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Knowledge Partner: **SIEMENS**



M3

ASSET
MANAGEMENT
in Power Transmission and Distribution



M3 ASSET MANAGEMENT
in Power Transmission and Distribution

Asset Management in Power Transmission and Distribution

Transmission and Distribution segments of Indian Power Sector have grown substantially in last 6 decades with robust Transmission grid consisting of AC voltage upto 765 kV and DC transmission upto \pm 800 kV. Even though the coal and hydro resources are located in Northern and Eastern part of our country, we are able to evacuate and transmit power throughout the country with single frequency. Apart from conventional generation, which has a quantum of 2,59,239 MW today including hydro, gas, nuclear, we are now putting thrust on Renewable Energy (RE) generation. The RE installed capacity has 13% share in terms of installed capacity and 5-6 % in terms of energy in the country.

Grid operation and constraints

The ambitious targets of RE, set by Government of India for 100 GW Solar and 60 GW of Wind, will bring load balancing nightmare for the System Operators, while respecting the merit order, low PLF & uncertainty of RE. The other well known critical challenges like load diversity dominated by agriculture load, different seasons prevailing countrywide at a time, peak and off-peak and over-voltages due to low demand during night hours etc., are anyway an integral part of grid operation. Also, we should not forget at this juncture that we have to go long way in providing support system devices for reliability and consistent grid operation. Some of such support systems immediately come to our mind are VAR compensation, Load Forecast, Spinning Reserves, Energy Storage System, Grid Protection and Stabilization Solution, PMU and WAMS with analytics, Islanding Systems, Governor mode operations, etc. We are already exposed to our weaknesses during the grid collapse in July 2012.

The integrity of grid operation under the above stated power system scenario has become the focal point both at Transmission and Distribution level for 24x7 uninterrupted power supply. We are now living with a reality that energy in the form of electricity is the lifeline of human living and utilities are compelled to re-evaluate the processes within the organization and deploy them strategically for reliable supply system at affordable cost to consumer in long run.

Nothing can move forward without a viable financial model which includes Network Development, Operation & Maintenance expenditure, Administrative

cost and Invisible losses. One has to make a prudent investment plan with justification and clarity on cost benefit analysis from the investment made in new Projects, maintenance infrastructure tools and System Improvement Plans. The later is gaining prominence as aged and obsolete technology assets in T&D grid are the major cause of break down maintenance and unsafe operation.

It will finally evolve around four Key Performance Indicators (KPI) of the utility.

1. Affordable Cost,
2. System Availability,
3. Quality of Power
4. T&D losses (AT&C for DISCOMs).

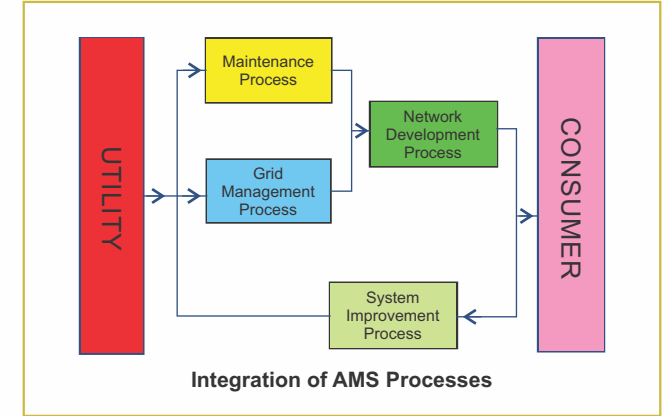
What is the way forward to fulfill these KPI?

Integrated Asset Management System

It is good that we have strong knowledge base in Advanced Control & Monitoring Devices, Diagnostic Equipments & Tools, Installation Techniques, Hotline Maintenance Tools etc. and top of it, we have IT and Communication (IT&C) Skills to use O&M data meaningfully.

An Asset Management System (AMS) which integrates Assets, Functions & Stakeholders, O&M Resources, State of art T&D technologies and grid operation, environment & safety, is the only way forward. IT&C infrastructures would be backbone to provide decision making tools. Such AMS has to be structured in the organization with ownership under four pillar processes:

1. Maintenance Process
2. Grid Management Process
3. System Improvement Process
4. Network Development Process



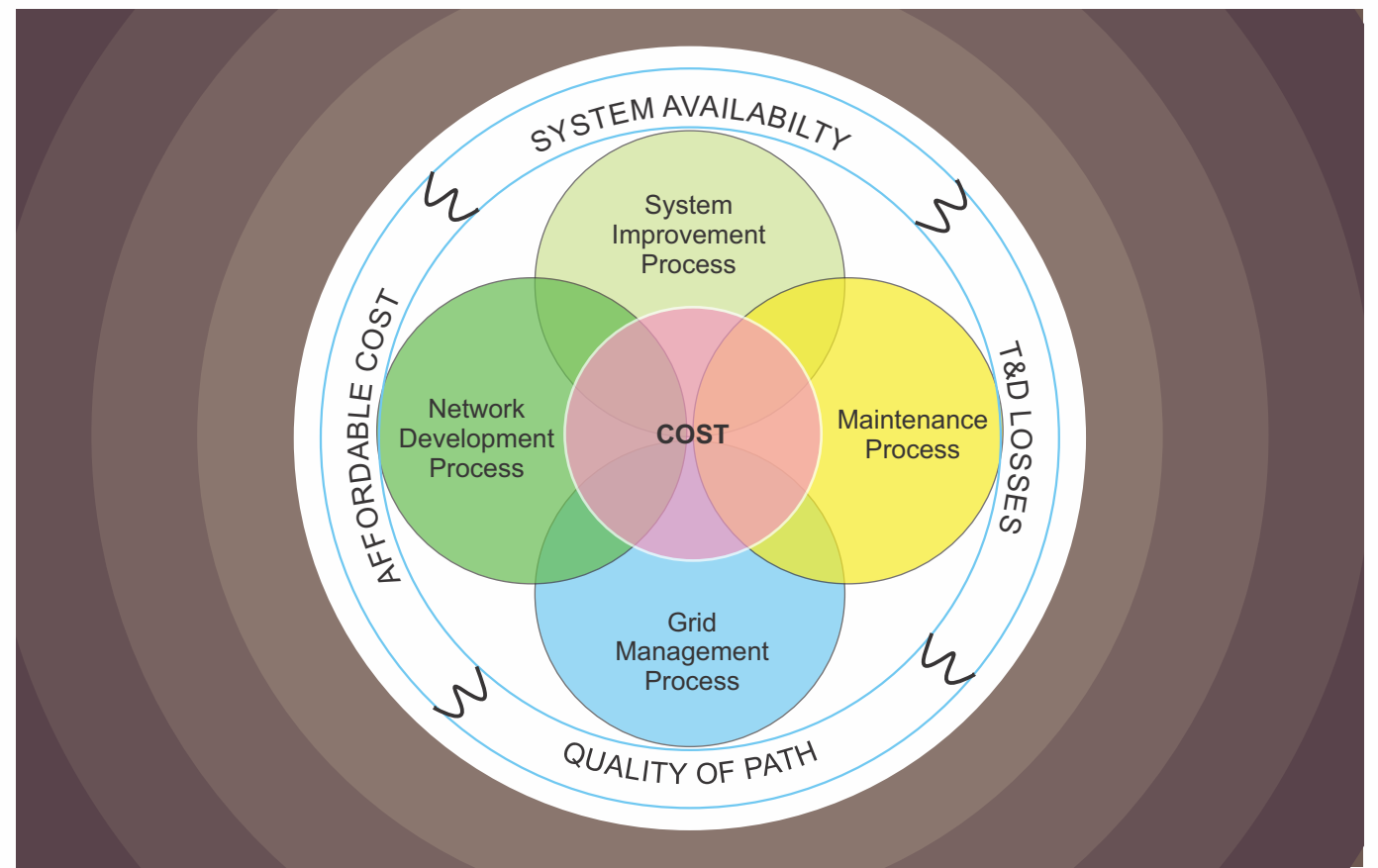
These processes are cost centre, but their decision on expenditure plan through close interface and co-relation will lead to best results in fulfilling the KPI of utility.

