffic Controllers employed for Air Traffic Management. The information gathered during the interaction with the officials is summarized below.

#### **1. Roles and responsibilities of Air Traffic Management**

Provision of air traffic management services is one of the essential functions of Airports Authority of India (AAI)<sup>1</sup>.

This function is carried out under the direction and control of Director (Operations), who is a whole time Board Member of AAI. The Executive Director (ATM), reporting to Director (Operations), is the head of ATM Directorate. The ATS in-charges are responsible to supervise the provision of ATS at their respective stations and report to the Regional Executive Directors of the region concerned. Thus the hierarchy in Air Traffic Management Group is as under:

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<sup>1</sup> Airports Authority of India is a Statutory Public Sector Undertaking of the Government of India formed by Act 95/1994 of Parliament as amended by AAI Amendment Act 43 of 2003. A Board of Directors consisting of whole time members, as well as part-time members, appointed by the Government of India, governs AAI.

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- ◆ Director (Operation)
- ◆ Executive Director
- ◆ General Manager
- ◆ Joint General Manager
- ◆ Dy. General Manager
- ◆ Sr. Manager
- ◆ Manager
- ◆ Assistant Manager
- ◆ Junior executive

The function to plan, procure, install and maintain navigational and surveillance aids and communication equipments at the airports and at such locations as may be considered necessary for safe navigation of aircraft, is carried out by Communication Navigation and Surveillance (CNS) wing of AAI.

Functions of directorate of Air Traffic Management:

- a. Provision of **Air Traffic Services (ATS)** to all arriving, departing & over flying aircraft over Indian airspace.
- b. Establishment of ATS routes, realignment of existing air routes in consultation with user airlines and international bodies such as International Air Transport Association (**IATA**) and International Civil Aviation Organization (**ICAO**).
- c. Establishment of control zones and control areas and changes to existing control zones and areas.
- d. Establishment of Danger / Prohibited and restricted areas and changes to mentioned areas in coordination with concerned Government Agencies.
- e. Providing Search & Rescue coordination for aircraft in distress
- f. Providing **Aeronautical Information Service (AIS)** as prescribed by ICAO to all domestic and international airlines and ATS of other countries.
- g. Survey of airports, publication of aeronautical maps and charts
- h. Development of **Instrument Approach to Land (IAL)** procedures & IAL charts
- i. Monitor and control of obstructions around airports to ensure compliance with SARPS (standard and recommended practices) of **ICAO**.

## **Annex-VI**

- j. Coordination with International Civil Aviation Organization (ICAO), Regional Office Bangkok and Headquarters Montreal, Canada on matters relating to airspace management, provision of Air Navigation Services and aviation rules and regulations.
- k. Manpower Planning, training and award of ratings to Air Traffic Controllers in conformity with ICAO rules and regulations as stated in Annex 1 (Personnel Licensing).
- l. Monitoring of standards and procedures in the provision of Air Traffic Services.
- m. Investigation of Air Traffic Incidents in coordination with DGCA and taking corrective action thereupon.
- n. Matters related to Aviation Security Monitoring of environmental hazards at airports.
- o. ATM services include provision of air traffic control, aeronautical information
- p. Airspace management, flow management and management of ATC training.
- q. The ATM directorate at AAI Corporate Headquarters oversees corporate strategy, development of processes and procedures for safety and uniformity in the provision of air traffic services, strategic supervision of the provision of air traffic services, training and rating of air traffic controllers, including refresher training, coordination with other concerned organizations in and outside India. The ATM directorate has also been assigned the responsibilities related to the provision of Airport Fire Services, Aeronautical Information Services, Cartography Services and Search & Rescue Services.

### **2 Operational supervision**

The dynamic application of supervision of air traffic services rests with the ATS in-charges at their respective stations where ATC centers are established for the provision of Air Traffic Services. The ATS In-Charges also receive technical and administrative support and guidance from the regional units in each FIRs as published in Aeronautical Information Publications (AIP).

### **3. Job Description of an Air Traffic Controller**

The daily routine of Air Traffic Controller is very demanding with various factors of safety he has to maintain. The round the clock job of providing air traffic services is divided into shifts manned by established and stable teams. Although the Air Traffic Controller is an individual professional, he is part of a large team. He coordinates with other sectors, other control centres, essentially quite a few other units, while controlling traffic, and yet the Air Traffic Controller is essentially alone when he has to take that decision which is to be taken in splits of second. However, the cooperation and coordination makes it possible for him to

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take correct decision and thus it is the backbone for a smooth and safe working environment.

Sitting like a rock for hours together the stoic Controller has to have an accurate mental map of a dynamic 3-D picture (altitude of an aircraft above the sea level, bearing from a navigational aid, distance from the aid) of the moving aircraft at any point of time. It is indeed a 4-D picture with time occupying the fourth dimension.

Based on the mental picture that he will create, update and foresee with time involved, he has to plan the future course of various aircraft which may have converge or diverge over the navigational aid. It also requires for him to assess the potential problem, priority of tasks, determine and issue appropriate instructions and ensure compliance with them. Controller actually fights against time to implement his decisions.

Apart from deriving information from mental mapping, a controller has to talk and understand aircraft transmissions and issue appropriate instructions mark the flight progress strips and monitor the coordination effected with other adjacent Air Traffic Services (ATS) units. These tasks performed under time pressure are aimed at achieving maximum safety and efficiency.

The nature of job of an Air Traffic Controller demands a very high degree of alertness and capability of decision-making. The Controller's reflexes and his memory has to be honed razor-sharp in order to help him correlate all data instantly to arrive at a decision while resolving air traffic situations. He utilises all his senses while discharging his functions as a Controller. Be it day or night, weekday or a weekend, festival day or a holiday, teatime or dinnertime, the Controller is expected to be in full command of his sensory organs to deal with any situation that may arise during the discharge of his duties.

Here in this job, you got to take decision in splits of second and decision has to be correct only, there is no opportunity of correcting a mistake. And one mistake, one incorrect decision by you, could very easily translate into untimely termination of maybe one thousand lives.

Controller is supposed to remain in full mental alertness at all times. Any lack of response or slackening of vigil on his part while in command can result in disaster and as such he can just not afford the luxury of mental or physical relaxation. Despite tension filled life, what motivates an Air Traffic Controller is a personal satisfaction the job gives which not only holds the highest degree of professionalism but also helps thousands of passengers reach their destinations safely.

So demanding is the job of Air Traffic Controllers that no compromise can be made in respect of their physical as well as mental fitness as a Controller. As such, an intensive training schedule has to be maintained during the entire period of Controller's activity. In order to remain an Air Traffic Controller, it is mandatory that the Air Traffic Controller continuously enriches himself with sound job knowledge, integrate his theoretical knowledge

## **Annex-VI**

with on- the- job practice of air space management, clear examinations and undertake simulation of Air Traffic Control Emergencies conducted from time to time by the training centre.

### **4. Selection/Appointment of ATC**

The ATM (Air Traffic Management) directorate is responsible for determining the operational (ATM) staffing requirements for the country as a whole for staff planning purposes. The staff requirements are worked out taking into account:

- ◆ ATS requirements based on assessment of traffic levels and airspace complexities
- ◆ Number of operational shifts to be operated
- ◆ Fatigue management
- ◆ Training including refresher training needs
- ◆ Leave requirements

Air Traffic Control Officers (ATCs) and ATC Assistants are recruited as per the established recruitment procedures of AAI. The candidates must meet the minimum prescribed qualification requirements. Such candidates have to undergo the selection process, including a competitive examination, personal interview and medical examination.

### **5. Admission Criteria**

- a. Aerodrome Officers' Ab-initio Course
  - i. Graduate in Telecommunication/ Electronic Engineering or Master's Degree in Physics Good Command of English language, both written and spoken. Medical fitness as per ICAO (International Civil Aviation Organization)
  - ii. Voice Test.
  - iii. On-the -job Assessment
  - iv. Oral examination
- b. Aerodrome Assistants' Ab-initio Course

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- i. A Graduate from a recognized University having Physics & Mathematics as main subjects. A good knowledge of English language both written and spoken. Medical fitness as per ICOA standards
- ii. At the end of every training schedule, the trainees have to pass a written examination, as well as practical examination consisting of simulated air traffic control exercises & an oral examination

### **6. Training**

Selected incumbents are nominated to undergo ATC training programmes of prescribed durations, at the Civil Aviation Training College, Allahabad. (C.A.T.C. India). The ATM Faculty at C.A.T.C. conducts following courses:

#### **a. Ab-initio Level Courses**

- i. Aerodrome Officers' Ab-initio Course
- ii. Aerodrome Assistants' Ab-initio Course

#### **b. Refresher - cum – Career Progression Courses**

- i. Aerodrome Control Course
- ii. Approach Control Course
- iii. Area Control Course
- iv. ATCO's Advanced Refresher Course

#### **c. Specialist Courses**

- i. Radar Control Approach Course Search and Rescue Course
- ii. ATC (OJT) Instructional Technique Course
- iii. Required navigation performance/ Area Navigation Application Criteria Course
- iv. Instrument Procedure Designing Course

### **7. On-the-job training and rating**

The ATC Officers, on successful completion of the approved course(s) at Civil Aviation Training College, Allahabad, are required to undergo on-the-job training (OJT) in ATC units at the stations of their posting (preferably on bigger airports) for a minimum of specified period (180 days/90 hours whichever is earlier). At a stretch on the job training is carried out only for 2 hours. Training related to RADAR has to be completed before attaining the age of 47 years. The ATC during OJT have to demonstrate a level of knowledge appropriate to the ATC unit in specified topics for becoming eligible to take the rating

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examination. A rating examination is held after the ATC has built up sufficient confidence and has shown ability to deal with various situations in handling Air Traffic independently. The rating examination consists of a written examination, on-the-job assessment, an oral examination

All ratings are issued subject to the requirements and processes notified in DARA (Defense Aviation Repair Agency) Circulars as amended from time to time.

### **8. Assessments Regular/Periodic**

#### **a. Regular Assessment**

- i. Proficiency assessment at Delhi, Mumbai, Kolkata, Guwahati and Chennai is conducted by respective GM (S&P) / DGM (S&P) / WSOs and at all other stations by the ATS in- charges.
- ii. Proficiency assessment is conducted at regular intervals and it will be ensured that every controller is assessed on all the operating positions for which ratings are held by the controller.
- iii. Individual records of the assessment is maintained at the station concerned and quarterly report sent to GM (S&P)
- iv. ATS in- charge ensures that all the rated controllers spend sufficient time at the operating positions to enable them to maintain satisfactory level of performance.

#### **b. Periodic assessment**

- i. Joint proficiency checks is carried out by a team comprising of officers from the Standardization Division of AAI and officers of the DGCA, once every year, at all the International Airports, the ACC centers and other major airports on rotational basis and with prior intimation. The team is also be responsible to identify operational and/or system deficiency, if any, and report the same to the ATS In- charge for immediate remedial actions before submitting the final report.
- ii. In case it is found that the performance of an air traffic controller is unsatisfactory, his/her rating (s) may be suspended and appropriate corrective training arranged and proficiency reassessed as per laid down procedures.
- iii. Proficiency assessment of air traffic controllers is carried subject to the requirements and procedures notified in different circulars by AAI.

### **9. Medical Requirements (General)**



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- a. As per ICOA standard
- b. Medical check up every three years after attaining the age of 40 and every year after attaining the age of 45.

### **10. Duty hours/ Rosters**

42 hours per week.

Typical roster of ATC at Indira Gandhi International Airport, New Delhi

**Day 1:** 1:30 to 07:30-Evening duty

**Day 2:** 07:30 to 01:30- Morning duty

**Day 3:** 07:30 evening to 07:30 of next day –Night duty

**Day 5:** again 01:30 to 07:30 -Evening duty

Every 2 hour it is mandatory to take rest for 40 minutes in rest rooms.

At bigger airports like IGI (Delhi) /Santa Cruz (Mumbai) 45 executives work in one shift.

### **11. Leave details**

30 casual leave in a calendar year. Only 8 leaves can be availed at a time

### **12. Allowances**

#### **a. Rating Allowance:**

A rating examination is held after the ATCO has built up sufficient confidence and has shown ability to deal with various situations in handling Air Traffic independently. The rating examination consists of:

- ◆ A written examination
- ◆ On-the -job Assessment
- ◆ An oral examination

All ratings are issued subject to the requirements and processes notified in DARA Circulars as amended from time to time. If an ATCO qualifies the examination, he is paid rating allowance. To keep the rating allowance active one has to work for minimum stipulated hours every six months.

#### **b. Stress allowance:**

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All rated ATCs are paid stress allowance if they are directly involved with the operation.

**c. Extra duty allowance:**

ATCs are paid 1500-2000 rupees/4 hours of extra working. However, the management discourages extra duty in view of the stress related to the job.

