

# **POWER SYSTEM OPERATION CORPORATION LTD**

## **Corporate Plan 2017-18**

The electricity grid in India is a conglomeration of the power systems owned by various utilities. The country is demarcated into five synchronized regional grids namely North, West, East, Northeast and South.

All the five Regional Grids are operating as one synchronized National Grid. Responsibility of managing these grids as a whole lies with Regional Load Despatch Centers (RLDCs) and National Load Despatch Center (NLDC) under POSOCO.

POSOCO has been incorporated for independent and neutral operation of the Power System. The company was registered as a wholly owned subsidiary company of POWERGRID on 20<sup>th</sup> March, 2009 in accordance with the directive of Ministry of Power vide their letter dated 4<sup>th</sup> July, 2008. In accordance with Ministry of Power notification dated 27<sup>th</sup> September 2010, under sub-section (3) of Section 26 and sub-section (2) of Section 27 of the Electricity Act, 2003 (36 of 2003), POSOCO is operating all the five RLDCs and the NLDC w.e.f. 1<sup>st</sup> October 2010. It is responsible for independent system operation with separate accounting and Board structure. POSOCO has now been notified as wholly owned independent Govt. Company with effect from 3<sup>rd</sup> January 2017 by Ministry of Power, vide notification dated 19<sup>th</sup> December 2016.

As per section 28 of the Electricity Act, 2003 RLDCs are the Apex bodies to ensure integrated operation in the concerned region. NLDC has been designated as Apex body to ensure integrated operation of National Power System vide Ministry of Power notification dated 2<sup>nd</sup> March 2005. Further, the RLDCs are 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. The Indian Electricity Grid Code (IEGC) notified by the Central Electricity Regulatory Commission (CERC), lays down the rules, guidelines and standards to be followed by the various agencies and participants in the system to plan, develop, maintain and operate the power system, in the most efficient, reliable, economic and secure manner, while facilitating healthy competition in the generation and supply of electricity in the country.

Corporate Plan of POSOCO has been envisaged to ensure Integrated Operation of Regional and National Power Systems to facilitate transfer of electric power within and across the regions and trans-national exchange of power with Reliability, Security and Economy and fulfilling the various other functions assigned by the Govt. of India, from time to time.

## **1. Functions of The Load Despatch Centers**

The functions of Load Despatch Centers have 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. System Operation and Market Operation have been envisaged as the two prime functions of the Load Despatch Centers.

The Gireesh Pradhan Committee constituted by Govt. of India in Feb'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 Centers has discussed in detail about the functions of Load Despatch Centers in its report on "Manpower, Certification and Incentives for System Operation and Ring fencing Load Despatch Centers".

The RLDCs and NLDC perform two distinct functions in the form of System Operation and Market operation. Ensuring reliable operation of the electricity grids is the first and foremost task and a pre-requisite for markets to operate. Administering the wholesale electricity market at the interstate level based on CERC Regulations comes the next.

The responsibilities of RLDCs/NLDC have increased many fold over the years starting with implementation of Availability Based Tariff (ABT), short term open access in inter-State transmission, integration of regional grids, operation of multiple Power Exchanges, Nodal agency for Ancillary Services Operations, integration of renewable energy sources, Nodal Agency for Renewable Energy Certificates (RECs) and its entire administration, Nodal Agency for Power System Development Fund (PSDF), implementing agency for the Point of Connection (POC) based transmission charges sharing mechanism, power supply regulation, etc. There is a continued thrust for strengthening of the manpower of the RLDCs & NLDC to take up these additional responsibilities. In this direction, the Central Commission has recognized the importance of role of the RLDCs & NLDC and has approved the manpower requirement as envisaged by Pradhan committee.

## **2. Revenue Stream of POSOCO**

The Load Despatch Centers are statutory bodies and are required to carry out specific tasks as assigned in the Act. RLDCs are required to carry out the functions like monitoring of system parameters and security, ensuring the integrated operation of the power system in the region, daily scheduling and operational planning, facilitating bilateral and inter-regional exchanges, etc. They are supposed to carry out these functions without being influenced by or biased in favour of any market player. The Load Despatch Centers shall also not engage in the business of generation or trading of electricity, as per the provisions of the Act, so that they can

discharge their functions free from conflict of interest. Moreover, the tasks assigned to the LDCs are specialized in nature. Financial independence is of utmost importance to an organization to work in an unbiased manner. It is in this context, CERC notifies 'Fee and Charges of Regional Load Despatch Centers and other Related Matters' Regulations at an interval of five year on rolling basis. The Regulations for control period 2009-14 were notified on 18<sup>th</sup> September, 2009 and for control period 2014-19 have been notified on 18<sup>th</sup> May 2015. The Regulations have ensured an independent revenue stream and financial autonomy for POSOCO.