There is no doubt that there will be high investment in the initial stages, but it will be cost effective and economical in long run by adopting AMS processes. It is, therefore, necessary that our decision to invest in any of the above processes has to be very thorough and doable.

Utility has to be in proactive mode and vary these cost

inputs wisely on regular interval within the gambit of utility KPIs and performance review. All the processes are interlinked and investment in a particular process has visible impact on improvement in other process. The performance review of each process as per matrix of Integrated AMS must look at such visible impacts and then take corrective and preventive action to have balanced investment in all four processes.

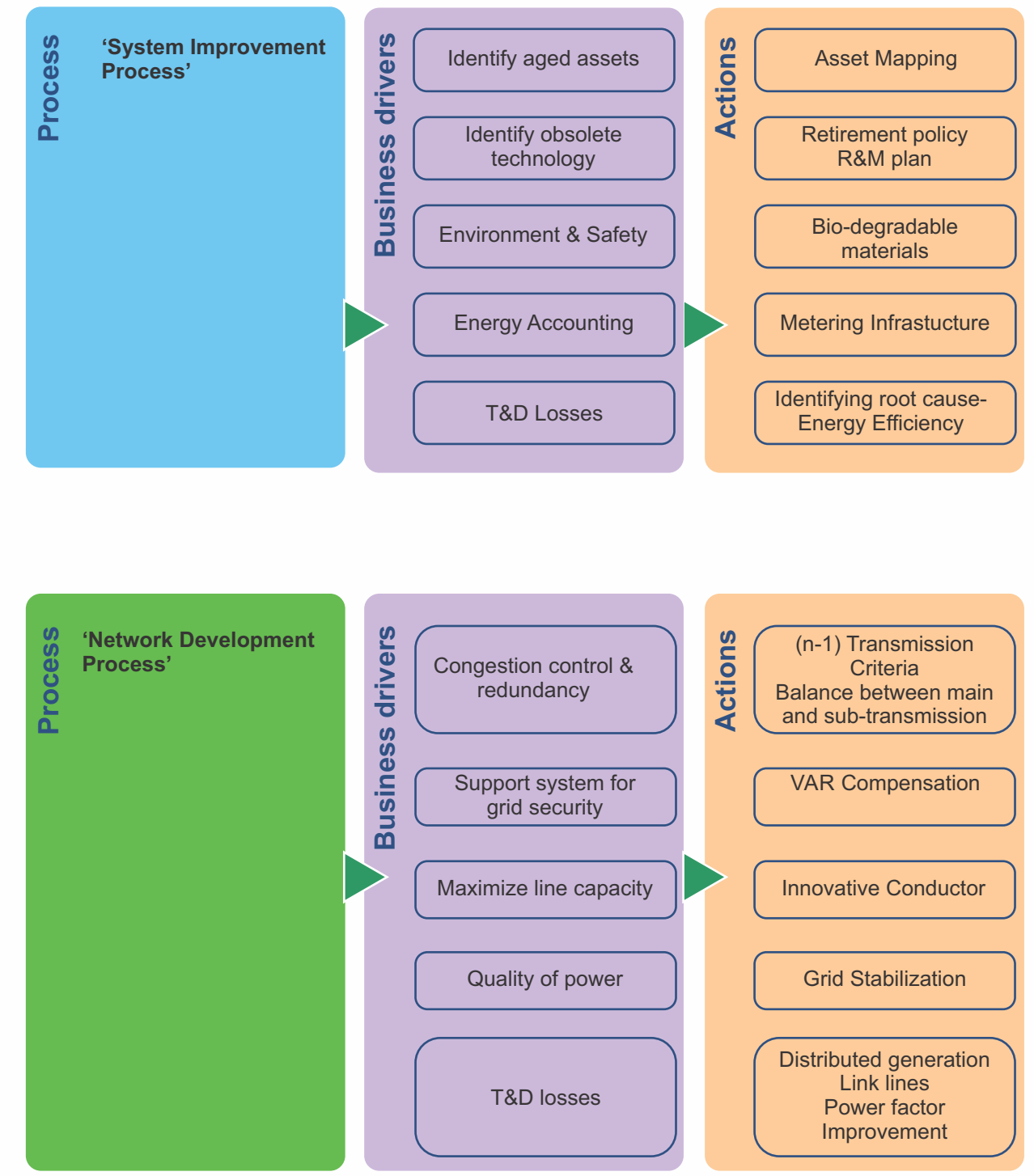
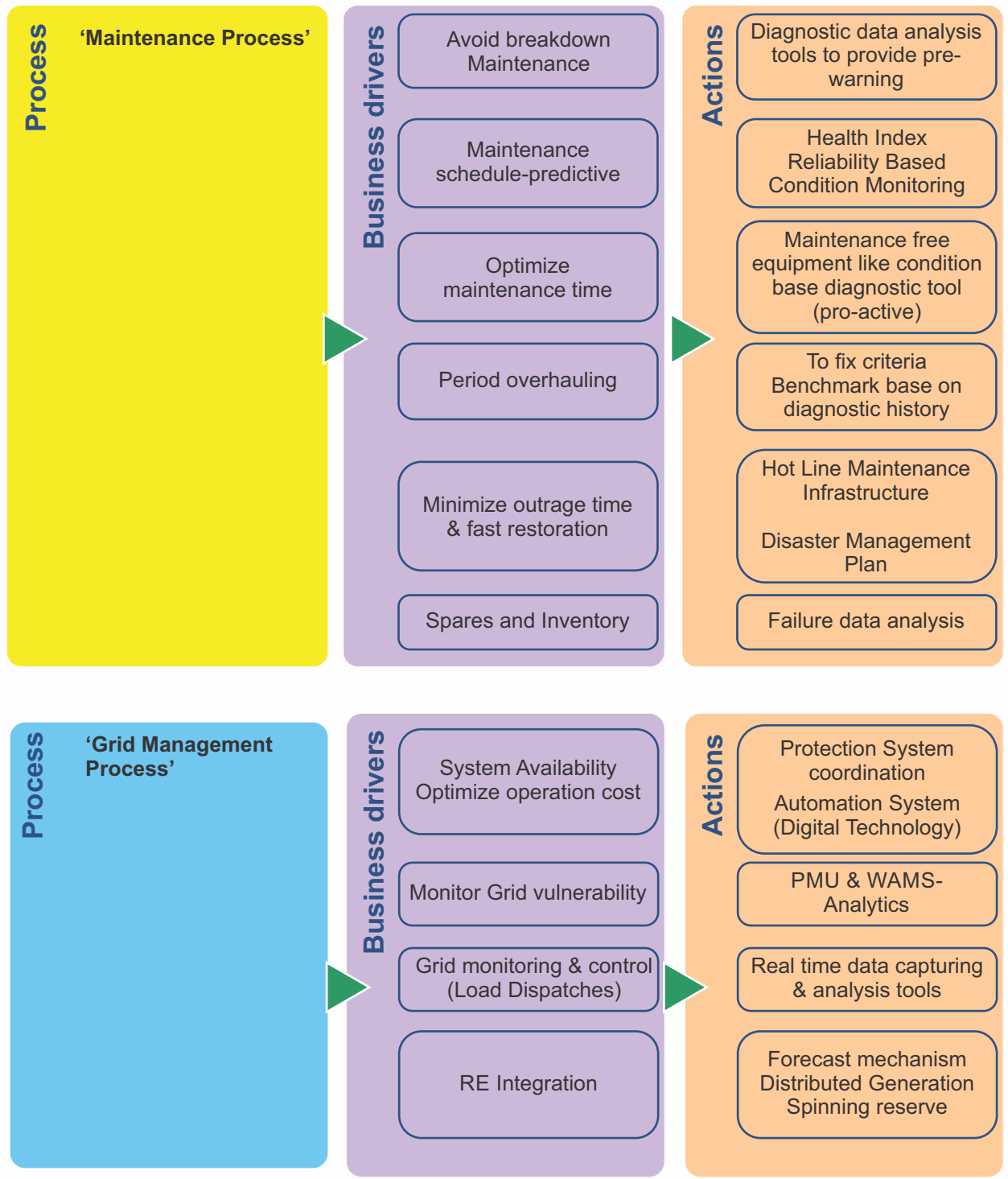
These has to be review mechanism which follows PDCA cycle and 'Act' (Improvement) part in this cycle shall be driven by output of above four processes.