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	<b>Dimension</b>	<b>Air Traffic Management (ATM)</b>	<b>Power System Operation (PSO)</b>
1	Service	Air travel	Delivery of electrical power/energy
2	Government body	Ministry of Civil Aviation	Ministry of Power
3	Regulatory body	Director General of Civil Aviation	Electricity Regulatory Commission
4	Management	Directorate of ATM	Central / State Transmission Utility
5	Tariff setting	Competition	Competition, Regulation
6	Market players	Public and private airlines	Public and private utilities
7	Inter-control area Harmonization	International Civil Aviation Organization Director General of Civil Aviation	Regional Power Committees/ sub-committees Forum of Regulators
8	Operation units	Air Traffic Control units	Load Despatch Centres
9	Personnel	Air Traffic Controllers	Power System Operator
10	Compliance to	Standards, protocols and procedures	Standards, Grid Code, Regulations, Procedures
11	Situational Awareness	Aeronautical Information Service (AIS) Communication Navigation and Surveillance (CNS)	Supervisory Control & Data Acquisition (SCADA) Energy Management Services (EMS) Network Management Services (NMS)
12	Reference maps	Aeronautical Maps & Charts	Power Maps, Single Line Diagrams
13	Worst failures	Accidents	Blackouts
14	Worst consequence	Loss of human lives	Economic loss and collateral damages
15	Technology deployment	For voice/data communication, surveillance, analysis	For voice/data communication, surveillance, analysis
16	Human involvement	For data interpretation & decision making	For data interpretation & decision making
17	Human challenges	Coordination, Situational awareness, time constraints, uncertainties, stress, failures	Coordination, Situational awareness, time constraints, uncertainties, stress, failures
18	Induction	Special exam conducted for ATC by Airports Authority of India	General exam by respective utilities
19	Eligibility	Graduate engineer	Diploma/ Graduate engineer
20	Admission tests	Written, Oral, Medical and Voice	Written, Oral and Medical
21	Medical norms	IOCA standards, medical check up every three years after attaining the age of 40 and every year after attaining the age of 45	No such common norm
22	Training norms	Uniform, standardized, mandatory	--
23	Completion of training	180 days/ 90 hours minimum on-the-job training before posting Rating exams	--
24	Quality assurance	Certification, proficiency tests	--
25	Duty hours	42 hours per week, 40 minutes rest after 2 hours	Different norms in different LDCs
26	Special allowances	For stress, extra duty and for rating acquired in assessment tests	Night shift allowance only in some LDCs

## **Annex-VII**

### **Report on the Survey of LDCs in India**

#### **1.0 Introduction**

Power System Operation is better known as Load Despatching in India and the place from where it is carried out are known as Load Despatch Centres (LDCs). Survey of all State, Regional and National Load Despatch Centres (LDCs) was conducted to assess and document the

- o Profile of personnel employed in LDCs;
- o Infrastructure/logistics/amenities available in LDCs

#### **2.0 Methodology adopted**

The survey was conducted with the help of 34 volunteers from various Regional Load Despatch Centres who visited the SLDCs within their regions. There were two sets of questionnaires to be filled by respondents in LDCs. One set contained 73 multiple choice questions while the second set contained 14 questions. The first set was to be filled by the respondent in LDCs while the second set was to be filled by the volunteer who conducted the survey. The questionnaire to be filled by the volunteers contained questions regarding the logistics and infrastructure facilities available in the LDCs. The list of volunteers who coordinated the survey is enclosed. All the responses received were coded and analysed with the help of the trial version of Statistical Program for Social Sciences which is popularly known as SPSS.

#### **3.0 Sample size**

Total 37 out of 39 control centres were surveyed and 777 responses were received. The control centres / offices of Arunachal Pradesh and Sikkim could not be covered as these were inaccessible due to heavy rains and floods. The control centres and the number of responses received from each control centre are tabulated below:

##### **3.1 Responses from National/ Regional LDCs**

<b>S No.</b>	<b>Control Center</b>	<b>No. of responses</b>
1	NLDC	21
2	NRLDC	28
3	WRLDC	29
4	ERLDC	37
5	SRLDC	33
6	NERLDC	24
	<b>Sub-Total</b>	<b>172</b>

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### 3.2 Responses from SLDCs in Northern Region

S No.	Northern Region	No. of responses
1	Punjab	25
2	Haryana	14
3	Rajasthan	33
4	Delhi	24
5	Uttar Pradesh	33
6	Jammu & Kashmir	18
7	Uttarakhand	12
8	Himachal Pradesh	21
9	Bhakhra Beas Management Board #	20
10	UT-Chandigarh*	1
	<b>Sub-Total</b>	<b>201</b>

\*SLDC of UT-Chandigarh is operating with limited facilities.

# Bhakra Beas Management Board (BBMB) has a control centre at Chandigarh that coordinates the water releases and the dispatch of hydro power stations of Bhakra, Dehar, Pong, Ganguwal and Kotla that are jointly owned by Punjab, Haryana, Rajasthan and Himachal Pradesh. Few interstate lines between these states that form a part of the Inter State Transmission System are also operated and maintained by BBMB. The O &M expenses are shared by the partner states.

### 3.3 Responses from SLDCs in Eastern Region

S No.	Eastern Region	No. of responses
1	West Bengal	20
2	Jharkhand	19
3	Orissa	25
4	Bihar	19
5	Damodar Valley Corporation #	14
6	Sikkim*	0
	<b>Sub-Total</b>	<b>97</b>

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# Damodar Valley Corporation (DVC) has a well defined control area in Eastern Region. DVC has its own generation, transmission and distribution system to meet its load.

\*SLDC at Sikkim is operating with very limited facilities.

### 3.4 Responses from SLDCs in Western Region

S No.	Western Region	No. of responses
1	Chattisgarh	19
2	Madhya Pradesh	18
3	Maharashtra#	52
4	Gujrat	10
5	Goa	1
6	UT Daman & Diu*	0
7	UT Dadra & Nagar Haveli*	0
	<b>Sub-Total</b>	<b>100</b>

#In Maharashtra out of the 52 responses, 30 were received from SLDC- at Kalwa and other 22 were received from the Area Load Despatch Centres situated in Nagpur and Ambazari.

\* UT Daman & Diu, Dadra & Nagar Haveli are yet to have a full fledged control centres like the other SLDCs.

### 3.5 Responses from SLDCs in Southern Region

S No.	Southern Region	No. of responses
1	Andhra Pradesh	37
2	Tamil Nadu	35
3	Karnataka	29
4	Kerala	34
5	UT-Puducherry	16
	<b>Sub-Total</b>	<b>151</b>

UT of Andaman-Nicobar and Lakshdweep islands are yet to have a full fledged control centres like the other SLDCs.

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### 3.6 Responses from SLDCs in North-Eastern Region

S No.	North-Eastern Region	No. of responses
1	Manipur	5
2	Meghalaya	8
3	Mizoram	10
4	Nagaland	2
5	Assam	16
6	Tripura	15
7	Arunanchal Pradesh#	0
	Sub-Total	56

# Survey of Arunachal Pradesh could not be carried out within the stipulated time due to heavy rains and floods.

#### 4.1 Summary of respondents who participated

Total number of respondents: 777

Responses received from SLDCs: 605

Responses received from RLDCs/NLDC: 172

Age profile

S No.	Age group	No. of responses
1	20 to 25 years	28 (4 %)
2	25 to 35 years	167 (21 %)
3	35 to 45 years	241 (31 %)
4	45 to 55 years	264 (34 %)
5	More than 55 years	77 (10 %)
6	Total	777 (100 %)
7	The number of respondents above 45 years	341 (44 %)

## Annex-VII

Position of the respondent within their respective organizations

S No.	Management level	No. of responses
1	Lower	351 (45 %)
2	Middle	311 (40 %)
3	Senior	66 (8.5 %)
4	Top	23 (3 %)
5	No response	26 (3.5 %)

### 4.2 Composition of workforce, skills and domain knowledge

44 % of the population surveyed is above 45 years of age and the middle management constitutes 40 % of the population. This means that in the next 10-15 years more than 40 % of the current population in LDCs would retire. It clearly demonstrates the need for aggressive recruitment to replace the aging workforce. The discipline of the respondents during graduation and their subsequent experience in the power sector industry is tabulated below:

#### Skills and domain knowledge of workforce

S No.	Discipline	No. of respondents
1.	Electrical	586 (76 %)
2.	Electronics	75 (10 %)
3.	Mechanical	50 (6 %)
4.	Computer Science	12 (1.5 %)
5.	Instrumentation	14 (1.8 %)
6.	Others Engineering streams, Humanities, etc.	35 (4.7 %)
7	Total	777 (100 %)



## Annex-VII

### Work experience

		Less than 1 year	1 year to 10 years	10 years to 20 years	More than 20 years	No Experience
1.	In LDC	146 (19 %)	460 (59 %)	122 (16 %)	49 (6 %)	-
2.	Past experience in Generation	30	142	56	15	534 (69 %)
3.	Past experience in T & D	33	241	102	46	355 (46 %)

### 4.3 Environment of learning in the LDCs in India

The highest qualification of the 777 respondents has been tabulated below:

S No.	Highest qualification	No. of responses
1	Diploma	122 (16 %)
2	Graduate	491 (63 %)
3	Postgraduate	155 (20 %)
4	Doctorate	1
5	Others	8 (1 %)
	Total	777 (100 %)

**593 (76 %)** persons are of the opinion that **acquiring higher qualification** is important and they are interested as well. However **529 (68 %)** of the population say that they have neither acquired any higher qualification nor are they pursuing it. This is also borne out by the fact that only **20 %** of the population surveyed has a **post graduation degree** and only **1 person** out of the 777 has a **doctoral degree**. Further 527 (67 %) persons feel that they are lightly loaded as far as the work volume is concerned. This implies that the work load is not a hindrance for pursuing higher studies. It appears that there is a general lack of favourable atmosphere within the organization for learning and acquiring new knowledge.

**578 (74 %)** of those surveyed had either none or just one opportunity for training. Only 130 (17 %) persons say that the training that they attended in last one year was greater than 1 week. In other words the **minimum norm of 1 week training** as per the training policy of the government is also **not being adhered to in case of 83 %** of the respondents. The only heartening fact in case of training practices at LDCs was that 60 % of the population has had an opportunity to visit a foreign country in official capacity at least once.

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Long duration of systematic and careful mentoring is required for developing good system operators. However only **79 (10 %)** of fresh engineer have **access to structured training** in system operation. **53 %** of the control centres **do not have a library**. In 47 % of control centres where library is available **23 %** do not have suitable books to cater to the needs.

All the above indicates that lot of efforts need to be done to transform the LDCs into learning organizations. A nation wide initiative similar to the Distribution Reforms Upgrades and Management (DRUM) project needs to be undertaken to achieve the desired results in system operation. Training needs to be made a mandatory requirement and the regulatory commissions could monitor compliance. The situation also needs immediate attention because more than 40 % of the population is above 45 years of age. Measures need to be taken to document the collective wisdom of the outgoing workforce. The knowledge and experience of the seniors need to be transferred to the new generation. Systems for knowledge management need to be developed to preserve what is already known.

### 4.4 Working environment, nature of work and the volume of work in LDC

More than 75 % respondents say that the working environment and seating arrangement within their control centre is comfortable. Desktop PCs, telephones and internet connection are available for all executives in more than 50 % of the control centres.

**681 (88%)** of the respondents say that the nature of **work at their LDC is challenging and interesting**. **587 (76 %)** say that they like to work in the LDC because of the all round **exposure** that they get in LDCs. **551 (71%)** of the respondents **desire to continue working in LDCs**. All this indicates that the respondents enjoy working in LDCs. However **527 (68%)** of the respondents say that the **work volume is “too little”**. This could be either due to poor work delegation, succession planning and/or absence of role clarity at LDCs. In the deficit scenario prevailing in India the system operators LDC have been involved mostly in load management and rostering. This situation continued for years together with the result that other statutory functions of the LDCs have taken a backseat. Operators who historically has been controlling frequency through load shedding and restoration of feeders might have gradually come to believe that this is all that is required from the LDC function. The situation needs to be improved and the LDCs have to give due attention to other functions like security monitoring, facilitation of open access, system protection coordination, contingency analysis, offline studies, disturbance analysis etc.

### 4.5 Operating aids and the capability to use them

The system operators are subjected to immense physiological and mental stress. Stress in the LDC results primarily from the need to respond to the unforeseen and random events. The operator is likely to experience pressure in situations where demands for power or quick decision making exceeds his capability to respond and where the operator sees that failing to bridge the imbalance would have serious safety or economic

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consequences. The other sources of stress could be deadlines and time pressure, system alarms, shifting quickly from periods of little activity to periods of peak activity, operational protocols and work schedules, skills/capabilities incommensurate with the job requirement. There are few positions in the industry that have similar consequences interwoven with daily activities; one similar occupation is Air Traffic Control.

A lot of the factors mentioned above would require initiatives at the macro level. The capacity addition, renovation and maintenance program and reform initiatives are a part of these efforts. At the organizational level the system operators have to be equipped with appropriate IT enabled applications and decision support tools and the training to use them.