POSOCO being a knowledge based Control Center organization, services are to be delivered by human beings having the required skills and capabilities. Even the best of technological tools provided in the form of SCADA/EMS and other offline support systems in the LDCs would require human skills and motivation for the tools to be utilized in the best manner. The human resource expenses are one of the most important and a major component of the entire expenditure of POSOCO and have been allowed separately in the Regulation. The Users comprising of Inter-State Generators, Buyers and Inter-State Transmission Licensees are availing the services of the RLDCs and NLDC and have been paying the charges of the RLDCs and NLDC. To maintain cash flow, healthy realization of the billing being done to the various users is of utmost importance for the Company. Petitions for approval of the Fees and Charges for the control period 2014-19 have been filed in the month of October, 2015, in accordance with the RLDC Fees and Charges Regulations notified by CERC on 18<sup>th</sup> May 2015.. CERC has approved the fees and charges in December 2016. Annual Charges amounting to Rs. 701 Crores have been allowed against the Rs. 1422 Crores filed with CERC for the control period 2014-19. Company may face cash flow issues following these orders. In view of the same, CERC is being approached for review of the orders.

### **3. CAPEX (REPEX)**

POSOCO being a knowledge centric organization which has been entrusted with specialized functions by Government of India. Its assets mainly comprises of SCADA-EMS system installed in the Control Centers of the RLDCs and NLDC. The SCADA-EMS system is used as a tool by the System Operator for Power System Operation.

Capital expenditure is incurred primarily for activities like replacement / augmentation of the existing SCADA-EMS system, renovation and modernization of the Control Centers, adaptation of new technologies like WAMS and PMU, development of IT infrastructure for offline activities, data warehousing and Cyber Security System etc. The CAPEX therefore can be classified as replacement of existing assets (REPEX) on an interval of 5 to 7 years on rolling basis and addition of new tools for support to the System Operation & Market operating function. The CAPEX had been approved by CERC for the Control Period 2009-14 as part of the annual charges of the RLDCs

and NLDC, for replacement of SCADA system of the RLDC's, IT tools for the system support, WAMS and PMU pilot schemes for snapshot visualization in real time environment, fault analysis etc. The LOA for replacement of SCADA system for all RLDC's have been placed in 2012-13 and the schemes have been completed in 2015-16 and 2016-17 in the control period 2014-19. The WAMS pilot schemes have been successfully implemented in all RLDC's and have proved to be path breaking. LOA for replacement of SCADA system of NLDC is likely to be placed in early 2017-18 and system is expected to be replaced by 2018-19.

#### **4. Human Resources**

POSOCO is a people driven organization with a team of motivated employees. At POSOCO, people are the real assets. It prides itself in grooming its employees to become finest System Operators in the country. With a balanced mix of young and experienced executives, it endeavours to be a vibrant, progressive and innovation oriented organization. POSOCO has consistently striven towards creating an employee value proposition by putting special focus on learning and development, and instituting best-in-industry practices. POSOCO has developed strong collaboration and Industry-Academia Partnerships for institutional and individual capability enhancement. As an organization, here the Value System is based on Integrity of purpose, Service to the nation and a commitment of excellence.

POSOCO took the initiative for Certification of System Operators in the country by an independent agency as recommended in the report on 'Manpower, Certification and Incentives for System Operation and Ring fencing of Load Despatch Centers issued by Ministry of Power. Thereafter, a combined committee headed by Member(GO&D), CEA for training and certification suggested three levels of certification viz. 'Basic Level', 'Specialist Level' and 'Management Level'. It also recommended that the Certification authority may conduct the online examination for all the three levels of certification on periodic basis. The training programs have been specifically designed by National Power Training Institute in consultation with POSOCO to meet the requirements of Power System Operation.