A critical function of Asset Management is to provide clarity in linking business drivers with business processes and related Key Performance Indicators (KPI) that can be measured to monitor business performance. Business drivers are revised / modified through internal and external influences, like shareholders, financial numbers, employees expectations, customer pressure to minimize rates, government policies and regulations, which push business managers to adapt specific strategies. While business processes are development internally in

response to the perceived drivers, but they articulate broader company objectives, like providing excellent customer service, uninterrupted power supply, providing a safe work environment, KPI are measureable performance indicators developed out of the business processes which can be used to gauge company performance as a whole.

The reasonably good maturity level of Utility in terms of knowledge, skills and ownership is the primary requirement in order to ensure seamless integration between four processes to sustain AMS in long run.



Abstract

To develop effective asset management strategies it is imperative to know at least three key operational parameters:

1. The current condition of the assets,
2. Their importance in relation to the functioning of the system they are embedded into, and
3. The impact of not having the assets available at a certain point in time.

Because of the meshed nature of power delivery systems for a particular asset, there are clear interdependencies between the latter two parameters and those for other interconnected assets.

In this paper we deal with the subject of assessing the condition of a given asset by gathering and interpreting information derived from the asset itself. We also discuss how this information can be used, together with one of the two other operational parameters mentioned above, to provide actionable asset management recommendations at the asset level.

Owners and operators of transmission and distribution network face numerous challenges in regard to the effective management of their assets. These challenges include:

- Maximizing the performance of both the individual assets as well as of the overall network.
- Determining the right time to perform an asset intervention (long-term maintenance, refurbishment, replacement).
- Predicting/anticipating asset failures.
- Determining whether or not to follow the time-based maintenance schedule recommended by the OEM.
- Assessing the risks of not following the recommended maintenance schedules.

Many traditional asset management strategies (such as time-based maintenance schemes) often ignore the actual condition of the equipment. In Figure (1) below, we refer to these strategies as Incidental/Basic Asset Management strategies, which essentially involve performing isolated reactive/corrective interventions on the assets (such as preventive maintenance, replacement, refurbishment, etc.) based on elapsed time or some measure of equipment utilization

(e.g., number of breaker trips).



Figure 1. Asset Management Approaches.

It is clear that asset management strategies can be improved by leveraging the “power of data,” that is, by capturing, processing, analyzing, and ultimately acting upon information about the assets themselves as well as about their functioning within the system these assets are embedded into. This is the concept behind the advanced asset management approaches at the top of Figure 1. In these approaches, sometimes known as Asset Performance Management (APM) strategies, operation and maintenance actions are determined by considering, among other parameters, the condition of the assets and the risks associated with asset failure.

A significant outcome of the implementation of APM strategies is that the classical trade-offs between capital expenditures (CapEx) and operational expenditures (OpEx) in power delivery systems are significantly impacted. For example, if asset failure can be predicted with better precision, then system redundancy can be reduced (for a given level of system reliability performance.) This would result in lowered CapEx requirements but likely higher OpEx budgets (due to the need to perform additional maintenance actions on some key equipment), with the concomitant technical, financial (e.g., cash flows), and regulatory (e.g., tariff) implications.

There are different ways in which assets can tell us about their condition. Under the traditional but by now largely outdated approaches, the asset only told us about its operational state, that is, in operation, failed, or in repair. Using this information, asset management

is clearly an indirect practice in the sense that it is mainly corrective. This approach, of course, is really far from optimal, since it often results in high failure rates and increased capital expenditure requirements in terms of necessary redundancy (back up) and spare parts inventories.

Next, employing more structured approaches and collecting and analyzing more data in a careful manner enabled the widespread implementation of preventive maintenance and the time-based plans proposed by manufacturers (the second layer of Figure 1). However, this approach is still very reactive in the sense that it does not factor in the condition of the assets and forced outages may unquestionably occur before any action has been taken. Financial and operational planning is more adequate under this approach – certainly more efficient than corrective maintenance - but still not an optimal solution.

Condition Base Maintenance (CBM) and Reliability Centered Maintenance (RCM) are the next stage in the evolution of asset management practices. They intend to consider - in near real time - the condition of the asset to determine whether an intervention (long term maintenance, refurbishment, replacement) is required before the occurrence of a forced outage resulting in an interruption of service. In addition to maintenance and operational records of the assets, a significant amount of online and offline condition monitoring information is required to be processed in order to estimate the right moment for an intervention.

It is important to point out that relying exclusively on real time information processing and analysis to

detect impending failures might not be enough to respond in a timely manner to certain outages, even if they are a consequence of an already identified deterioration process.

In general, it is imperative to use both online and offline information within a Predictive Maintenance (PM) process which basically intends to estimate the current and future condition of the asset. PM not only contributes to increased reliability and efficiency, but also supports maintenance planning and budgeting, as well as the formulation of effective asset management strategies and policies

Studies have shown that only between 5% and 30% of forced outages are random. This means that anywhere between 70% and 95% of forced outages are predictable and therefore preventable by means of interventions. This represents a tremendous opportunity for asset owners and operators.