All the LDCs are equipped with SCADA systems. The operators have to use it for effective supervision of the power system. The first step is the ability to log in and out of the SCADA system and the second step is the ability to navigate in the system to obtain the desired information. Each and every engineer posted at the LDC must be capable of doing this. However **126 (16 %) respondents** say that the executives in their control centres **cannot login in the SCADA system**. Likewise on an average 88 (11 %) persons are not comfortable with the MS-Office applications such as MS-word, MS-Excel and MS-Power point. This situation needs to be corrected and every person in the LDC must be a computer literate and proficient in at least these IT applications.

### 4.6 Opinion on certification and need for ethics, transparency and neutrality of LDCs

S No.		Strongly Agree	Agree
1.	Need for certification for improving overall standards of system operation	412 (53 %)	310 (40 %)
2.	Ethics are important in System Operation	392 (50 %)	312 (40 %)
3.	Non-discrimination and transparency are important in system operation	512 (66 %)	223 (29 %)

Presently, there is no “Certification” requirement for becoming a system operator unlike other mission critical operations such as Air Traffic Management. In most of the other countries it is a mandatory requirement to have a certificate for working in specific area with in system operation. There was an overwhelming response in favour of having a similar practice in India. **93 %** of the population surveyed agrees that certification would improve the overall standards of system operation in the country.

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More than 90 % of the population believes that ethics, transparency and neutrality are important in system operation.

### 4.7 Infrastructure and other amenities available in LDCs

The questions covered feedback on the working environment, availability of rest rooms, library, conference rooms, desktop PC, internet access, telephone, transport facility after night shift and canteen facility. Total 34 volunteers provided their opinion on above issues. Summary of responses are tabulated below:

#### 4.7.1 Work environment, working space and seating arrangement:

S No.	Facility	Comfortable	Uncomfortable	Can't Say
1.	Work environment	85 %	9 %	6 %
2.	Work space	79 %	18 %	3 %
3.	Seating arrangement	76 %	15 %	9 %

#### 4.7.2 Rest room, Library, Conference room and Canteen

S No.	Facility	Not available	Available & comfortable/ useful	Available but uncomfortable/ inadequate
4.	Rest room	53 %	32 %	15 %
5.	Library	53 %	24 %	23 %
6.	Conference room	41 %	44 %	15 %
	Canteen at least with facility for tea/coffee	62 %	9 %	29 %

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### 4.7.3 Desktop PCs, Internet Access, Telephone

S No.	Facility	Available for all	Available but only for few	Can't say
7.	Desk top PCs	56 %	32 %	12 %
8.	Internet Access	65 %	29 %	6 %
9.	Telephone	76 %	21 %	3 %

### 4.7.4 Inference

The LDC offices operate round the clock with people coming in rotating shifts. These engineers work in unconventional hours and encounter most difficulty in adjusting their physiological circadian rhythms to their work schedules. The real-time operators are assisted by offline engineers to ensure continuity in operation strategy. During contingencies often these engineers also are called upon at odd hours to augment the rotating shift. To address the physiological needs of system operators they must have access to amenities that make them comfortable at workplace. However it is distressing that 53 % of the control centres do not have restroom and 62 % do not have a canteen even with minimum arrangement of tea / coffee. All the control centres are located in cities or state capital. Only 4 % have township near the control centres, which means that the engineers at 96 % of control centres have to commute long distances to attend duty. Public transport may often be not available at odd hours and holidays especially when one has report at the LDC for night shift. Similar situation may arise when the LDC-person has to go back to his residence after night shift. These persons may not be in their best condition to drive their own vehicles. However 67 % of the control centres do not have official pick up or drop facility for night shift.

System operators are required to coordinate with different utilities within their jurisdiction. Discussions, meetings and technical presentations, brainstorming sessions are a part and parcel of a system operator's life. However 41 % of the control centres do not have a conference room, which implies that the above activities cannot be taken up conveniently. A library is not available at 53 % of the control centres while 23 % have it but they are not equipped with suitable reference books. This indicates that the either the control centres are severely constrained with funds to provide these facilities or there is a lack of awareness regarding these needs.

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List of volunteers from various RLDCs who coordinated the survey

S No.	Name (Mr./ Ms. )	Designation	LDC covered
1.	P. Pentayya	D.G.M., WRLDC	WRLDC
2.	V. A. Murthy	D.G.M. ,WRLDC	Madhya Pradesh
3.	A. Anbunesan	D.G.M., WRLDC	Gujrat
4.	R. K. Dutta	D.G.M., WRLDC	Maharashtra & Goa
5.	S. Ganguly	Chief Manager, WRLDC	Chattisgarh
6.	R. Sutradhar	Chief Manager, NERLDC	Manipur
7.	A. Mallick	Chief Manager, NERLDC	Meghalaya
8.	N.R. Paul	Chief Manager, NERLDC	Tripura, Assam
9.	V. Kaikhochin	Chief Manager, NERLDC	Mizoram
10.	Shiekh Shadrudin	Dy. Manager, NERLDC	Nagaland
11.	D. K. Srivastava	D.G.M., ERLDC	ERLDC, Bihar
12.	S. K. Hazra	Chief Manager, ERLDC	Jharkhand
13.	T.K. Mandal	Manager, ERLDC	DVC
14.	P. S. Das	Manager, ERLDC	Orissa
15.	P. Mukhopadhyay	D.G.M., ERLDC	West Bengal
16.	D. K. Jain	D.G.M., NRLDC	Punjab & Uttar Pradesh
17.	Gurmit Singh	Sr. Engineer, NRLDC	Punjab
18.	P.R. Raghuram	G.M., NRLDC	Haryana, H.P., BBMB & UT - Chandigarh
19.	Alok Kumar	Dy. Manager, NRLDC	
20.	P. K. Agrawal	D.G.M., NRLDC	Rajasthan
21.	Neeraj Kumar	Dy. Manager, NRLDC	Rajasthan
22.	O.N. Mondal	D.G.M. , NRLDC	Delhi
23.	Vineeta Agrawal	Chief Manager, NRLDC	Delhi
24.	Vivek Pandey	Dy. Manager, NRLDC	Uttar Pradesh, NRLDC
25.	A.K. Agrawal	D. G. M., NRLDC	Uttarakhand
26.	Rajesh Kumar	Manager, NRLDC	Uttarakhand
27.	S.R. Narasimhan	Chief Manager, NRLDC	Jammu & Kashmir
28.	U.K. Verma	D.G.M. SRLDC	SRLDC
29.	B. R. Ganesh	Chief Manager, SRLDC	Kerala
30.	S. P Kumar	Chief Manager, SRLDC	Karnataka
31.	M.K. Ramesh	Manager, SRLDC	Tamil Nadu & Puducherry
32.	V. Suresh	Chief Manager, SRLDC	Andhra Pradesh
33.	Kaushik Dey	Engineer, NLDC	NLDC



## **Annex-VII**

No. 6/2/2008-Trans  
Government of India  
Ministry of Power

....

Shram Shakti Bhawan, Rafi Marg,  
New Delhi, the 2nd June, 2008

To  
The Secretary (Energy)  
Government of .....

Sub: Survey of Load Despatch Centres in India

A committee has been constituted by Ministry of Power, Government of India, under the chairmanship of Shri Gireesh B. Pradhan, Additional Secretary, Ministry of Power to examine issues relating to manpower, certification and incentives for the personnel employed in System Operation at various levels.

It has been desired by the committee to conduct a survey with the help of a questionnaire to be filled by the persons in system operation at state, regional and national level. Kindly extend your cooperation in conducting this survey.

Yours faithfully

(Lokesh Chandra)  
Director  
Tel: 2371 5250

Encl: As above





## Annex-VII

### Survey of Load Despatch Centres in India

**Dear respondent,**

Section 28, 29, 31 & 32 of the Electricity Act 2003 designate Load Despatch Centres (LDCs) as apex bodies to ensure integrated operation of power systems within their area of jurisdiction. The Act clearly states that the LDCs are responsible for operating the power system with security, economy and efficiency. Thus the statute places a huge responsibility on the LDCs. Central Electricity Regulatory Commission in its order dated 07<sup>th</sup> May 2008 (suo motu petition number 58/2008) has elaborated on the personnel related obligations of a State and Regional Load Despatch Centres.

A committee has been constituted by Ministry of Power, Government of India, under the chairmanship of Sh Gireesh B. Pradhan, Addl. Secretary, MoP **to examine issues relating to manpower, certification and incentives for the personnel employed in System Operation at various levels**. This survey is being carried out under the direction of the Committee and the information gathered would be forwarded to the Committee.

Please take a few minutes to fill in this questionnaire. Your participation is completely voluntary and your identity would be kept completely confidential.

**Please return the response to .....**

Thank you for your time and support!



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**Please tick the option most appropriate in your case**

**1. Personal details**

<b>i) Present workplace</b>	<b>ii) Age</b>	<b>iii) Highest qualification</b>
<ul style="list-style-type: none"> <li>♦ National Load Despatch Centre</li> <li>♦ Regional Load Despatch Centre</li> <li>♦ State Load Despatch Centre</li> </ul>	<ul style="list-style-type: none"> <li>♦ 20 to 25 years</li> <li>♦ 25 to 35 years</li> <li>♦ 35 to 45 years</li> <li>♦ 45 to 55 years</li> <li>♦ &gt;55 years</li> </ul>	<ul style="list-style-type: none"> <li>♦ Diploma</li> <li>♦ Graduate</li> <li>♦ Postgraduate</li> <li>♦ Doctorate</li> <li>♦ Others</li> </ul>

**iv. Discipline during graduation/diploma**

<b>Engineering</b>	<b>Humanities</b>	<b>Others</b>
<ul style="list-style-type: none"> <li>♦ Electrical</li> <li>♦ Electronics</li> <li>♦ Instrumentation</li> <li>♦ Computer</li> <li>♦ Telecommunications</li> <li>♦ Mechanical</li> <li>♦ Civil</li> <li>♦ Others</li> </ul>	<ul style="list-style-type: none"> <li>♦ Economics</li> <li>♦ Law</li> <li>♦ Management</li> <li>♦ Others</li> </ul>	<ul style="list-style-type: none"> <li>♦ Science</li> <li>♦ Others</li> </ul>

**v. Position in the organization**

- ♦ Top (Chief Engineer & above/General Manager & above)
- ♦ Senior (Superintending Engineer/Addl. General Manager/Dy. General Manager)
- ♦ Middle (Executive Engineer/Chief Manager/Manager)
- ♦ Assistant Engineer/ Supervisor to Dy. Manager
- ♦ Others please specify.....

**vi. Total work experience (Please tick in appropriate box in each row)**

	<b>Less than 1 year</b>	<b>1 year to 10 years</b>	<b>10 years to 20 years</b>	<b>More than 20 years</b>
In Load Despatch Centre				
In generation				
In transmission & Distribution				
In regulatory Commission				
In other industry/department				
Total				

## Annex-VII

2. Mission critical services are those where failure of execution or faulty execution may have far reaching effects. System Operation is a mission critical service. Please tick in the column closest to your opinion

S No.	Statement	Strongly Agree	Agree	Neither Agree nor disagree	Disagree	Strongly disagree
a.	Professionals such as aircraft pilots who are involved in mission critical services undergo rigorous training and certification process before taking up responsibility. Adopting a similar approach in system operation would improve the overall standards of system operation in India.					
b.	Power system operation is a public service where ethics are very important					
c.	System Operator must carry out his duties in a transparent and non-discriminatory manner					

### 3. Acquiring higher qualification

- a. Your opinion on acquiring higher qualification

- ◆ Yes, I feel it is important and I am interested
- ◆ Yes, I feel it is important but I am not interested
- ◆ No it is not required therefore I am not interested
- ◆ No it is not required but still I am interested
- ◆ Can't say

- b. Support from the organization for acquiring higher qualification

- ◆ Not allowed in my organization
- ◆ Only correspondence or part-time course course is allowed
- ◆ Even study leave can be easily availed for pursuing full time course
- ◆ Don't know/Can't say

## **Annex-VII**

- c. Your action regarding acquiring higher qualification
  - ◆ Yes I have applied for/ pursuing/completed
  - ◆ No I have not applied for/ pursuing/completed/ not relevant/not interested

### **4. Career progression within your organization**

- a. Recruitment in your organization is
  - ◆ Direct at induction level
  - ◆ Lateral
  - ◆ Deputation
  - ◆ Others
- b. Mode of promotion up to Superintending Engineer or Addl. General Manager level is
  - ◆ Vacancy based
  - ◆ Normal progression
- c. As per your assessment the criteria for promotion (up to Executive Engineer/ Sr.Manager) in your organization is
  - ◆ Merit based
  - ◆ Seniority based
  - ◆ Merit cum seniority based

### **5. Professional engagements**

- a. Number of opportunities to attend development programs such as training, conferences, seminar, meetings, workshops, regulatory commission hearings etc.
  - ◆ More than one every year
  - ◆ At least one every year
  - ◆ None
- b. Duration of development programs/ training attended in last one year
  - ◆ More than one week
  - ◆ Less than one week

## **Annex-VII**

- ◆ Nil

c. Official foreign visits for training, workshop, conference, testing etc.