The Basic level training has been conducted successfully by NPTI since 2011 onwards. The Basic Level Certification Examinations were held by NPTI in November 2011, December 2012, July 2014 November 2015 and December 2016. December 2016 exam saw participation by Jharkhand and Manipur for the first time. In the first basic level certification program, 324 system operators from 26 LDC's had appeared and 266 candidates were successful. Second Basic Level System Operator Certification exam was held in December'2012 and 22 LDC's participated, 303 candidates appeared of which 240 candidates declared successful. The third Basic Level System Operator Exam was held in July 2014 and 136 candidates were declared successful. In the fourth basic level examination held in in November 2015, 246 candidates were declared successful. In the Fifth Basic Level Exam 18 LDCs

participated and 134 System Operators were declared successful. Basic Level Training and Specialist Level Training have been organized by NPTI for System Operators at a regular basis in the past 5 years, the topic for specialist level training includes- Power System Reliability, Power, Regulatory Framework in Power Sector, RES & Grid Integration, Wind Energy Technology, Power System Stability and Control and Power System Economics. Subsequently, two specialist level certification exams on 'Regulatory framework in Power Sector' have been organized in March 2013 & February 2016, total of 138 System Operators have cleared these two exams. The exam on 'Power System Reliability' certification was held in Feb'2015 in which 77 candidates were declared successful.

For furthering capability enhancement for System Operators and developing research capacity by promoting Industry-academia partnership, POSOCO signed an MoU with Indian Institute of Technology, Kanpur, Indian Institute of Technology, Kharagpur and Jamia Milia Islamia (JMI).

POSOCO has been regularly organizing the learning and development programs for capability enhancement and perceives these capacity building activities as a continuous process. POSOCO has taken initiative for funding of the training expenses of state level load dispatch centers System operators from 'LDC Development Fund'.

## **5. Participation in Regulatory Reforms Process.**

The RLDCs and NLDC have been giving feedback and inputs at various stages of formulation of the regulations pertaining to the design and operational aspects. During the year, POSOCO has given feedback to CERC on a number of Regulations, viz. Indian Electricity Grid Code, , UI & Related Matters, Deviation Settlement Mechanism & Related matters, Grant of Connectivity, Medium Term Open Access and Long Term Access and Sharing of Inter State Transmission Charges and Losses, Open Access in inter-State Transmission, Ancillary Services Operations, Framework on Forecasting, Scheduling, Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar), RLDC Fees and Charges, Power System Development Fund and issuance of Renewable Energy Certificate for Renewable Energy Generation. Company plans to make best efforts towards implementing these Regulations in letter and spirit and continue to provide feedback and participate in the Regulatory process.

## **6. Operational Feedback to CEA & CTU**

NLDC Rules, 2005, clause 4(j) specifies providing operational feedback for National Grid planning to CEA and CTU as one of the functions. A quarterly feedback on operational constraints faced in Power System Operation is being furnished to CEA and CTU. Apart from this, feedback is also being given on exceptional situations

faced in the system. A feedback by system operator on congestion being experienced and likely congestion in foreseeable future helps planners and policy makers to optimize development of Power System.

Company plans to ensure that this operational feedback remain consistent with the objective of achieving secure and reliable Power System Operation and helps in optimizing the overall development of national Power System.

## **7. Declaration of Pan India Transfer Capability**

Regulation 3 of CERC Measures to relieve congestion in real time operation Regulations, 2009 (notified in December 2009) entrusts the RLDCs and NLDC with the responsibility of assessing transfer capability on various Inter-regional corridors for facilitating inter-state open access. After grid disturbance in July'2012, a revised procedure for implementation of the above was prepared by NLDC and the RLDCs and was approved by the CERC. Monthly transfer capability along with its subsequent revisions is being assessed in a transparent manner. Information regarding this is being maintained on NLDC website and is publically available for all the stakeholders. Declaration of the Pan India Transfer Capability is an important activity which facilitates Market Operation and would be done in accordance with the CERC Regulations

NLDC being the nodal agency for co-ordination of cross border power transactions has also started declaring the transfer capability for export of power to Bangladesh which is enabling smooth transfer of power from India to Bangladesh recognizing the security constraints as well as optimizing the transfers. With strong AC interconnections to Nepal and Bhutan also on the anvil, there is a strong need for further interaction with the system operators of neighbouring countries and information exchange as far as network model and real time data is concerned. POSOCO is poised to undertake this task.

## **8. Introduction of Ancillary Services in Indian Electricity Market**

CERC notified Ancillary Services Operations Regulations on 13th August, 2015. NLDC has been designated as the Nodal Agency for the implementation of the Ancillary Services Operations framework at inter-state level. Ancillary Services are essential for secure & reliable grid operation. It is first time in the Indian Electricity Market that Ancillary Services are being introduced by harnessing Un-requisitioned Surplus in the Inter-State Generating Stations.