As mentioned above, advanced asset management strategies (such as CBM and PM) rely on estimations of asset condition, both in the present and projected in the future. In turn, asset condition is estimated from online and offline information such as maintenance and operational records, sensor signals, chemical readings, etc. The volume and diversity of data and information that needs to be processed is quite vast, making the assessment of the condition of the assets quite a challenge. A simple and effective way to manage this complexity is the use of a composite (proxy) indicator generally known as Condition Index or, more commonly, Health Index (HI).

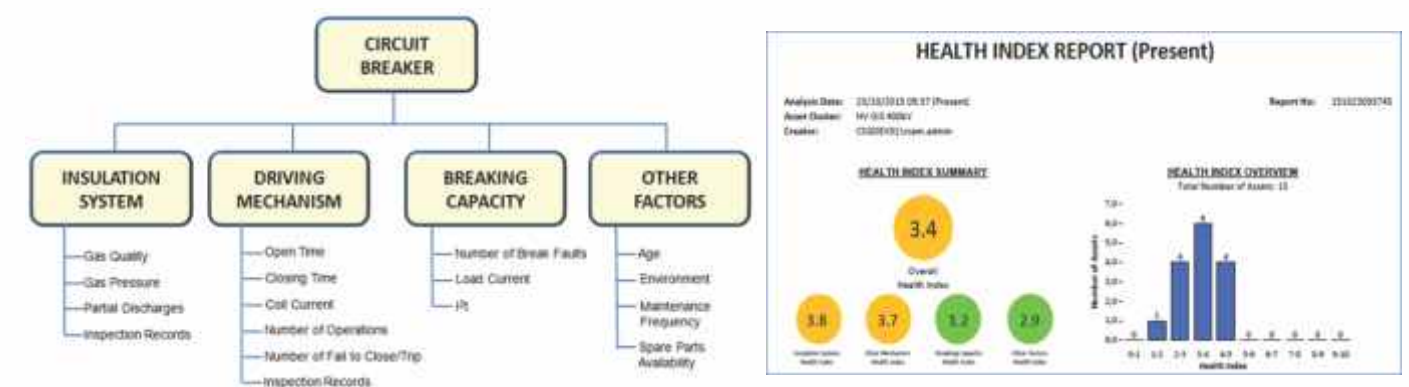


Figure 2. Parameters Health Index GIS Circuit Breakers and Health Index Report

Figure 2 above shows some of the factors that could be considered in the development of a health index for a specific asset type and a typical HI report.

HI is a numerical representation of the estimated condition of a given asset. In principle, HI should: i) be indicative of the suitability of the asset for continued service, ii) contain objective and verifiable measures of asset condition, iii) be understandable, iv) be readily interpreted, and v) be correlated with the asset risk of failure and remaining useful life. The development of the Health Index metric is quite a complex matter, as it is usually customized (tailor made) for every asset type and for every system/utility.

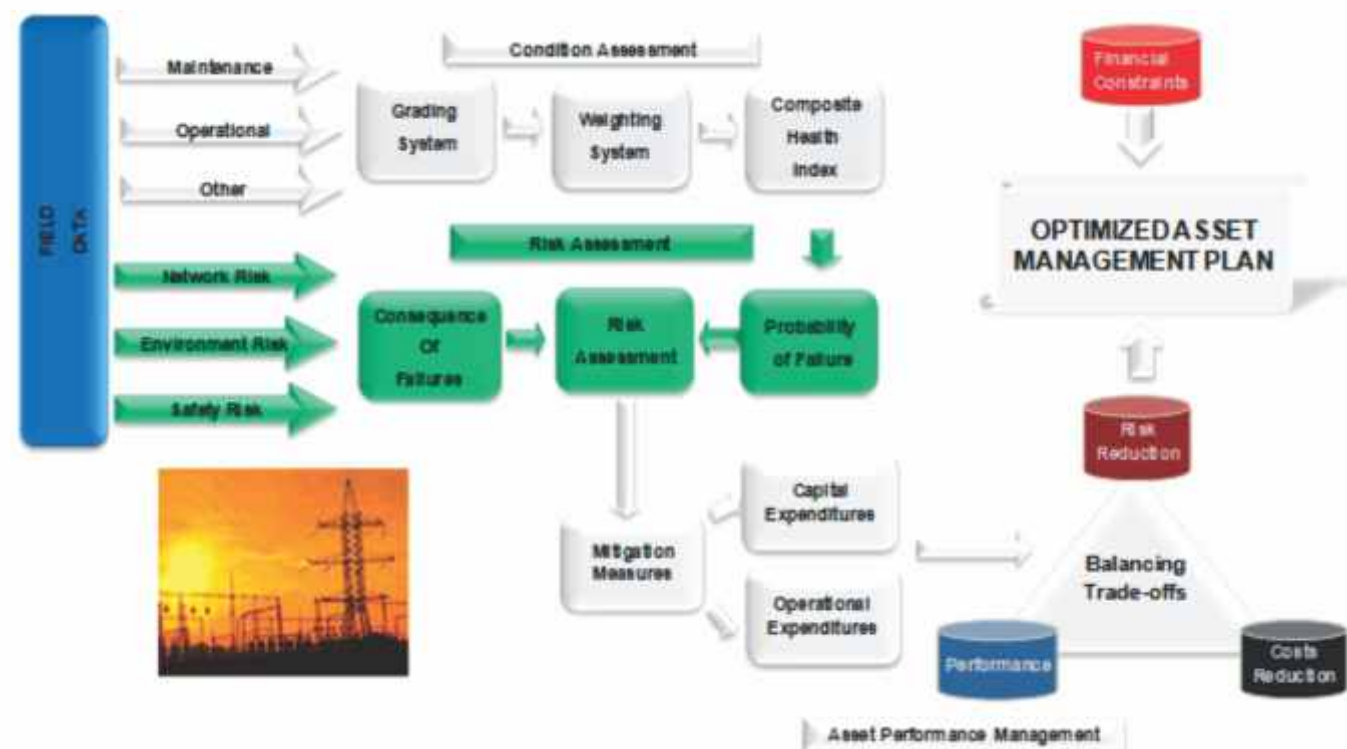
The risk associated with an asset is the sum of all the consequences of potential/future outages, usually expressed in monetary terms. The risk is often linked to

a failure rate or failure frequency, which may be affected or not by the asset condition. Figure 3 shows the typical factors that are considered in the estimation of the asset risks. These factors are combined together to derive a Criticality (or Importance) Index.



Figure 3. Typical Risk Assessment Factors.

The final stage is to combine the results of asset condition assessment and importance to produce more effective asset management actions, strategies, and plans. These outputs should provide an adequate balance of risk mitigation, expected network performance, and maintenance/intervention costs. Figure 4 shows the overall Asset Performance Management process from the data collection to the condition and risk assessment to the development of optimal asset management plans.