- ◆ More than one every year
- ◆ One every year
- ◆ Occasionally
- ◆ None

### **6. In your opinion the quantity of work in your load despatch is**

- ◆ Adequate
- ◆ Too much
- ◆ Too little

### **7. In your opinion the nature of work in your a load despatch is**

- ◆ Challenging and interesting
- ◆ Just like in any other office
- ◆ Monotonous and boring

### **8. The best thing that you like about your LDC**

- ◆ It is located in a city and almost all facilities like hospital, schools, recreation, shopping are available
- ◆ It provides a very good exposure of several aspects such as technical, social, commercial, economics, political
- ◆ It is a small place and you know every body
- ◆ All of the above and other reasons as well

## Annex-VII

### 9. Your opinion about your load despatch centre (Please tick option closest to your opinion))

S No.	Statements	Strongly Agree	Agree	Neither Agree nor disagree	Disagree	Strongly disagree
a.	Simulation/ System studies are carried out in your load despatch centre before approving a major shut down					
b	Whenever an emergency shut down is to be approved the concerned switching/network diagram is seen always					
c.	Requisition from ISGS is prepared by only seeing previous day's figures and open access transactions					
d.	Requisition from ISGS are filled after carrying out load forecasting most of the time					
e.	Tripping time of a transmission line or generating unit is most of the time seen from the Exception list, Sequence of Events					
f.	Instructions for generation backing down given from your control room to the generating stations within your jurisdiction are complied always					
g.	Transfer capability of your system is assessed regularly					
h.	Transfer capability is checked before finalising the schedules					
i.	Important data regarding power flow, energy, frequency, voltage etc. is stored mostly in electronic form					
j.	Most of the data required for preparing reports for senior officials is obtained from paper files / logsheets etc.					
k.	After major disturbance in your system SoE records are taken out and analysed					
l.	Responsibility of technical feasibility for planned shut down of elements within your system is with staff in general shift					
m.	Feeders opened in your shift for load shedding are generally restored before the end of the shift					



## **Annex-VII**

### **10. A young engineering graduate who is posted in your LDC**

- ◆ Makes all efforts to continue to be posted there as long as possible
- ◆ Makes all efforts to move out to a different place as soon as possible
- ◆ Is transferred outside LDC within one or two years
- ◆ Joins a different organization after some time

### **11. If a young engineering graduate is posted in your LDC he is**

- ◆ Posted in shift operation within one a few days/weeks
- ◆ Posted in shift operation after he has worked in general shift
- ◆ Generally not posted in shift
- ◆ Can't say

### **12. If a new person (young or old) is posted at your LDC, he**

- ◆ Undergoes structured training in system operation (within or outside LDC)
- ◆ Learns his job on his own as he works along
- ◆ Is attached with a person who continuously guides him formally / informally and ensures that he quickly grasps all aspects of system operation

### **13. In case someone you know has two offers one at your load despatch centre and second in some other department in the same city with similar salary and compensation you would**

- ◆ Strongly recommend him to choose your LDC
- ◆ Recommend him to join the other department
- ◆ Leave it for him to take his own decision
- ◆ Can't say

### **14. If you had a choice you would like to work in**

- ◆ Same department within Load Despatch Centre
- ◆ Other department within Load Despatch Centre
- ◆ In power sector but outside Load Despatch Centre
- ◆ Any other industry

## Annex-VII

### 15. Your opinion about other executives in your Load Despatch Centre (Tick the box which is closest to your opinion)

S No.	Statement	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly disagree
a.	Most executives in your LDC can Log in / log out of the SCADA system without help from others					
b.	Most executives in your LDC can open switching diagrams, network diagrams, summary diagrams etc. in the SCADA system without help from others					
c.	Most executives in your LDC can Retrieve data from SCADA system without help from others					
d.	Most executives in your LDC can Draw the network of their system (at least up to 220 kV) by heart					
e.	Most executives in your LDC can draw the 400 kV network of their region by heart					
f.	Most executives in your LDC can prepare a report in Microsoft Word regarding anticipated power supply position without help from others					
g.	Most executives in your LDC can confidently work in Microsoft excel					
h.	Most executives in your LDC can check their email without help from others					
i.	Most executives in your LDC can surf the internet without help from others					
j.	Most executives in your LDC can prepare a 10-slide presentation in Microsoft Power Point without help from others					
k.	Most executives in your LDC can retrieve SoE data from SCADA system without help from others					
l.	Most persons coming in shift					

## **Annex-VII**

16. Which activity takes up or consumes more than 50 % of the time the control room of your load despatch centre

- ◆ Opening /Restoring feeders and attending calls regarding the power supply position
- ◆ Supervision of system parameters, contingency analysis, reactive power management
- ◆ Preparation of daily or exceptional reports
- ◆ Others

17. Instructions for generation backing down given from your control room to the generating stations within your jurisdiction

- ◆ Are complied only after the higher officials from your organization exert pressure on the higher officials of the generating station
- ◆ Are complied sometimes but not always
- ◆ Are complied immediately by the generating stations
- ◆ Not complied at all

18. When most of the system parameters (frequency, voltage, line loading etc.) are normal and you see an abnormal value on the SCADA display, you try to investigate yourself (Cross checking, validating) and report/document if no solution is found

- ◆ Report to the concerned SCADA personnel immediately
- ◆ Simply record it in log book or register and forget about it
- ◆ Ignore it as you consider it to be someone else's job
- ◆ Can't say

19. You look at the alarms displayed in the SCADA system

- ◆ Frequently
- ◆ Once a while
- ◆ Only when brought to your notice by someone else
- ◆ Never as it is not important
- ◆ Don't know about it
- ◆ Can't say

## **Annex-VII**

20. In case a shutdown is requested by any agency for the same day in your shift then you

- ◆ Approve immediately by issuing a code/message/telephonic instruction
- ◆ Discuss all concerned (internal and external) and then approve
- ◆ Discuss only with higher-officials
- ◆ Postpone it for the next shift

21. While handing over the shift to the next group

- ◆ Inform only the feeders to be opened or restored
- ◆ Nothing special is done as everything is available in SCADA system
- ◆ Everything is explained verbally only
- ◆ Everything is written in log book and also explained verbally

22. While taking over the shift from other group you

- ◆ Only read the log book
- ◆ Simply see the system parameters
- ◆ Discuss with shift personnel in other RLDC/SLDC

23. In case of system contingency you

- ◆ Discuss within your team and take corrective action immediately
- ◆ Immediately inform the higher up and respond as per their instruction
- ◆ Do not do anything till other load despatch centre advises/requests

24. After issuing an switching instruction you

- ◆ Keep track of it till it is implemented
- ◆ Concentrate on other activities and let the field staff implement it on their own
- ◆ Cancel the code if the operation is not done within reasonable time

25. Operation reports prepared during the shift are checked

- ◆ Only by person preparing the report
- ◆ Only by the shift in-charge
- ◆ Only by higher ups
- ◆ By more than one of the above

## **Annex-VII**

11. When the grid is perfectly normal the discussion within or other LDC is regarding

- ◆ New elements commissioned and future planning/expansion of power system
- ◆ System conditions in the past few hours and the likely scenario till the end of shift
- ◆ Subjects other than system operation

12. If you want to know the bus arrangement in a substation without calling the substation you

- ◆ Would refer a written document
- ◆ Would ask the concerned SCADA personnel
- ◆ Would ask your shift-in-charge since you are sure he knows it
- ◆ Would obtain from SCADA displays without anybody's help

13. Your comments and suggestions to enhance the standard of system operation in India

.....  
Your responses would be kept completely confidential

Thank you for time and support!

## Annex-VII

### Feed back form to be filled by RLDC volunteers visiting the SLDC

#### Dear volunteers,

Thank you for taking up this initiative. This survey is an attempt to assess and document the variance between current capabilities/resources and those required for fulfilling these statutory responsibilities by the LDCs in the country. The objectives of this survey are briefly stated below:

- ◆ To assess the profile of the personnel involved in System Operation in India
- ◆ To assess the infrastructure/logistics/amenities available at LDCs in India
- ◆ To assess the motivational level of the persons posted at LDCs
- ◆ To assess the extent up to which the functions of system operator are carried out at various LDCs in the country

#### Sample size:

The survey would include the entire population of executives posted in National/Regional/State Load Despatch Centre in India.

Volunteers may fill in their opinion about the following facilities in the load despatch centre that he/she has visited. Name of the LDC.....

### 29. Basic infrastructure and amenities

S No.		Comfortable	Uncomfortable	Can't say
a.	Work environment is			
b.	Work space is			
c.	Seating arrangement is			

d. Rest rooms for personnel working in shift is

- ◆ Available and comfortable
- ◆ Available but uncomfortable
- ◆ Not available/Can't say

e. Library is

- ◆ Available and useful
- ◆ Available but inadequate
- ◆ Not available

f. Conference room is

- ◆ Available and equipped with LCD projector
- ◆ Available but no LCD projector
- ◆ Not available

## **Annex-VII**

- g. Desktops for offline work are available
  - ◆ For all executive
  - ◆ For few executives
  - ◆ Not required (Manual system)
- h. Internet access for checking e-mails is available
  - ◆ For all executive
  - ◆ For few executives
  - ◆ Can't say
- i. Type of internet access is
  - ◆ Broadband
  - ◆ Dial up
  - ◆ Not available
- j. PSTN telephones for local call is available
  - ◆ For all executive
  - ◆ For few executives
  - ◆ Can't say
- k. Official transport facility after attending night shift is available
  - ◆ Available
  - ◆ Not available
  - ◆ Can't say
- l. Official transport facility after attending night shift is available
  - ◆ For all executive
  - ◆ For few executives
  - ◆ Not relevant
- m. Official transport facility after attending night shift is available
  - ◆ Up to residence
  - ◆ Up to convenient point
  - ◆ Not required
- n. Official canteen where one can get at least tea/coffee is
  - ◆ Available round the clock
  - ◆ Available only during day time
  - ◆ Not available

Thank you for your efforts !

## **Annex-VIII**

### **Chronology of development of electricity laws in India related to the Load Despatch function**

#### **A. No mention of load despatch in the electricity laws till 14<sup>th</sup> October 1991.**

However, the original Electricity Supply Act 1948 stated that

##### **'55. Licensees to comply with Board's directions'**

Every licensee shall comply with such directions as the Board may, from time to time, give him for the purpose of achieving the maximum economy and efficiency in the operation of Station.'

This provision was amended slightly in 1956 by qualifying the word 'directions' with 'reasonable' and substituting the word 'station' above with 'his undertaking or any part thereof'. The amendment also provided for dispute resolution by the Authority in case of any conflict on the issue of reasonability of directions issued by the Board under the above section.

#### **B. Amendment w.e.f 15th October 1991 in the Electricity Supply Act 1948.**

"[55] :: Compliance of directions of the Regional Electricity Board, etc. by licensees or Generating Companies.

- 1). Every Licensee shall comply with such reasonable directions as the Board may, from time to time give him for the purpose of achieving the maximum economy and efficiency in the operation of his undertaking or any part thereof.
- 2). Every licensee or Generating Company shall follow all the directions of Regional Electricity Board and shall conduct their operation in accordance with the instructions of the Regional Load Despatch Centre so as to ensure integrated grid operation.
- 3) If any dispute arises with reference to the integrated grid operation as to whether any direction given under sub-section (1) or sub-section (2), is reasonable or not, it shall be referred to the Authority, whose decision thereon shall be final; so, however, pending the decision of the Authority, directions of the Regional Load Despatch Centre shall prevail in the interest of smooth operation of the integrated grid."

#### **C. Amendment w.e.f 11th August 1998 to the Electricity Supply Act 1948**

"55. Compliance of directions of the Regional Electricity Board, etc. by licensees or Generating Companies.

- 1). Until otherwise specified by the Central Government, Central Transmission Utility shall operate the Regional Load Despatch Centres and the State Transmission Utility shall operate the State Load Despatch Centre.



## **Annex-VIII**

- 2). The Regional Load Despatch Centre shall be the apex body to ensure integrated operation of the power system in the concerned region.
- 3). The Regional Load Despatch Centre may give such directions and exercise such supervision and control as may be required for ensuring integrated grid operation and for achieving the maximum economy and efficiency in the operation of the power system in the region under its control.
- 4). Subject to the provisions of sub-section(3), the State Load Despatch Centre in a State may give such directions and exercise such supervision and control as may be required for ensuring integrated grid operation and for achieving the maximum economy and efficiency in the operation of the power system in that state.
- 5). Every licensee , transmission licensee, Board, generating company, generating stations, sub-stations and any other person connected with the operation of the power system shall comply with the directions issued by the Load Despatch Centres under sub-sections (3) and (4).
- 6). All directions issued by the Regional Load Despatch Centres to any transmission licensee of State Transmission lines or any other licensee of the State or generating company (other than those connected to inter-state transmission system) or sub-station in the State shall be issued through the State Load Despatch Centre and the State Load Despatch Centre shall ensure that such directions are duly complied by the transmission licensee or licensee or generating company or sub-station.
- 7). Subject to the above provisions of this section, the Regional Electricity Board in the region from time to time any mutually agree on matters concerning the smooth operation of the integrated grid and economy and efficiency in the operation of the power system in that region and every licensee, transmission licensee and others involved in the operation of the power system shall comply with the directions of the Regional Electricity Board.
- 8). The Regional Load Despatch Centre or the State Load Despatch Centre, as the case may be, shall enforce, the decision of the Regional Electricity Boards.
- 9). Subject to regulations made under the Electricity Regulatory Commissions Act, 1998 (14 of 1988) by the Central Commission, in the case of Regional Load Despatch Centres, or by the State Commission, in the case of State Load Despatch Centres any dispute with reference to the operation of the power system including grid operation and as to whether any directions issued under sub-section (3) or sub-section (4) is reasonable or not, shall referred to the authority for decisions:

PROVIDED that pending the decision of the authority, the directions of the Regional Load Despatch Centres or the State Load Despatch Centres, as the case may be, shall be complied with.