Ancillary Services would address the congestion management issues along with more economy & efficiency in grid management. New interactive displays have been developed in Load Despatch Centres of POSOCO to help the Grid Operator in

dispatching the Spinning Reserve. Ancillary services are operational from 12<sup>th</sup> April'16 through in-house developed software.

## **9. Frequency Control**

With a large footprint of the Indian grid, there is an increasing need for automatic controls in the form of primary, secondary and tertiary frequency control services which would help in maintaining the frequency at its nominal value besides ensuring that Area Control Error (ACE) remains close to zero and tie-line flows remain in control.

POSOCO is working with eminent experts, stakeholders and the staff of CERC in ensuring that such controls are planned, designed and implemented at the earliest so that secure grid operation can be ensured.

## **10. Implementing Agency for Sharing of Interstate Transmission Charges & Losses Regulation 2010**

The CERC Regulation on Sharing of Inter-State Transmission Charges and Losses was notified on 15th June, 2010. The new Transmission Pricing Mechanism aims to make the transmission charges sensitive to distance direction and quantum of flow as directed in the National Electricity Policy and Tariff Policy. NLDC has been designated as the Implementing Agency (IA) for the new Pricing Mechanism. Responsibilities of the IA included collection of All India Power System Data and commercial data from the stakeholders, preparation and validation of network model and computing the point of connection (PoC) charges and losses. Based on the results submitted by the Implementing Agency, CERC notifies the slab rates for PoC Charges and Losses. Presently, the computation of PoC charges and losses are being carried out quarterly. The 3<sup>rd</sup> and 4<sup>th</sup> Amendments in CERC (Sharing of Inter-State Transmission Charges and Losses) have ushered in major changes in the transmission pricing mechanism.

Company plans to ensure that the responsibilities given by CERC as Implementing Agency are discharged in a non-discriminatory manner and the provisions of the regulations and CERC Orders on Transmission Pricing are implemented in letter and spirit.

## **11. Renewable Energy Certificate (REC) Mechanism**

REC is a market based instrument which has accelerated new investments in Renewable Energy Sector and introduced competition in purchase of renewable energy. Under this mechanism, the RE generator can now sell the electricity component locally at the price of conventional electricity and trade the environmental attribute in the form of REC separately through Power Exchanges.

National Load Despatch Centre (NLDC) has been designated as the “Central Agency” for the implementation of the REC mechanism.

Till Dec'2016, 1137 RE generators with cumulative capacity of 4728 MW have been 'Registered' and 3,66,55,801 RECs (solar & non-solar combined) have been issued. Further, 2 DISCOMs have also been Registered under REC Mechanism. The RECs are traded on last Wednesday of every month on POWER Exchange Platform. Seventy successful REC Trading sessions have taken place so far and more than 171.64 lacs RECs (Solar & non-solar combined) have been redeemed. Further, 7.87 lacs RECs, have been self-retained by RE generators to fulfil their Renewable Purchase Obligation (RPO).

In its designated role of Central Agency for REC Mechanism, NLDC would continue to facilitate the REC Mechanism. Six year has been completed since the launch of the REC mechanism in Nov'10, response of the stakeholders towards REC Mechanism is quite encouraging. The sheer number of hits on the REC website and no. of RE projects registered under REC Mechanism shows that the REC Mechanism has achieved success in a very short span of time. With the emphasis on RPO compliance, it is expected that the volume of trading of RECs will substantially increase in coming years.

## **12. Energy Efficiency and PAT Scheme**

To improve energy efficiency in the large energy intensive industries, Central Government has launched Perform, Achieve and Trade (PAT) scheme under National Mission for Enhanced Energy Efficiency (NMEEE). Central Government has notified the energy consumption norms and standards for the 478 Designated Consumers (DCs) of 8 Energy intensive sectors in 1st PAT Cycle (2012-15) and 621 DCs of 11 Sectors in 2nd PAT Cycle (2016-19). Under PAT scheme, the quantified energy savings are converted into Energy Saving Certificates (ESCerts) which may be traded through the Power Exchanges. Each ESCert is equivalent to one metric ton of oil equivalent of energy (toe). ESCerts shall be issued by Ministry of Power (MoP) to the DCs who have conserved energy over and above their consumption targets. The DCs who do not meet their targets may purchase the ESCerts equivalent to their shortfall from the target from Power Exchanges (PXs).