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M3

ASSET MANAGEMENT

in Power Transmission and Distribution

| Sequence | Topic | Speaker | Duration (Mins) | Form | To |
|------------------|---|---|-----------------|-------|-------|
| Introduction | Welcome & Inaugural Address | Dr. Harald Griem -Executive VP Siemens Mr. S.K. Negi -MD GETCO | 15 | 9:30 | 9:45 |
| Key Note Address | Genesis of Asset Management | Mr. Juan C. Ledezma -Associate Director Siemens | 30 | 9:45 | 10:15 |
| | Evolution of Asset Management Idea/Fundamental. What generated need of Asset Management? | | | | |
| | Factors of influence for asset management in transmission | | | | |
| | Why does asset condition matter? | | | | |
| | Combining condition and importance for developing more effective Asset Management | | | | |
| | Actual structure of maintenance spending | | | | |
| | Comments on Maintenance efficiency and the impact of replacement and maintenance strategies on maintenance spending | | | | |
| Session 1 | Asset Management - Indian Power Generation Sector | Mr. Prashant Jain - CEO Siemens Power service, India | 30 | 10:15 | 10:45 |
| | State of the art Super Critical Plants | | | | |
| | Cost effective generation, Plant heat rate, Auxiliary Consumption | | | | |
| | Ageing Assets | | | | |
| | Maintenance Strategies | | | | |
| | Renovation v/s New Built | | | | |
| | Tea Break | | 15 | 10:45 | 11:00 |
| Session 2 | Fleet Management | Mr. Sorin S. Georgescu - Solution Architech, Siemens | 30 | 11:00 | 11:30 |
| | Digital center solutions for power plant performance monitoring, asset diagnostics and operation optimization. | | | | |
| | Power Generation - major market trends and influencers on Asset Management | | | | |
| | Condition Monitoring as central piece of Asset Management | | | | |
| | Focus on Asset Diagnostics | | | | |
| Session 3 | Asset Management - T & D sector | Mr. S. K. Negi, GETCO | 30 | 11:30 | 12:00 |
| | Key Performance Indicators of Grid Operation | | | | |
| | Maintenance Strategies | | | | |
| | Aged Assets and Health Indexing | | | | |
| | Network improvement and New networks | | | | |
| | Optimisation of Resources | | | | |
| | Balance Investment | | | | |

| Sequence | Topic | Speaker | Duration (Mins) | Form | To |
|-----------|--|--|-----------------|-------|-------|
| Session 4 | Health Index | 1. Mr. Nihar Raj- Hub Manager Asia consulting , ABB 2. Mr. Emilio Morales Cruz - Qualitrol 3. Mr. Ravinder Negi - DGM GE | 20 | 12:00 | 12:20 |
| | Objective of Health Indexing | | 20 | 12:20 | 12:40 |
| | Proactive Diagnostic Condition Monitoring | | 20 | 12:40 | 13:00 |
| | Failure rate and Route causes | | | | |
| | Health assessment fundamentals | | | | |
| | Role of IT and Analysis tools | | | | |
| | Health Indexing as basis for investment decisions | | | | |
| Session 5 | Lunch Break | | 60 | 13:00 | 14:00 |
| | Panel discussion - Renovation and Retrofitting of Thermal Power Plants | Mr. A.K. Jha -Director (Tech) NTPC Mr. S.K. Negi - MD GETCO Mr. Pradip Dahake - MD GSECL Mr. S.B. Agarawal - MD CSPGCL Mr. A. K. Singh - VP Reliance Mr. Mariasundaram Antony - GM GE Power Mr. Anand K. Gupta - ED (Com) NTPC Mr. Arun K. Sinha - ED (Engg) NTPC Mr. Ashok Ganeshan - EMD GE Power | 45 | 14:00 | 14:45 |
| | Techno-commercial factors for decision of R&R of thermal plants | | | | |
| | Factors favouring R&R of thermal plants | | | | |
| | Commercial aspects | | | | |
| | Consideration of Supler critical and Ultra super critical boilers | | | | |
| | | | | | |
| | | | | | |
| Session 6 | Panel discussion - Implementation of Asset Management System in T & D | Mr. R.P. Sasmal -Director Op. Powergrid Mr. M. Krishnakumar - ED Powergrid Mr. Y.K. Sehgal - ED Powergrid Dr. Herald Griem - Executive VP, Siemens Mr. S.K. Negi - MD GETCO | 60 | 14:45 | 15:45 |
| | Huge capacity addition - complex T&D network as well as Grid | | | | |
| | Need of integrated asset management system - Role of IT and | | | | |
| | Role of stake holders in implementinng Asset Mngement System | | | | |
| | Roadmpas for implimentation stratagies and long term benefits of AMS | | | | |

| Sequence | Topic | Speaker | Duration (Mins) | Form | To |
|-----------|--|---|-----------------|-------|-------|
| | | Mr. Rajendrakumar Pandey - Director NPTI Mr. B.N.D. Bhaumik - GM Powergrid Mr. R. K. Tyagi - AGM Powergrid Mr. N. S. Sodha - Ex. Powergrid Mr. Ramchandran Pillai - Tech. Advisor Tata Power Dr. Aradhana Ray - Tech. Director (Laxmi Associates) & Asset mgmt consultant | | | |
| | Tea Break | | 15 | 15:45 | 16:00 |
| Session 7 | " Space Technology Applications for Asset Management Of Power Transmission System" | Mr. M.Krishnakumar - ED (Tech. Development) | 15 | 16:00 | 16:15 |
| | Technical Paper Review and Q&A Session | Mr. Nihar Raj - Hub Manager Asia consulting, ABB Mr. P.B. Mehta - Persotech solution | 90 | 16:15 | 17:45 |
| Closing | Vote of thanks from Knowledge Partner | Mr. Prashant Jain -CEO, Siemens Power Service, India | 15 | 17:45 | 18:00 |

SPEAKERS



Mr. Surinder Kumar Negi,
Managing Director,
Gujarat Energy Transmission
Corporation Ltd., Vadodara

He passed out from G.B. Pant University of Agriculture & Technology, Pantnagar in the year 1980 as an Electrical Engineering graduate and same year joined NTPC as 5th Batch Executive Trainee.

He has been in Transmission and Distribution of Power Sector throughout his career both in Public and Private Sector companies.

He has taken lead role in execution of many Extra High Voltage AC and HVDC stations and transmission lines, Design and Engineering of EHV Substations, implementation of Project Management Practices, established Design and Engineering process for ISO 9001-2000 and has been member of many expert groups including Transformer Maintenance and Cost Effective Design and Engineering Solutions for Renovation and Modernization in T&D.

Presently, he is Managing Director of Gujarat Energy Transmission Corporation Limited (GETCO), a State Transmission Utility in Gujarat for last ten years. GETCO has taken a lead role in promoting and implementation of state of art technology solutions like Digital Substation,

FOTE, Hybrid Switchgear, High Performance Conductor, Asset Management etc.

Mr. S.K. Negi has the honour of title "Distinguished Member" from the Administrative Council of CIGRE in the year 2016.



Dr. Harald Griem,
Executive Vice President
Energy Management Division,
Siemens Ltd

Dr Harald Griem is currently E VP of Energy Management Division, South Asia, Siemens and a member of Corporate Executive Management for Siemens Ltd.