## **Annex-VIII**

- 10). Until the Central Commission is established, the Central Government and thereafter the Central Commission in the case of Regional Load Despatch Centre and until the State Commission is established, the State Government and thereafter the State Commission in the case of the State Load Despatch Centre of the State, may by notification, specify the fees and charges to be paid to the Regional Load Despatch Centres and the State Load Despatch Centres, as the case may be, for undertaking the load despatch functions entrusted by the Central Government or by the State Government, as the case may be.
- 11). The provision of sub-section (3) of section 4B shall apply in relation to any notification issued by the Central Government or the Central Commission, as the case may be, under sub-section (10), as they apply in relation to the rules made by that government under Chapter II."

### **D. Electricity Act 2003 w.e.f 10th June 2003:**

#### **a. National Load Despatch Centre**

26. (1) The Central Government may establish a centre at the national level, to be known as the National Load Despatch Centre for optimum scheduling and despatch of electricity among the Regional Load Despatch Centres.
- (2) The constitution and functions of the National Load Despatch Centre shall be such as may be prescribed by the Central Government:  
  
Provided that the National Load Despatch Centre shall not engage in the business of trading in electricity.
- (3) The National Load Despatch Centre shall be operated by a Government company or any authority or corporation established or constituted by or under any Central Act, as may be notified by the Central Government.

#### **b. Regional Load Despatch Centre**

27. (1) The Central Government shall establish a centre for each region to be known as the Regional Load Despatch Centre having territorial jurisdiction as determined by the Central Government in accordance with section 25 for the purposes of exercising the powers and discharging the power and discharging the functions under this Part.
- (2) The Regional Load Despatch Centre shall be operated by a Government Company or any authority or corporation established or constituted by or under any Central Act, as may be notified by the Central Government:

## **Annex-VIII**

Provided that until a Government company or authority or corporation referred to in this sub-section is notified by the Central Government, the Central Transmission Utility shall operate the Regional Load Despatch Centre:

Provided further that no Regional Load Despatch Centre shall engage in the business of generation of electricity or trading in electricity.

### **c. Functions of Regional Load Despatch Centre**

28. (1) The Regional Load Despatch Centre shall be the apex body to ensure integrated operation of the power system in the concerned region.
- (2) The Regional Load Despatch Centre shall comply with such principles, guidelines and methodologies in respect of the wheeling and optimum scheduling and despatch of electricity as the Central Commission may specify in the Grid Code.
- (3) The Regional Load Despatch Centre shall -
- (a) be responsible for optimum scheduling and despatch of electricity within the region, in accordance with the contracts entered into with the licensees or the generating companies operating in the region;
  - (b) monitor grid operations;
  - (c) keep accounts of the quantity of electricity transmitted through the regional grid;
  - (d) exercise supervision and control over the inter-State transmission system; and
  - (e) be responsible for carrying out real time operations for grid control and despatch of electricity within the region through secure and economic operation of the regional grid in accordance with the Grid Standards and the Grid Code.
- (4) The Regional Load Despatch Centre may levy and collect such fee and charges from the generating companies or licensees engaged in inter-State transmission of electricity as may be specified by the Central Commission.

### **d. Compliance of directions of RLDC**

29. (1) The Regional Load Despatch Centre may give such directions and exercise such supervision and control as may be required for ensuring stability of grid operations and for achieving the maximum economy and efficiency in the operation of the power system in the region under its control.

## **Annex-VIII**

- (2) Every licensee, generating company, generating station, substation and any other person connected with the operation of the power system shall comply with the direction issued by the Regional Load Despatch Centres under sub-section (1).
- (3) All directions issued by the Regional Load Despatch Centres to any transmission licensee of State transmission lines or any other licensee of the State or generating company (other than those connected to inter State transmission system) or sub-station in the State shall be issued through the State Load Despatch Centre and the State Load Despatch Centres shall ensure that such directions are duly complied with the licensee or generating company or sub-station.
- (4) The Regional Power Committee in the region may, from time to time, agree on matters concerning the stability and smooth operation of the integrated grid and economy and efficiency in the operation of the power system in that region.
- (5) If any dispute arises with reference to the quality of electricity or safe, secure and integrated operation of the regional grid or in relation to any direction given under sub-section (1), it shall be referred to the Central Commission for decision:  
  
Provided that pending the decision of the Central Commission, the directions of the Regional Load Despatch Centre shall be complied with by the State Load Despatch Centre or the licensee or the generating company, as the case may be.
- (6) If any licensee, generating company or any other person fails to comply with the directions issued under sub-section (2) or sub-section (3), he shall be liable to penalty not exceeding rupees fifteen lacs.

### **e. State Load Despatch Centres**

- 31. (1) The State Government shall establish a Centre to be known as the State Load Despatch Centre for the purposes of exercising the powers and discharging the functions under this Part.
- (2) The State Load Despatch Centre shall be operated by a Government company or any authority or corporation established or constituted Government company or any authority or corporation established or constituted by or under any State Act, as may be notified by the State Government. Provided that until a Government company or any authority or corporation is notified by the State Government, the State Transmission Utility shall operate the State Load Despatch Centre:

## **Annex-VIII**

Provided further that no State Load Despatch Centre shall engage in the business of trading in electricity.

### **f. Functions of State Load Despatch Centres**

32. (1) The State Load Despatch Centre shall be the apex body to ensure integrated operation of the power system in a State.
- (2) The State Load Despatch Centre shall -
- (a) be responsible for optimum scheduling and despatch of electricity within a State, in accordance with the contracts entered into with the licensees or the generating companies operating in that State;
  - (b) monitor grid operations;
  - (c) keep accounts of the quantity of electricity transmitted through the State grid;
  - (d) exercise supervision and control over the intra-state transmission system; and
  - (e) be responsible for carrying out real time operations for grid control and despatch of electricity within the State through secure and economic operation of the State grid in accordance with the Grid Standards and the State Grid Code.
- (3) The State Load Despatch Centre may levy and collect such fee and charges from the generating companies and licensees engaged in intra-State transmission of electricity as may be specified by the State Commission.

### **g. Compliance of directions of SLDC**

33. (1) The State Load Despatch Centre in a State may give such directions and exercise such supervision and control as may be required for ensuring the integrated grid operations and for achieving the maximum economy and efficiency in the operation of power system in that State.
- (2) Every licensee, generating company, generating station, substation and any other person connected with the operation of the power system shall comply with the direction issued by the State Load Despatch Centre under subsection (1).
- (3) The State Load Despatch Centre shall comply with the directions of the Regional Load Despatch Centre.

## **Annex-VIII**

- (4) If any dispute arises with reference to the quality of electricity or safe, secure and integrated operation of the State grid or in relation to any direction given under sub-section (1), it shall be referred to the State Commission for decision:

Provided that pending the decision of the State Commission, the direction of the State Load Despatch Centre shall be complied with by the licensee or generating company.

- (5) If any licensee, generating company or any other person fails to comply with the directions issued under sub-section (1), he shall be liable to penalty not exceeding rupees five lacs.”

### **E. Resolution dated 2<sup>nd</sup> March 2005**

Designated NLDC as apex body to ensure integrated operation of the national power system and entrusted following functions of NLDC:

- a). Supervision over the Regional Load Dispatch Centres.
- b). Scheduling and dispatch of electricity over the inter-regional links in accordance with grid standards specified by the authority and grid code specified by Central Commission in coordination with Regional Load Dispatch Centres.
- c). Coordination with Regional Load Dispatch Centres for achieving maximum economy and efficiency in the operation of National Grid.
- d). Monitoring of operations and grid security of the National Grid.
- e). Supervision and control over the inter-regional links as may be required for ensuring stability of the power system under its control.
- f). Coordination with Regional Power Committees for regional outage schedule in the national perspective to ensure optimal utilization of power resources.
- g). Coordination with Regional Load Dispatch Centres for the energy accounting of inter-regional exchange of power.
- h). Coordination for restoration of synchronous operation of national grid with Regional Load Dispatch Centres.
- i). Coordination for trans-national exchange of power.
- j). Providing operational feedback for national grid planning to the Authority and Central Transmission Utility.

## **Annex-VIII**

- k). Levy and collection of such fee and charges from the generating companies or licensees involved in the power system, as may be specified by the Central Commission
- l). Dissemination of information relating to operations of transmission system in accordance with directions or regulations issued by Central Government from time to time

### **F. Amendment 8th June 2005:**

#### **1. Short Title and Commencement:-**

- (1) This order shall be called the Electricity (Removal of Difficulty) (sixth) Order 2005.
- (2) This order shall come into force on the date of its publication in the Official Gazette.

#### **2. Levy and collection of fees and charges for using transmission system.-**

- (1) The Regional Load Despatch Centre may levy and collect such fee and charges from the licensees using the inter-state transmission system as may be specified by the Central Commission.
- (2) The State Load Despatch Centre may levy and collect such fee and charges from the licensees using the intra-state transmission system as may be specified by the State Commission.

## Annex-IX

### Manpower Requirement at LDC

#### Top management- Expert level (5)

S. No	Position	Department	Level	No.
1	Head- LDC	--	E8- E10	1
2	Divisional Head- System Operation	System Operation	E7- E8	1
3	Divisional Head- Market Operation	Market Operation	E7- E8	1
4	Divisional Head- System Logistics	Logistics	E7- E8	1
5	Divisional Head- Establishment Services	Services	E7- E8	1

#### Middle management- Proficient level (15)

S. No	Position	Department	Level	No.
6	Shift Charge Manager- Real-time	System Operation	E6 - E7	5
7	Chief- Reliability Coordinator	System Operation	E6- E7	1
8	Chief- Grid Ancillary Services Coordinator	System Operation	E6- E7	1
9	Chief- Open Access & Scheduling Coordinator	Market Operation	E6- E7	1
10	Chief- Settlement System Coordinator	Market Operation	E6- E7	1
11	Chief- Pool Account Administrator	Market Operation	E6- E7	1
12	Chief- Logistics (SCADA)	Logistics	E6 - E7	1
13	Chief- Logistics (IT & Communication)	Logistics	E6 – E7	1
14	Chief- Establishment Services	Services	E6 - E7	1
15	Chief- Regulatory Affairs	Services	E6- E7	1
16	Chief- Human Resources	Services	E6- E7	1

#### Executives-Basic level [Real-time]- (15)

S. No	Position	Department	Level	No.
17	Executive- Power System Security	System Operation	E2 - E5	5
18	Executive- Resource Scheduling	Market Operation	E2 – E5	5
19	Executive- Open Access	Market Operation	E2 – E5	5

#### Executives- Basic level [Off-line] – (33)

S. No	Position	Department	Level	No.
20	Executive- Grid Ancillary Services	System Operation	E2 - E5	1
21	Executive- Analysis & Offline Simulations	System Operation	E2 – E5	1
22	Executive- Energy Management System	System Operation	E2 – E5	1
23	Executive- System Protection Coordination	System Operation	E2 – E5	1
24	Executive- Planned Outage Coordination	System Operation	E2 – E5	1
25	Executive- Dispatcher Training Simulator	System Operation	E2 – E5	1
26	Executive- Documentation	System Operation	E2 – E5	1
27	Executive- Power System Information	System Operation	E2 – E5	1
28	Executive- Coordination Committee	System Operation	E2 – E5	1