Considering the experience of POSOCO with regards to Renewable Energy Certificate Mechanism, MoP, vide Order No. 10/4/2015 dated 05.01.2016, has assigned the function of Registry of ESCerts to POSOCO. In this context, POSOCO shall establish the necessary framework to discharge the functions under PAT Mechanism.



### **13. Power System Development Fund**

Power System Development Fund (PSDF) constituted vide Central Electricity Regulatory Commission (Power System Development Fund) Regulations, 2010 dated 4th June 2010, became operational from 20th Oct., 2010. The Regulations stipulate that the balances in regulatory pool accounts such as Congestion Charges, Congestion Revenue, Unscheduled Interchange Charges, and RLDC Reactive Energy Charges lying with constituents shall be periodically transferred to PSDF for custody, management and eventual disbursements towards approved development projects and schemes. CERC (PSDF) Regulations, 2010 dated 4th June 2010 have been modified and replaced with PSDF Regulations, 2014 notified by CERC on 9th June 2014. NLDC has been designated as the Nodal Agency for implementation of this scheme.

Regional Power Committees, Generating Companies, Transmission Licensees, Distribution Licensees and Load Despatch Centers as the case may be, shall submit the schemes to NLDC as Nodal Agency for funding from PSDF. NLDC would pose these schemes to the Appraisal Committee for technical Scrutiny. Based on the recommendations of the Appraisal Committee headed by chairperson, CEA and communication of the CERC, the disbursement of the funds under PSDF shall be sanctioned by an inter-ministerial Monitoring Committee headed by Secretary, Power. The Nodal Agency will also act as the Secretariat to the Appraisal Committee and the Monitoring Committee.

NLDC has been receiving various type of Schemes like, Renovation and Modernization (R&M) of transmission and distribution systems for relieving congestion, Installation of standard and special protection schemes, Installation of shunt capacitors & series compensators for improvement of voltage profile in the Grid etc. from the various eligible entities for funding from PSDF. Fifty Seven (57) schemes with sanctioned grant amount of Rs. 7268 Crores have been approved by the Monitoring Committee. Further, another Forty Nine (49) other various schemes are under different stages of Examination/Approval. Disbursement of the Fund has been started during the year 2015-16 and an amount of Rs. 312 Crores already disbursed out of Rs.360 Crores released by MoP. NLDC would endeavor to fulfill the responsibility assigned as the Nodal Agency for implementation this scheme in the coming years for the betterment of the Power System of the Country.

### **14. Corporate Social Responsibility (CSR) and Research and Development**

In compliance of the provisions of the Companies Act, 2013, following CSR projects/activities are being undertaken by POSOCO during FY 2016-17:

- i) Promoting research and studies related to Power Systems in the engineering institutions to encourage excellence in the area

- ii) Awareness programs and capacity building for school children on energy efficiency, environment friendly technologies and non-conventional energy sources- Project titled 'E for Energy Efficiency
- iii) Procurement of Renewable Energy Certificates
- iv) Providing solar lanterns including cooking stoves in the backward areas of the country

Reputed and experienced agencies like TERI and IIT Delhi are being engaged for rendering necessary assistance for implementation of the activities.

Under the R&D activities, POSOCO is getting associated with the Academic Institutions within the Country and Abroad and collaborating with them to carry out activities like Upgradation of capability through electromagnetic transient analysis software and Upgrading capability for RE integration analysis using PLEXOS optimisation software.

Understanding the responsibility towards society and future generations, the Company is implementing these activities in full spirit and plans to undertake such activities in the coming year with the same passion and intensity in sync with objectives set in the Companies Act, 2013.

## **15. Participation at International Fora**

POSOCO is member of various international groups/bodies such as the Very Large Power Grid Operators (VLPGO- now GO 15), TSO – Comparison and CIGRE with the objective of sharing of experiences, best practices and bench marking System Operation and Market Operation against the very best across the world.

The executives of POSOCO have been actively participating in these forums. Participation at the international level in the VLPGO Working Groups Technical Committees and CIGRE has benefited POSOCO by exchange of knowledge, new technology (such as Synchrophasors, Renewables, HVDC, Power System Restoration, Prevention of Blackouts, etc.) and best practices for Power System Operation.

