

PREFACE



GETS 2014

The first Global Energy Technology Summit (GETS) hosted by NTPC, was held between 7th - 9th November 2014. It was a first such initiative by NTPC to bring the technology-leaders & power professionals from all over the world under one roof to showcase the technological advancements & innovations achieved so far in fossil fuel based as well as renewable power generation and enlighten the industry with their vision and ideas for the growth of Indian Power sector.

The Summit began with a grand inaugural ceremony, commemorating also the 39th Raising Day of NTPC on 7th Nov, 2014 along with this memorable event at Manekshaw Centre, New Delhi. Honorable Minister of state for Power & Coal, Principal Scientific Advisor to Govt. of India and Secretary (MNRE) graced the ceremony. The inaugural ceremony was followed by a lively panel discussion moderated by Editor (Opinion). The Economic Times, focusing on the challenges facing Indian Power Sector vis-à-vis those facing the Global energy business.. The panel discussion included presentations by Director (Technical), NTPC on the Technology Vision of NTPC and by IEA Paris on Energy Technology Perspectives in Indian Context.

The subsequent two days of the Summit (8th Nov & 9th Nov) were devoted to technical sessions at power Management Institute (PMI) with focus on contemporary themes like Energy efficiency &

conservation, Environment protection, Renewable energy, Resource Optimization, Reliability & safety and Automation related to Power Generation, Transmission and Distribution. The summit received 169 technical papers from all around the world including 52 papers from foreign authors. Seventy two (72) papers were presented over the 2 days at PMI, which included 44 international papers presented by foreign authors from 18 countries. The submitted papers have been published on the GETS website, which was created in-house, and served as a platform for technical paper submissions, registrations and communication. The compendium of abstracts was published in a book form.

On the side lines of the technical sessions, parallel exhibition “GETS-EXPO-2014” was held as an added attraction which showcased the latest technologies and products by Technology leaders, OEMs, EPC contractors such as Alstom, Doosan, GEA, Toshiba, Thermax to name a few.

The maiden Summit received an overwhelming response from delegates from India as well as from countries all around the world. In all 939 numbers of delegates took part in GETS-2014 held at Manekshaw center and PMI, which included 449 delegates outside NTPC comprising 102 Foreign Delegates/Authors. The GETS-EXPO had puts up eye catching stalls by 34 different Power Sector Equipment Manufacturing Companies/Suppliers.

The summit underscored the importance of continuing with fossil fuel based power generation for India with the adoption of latest supercritical & ultra-super critical technologies to minimize environmental impact. A clarion call was made in the summit to go more vigorously & aggressively towards achieving a quantum leap in the generation of power from renewable resources as well to reach the expected level of renewable to non-renewable power generation ratio in line with the norms followed globally.

The show ended with glorious closing ceremony in front of a packed house at PMI on 9th Nov 2014. In the concluding note, NTPC reiterated its resolve to adopt those new & innovative technologies, which will be most appropriate to mitigate the energy needs of the country in the most eco-friendly manner. Total 55 recommendations have been short-listed by the technical committee based on the papers presented in the conference. NTPC is keenly exploring the possibilities to implement them in its upcoming projects.

GETS 2014 TEAM

GETS 2014 Sessions:



Session 1& 2 Efficiency...The Wannable

Session 3A & 4A Diversity of Energy Sources. For Sustainability

Session 3B Speedy and Quality Executions

Session 4B Towards Green

Session 5A & 6A Automation.... For the Paradigm Shift

Session 5B Energy Conservation

Session 6B Advanced Computations and software tools

Session 7A Optimising Resources

Session 7B Reliability, Safety & Security....A Must

SESSION 1 & 2

1. Session Name : Efficiency ...The Ever Wannabe
2. Session Chair : Mr. Michael SELL (Director – R&D , Alstom)
3. Session Co-chair : Mr. Anil Gupta (Executive Director –QA&I, NTPC)
4. Session Developer : Mr. Amit Kulshreshtha
6. Number of Papers Presented : 10