## Annex-IX

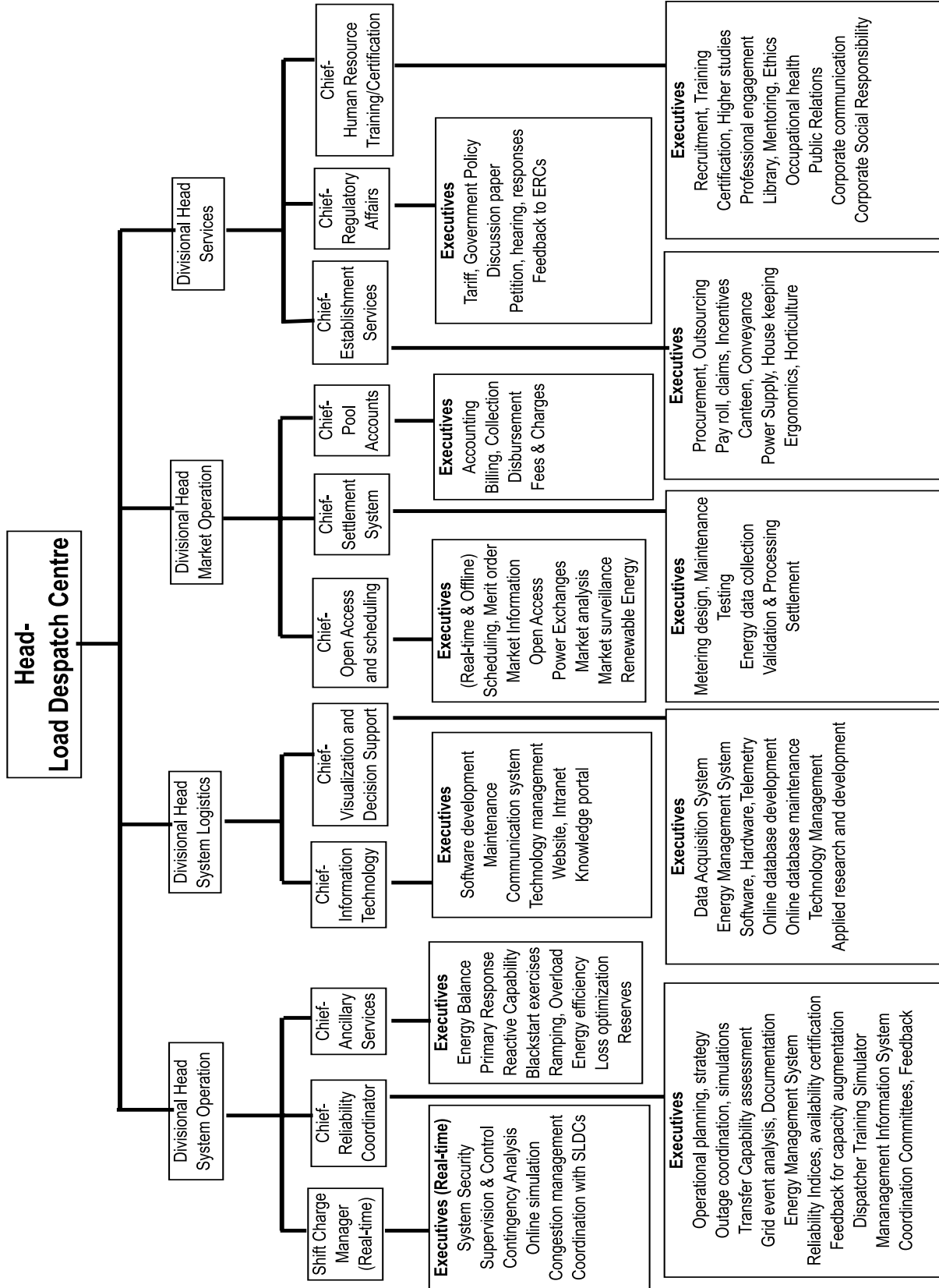
S. No	Position	Department	Level	No.
29	Executive- Metering System Design	Market Operation	E2 – E5	1
30	Executive- Metering System Maintenance	Market Operation	E2 – E5	1
31	Executive- Meter data Collection	Market Operation	S1 – E2	1
32	Executive- Meter data Validation & Processing	Market Operation	S1 – E2	1
33	Executive- Energy Accounting	Market Operation	E2 – E5	2
34	Executive- Settlement	Market Operation	E2 – E5	1
35	Executive- Pool Account Administration	Market Operation	E2 – E5	1
36	Executive- SCADA Hardware	Logistics	E2 – E5	1
37	Executive- SCADA Software	Logistics	E2 – E5	1
38	Executive- Telemetry	Logistics	E2 – E5	1
39	Executive- Online Database Development	Logistics	S1 – E2	1
40	Executive- Online Database Maintenance	Logistics	E2 – E5	1
41	Executive- IT software development	Logistics	E2 – E5	1
42	Executive- IT systems maintenance	Logistics	S1- E2	1
43	Executive- Applied R & D	Logistics	E2 – E5	1
44	Executive- Communication System	Logistics	S1 – E2	1
45	Executive- LDC Fees and Charges	Services	E2 – E5	1
46	Executive- Human Resource Management	Services	E2 – E5	1
47	Executive- Law and Regulatory Affairs	Services	E2 – E5	1
48	Executive- Procurement & Outsourcing	Services	E2 – E5	1
49	Executive- Administration (Library, Canteen, DG etc.)	Services	E2 – E5	1
50	Executive- Establishment (Payroll, claims, incentives)	Services	S1 – E2	2
51	Executive- CSR, Renewables, Energy Efficiency	Services	E2- E5	1

**Total executives in a typical LDC: 60 - 70**

**Total estimated number for all India with 39 control centres: 2250 - 2750**

Assumptions:

LDCs would focus on their core activities and outsource the routine and non-core activities to improve their productivity.



ORGANIZATION CHART FOR A TYPICAL LOAD DESPATCH CENTRE



## Annex-X

### International Practices for ensuring competence of System Operators

Country	System Operator Competence criteria	Compliance & Validity
Argentina	Certification requirements established by the respective organization 'Qualification license' issued to operate generators/ high voltage facilities, distribution facilities, bulk power customer facilities	Required for all real-time operating personnel since Nov-1998. Compliance was mandated within 270 days Mandated by Secretary of Energy Monitored by Electricity National Regulator Entity Three years validity
Finland	Written test, discussions, hands-on training, psychological tests Experienced operators evaluated on-job	Required for operating 110- 400 kV system Five years validity
France	Oral and simulator based tests Competency evaluation by management	Internal evaluation Retakes discouraged
Ireland	Simulator based tests Written reports on project assignments Interview	Required for all dispatchers One year validity
North America	Nationwide computerised test for all bulk power system operators	Compliance monitored by NERC Five year validity
Russia	Test of knowledge of industry, rules, regulations and other binding documents Test of qualification grade after first year of appointment Test conducted after counter emergency training three times a year	Internal evaluation
Spain	Written and simulator based tests	Internal evaluation
Switzerland	License for switching in grid 16 kV to 380 kV Cumulative operator errors result in dismissal	Internal evaluation
Venezuela	Written tests, presentations, viva	Internal evaluation Dismissal on slow response to acquiring knowledge & skills
United States California Power & Light	Written tests, job evaluation, simulator tests	Retakes permitted after six months in case of failures No re-qualification required, only remedial training

Source: CIGRE 39-103 session 2000 paper titled “**Certification and Competency Evaluation of System Operators**” by Hugh Jones, Rolf Knopf, Pasi Lehtonen, Sarah Lutterodt on behalf of Working Group 39.03



## **Annex-XI**

### **System Operator Training and Certification – An Approach Paper**

#### **1. Executive Summary**

The System Operator has to ensure reliable, economic and efficient operation of the power system. This requires an in-depth understanding of not only the technical aspects of system operation but also the market mechanisms and the institutional & legal framework. The System Operator must be able to clearly visualize the present state of the power system, assimilate and analyze, draw conclusions, take actions, which are in conformity with the existing Grid Code, Standards and Market Rules. Over the years, the job of the System Operator has seen a paradigm shift from being an Operator with a pure technical background to one who is essentially required to operate both the power system and the power market. Information dissemination and interaction with the stakeholders/utilities is another important part of the System Operator's job. In-depth knowledge and skill of the System Operator are essential pre-requisites and extremely important for the effective functioning of the control center.

This approach paper attempts to bring out the necessity of providing adequate training to the System Operators and putting in place a system of Certification for the Operators manning the control centers. The present scenario along with the duties and tasks of the System Operators are discussed, means and ways of putting a system of operator certification along with a roadmap and time frame are proposed. The term 'Operator' as used in this approach paper refers to all the technical staff working the Control Centers (both the shift staff and support personnel outside shifts).

#### **2. The Present Scenario**

The country's electricity grid is divided into five regional grids namely the Northern, Southern, Eastern, Western and the Northeastern. The Eastern, Western and the Northeastern systems are synchronously connected and constitute what has now become known as the Central Grid. The Northern Grid and the Central Grid have been synchronized on 26<sup>th</sup> - August-2006 to form the NEW grid. The NEW grid has an installed generating capacity of nearly 104,000 MW and meets a peak demand of 65,000 MW. The Southern Grid is asynchronously connected with the North-Central Grid through high capacity HVDC links presently and is likely to be synchronized with the rest of the country by the year 2012. The installed capacity is nearly 40,000 MW and a peak demand of 25,000 is being met. The total installed capacity in the country is thus over 144,000 MW and a peak demand of 91,000 MW is being met.

International connections exist with Bhutan & Nepal at 400 KV / 220 KV and are likely to get an impetus in the coming years.

## **Annex-XI**

Substantial changes in the power scenario have been brought about with the enactment of the Indian Electricity Act 2003. The Act envisages the establishment of the Regional Load Dispatch Centers (RLDCs) as the apex bodies for ensuring integrated operation of the power system at the regional level in accordance with prevailing grid codes and standards. The RLDCs are responsible for real time monitoring of grid operations, maintaining accounts of the electricity transmitted, supervision and control of the inter-state and inter-regional transmission system, operational planning and establishment and maintenance of the data telemetry (SCADA/EMS) facilities. Similar responsibilities have been entrusted to the State Load Dispatch Centers (SLDCs) who act at the state level in conjunction with the respective RLDC.

The functions assigned to the System Operator today can be classified as follows:

- a. Pre-dispatch –
  - i. Load Forecasting & Demand Estimation
  - ii. Outage Planning (Generating Units & Transmission Elements)
  - iii. System studies / Simulation studies
  - iv. Evaluation of Available Transfer Capability (ATC) for short term bilateral transactions
  - v. Resource Scheduling
- b. Real Time –
  - i. Resource re-scheduling to mitigate real time constraints
  - ii. Real time load generation balance
  - iii. Maintenance and control of system parameters
  - iv. Ensure grid security, quality of power and reliability in line with the Indian Electricity Grid Code (IEGC) stipulations.
  - v. Co-ordination of outages (generating units / transmission elements), both planned and emergency
  - vi. Secure grid operation in emergency conditions / alert states
  - vii. Optimal utilization of resources & minimization of transmission losses
  - viii. Implementation of Contracts

## Annex-XI

- c. Post-dispatch –
  - i. Post facto event analysis – disturbance data collection, analysis, reporting and follow-up
  - ii. Energy Meter Data Collection, validation & processing
  - iii. Energy Accounting
  - iv. Pool Account operation
- d. Interaction with the external environment –
  - i. Event information & reporting – Feedback to utilities, management, planners, administrators and regulators
  - ii. Meetings of the Regional Power Committee (RPC) and its subcommittees

### 3. Need for Operator Training and Certification

**Large Interconnected Systems & New Technologies** - The operation of an interconnected power system requires an overall system overview as well as deep insight on the part of the Operator. The Operator is required to have an understanding of the technical aspects and he must keep himself updated on the newer technological applications such as the Static VAR Compensation (SVC) & Flexible Alternating Current Transmission System (FACTS). A huge amount of data is presented to the Operator in real time through which he must be able to visualize the power system, assimilate the information, analyze the situation and take suitable corrective actions. The approach of the System Operator has to be totally professional as the responsibility for correct operations lies with the Operator. He has to ensure that his decisions are clearly and correctly communicated and implemented as desired in the given time frame. The Operator needs to be aware of the technical limits of the system he is operating and must be capable of risk management.

**Fast Expanding Networks** - With the formation of the National Grid, interconnection of different regions synchronously and asynchronously and large international connectivity, the size of the systems is growing and addition of new elements is taking place at a rapid pace. This has resulted in an ever-increasing risk of outages in the systems with repercussions spreading across regional boundaries. The impact of the outages of various elements along with the risk posed by such outages must be clearly understood by the Operator. He must have an excellent situational awareness and a very fast reaction time to minimize the damage & risk to the system as a whole. Once an outage or a disturbance has occurred, system restoration in the shortest possible time is a very important task. The job of system restoration in the event of an outage assumes a new dimension as now, it has to be a coordinated multi-agency effort. This poses the requirement of good inter-personal communication skills and other managerial capabilities in the System Operator.



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**Advanced Tools & Techniques** - Use of visualization tools is a must for the System Operator to assist him in the task of system operation. Effective visualization tools and techniques are a key to empowering a System Operator and facilitating quick Operator response. These tools improve the ability of the Operators to monitor the power system, detect anomalous situations and take quick corrective actions. Advanced EMS applications are available with the SCADA systems such as State Estimation, Optimal Power Flow (OPF), Contingency Analysis (CA), offline simulation, etc. which can be used effectively to assist Operator decisions and actions. Operator decisions, actions and response times have a direct bearing on the grid operation as well as the commercial aspects. It is therefore an essential pre-requisite that the Operators manning the control rooms have full knowledge of the SCADA/EMS systems and communication facilities provided to them for their use in the day-to-day operation.

Newer technologies like synchrophasor technology, Wide Area Measurement System (WAMS) would be introduced and the Operator has to stay current with these developments.