In future, some of the broad subject areas for international cooperation are:

- Grid for Flexible Resources
- Grid for Reliability and Security
- Grid for Economic Sustainability
- Grid Intelligence

POSOCO signed a Memorandum of Understanding with Lawrence Berkeley National Laboratory (LBNL) in December, 2012 for collaboration on Power System Operation, Electricity Markets and Integration of Renewable Energy Resources. POSOCO is an

active partner and nodal agency in USAID/USEA and Ministry of Power collaborated Greening the Grid System Operators Partnership with the objective of mobilizing relevant technical capacity for system operators for large-scale RE integration. The focus of the partnership activities provide a better understanding of international best practices, technical approaches, regulatory mechanisms, market design, technical standards, data requirements, etc. As part of the USAID's Greening the Grid (GtG) program in collaboration with Ministry of Power, training program on RE integration and modelling using PLEXOS software are being held for system operators at all levels. POSOCO has been actively associated with the activities pertaining to energy cooperation in the SAARC region and the development of a SAARC Electricity Market.

Besides continuing its membership in the prestigious international bodies, the Company plans to increase its participation in other forums also. The executives are encouraged to engage themselves professionally at such forums through submission of technical papers which are peer reviewed before publication. The endeavor is to see that the Indian experience starts to find mention at the international level.

## **16.Leveraging Technology: System Logistics**

Real-time data acquisition from various stations across the country is a challenging task and it involves state-of-the-art technology, strong communication network and rigorous planning to achieve it. Real-time grid operation depends on the real-time data provided by SCADA/EMS system and WAMS system. System Operators relies on the real-time data for grid monitoring and decision making in day to day Grid Operation. It is desired that the system operators are equipped with latest tools to facilitate real time decisions making process. SCADA/EMS systems at all the control centres on All India basis including at RLDCs have been replaced/upgraded in order to equip the operators with latest available visualization and power system application tools. All the SCADA/EMS projects are commissioned except in North Eastern Region which is under commissioning.

NLDC SCADA/EMS system is also under Up-gradation and sophisticated power application tools like DSA (Dynamic Security Assessment) and AGC (Automatic Generation Control) applications are also envisaged in the SCADA up gradation project of NLDC.

To provide dynamic visibility of the grid, Wide Area Management Systems (WAMS) are being installed nationwide under the Unified Real Time Dynamic State Measurement (URTDSM) project being implemented by POWERGRID. This system would provide microscopic view of the power system. Presently, under the URTDSM project about 1200 PMUs are under commissioning and expected to complete by January'17.

A hotline voice communication system covering all control centers, sub-stations, generating stations across India using dedicated wideband communication system is under commissioning. The system in Northern and Eastern Region is under completion. This communication, which is independent of public communication network, will provide express voice communication for day-to-day operation of the grid as well as during crisis and disaster situations. On implementation of this system, control center operator would be able to connect the any other control center sub-station/generating stations operator directly without using public communication network.

Establishment of Renewable Energy Management Centres (REMCs) have been approved by Ministry of Power and Ministry of New and Renewable Energy, GoI and its Detailed Project Reports (DPR) are under preparation. 11 nos. Renewable Energy Management Centre (REMC) would be established under the project out of which 7 nos. are in RE rich States, 3 nos. are at regional level and one at National level.

## **17. Trans-national Operation**

POSOCO in its domain is also contributing in the formation of South Asian Grid for effective utilization of resources among the neighbouring countries. Presently, power is being imported from the generating stations of Chukha, Tala and Kurichhu in Bhutan. Power has been allocated from these power stations to Beneficiaries located in Eastern and Northern Regions of India. Also, power from Dagachhu Hydro Power plant in Bhutan, is being sold in the Short Term Electricity market in India.

Regarding transaction with Bangladesh, power is exported through 400 kV Behrampur- Bheramara D/C line and 500 MW HVDC back-to-back at Bheramara. Govt. of India has allocated 250 MW (Gross) from different stations of NTPC to Bangladesh and Bangladesh also purchases power through Medium Term and Short Term arrangements. Transmission system augmentation to facilitate further 500 MW interchange with Bangladesh is under active consideration. Power export of the order of 80-100 MW from India to Bangladesh over 132 kV Surjamaninagar – Comilla D/C lines (changed at 132 kV) commenced from 17th March 2016 in a radial manner.