Dr Griem has Masters in Mechanical Engineering from Technische Universittat, Munich and a Doctorate in Thermodynamics. He started his career with the house of Siemens in 1992 at Siemens KWA, Erlangen in the area of Boiler Technology and then worked extensively in Steam Turbine business in various capacities until 2009. During the period he held various roles in Products and Service domain, handling Sales & Marketing, Strategic Planning, Business Development. Through M&A he drove growth in Service Portfolio and expanded portfolio in environmental protection. He is credited with leading cross functional and cross cultural team in Europe and USA during various stints. In 2009, he took over as General Manager, Generator products [20-2000 MW], a global position responsible for R&D, Engineering, Procurement, Manufacturing, project management and Sales. He was leading a business with operating units in Germany, US, Chinese, India

From the Power generation space, he then moved to High Voltage transmission products business and took over the responsibility as Global head, High Voltage Products based out of Erlangen until Sep 2015

In Oct2015, he moved to India as head of Energy management Division. The Division is the largest in Siemens Ltd with 11 state of the art factories, enjoying market leadership in most products in the area of Electrification, Automation and Digitalisation. Division has a revenue of Inr 35 Bn and an employe strength of 2800. He brings his rich global experience to drive the Divisions strategic growth programme in the country's large power landscape

On the personal front Dr Griem is married, with two daughters. He is a multifaceted personality with versatile musical Skills. He is proficient in playing Saxophone, Flute and Drums and has given number of stage performances in the company's events. Besides music, he is also passionate in sports.



Mr. Prashant Jain
CEO, Siemens Power
Generation Services, India

20 years experience, driving growth, profitability, start-ups in multi sector / multi-unit environment with organizations like Siemens, Schneider Electric. Experience: Across Renewable Energy, Solar and Wind, Oil and Gas, Power generation, Industrial Low voltage switchgear and motors, products, projects and solutions. Strategy planning experience with M&A and market entry projects in strategy, corporate planning Hands on hard core sales experience with product sales, distributors, channel management, product management, services. International experience with one year work experience in the US, and several years with cross country diverse teams.



Mr. Juan C. Ledezma,
Principal Consultant Associate
Director Asset Management
Consulting and Advisory Services

Holds both Electrical Engineering and Master of Engineering degrees in electric power systems from Universidad Simon Bolivar in Caracas, Venezuela, and Rensselaer Polytechnic Institute (RPI), in Troy, New York, USA, respectively. He is currently responsible for the development and sales of projects in the areas of advanced technical due diligence evaluations of electricity transmission & distribution systems, asset management support services, and operations, management, and maintenance services for electric power delivery networks. Mr. Ledezma is the Product Lifecycle Manager for the Asset Management portfolio element of Siemens Network Services.



Mr. Ashok Singh,
Vice President
Reliance Industries Ltd.

PROFESSIONAL QUALIFICATIONS / ACADEMIC STUDIES:

- Bachelor of Science (Mechanical Engineering) in 1986 from Patna University
- NEBOSH (The National Examination Board in Occupational Safety and Health) from UK.
- Executive Development Programme at IMD, Lausanne, Switzerland
- Senior Management Programme at IIM, Ahmedabad.
- Management Horizon course from Ashridge Management Institute, UK.

Engineer with more than 28 years of hands-on experience in power industry including Business Development, Commercial, Trading, Project Management, operation and maintenance and managed commercial contracts, assessed development and acquisition opportunities and construction of large projects for multinational power companies in India and in UK.

Started professional career with largest Power Utility Company in India a Navratna public sector undertaking and worked with large Indian private company and with MNC in India and in UK. Worked in development, erection, commissioning and Operation and Maintenance of one of the first combined cycle power plant in India. Have worked in large thermal power plants and negotiated for development and acquisition of some large hydro, transmission and thermal power plants. Negotiated some large EPC, Gas Supply and Gas Transmission contracts of International standard. Recruited, trained, coached, and mentored many young and experience professional to ensure they are successful in their career.

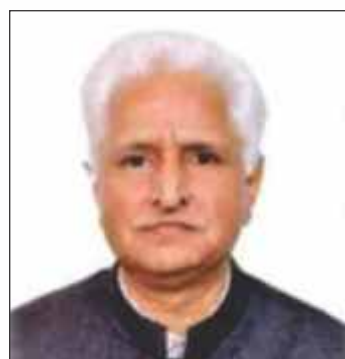


Mr. P.R. DAHAKE,
Managing
Director-GSECL

Power professional having over 35 years of rich experience in the Power Sector, starting his career as Executive Engineer (Trainee) in NTPC and have worked in different areas of Business Development, Construction and Operations. A bachelor in electrical engineering from Maulana Azad College of Technology, Bhopal (1980), Shri P.R. Dahake joined NTPC in November 1980 as an Executive Trainee.

Born on 14th April, 1959, Shri Dahake has a long stint of 35 years in NTPC. He started his career at Korba. He was the Head of (O&M) in Simadhri Super Thermal Power Station & Sipat Super Thermal Power from 2005 to 2008. He was Business Unit Head of Anta Gas Project in 2008 and later headed Dadri thermal power station and Farakka Super Thermal Station. Shri Dahake was appointed as Executive Director, Talcher Super Thermal Power Station (TSTPS) on 6th August, 2014. He was ED (Project Planning & Monitoring) from November 2014 to August 2016 at Corporate Centre, New Delhi.

Shri Dahake took over as Managing Director, Gujarat State Electricity Corporation Limited (GSECL) on 1st Sept.2016. He has worked through the ranks to reach to the top position of Gujarat State Electricity Corporation Limited (GSECL).



Mr. N. S. Sodha,
Former Executive Director
(Load Despatch and
Communication)
POWERGRID

Shri N. S. Sodha, born in Nov. 1954, graduated in Electrical Engineering with Honours from Malaviya Regional Engineering College, Jaipur in 1976. He also holds a Business Management Degree. Shri Sodha has rich experience of over 39 years in Indian Power Sector having contributed immensely in Project Implementation, Operation, Maintenance, Renovation and Modernization of EHV Transmission Lines & Substations, System Operation through Load Dispatch Centre & Design and Engineering of Load Dispatch & Communication facilities. During his long tenure, he has worked with multinational M/s HBB Ltd (Now ABB Ltd) and PSU giants like NTPC Ltd and Power Grid Corporation Of India Limited thus bringing in best experience of both sides to Indian Power Sector. His contributions in Project Implementation and Standardization of the policy and procedures for Operation and Maintenance of EHV Transmission System, Grid Management & Smart Grid is noteworthy. He travelled many

countries globally on various assignments as part of MoP/PSU delegation as Power System & Smart Grid Expert. He has published & presented numerous Technical papers on Power System, T&D & Smart Grid in various National and International forums like CIGRE, Paris, Smart Grid Week & Doble, USA.

At the time of retirement he was heading, as "Executive Director", the Load Dispatch and Communications Department of POWERGRID & was responsible for design and implementation of Power System Control Centers [SCADA/EMS] and OPGW Communication Network at National, Regional and State levels. He actively spearheaded the POWERGRID foray into Smart Grid area in Indian Power Transmission & Distribution Sectors.

He also represented POWERGRID on "India Smart Grid Task Force" constituted by 'Ministry of Power', Govt. of India for coordinating efforts on building Indian Smart Grid Road Map, Smart Grid Regulations & policy matters on "Smart Grid Pilot Projects" & "Cyber Security" for Indian Power System.