**Legal, Institutional & Regulatory Framework** - The legal, regulatory and the institutional framework in the country are evolving. The Operator is required to have a full and clear understanding of the legal & institutional framework he is working in. This may include Indian Electricity Grid Code (IEGC), Grid Standards, Metering Standards, Connectivity Standards etc. The regulators – Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERC) – issue orders and guidelines, which must be complied with by all agencies involved. Thus, the Operator must be aware of the prevailing laws of the land, the regulatory orders, institutional setups and procedures and all his actions must comply with the rules and regulations. Most of the rulings by the regulator today relate to the electricity market structure & operation where the System Operator has a key-enabling role. Reliability standards are currently at a rudimentary stage and are contained in the Indian Electricity Grid Code (IEGC).

**Commercial Mechanisms** - Availability Based Tariff (ABT) has been introduced in the country, which requires the Operators to be all the more vigilant in the operation. He must also be aware of all the commercial contracts in effect, which are to be implemented during the course of the operation. Open access in transmission has been mandated and this has facilitated utilization of the available spare transmission capacities. For allowing open access, a procedure is in place, which must be followed. Under certain pre-defined circumstances (or emergencies), curtailment of the Open access can also be done. One Power Exchange (PX) is already operational since 27<sup>th</sup> June 2008 and another one is likely to come up shortly. These exchanges are currently dealing only with Day Ahead Market (DAM) involving physical delivery. The Operators must therefore have an understanding of the market mechanisms involved and the commercial implications of their actions.

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**Transparency** - The System Operator is also required to share information with other players in the grid. The decision making process of the Operator is required to be transparent and he is expected to interact with both technical as well as non-technical persons. He must have an understanding of the information that can be shared and that which is confidential and sensitive. Human performance requirements have changed for the System Operator. As system and market operation evolve, the mental pressures on the job of the System Operator increases. Market mechanisms force the system to run closer to their operating limits for maximum efficiency. This reduces the security margins but the system must still be operated securely and efficiently.

Hence, it has become imperative to put into place a rigorous system of **training and re-training the System Operators** manning the control centers. A system of Certification of the Operators similar to that being done for other mission critical jobs such as that of a pilot, maritime operators, etc. is required to be put in place. A certified pilot is responsible for the lives of 500 people at a time and an aircraft costing Rs. 150 crores. An Indian System Operator is responsible for the security of the electricity supply industry feeding a billion people handling Rs. 180 crores worth of energy and affecting the economy of the entire country. The importance of certification cannot be emphasized more. There should be a validity period for the certification, mandatory operating hours to keep the certificate valid, and a re-validation procedure after re-training. This paper discusses the possibilities for Operator training and certification.

### 4. The Operator Certification Program

It is proposed that only certified System Operators be allowed to man the control centers – both regional and state. In order to facilitate this, the Operator must undergo a course in power system operation and obtain certification. The approach to certification is discussed below.

#### (a) Certification Cycle -

Operators would have to undergo a classroom-training program followed by an examination before they are awarded a degree of Certified System Operator. This certification should have a pre-defined validity period, say three years. The Operator would be required to maintain a record of the professional development activities undertaken by him.

#### (b) Maintaining Active Certification -

During these three years, in order to maintain the certification status as '**active**', it should be made mandatory for the Operator to work in the actual operation for a specified number of man-days. Moreover, he should also have attended refresher courses as part of Continuing Professional Development (CPD) during each year of certification. In case an Operator fails to fulfill any of the mandatory requirements

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say because of long leave or a medical condition, his certification status would automatically pass to '*inactive*'. To re-activate his certification, he can change the status to active by clearing an examination.

### **(c) Re-Certification**

The process of re-certification of the Operator must begin at least six months prior to the expiry of his current certification. The re-certification of the Operator at the end of the certification period would be possible through a system where due weightage would be given to the meeting of mandatory requirements for each year and an examination which must be cleared. The weightage given could be 20% for mandatory CPD fulfilled during each year of certification, a total of 60% for three years and 40% for the examination. A system of accruing points on the basis of CPD for certification could also be designed.

### **(d) Re-activating Expired Certification**

The Operator whose certification has expired must undergo a fresh examination and only then can he be re-certified.

### **(e) Continuing Professional Development (CPD)**

What can be classified as continuing professional development? Some of the possibilities are –

- a. Active practice in the area of certification
- b. Acquiring additional education pertinent to the area of certification.
- c. Active participation in activities which advance or broaden the knowledge in the area of certification such as seminars, proceedings of premier professional bodies such as IEEE, IE (India), CIGRE, PES, etc.
- d. Additional certification in other areas related to the primary area of certification.
- e. Successful completion of a special written examination for certification maintenance.

A system of assigning points for the above options can be worked out.

### **(f) Course Design - Proposed Training Modules**

The following modules are suggested for incorporation in the training program for certification. These modules need to be structured into a basic course (which would be considered mandatory for all the Operators) and specialization courses.

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- a. Orientation
  - o Evolution of the Indian power systems – a brief historical background
  - o Load dispatch functions
  - o Regional and state power systems
  - o Institutional framework
  - o Job profile of a load dispatcher
  - o Power in balanced 3-phase system – Active, Reactive and Apparent.
  - o Characteristics of power equipments – Generators, transmission lines, transformers, shunt capacitors and reactors, series capacitors, HVDC
  - o Production of electric energy – control of active power and reactive power by generators
  - o Reactive power – Sources and sinks of reactive power in transmission system, reactive compensation.
- b. Elements of Power System
  - o Generation – Thermal, Hydro, Nuclear, Gas, Non-Conventional
  - o Elements of the Transmission System
  - o Protection Systems
  - o Substation – equipment
  - o HVDC
  - o SVC & FACTS
  - o Distribution
- c. Principles of Power System Operation
  - o Power System operation in normal conditions
  - o Power System operation in emergencies
  - o Generation and tie line scheduling, Unit Commitment
  - o System security, monitoring & control
  - o Grid Code, operating procedures, regulations

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- o System restoration and Black Start
- o Reactive power management and voltage control
- o Frequency Control - primary, secondary and tertiary
- o System Stability – transient and dynamic
- o Reliability assessment
- o Angular Stability
- o Load management, demand side management
- o Element Outage planning / scheduling
- o Disturbance analysis
- o Generation reserve management
- o Congestion Management
- o Power system analysis
  - Mathematical modeling of power system network and components
  - Load flow studies
  - Short circuit calculations
  - Transient stability studies
  - Transient stability studies using EMTP / PSS/E platforms
  - Application of above to assessment of ATC, implementation of transmission pricing methodologies, allocation of transmission losses, incremental losses.
- d. SCADA / EMS & IT Systems
  - o RTU
  - o Telemetry Systems
  - o SCADA Systems
  - o Historical data recording, archival and retrieval systems

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- o EMS – Load forecasting, real time contingency analysis, off line simulation studies, security enhancement
  - o DTS
  - o IT Facilities – IT Security
- e. Telecommunication Systems
  - o Voice and data communication
- f. Protection Systems
  - o Protection of power system elements
  - o Types of relays
  - o Role of communication systems in protection schemes
  - o System Protection Schemes (SPS)
- g. Commercial Systems
  - o Generation Tariff
  - o Transmission Tariff
  - o Availability Based Tariff & UI Mechanism
  - o Open Access
  - o Regional Energy Accounting
- h. Power Markets
  - o Bilateral market
  - o Power Exchange
  - o Interplay between different types of markets
- i. Legislative and Regulatory Framework
  - o Legislative framework - Indian Electricity Act
  - o Regulations / Rules – IEGC, Connectivity standards, etc.
  - o Regulatory Framework – CERC, SERC, Appellate Tribunal
- j. Managerial & Communication Skills

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### **(g) Specialization**

Operator certification can be for general operation or in a specialized area. The possible areas of specialization are –

- a. Power System Operation and Control
- b. System Restoration – Black Start Procedures & Facilities
- c. SCADA Systems
- d. EMS
- e. Generation – hydro, thermal, nuclear & non-conventional
- f. Transmission Systems
- g. Protection Systems
- h. Reactive Power Management and Voltage Control
- i. Resource Scheduling & Economic Dispatch
- j. Telecommunication facilities
- k. Power Markets – PX, Bilateral, Open Access, etc.
- l. Legal Framework – Electricity Act 2003, IEGC, etc.
- m. Regulatory Affairs
- n. Simulation & System Studies
- o. Power System Stability (transient & dynamic)
- p. Power System Reliability (generation, transmission and interconnected systems)
- q. Load Management / Demand Side Management
- r. Frequency Control and Generation Reserve Management
- s. Stress Management
- t. Power System Operation in Emergencies
- u. Transmission Pricing

Certification in power system operation and control can be considered as a primary certification and others as add-on specializations. Benchmarking of the courses that can be taken up by the Operators and the pre-requisites also need to be laid out.

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### (h) Cost of Certification

Who bears the cost of Operator certification? Primarily, it is in the interest of the parent organization to have trained, efficient, certified and professional Operators manning its control centers. Hence, the cost of certification must be borne by the parent organization, which must have an explicit budgeting for this. However, there could be cases where an individual is keenly interested in the area of power system operation and yet cannot be trained by the organization. It is therefore proposed that a two tier cost structure be evolved. First would be the cost of undertaking the designated courses and second would be the fees/charges of the agency conducting the examination for the grant of the Certification. Such a structure would provide the option to an individual to undertake self-study and appear directly for the Certification examination. Others, if necessary, could undertake a course of study sponsored by the organization (or independently financed) before the examination. Such a two-tier cost structure is all the more essential in order to facilitate change of certification status from '*inactive*' to '*active*', re-activation of *expired* certification. Moreover, such a system would also facilitate re-imbursement of the fees incurred for the examination, if independently taken by an Operator.

### 5. Training Infrastructure

In order to carry out the certification programs, it is necessary to have extensive training infrastructure available for the Operators. The Operator certification program proposed has both theory and practical elements. In order to design the course effectively, practical hands on should follow detailed theory (classroom) sessions. Under the ULDC schemes, all the regions in the country have been equipped with a Dispatcher Training Simulator (DTS) for the use of the Operators. Premier institutes such as the IITs (Delhi, Mumbai, Chennai, Kanpur, Kharagpur & Guwahati) and IISc, Bangalore can provide the necessary theoretical inputs required for course design. Hands on practical sessions can be held on the DTS installed at each RLDC.

Training capacity constraints, shortage of trained instructors at the RLDCs which are already facing shortage of trained operational manpower, are some of the key issues that need to be addressed before the DTS can be effectively used for imparting training to the System Operators and awarding certifications.

However, these issues can be addressed by designating some of the other agencies that are equipped to handle such training & certification programs. Some of the training facilities available in the country are listed below –

- a. Power plant training simulator for 500 MW fossil fuel fired plant available at National Power Training Institute (NPTI), Faridabad as well as a simulator for combined cycle gas power station at NPTI Faridabad.



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- b. Power plant training simulator for 210 MW fossil fuel fired plant available at Regional Power Training Institute (RPTI), Badarpur (New Delhi), Nagpur etc.
- c. Hydro power plant training simulator at NPTI Nangal.
- d. Dispatcher Training Simulator at Power Systems Training Institute (PSTI), Bangalore.
- e. Real Time Digital Simulator (RTDS) at Central Power Research Institute (CPRI), Bangalore.

### **6. Manpower to be trained**

Across the country, there are 39 control centers (1 NLDC, 5 RLDCs and 33 SLDCs). Assuming 60-70 professionals in a typical Load Despatch Centre, nearly 2500 individuals would be required to be trained and certified with specialization in their respective areas. A provision for training and certification of new recruits and attrition as a result of reduction in strength due to retirement, promotions, resignation or death would also have to be made. In effect, a whole new cadre of System Operators would have to be developed for manning the control centers. It is also important to attract and retain the right kind of talent with appropriate incentives linked to the certification system.

### **7. The Certifying Agency**

The Certifying Agency for the Operator Certification program has to be an independent organization, which would award the Certification acceptable to all. A central agency may be nominated as the Certifying Agency. It is also proposed that the examination to be conducted by the Certifying Agency should be a continuous process. The Operators should be able to appear for the examination online over the Internet any time during the year. A separate central institute for training the System Operators may also be created. The Institute for training and the agency for certifying the System Operators should be different to ensure standards and objectivity.

### **8. Practices Abroad – NERC**

The North American Electric Reliability Corporation (NERC) has a System Operator Certification Program which provides the framework for the examinations used to obtain initial certification in one of four NERC credentials: *Transmission Operator, Balancing and Interchange Operator, Balancing, Interchange and Transmission Operator, and Reliability Operator*. A System Operator credential is a personal credential issued to a person for successfully passing a NERC System Operator certification exam. The credential is maintained by accumulating a specified number of continuing education hours within a specified period of time. The program will allow System Operators to maintain their credential through continuing education rather than to re-certify by retaking an examination. The NERC program establishes standards for Operator training programs – both those developed and conducted in-house by the transmission providers and those offered by

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commercial providers. It addresses the amount of training required, the quality of materials and facilities to be used for each program and the qualifications of the instructors teaching these courses. A written examination is conducted testing the Operators on their knowledge of NERC operating policies along with the principles of operation of interconnected power systems before the award of the Certification. Manning the control centers with such Certified Operators is a mandatory requirement.