There are a number of 11 kV, 33 kV and 132 kV transmission lines between India and Nepal, and bilateral power transaction takes place between the States in India (Bihar/UP) and Nepal in a radial mode. With effect from 17th February 2016, export of 80-100 MW power from India to Nepal commenced over 400 kV Muzaffarpur – Dhalkebar D/C line (charged at 132 kV) in a radial mode. Also, cross border transactions in electricity between India and Myanmar through 11 kV Moreh (Manipur, India) –Tamu (Myanmar) started w.e.f. 8<sup>th</sup> April' 16.

## **18. Development of Power Atlas**

POSOCO had taken up the development of Power Atlas of India, in last year and the updated version was released on 2nd March 2016. The Atlas consists of Power maps of all states along with regional and all-India maps. An interactive flash application was also updated as a part of the atlas which allows display of much more details that can be accommodated in a paper map. Indication of latitude and longitude in these power maps proved to be of great help during natural calamities and determine as to which substations or transmission lines are likely to be affected.

## **19. Forum of Load Despatchers (FOLD)**

NLDC has been designated as secretariat of FOLD. The meetings of FOLD discuss various issues related to reliability and security of power system at the central as well as state level. FOLD is working as a catalyst in reliable, efficient and economic operation of the Indian bulk electric power supply system.

FOLD strives to achieve its vision through technical co-operation, knowledge sharing, regular interaction, active collaboration, capacity building, mutual respect, consensus building, international benchmarking and promoting ethical, non-discriminatory and fair practices. All the State Load Despatch Centres, Regional Load Despatch Centres and National Load Despatch Centre in India are members of this forum.

The inaugural meeting of FOLD was held on 21st August 2009 and upto Dec'16, eighteen meetings of FOLD has been held at various places.

During 2016-17, two meetings have been held wherein SAMAST Report and other technical issues have been discussed among members. Further, various capacity building workshops have been organised under aegis of FOLD and PPTs are available on FOLD website. In the coming years also, NLDC would continue to play the vital role in fulfilling the FOLD objectives.

## **20. Challenges Ahead**

Indian Power Sector is growing at a fast pace and the business environment is changing rapidly under Regulatory oversight. The complexity of the national power system is expected to increase with more inter connections, bulk power transfer corridors, international interconnections, higher transmission voltages, new technologies in generation and transmission, increasing presence of renewable energy sources, large size generation projects, system protection schemes and Smart Grid technologies. Further, the increase in competition among participants and

evolving market mechanisms are likely to increase the pressure on system operators. The challenge would be to adapt to the changing paradigm and to facilitate the functioning of the electricity market without compromising grid security and reliability. Grid Management has to be geared up to efficiently handle these challenges.

Reliable and secure operation of the grid must be maintained at all times. Standards are provided by CEA and the Regulatory framework by CERC. There is a strong need for the development of 'Reliability Standards' for the Indian Electricity Grids. POSOCO as the System Operator is making efforts to develop Reliability Standards which may be implemented with the approval of the Regulator. The operationalization of Ancillary Services, Reserves and AGC in 2017 will be key focus areas of POSOCO which will leapfrog our grid operation to the next generation.

A vibrant Electricity market is functioning in the country and the size of the short-term market is of the order of 10%. Further development of the electricity market needs to be taken up and new market segments such as 'Capacity Market' and 'Ramping' need to be introduced. In view of the large scale integration of renewables, new products need to be introduced in the electricity market such as 'Demand Response'. Further, the number of iterations of the Power Exchange market also needs to be increased. All these developmental activities are being taken up by POSOCO.

It is proposed to share the expertise of POSOCO in the field of System Operation and Market Operation with Load Despatch Centers within as well as outside the country.

Today, the electricity landscape is changing faster than ever before. The achievement of a reliable and secure grid requires new rules, new technologies, and new ways of operating the power system. Closer co-operation among all players, be it generators, consumers, power exchanges, power suppliers or technology providers is key to the optimization of the overall system. Power System Operators manage the backbone of the electricity supply for the benefit of the society.

POSOCO faces many challenges as the Indian power sector is undergoing a significant change that is redefining the industry outlook. The measures for combating the same are enumerated below:

- POSOCO is handling challenges such as increasing penetration of Renewable Energy (RE) generation, new 660/800/1000 MW generating units, rapid expansion of 765 kV systems in the country, newer HVDC links in the offing, small signal stability issues, frequency fluctuations and also the expectations of stakeholders to get 24x7 power. More parallel AC corridors are required both in upstream and downstream directions of any inter – regional corridor.