Shri Sodha has superannuated in November, 2014 after gracefully serving Indian Power Sector in various capacities with dedication for over 38 years.

Currently he is Chairman, ETDC {Electro-Technical Divisional Council} of BIS & ETD-30 Surge Arrester BIS Committee. He is also heading CIGRE, Paris National Study Committee NSC D-2 on "Information Technology, Automation & Communications"

Currently he is "Advisor & Consultant" on Power Transmission & Distribution, Smart Grids & Smart Cities & helping Indian Power Sector at various forums with his rich experience.



Mr. Ramachandran Pillai
Principal Executive Advisor
- Technical, The Tata Power
Company Ltd, Mumbai

More than 36 years in all areas of Power Transmission and Distribution Business.

- Pivotal role in the success of PPP Model of Tata Power Delhi Distribution Ltd (erstwhile North Delhi Power Ltd).
- Member of various BIS committees.
- Presently Chairman of the Working Group One-T&D, India Smart Grid Forum, MoP, GoI.
- Pivotal role played in bringing in advances/ smart technologies in Indian Power Sector
 - First Gas Insulated Switchgears for RSS
 - First Natural Ester filled Power Transformer
 - First compact, Natural Ester based self-protected Pad Mounted Substation
 - First compact, pre-fabricated, plug & play 33/11kV Substation, E-house (Electrical House) by any Distribution Utility

- Experience includes notable contribution -
 - Integration of IT & OT for the Distribution sector (seamless integration of Enterprise system SAP with SCADA-DMS, AMI, Network Analysis Software, GIS, & CRM)
- Use of Analytics for RLA & Predictive Diagnostics for Cables, Switchgears, Load forecasting
- Remote Relay parameterisation.
- Design, Development and Commissioning of Natural Esters for Distribution and Power Transformers.

Digitalization of Customer Services, Operational & Commercial Processes in Power Sector



**Mr. Mariasundaram
Antony,**
General Manager
India Engineering
Operations GE Power

Mariasundaram is the General Manager for the India Engineering Operations for GE Power Business. The team works across the GE Power portfolio covering Gas Power Systems, Steam Power Systems, Power Services, Distributed power and Water.

In his 17+ years at GE, Mariasundaram has progressed through various leadership positions, his last role being that of India Engineering Leader for GE Energy Connections and Site Leader for GE's Hyderabad Technology Centre. Prior to GE, he worked with Bharat Heavy Electricals Ltd. in the area of Nuclear power generation and TVS Sundaram Clayton in the area of railway products design.

Mariasundaram holds a Bachelor's degree in Mechanical Engineering from Guindy Engineering College, Chennai and a Master's from National Institute of Technology, Trichy. His special interests include emerging technologies like the Industrial Internet (IoT), Smart grids, Distributed power and Clean Coal. He has been active in forums like CII (Confederation of Indian Industry) and is a member of the CII National Committee on Power & Energy IoT Panel of Institute of Engineering & Technology (IET). He is also a member of the American Society of Mechanical Engineers and the Institute of Electrical & Electronics Engineers as well as a board member of United Way, Hyderabad. He is a member of the Systems Engineering council within GE and GE Certified Six Sigma Master Black Belt (MBB).



Mr. R.P. Sasmal,
Director (Operations)
POWERGRID

Shri R.P. Sasmal, aged 58 years, is Director (Operations) of Power Grid Corporation of India Ltd. Prior to taking up this assignment, he was Executive Director (Operation Services) in the company. A graduate Engineer from Sambalpur University, Odisha, Shri Sasmal has more than 37 years of experience in power sector. Shri Sasmal has handled multi disciplinary functions such as Planning, Monitoring and Implementation of HVDC projects, EHV transmission systems and Load Despatch & Communication Systems. He was instrumental in introducing the ± 800 kV multi terminal HVDC transmission system, which is first of its kind in the world. Now, 120 no. of stations of POWERGRID are being operated remotely from its National Transmission Asset Management Centre at Manesar. He has been bestowed upon with "Distinguished Member of CIGRE, 2012" and has published various technical papers on transmission systems especially on HVDC in various national and international professional forums/societies like IEEE and CIGRE. He was appointed as a Director in POWERGRID in August, 2012



Mr. M. Krishnakumar,
ED
(Technology Development)
POWERGRID

M Krishna Kumar, presently Executive Director (Technology Development) in Powergrid Corporation of India Limited (POWERGRID) has professional experience spanning over 35 years in Power Transmission and contributed actively to the fast pace Power Transmission Development in India. His areas of expertise include Design optimization, Engineering & implementation of Power Transmission lines viz EHV & UHV AC TL up to 800 & 1200kV level, 500 & 800 kV HVDC lines, Upgrading & Uprating of TL corridors, High SIL lines, Compact lines etc. Few of his areas of interest are Reliability Based Designs, Right of Way conservation, Electromagnetic Field effects & mitigation, Vibration Control, Insulation design, Pollution design, Application of space technology for TL routing etc. He has presented/published about 40 numbers of technical papers in National / International conferences / publications including CIGRE, Afro Asian conference etc. He is a recipient of CBIP Tag Corporation Award for his active contribution to Indian power sector. He earlier served as chairman of BIS Technical committees ET-06 and ET-36 for multiple terms and also immensely encouraged and succeeded in indigenisation of power transmission line equipment/ material up to 1200 kV level.



Mr. B.N De Bhowmick
GM
(Technology Development)
POWERGRID

Mr. B.N. De Bhowmick is presently General Manager, Technology Development in Power Grid corporation of India Ltd. He graduated in Electrical Engineering from Indian Institute of Technology, Kharagpur in the year 1983 and started his career in NTPC Ltd as Executive Trainee in the year 1983, where he was involved in the erection, testing and commissioning of 400 kV substation and lines. He joined POWERGRID after amalgamation of transmission business of various power utilities in 1991. He is specialized in condition monitoring and diagnostics of substation equipment. He is directly involved in various new technology projects e.g., 1200kV National test Station at Bina, India, Process Bus implementation, etc and in the process of conducting pollution mapping in India. He has also published a number of papers in both International and National forum like, IEC, IEEE, CIGRE, DOBLE, CBIP etc on subjects like 1200kV, Transformer Diagnostics etc. He is presently the member of International CIGRE Working Group A2.49 for health indexing of Transformers, Member of IEC TC122 for UHV AC Transmission system and Chairman of the mirror group of IEC TC 122 in India namely BIS ETD-48. He is also member BIS (Bureau of Indian Standards) ETD-03 (Electro Technical Fluid)



Mr. R.K. Tyagi,
Additional General Manager
POWERGRID

He passed B.E. (Electricals) from PEC, Chandigarh in 1987 and did M. Tech from IIT Delhi. He is a Fulbright Scholar from Carnegie Mellon University, USA. Mr.Tyagi started his carrier from NTPC as Engineer in 1989. He joined POWERGRID in 1991 and has been associated with Operation Services, Engineering and Technology Development departments since last 26 years. He has wide exposure on Switchgears, Power Transformers, Instrument Transformers and Surge Arresters. He is chairman of CIGRE NSC- A3 and member of BIS- Switchgear-ET08; CIGRE WG A2-53; IEC- TC122 and he is representing India in MT-36 on Circuit Breakers for preparation of International Standard IEC-62271-100. He was involved in development of 1200kV AC Technology in India in association of world renowned Experts. He has travelled all over the world and has presented about 35 Technical papers in various National/ International forums/ Conferences.