### **9. The Roadmap**

The National Electricity Policy refers to the need for a concerted action towards making adequate trained manpower available to the electricity industry (Section 5.11). A roadmap needs to be drawn up for the implementation of the Operator Certification Program. The migration from the existing scenario to a regime where only Certified Operators would be allowed to man the Control Centers has to be taken up in a phased manner. To begin with, one Operator in each shift at the RLDC and the SLDC level should be nominated for the Certification Program. Gradually the other operators can be brought under the ambit of Certification. A deadline must be also be decided for the beginning of implementation of this program and time frame of say 2 to 3 years be specified at the end of which, all Operators manning the Control Room in each Control Center are Certified professionals.

The Certification program should be such that it includes training and certification of the support staff that do not come in the actual shift operation. These include the Technical Support group, the SCADA/EMS/IT group, the Telecommunication group, etc. These groups should be staffed with persons who are certified professionals with a specialization in the respective areas of operation.

### **10. Conclusion**

Manning the control centers with certified professionals has thus become imperative in today's scenario. It is essential to develop a process of providing adequate training and subsequent certification to the Operators. The infrastructure to provide this training must be put in place and a process of conducting regular certification examinations must be evolved. Stress must also be given on the continuous professional development of the Operators so that they keep abreast with the latest technological developments and equip them with the newer skills.



## **Annex-XII**

### **Brief History of funding of LDCs in India**

Regional Load Despatch Centres (RLDCs) were operated by Central Electricity Authority (CEA) through the Regional Electricity Boards (REBs) since 1964. The RLDC expenses were met out of budgetary allocations made by the Central Government. To facilitate new investments in a modern control centre in 1989 the National Power Transmission Corporation (NPTC) was set up with establishment of modern Load Despatch Centres as one of its functions. NPTC was subsequently renamed as POWERGRID. The work of engineering modern load dispatch centres at the state and regional level and the first set of orders for the Northern and Southern Region was placed in January 1998. Simultaneously from 1994-96, the RLDCs were transferred from CEA to POWERGRID.

The Electricity Supply Act 1948 did not have any specific provision for payment against RLDC services. In 1996-97, Rs. 14.94 crores was spent on RLDC operations. CEA in July 1998 finalized a base figure of Rs. 12 crores for the year 1996-97 with 10% escalation every year as the expenses that could be reimbursed to RLDCs every year by the state utilities.

In mid 1998, the Electricity Supply Act 1948 was amended and RLDCs designated as apex bodies as far as real time operation of the power system was concerned. The Act had specific provisions for RLDC fees and charges. Petition no. 109/2000 filed before the CERC seeking actual expenses incurred as per audited figures for the year 1998-99 and 1999-2000 with 10% escalation on these audited figures for the subsequent period, was heard in Jan 2001 and the CERC requested CEA to conduct a fresh detailed study for assessing the RLDC expenses for the year 2000-01 and onward. CEA submitted its report in Sep 2001 and subsequently based on the CEA report and comments from the stakeholders, CERC issued an order dated 22<sup>nd</sup> March 2002. CERC's order dated 03<sup>rd</sup> January 2001 (petition no. 109/2000) directed that the approved expenses<sup>1</sup> of the RLDC were to be reimbursed by the respective regional constituent SEB or STU in the ratio of their entitlements in central sector generating stations for the sake of simplicity.

Later on a single member bench under Sh G. S. Rajamani, Member CERC was constituted to submit recommendations on the matter. The single member Bench submitted its report on 7<sup>th</sup> February 2003. CERC order dated 08<sup>th</sup> May 2003 finally approved the charges to be recovered by POWERGRID from state utilities. No retrospective revision was allowed for the year 1998-99 and 1999-2000 and the CERC approved Rs. 21.52 crores, Rs. 24.52 crores, Rs. 26.16 crores and Rs. 27.9 crores respectively for the years starting from 2000-2001.

There was lot of discussions from 1996 to 2003 to convince the stakeholders on the charges incurred in providing the services. The situation was difficult at the state level there was either no unbundling or even after unbundling there was still a single buyer model viz. STU and clear

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<sup>1</sup> RLDC charges for 1998-1999, 1999-2000, 2001-2001 and onwards were approved by CERC order dated 08<sup>th</sup> May 2003 after submission of the recommendations by the one member bench to look into the matter.

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segregation of SLDC charges was not available making the stakeholders difficult to appreciate this service.

In the meantime, the modern load dispatch schemes in the Southern and Northern Regions came under commercial operation w.e.f August 2002 and POWERGRID filed tariff petitions before the CERC (petition nos. 83/2002 and 82/2002). In the hearing on 9th August 2002, the Commission in its order dated 13th August 2002 vide para 7, observed that ULDC Scheme do not fall within the scope of Section 13 (c ) of ERC Act 1998. Subsequently while approving the tariff for NR-ULDC scheme CERC in its order dated 02nd September 2005 directed that RLDC fees and charges recovered from the regional constituents based on order dated 08th May 2003 should be proportionately adjusted within the ULDC tariff.

CERC in its order dated November 2003 in petition no. 48/2003 made provisions for payment of scheduling operating charges to all LDCs involved in facilitating Short-term Open Access in inter state transmission.

## Annex-XIII

### Status of declaration of separate fees and charges for SLDCs

Sl. No.	State	Whether Separate SLDC charges	Annual Fee & Charges (Rs. Crore)	Year	Remarks	Referenced SERC Website
1.	Assam	Yes	6.75	2007-08	Includes payable RLDC/ULDC charges. SERC order 22 <sup>nd</sup> Nov 2007 in respect of AAR of AEGCL.	<a href="http://aerc.nic.in">http://aerc.nic.in</a>
2.	Andhra Pradesh	Yes	30.61	2008-09	SERC order dated 7 <sup>th</sup> Mar 2007 in petition no. 32 of 2006.	<a href="http://www.ercap.org">http://www.ercap.org</a>
3.	Arunachal Pradesh	No	----	----	SERC not Operational	----
4.	Bihar	No	----	----	Regulation for SLDC fee and charges issued on 9 <sup>th</sup> Feb 2007 by SERC	<a href="http://www.berc.co.in">http://www.berc.co.in</a>
5.	Chattisgarh	No	----	----	Vertically Integrated Utility	<a href="http://cserc.gov.in">http://cserc.gov.in</a>
6.	Delhi	Yes	7.55	2008-09	Regulation issued on 8 <sup>th</sup> October 2007. SERC order dated 20 <sup>th</sup> Dec 2007 in petition no. 46/2007.	<a href="http://www.derc.gov.in">http://www.derc.gov.in</a>
7.	Gujrat	No	----	----	Regulation issued on 30 <sup>th</sup> Mar 2005. SERC order dated 31 <sup>st</sup> Mar 2007 in petition no. 897/2006 for AAR of GETCO includes Rs. 15.36 Crore for ULDC charges.	<a href="http://www.gercin.org">http://www.gercin.org</a>
8.	Haryana	Yes	7.818	2008-09	SERC order dated 23 <sup>rd</sup> April 2008 in proceedings 3 of 2008.	<a href="http://herc.nic.in">http://herc.nic.in</a>
9.	Himachal Pradesh	No	----	----	Vertically Integrated Utility	
10.	Jharkhand	No	----	----	Vertically Integrated Utility	<a href="http://jserc.org">http://jserc.org</a>
11.	Jammu & Kashmir	No	----	----	Power Department	<a href="http://jkserc.nic.in">http://jkserc.nic.in</a>
11.	Karnataka	No	----	----	Regulation issued on 7 <sup>th</sup> July 2004.	<a href="http://www.kerc.org">http://www.kerc.org</a>

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Sl. No.	State	Whether Separate SLDC charges	Annual Fee & Charges (Rs. Crore)	Year	Remarks	Referenced SERC Website
12.	Orissa	No	----	-----	OPTCL to furnish proper details by next year.	<a href="http://www.orierc.org">http://www.orierc.org</a>
13.	Kerala	No	----	-----	Vertically Integrated Utility	<a href="http://www.erckerala.org">http://www.erckerala.org</a>
14.	Madhya Pradesh	Yes	3.8	2007-08	SERC order dated 18 <sup>th</sup> January 2008 in petition no. 121/2006	<a href="http://www.mperc.org">http://www.mperc.org</a>
15.	Maharashtra	Yes	14.98	2008-09	Includes payable RLDC charges. SERC order dated 30 <sup>th</sup> May 2008 in petition no 88 of 2007	<a href="http://mercindia.org.in">http://mercindia.org.in</a>
16.	Punjab	No	----	-----	Vertically Integrated Utility	<a href="http://www.pserc.nic.in">http://www.pserc.nic.in</a>
17.	Rajasthan	Yes	23.15	2008-09	Includes payable RLDC charges. SERC order dated 31 <sup>st</sup> March 2008 in petition no 143/07 for AAR of RVPNL	<a href="http://www.rerc.gov.in">http://www.rerc.gov.in</a>
18.	Tamil Nadu	No	----	-----	Vertically Integrated Utility	<a href="http://tnerc.tn.nic.in">http://tnerc.tn.nic.in</a>
20.	Tripura	No	----	-----	Power Department	<a href="http://terc.nic.in">http://terc.nic.in</a>
21.	Uttarakhand	No	----	-----	Embedded in AAR of STU	<a href="http://www.uerc.in">http://www.uerc.in</a>
22.	Uttar Pradesh	No	----	-----	Embedded in AAR of STU	<a href="http://www.uperc.org">http://www.uperc.org</a>
23.	West Bengal	No	----	-----	Embedded in AAR of STU	<a href="http://www.wberc.net">http://www.wberc.net</a>

## Annex-XIV

### Website of Load Despatch Centres (LDCs) in India

(As seen on 31<sup>st</sup> July 2008)

S No.	Name of the LDC	Website	Website address of LDC	Alternate address for LDC information
1	National LDC	Yes	<a href="http://www.nldc.in">http://www.nldc.in</a>	
<b>Regional Load Despatch Centres (RLDC)</b>				
1	Northern	Yes	<a href="http://www.nrlcdc.org">http://www.nrlcdc.org</a>	
2	Eastern	Yes	<a href="http://www.erldc.org">http://www.erldc.org</a>	
3	Western	Yes	<a href="http://www.wrlcdc.com">http://www.wrlcdc.com</a>	
4	Southern	Yes	<a href="http://www.srlcdc.org">http://www.srlcdc.org</a>	
5	North-Eastern	Yes	<a href="http://www.nerldc.org">http://www.nerldc.org</a>	
<b>State Load Despatch Centres (SLDC)</b>				
1	Assam	Yes	<a href="http://aegclslcdc.org">http://aegclslcdc.org</a>	---
2	Andhra Pradesh	No	---	<a href="http://www.aptransco.gov.in">www.aptransco.gov.in</a>
3	Arunachal Pradesh	No	---	---
4	BBMB	No	---	---
5	Bihar	No	---	<a href="http://www.bseb.org">http://www.bseb.org</a>
6	Chandigarh	No	---	---
7	Chattisgarh	No	---	<a href="http://www.cseb.gov.in/">www.cseb.gov.in/</a>
8	Delhi	Yes	<a href="http://www.delhisldc.org">http://www.delhisldc.org</a>	---
9	DVC	No	---	---
10	Gujarat	Yes	<a href="http://www.sldcguj.com">http://www.sldcguj.com</a>	---
11	Goa	No	----	---
12	Haryana	Yes	<a href="http://www.haryanasldc.org">http://www.haryanasldc.org</a>	---
13	Himachal Pradesh	Yes	<a href="http://www.hpsldc.org">http://www.hpsldc.org</a>	---
14	Jharkhand	No	---	---
15	Jammu & Kashmir	No	---	<a href="http://www.jkpdd.gov.in">www.jkpdd.gov.in</a>
16	Karnataka	No	---	<a href="http://www.kptcl.com">http://www.kptcl.com</a>
17	Orissa	Yes	<a href="http://www.sldcorissa.org.in">http://www.sldcorissa.org.in</a>	---
18	Kerala	Yes	<a href="http://www.sldckerala.com">http://www.sldckerala.com</a>	---
19	Madhya Pradesh	Yes	<a href="http://www.sldcmpindia.com">http://www.sldcmpindia.com</a>	---
20	Maharashtra	Yes	<a href="http://mahasldc.in">http://mahasldc.in</a>	---
21	Manipur	No	---	---
22	Meghalaya	No	---	<a href="http://www.meseb.nic.in">www.meseb.nic.in</a>
23	Mizoram	No	---	---
24	Nagaland	No	---	---
25	Puducherry	No	---	---
26	Punjab	No	---	<a href="http://www.psebindia.org">www.psebindia.org</a>
27	Sikkim	No	---	---
28	Rajasthan	No	---	<a href="http://www.rajenergy.com">www.rajenergy.com</a>
29	Tamil Nadu	No	---	<a href="http://www.tneb.in">http://www.tneb.in</a>
30	Tripura	No	---	---
31	Uttarakhand	No	---	<a href="http://www.ptcul.org">http://www.ptcul.org</a>
32	Uttar Pradesh	No	---	<a href="http://www.uppcl.org/">http://www.uppcl.org/</a>
33	West Bengal	No	---	<a href="http://www.wbsetcl.in">www.wbsetcl.in</a>





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