- POSOCO has an onerous responsibility of operating the All India synchronous grid, which is one of the largest in the world, meeting a peak demand of the order of 160 GW grid through its five (5) RLDCs and the NLDC.
- The country has set an ambitious target of adding 175 GW of renewable generation capacity by 2022. It includes Solar (utility-scale, distributed, off-grid/mini-grid – 100 GW), Wind (utility-scale – 60 GW), Small hydro (5 GW) and Bioenergy (10 GW). In this direction, a high level Technical committee, constituted by Ministry of Power, for Large Scale Integration of Renewable energy submitted its recommendations in April-2016. Several actions are being taken covering regulatory, transmission, system operation and capacity building.
- In order to facilitate grid integration of renewables at inter-state level, the CERC regulatory framework for forecasting, scheduling and deviation settlement for renewables at inter-state level has been implemented in November - 2015. At present, a total of about 40 MW of solar generation from 4 plants is being scheduled by RLDCs at inter-state level. Model Regulatory Framework for Forecasting, Scheduling and Imbalance Handling of RE generators at intra-state level was formulated by Forum of Regulators (FOR).
- Massive investments in generation and transmission in the grid implies that the country is on a 'high-build' phase. Needless to mention, this necessitates a large number of construction related outages on the transmission lines, which is over and above the maintenance related outages. A careful study and coordination with several utilities is done to ensure that the grid continues to operate in a reliable fashion and economy transactions are curtailed to the minimum possible extent.
- Maintaining frequency within the stipulated Indian Electricity Grid Code (IEGC) band without adequate primary response, secondary control and ancillary services has been challenging for POSOCO.
- Ancillary services, operationalized in April 2016 by utilizing the Un-Requisitioned Surpluses (URS) in Central Sector power stations and Ultra Mega Power Projects (UMPPs) which are under RLDC's jurisdiction, is providing fast tertiary control. Meanwhile, CERC has notified on 13th October 2015, the roadmap for operationalization of reserves in the country and POSOCO submitted a detailed procedure and initiated the action for implementation of Automatic Generation Control (AGC) pilot project in Northern Region. This would help in faster secondary control.

- With a vibrant electricity market in the country and the continuous pursuit of the distribution utilities to scout for the cheaper sources of electricity anywhere in the country, pressure on the transmission network is inevitable. A few transmission corridors get congested on seasonal basis. In the planning horizon several transmission lines are envisaged to mitigate this congestion. POSOCO through its operational feedback and discussion has persuaded several transmission utilities to fast track certain projects, so that the congestion is mitigated quickly. This process has been very successful and has helped in slowly reducing the congestion in the last three years.
- With increasing penetration of variable and intermittent RE generation, there is a need for more flexibility in the operation of conventional generation plants. The flexibility needs to be quantified, measured and duly compensated for. CERC notified regulatory provisions in April 2016 for the technical minimum for operation of Inter-State Generating Stations at 55% of Maximum Continuous Rating (MCR) installed capacity. The compensation mechanism is linked to station heat rate. The detailed procedure is under discussion.
- Managing power system in natural disasters such as earthquakes and cyclones has been quite challenging in the last year. The recent Earthquake in Nepal in April 2015 and Very Severe cyclone Hudhud in India was an alarm for the safety and reliability of Indian Grid. The immediate effects of such natural disasters on the power system are system faults and loads throw off. This leads to high voltages and frequency in the system which if uncontrolled may lead to cascade failure. The proactive and fast response from POSOCO has averted cascading failures in both the cases. Such low probability high impact events bring out the need for a resilient grid and design of such a resilient grid at the planning horizon itself.
- Outage coordination which includes construction related outages on the power system elements and maintenance related outages at all India level is a paramount task. This is being done by RLDCs/NLDC after a careful study and coordination with several utilities to ensure reliable and secure grid operation. Nearly 50-80 transmission elements / bay outages at 400 kV level and above are facilitated by RLDCs/NLDC every day.
- POSOCO also signed MoU with Earth System Science Organisation - India Meteorological Department (ESSO-IMD), Ministry of Earth Sciences on 18<sup>th</sup> May 2015 for synergy in the management of Indian Power System and weather related impact.



## **21. Commitment**

POSOCO is committed to neutral, impartial system operation and market operation aimed at delivering value to the stakeholders by creating robust institutional systems, nurturing human capabilities, leveraging technologies and deploying knowledge management.