Mr. Ravinder Negi
Deputy General Manager,
LTMC and Asset Management
GE T&D India Ltd.

Ravinder Negi is an Electrical Graduate Engineer from Jamia Millia Islamia University, New Delhi with Masters in Business Administration (Marketing) from Sikkim Manipal University having 21+ years of experience in Energy and Power sector.

His areas of expertise include Installation, Testing, Commissioning, Operation and Maintenance and Asset Management of switchgears and equipment ranging from Low Voltage (415V) to Ultra High Voltage (765kV). He has Strong field experience on equipment and their assessment to analyze their health status.

Ravinder Negi is Deputy General Manager, LTMC and Asset Management at GE T&D India Ltd.

Overview of the presentation:

Title: An innovative analytics-based approach for Asset maintenance and Asset replacement

- Electrical equipment such as Power Transformers are critical components of Utility asset portfolio. Beyond their financial value, they play a major role in the business performance.
- The Asset management offering from GE is a comprehensive business solution designed to maximize the value and reliability obtained from these assets.
- The objective of the presentation is to integrate the budget constraints and the criticality of each piece of equipment to optimize the maintenance and asset replacement decisions.



Mr. Nihar S. Raj
Hub Manager, Asia,
Power Consulting,
ABB India Limited

Nihar S. Raj is the Business Head for Power Consulting – Asia. In his previous role he contributed as Head of Engineering for +/-800kV HVDC North East Agra Project in ABB India. He has designed several air and gas insulated substations ranging from 11kV to 800kV. He was also involved for design of 800kV GIS, hybrid substation solutions and preliminary conceptualization of 1200kV system.

He completed his electrical engineering degree from M.S. University Vadodara and areas of expertise includes Power Systems, Substation Design (AIS, GIS), and Earthing Systems.

He is a life member of Society of Power Engineers (Vadodara Chapter), member of CIGRE India, CBIP National Expert group member for Earthing, GIS, IEEE PES member (Gujarat Chapter) and has presented several technical papers at various national and international conferences.

ABB (www.abb.com) is a leading global technology company in power and automation that enables utility, industry, and transport & infrastructure customers to improve their performance while lowering environmental impact. The ABB Group of companies operates in roughly 100 countries and employs about 135,000 people



Mr. Emilio Morales Cruz,
Qualitrol

Emilio joined Qualitrol in June 2012, as a member of the Global team of Technical Application Specialists.

Emilio is the Technical Application Specialist in Transformer applications at Qualitrol Company LLC. His main focus is to support our solutions in comprehensive monitoring for Transformer applications Emilio has a Bachelor of Science degree with major in Electro Mechanical Engineering. He is senior member of IEEE, member of ANSI, CIGRE, USTAG and US nominated expert on IEC TC14, and actively participating in different task forces in the IEEE Transformer Committee and CIGRE. Emilio has spent his entire career in the power transformer manufacturing industry. He has over 30 years of experience in design which includes transformers up to 500 MVA and 500 kV as well as furnace and rectifier transformers and different type of reactors. Emilio previously worked with GE-Prolec, Ohio Transformer, Sunbelt Transformer and Efacec Power Transformers.



Dr. Aradhana Ray,
Technical Director,
Laxmi Associates

Dr. Aradhana Ray from Laxmi Associates, Gujarat, India is Ph. D. in Electrical Engineering with 21 years' experience including 6 years with, Doble Engineering USA as consulting engineer and Omicron Energy Services, Austria as Services Manager and 10 years in Short Circuit Test Laboratory ERDA, Vadodara. She has done consulting, third party inspection and Asset management projects, specification & maintenance manual (third party) documentation related to EHV class power equipment in several countries such as India, Malaysia, Dubai, OMAN, North America, South Africa and Australia. She has conducted many Workshops worldwide over the last 8 years. Some 4,000 managers, engineers have attended her training courses and workshops. She has written more than 40 national and international publications. She was a recipient of "Dr Vikram Sharabhai Young Scientist Award" by Department of Science & Tech. India, for "Development of fault current limiter" in 2005. She has also served on technical committees of national and international conferences including IEEMA, TIFAC, CIRED Malaysia Conferences. Currently she is working on implementation of Asset Management project based on PASS 55 Standards with various utilities like SEB, TNB & TAMAS Malaysia.


Mr. Pravinchandra Mehta

A member IEEE ,member CIGRE and member of National Study Committee (NSC) C4 of CIGRE India .Member of International working group /study committee WG C4-42 for “study on harmonics at customer end “ formed by International Conference on Electricity Distribution (CIRED) currently CEO - Persotech Solutions and consultant for MBH Power Pvt. Ltd. Vadodara & few more companies involved in EPC business for substation /power station /lines .Before that Pravinchandra Mehta has worked at EMCO Ltd Thane (Mumbai) and GETCO with total experience of 30 yrs. in power sector . He has presented many papers in National and International conferences. He is also involved in the training, research and development activities.


Mr. Ashok Ganesan-Region

General Manager - India
Power Services

Ashok is the Region general manager, India for GE's Power Services business, a \$15 billion organization within GE Power. Based in Baden, Switzerland, Power Services is a combination of two of the best service teams in the power industry – GE's Power Generation Services and

Alstom's Thermal Services. The largest industrial services business in GE, Power Services has approximately 26,000 people in more than 150 countries. Power Services offers customers total plant capabilities, expanded local resources and expertise, and stronger collaboration opportunities to help them be more successful.

In this role, Ashok is responsible for driving India's regional growth and execution. He oversees all operational functions in the region covering parts, field services, upgrades and project management, on-site repairs, and training. He is responsible for developing and delivering a regional services strategy that offers customers the technology, knowledge and insight they need to manage the entire lifecycle of their power plants,

ultimately providing reliable power to people around the world.

Ashok started his GE career as a Black Belt in the Healthcare supply chain. He then moved to Corporate Audit Staff, where he worked across various infrastructure services businesses.

After graduation from Corporate Audit Staff, he joined Power Generation Services (PGS) as the services productivity and risk leader, and in 2013, he led the Global Services Excellence team. In 2014, Ashok was named PGS integration leader and played a key role in helping to ensure strong plans were in place for a smooth transition from PGS and Alstom Thermal Services to Power Services for both customers and employees. He was appointed to his current role in November 2015.

Prior to joining GE, Ashok worked as a supply chain consultant at i2 Technologies and as a plant engineer at Indo Rama synthetics in India.

Ashok is a graduate of the Indian Institute of Technology in Bombay and has a bachelor's in chemical engineering and a master's in management from Purdue University in the USA.

He is based in the greater Delhi area

Other Dignitaries / Speakers / Panelist

Sh. A.K. Jha, Director NTPC

Sh. Rajendrakumar Pandey, Director NPTI

Sh. Y.K. Sehgal, ED Powergrid

Sh. S.B. Agarawal, MD CSPGCL

Sh. Anand K. Gupta, ED (Commerce) NTPC

Sh. Arun K. Sinha, ED (Engg) NTPC