Details of Presentation

- (i) Title : Siemens Innovative repair/replacement and efficiency improvement solution of Steam turbines
- Speaker : Thorsten Strunk ,SIEMENS AG
- Summary : This paper addresses features and benefits of both Repair/Replacement and Modernization of Steam Turbines. In Repair features, In-situ assessment, (NDT, etc.), Remaining Lifetime Assessment, In-situ repair, Replacement of component are explained. In Modernization features, author has explained change in Turbine Blade profiles especially of 3D profile with cylindrical section having variable reaction resulting in about 3% improvement , Sealing arrangement with abatable coating added to the seal to reduce clearances; brush seal design and HP,IP and LP Turbine module along with R&M case studies, already implemented in the plant and due to which efficiency improvement was found which in turn helps in extra output , reducing maintenance costs, increasing reliability and availability, reducing CO2 emission and thereby contributing to environmental protection.
- (ii) Title : The Study for Life Extension and Upgrade of Supercritical 500MW Coal-fired Power Plant in S Korea
- Speaker : Yongkeun Chung, Doosan
- Summary : The Author has considered '4' R&M case studies of Ageing 500 MW Supercritical power plant (existing parameters 246 ata /538 deg C/ 538 deg C) of South Korea. Thermal aging, boiler reliability issues due to low grade coal and greenhouse gas emissions were

the target areas for enhancement. These case studies are with '4' different steam condition cases with an aim to increase power output by 10%. The Author brought out about the Boiler, Turbine & BOP component replacement cost for different cases w.r.t. base ageing unit and respective Economic Analysis has been carried out. The case with parameters 593 deg C / 593 deg C was found to be the optimal solution resulting in 2% efficiency increase, while maintaining the original BMCR rating. For the selected case, the author detailed out the modifications that needs to be done in the existing unit.

- (iii) Title : High moisture Coal – effect of blending on boiler performance
- Speaker : Pradip Chanda, NTPC Ltd.
- Summary : This paper has comes out with a study on blending domestic coal with high moisture imported coal to offset the adverse effect. Mill Temperature, Flame Temperature and Temperature profile of Furnace zone determined from a model developed for this purpose is compared with actual temperature measurement in the furnace of a reference plant. 15 – 20% blending was claimed to be optimum bending ratio for Indian conditions. It was explained that moisture due to blending reduces the flame as well as furnace zone temperature but the ash generation is less and blending is not adversely affecting the slagging of ash.
- (iv) Title : Optimization of the Power Cycle for Improved Operating Efficiency
- Speaker : Mahendra Mehra ,Alstom Bharat Forge Power Limited
- Summary : In the paper author mentioned about the various methods to improve thermal cycle efficiency and address the performance and emission issues .It discussed the effect of increased turbine inlet steam parameters, double reheat cycle, optimum CRH pressure & Final Feed water Temperature (FFWT) and Last stage blade (LSB) selection for real vacuum in a power plant. Author also discussed about the importance of part load optimization for a power plant.
- (v) Title : Efficient Combustion of Waste Fuel with Supercritical CFB Technology
- Speaker : Scott Anderson ,Babcock and Wilcox
- Summary : The focus of the presentation was on the use of Supercritical CFB technology for combustion of waste fuel. The author started with the statistics that the coal demand, coal washing, and thus washery rejects continue to increase year over year. He added that CFB is ideal technology for washery rejects. The author in his proposed technology, claims to use the best of CFB, BFB and PC technologies. It offers the user the advantages such as Fuel Flexibility, Low Emissions, High Heat Transfer, High Turndown and High Plant Efficiency. Controllable solids flow is used for steam temperature control through an arrangement of overflow and underflow ports. Simulation, Cold Pilot, Hot Pilot testing are being done for this project currently.

- (vi) Title : State-of-the-Art Ultra-Supercritical (USC) and readiness for Advanced USC Steam Power Plants
- Speaker : John L. Marion, ALSTOM Power, USA
- Summary : The Author has brought out the Benefits of USC & A-USC technologies and has demonstrated the reliability of SC/USC units for Design, Construction & Operation aspects. The Author also covers about M/s Alstom's readiness for Advanced USC i.e. steam cycles with steam temperature of 700 – 760°C and M/s Alstom's involvement in A-USC development and their various installations of test rigs for this in operating utilities. Author, while concluding, says that M/s Alstom is already done with the design work for A-USC and now a demonstration project is needed to prove First-of-a-kind A-USC reference, its performance & operation characteristics, supply chain for advanced nickel based alloy components and cost economics.
- (vii) Title : INCONEL® alloy 740H and P-92 Alloys Designed for Advanced Ultra-supercritical Applications
- Speaker : Leon George Klingensmith Jr., (P-92) and John de Barbadillo (INCONEL® 740H) Special Metals Corporation
- Summary : The Author brought out comparison of P-92 alloy with various other widely used materials P91, P22, P122, etc and showed the resultant reduction in required thickness for same steam parameters. Author also elaborated about the P92's exceptional creep strength & elevated temperature tensile properties and concludes that for USC boilers, P92 is clearly a more capable alloy than currently used 9-12% Chromium alternatives.
- On INCONEL alloy 740H, the author stated about its design and use in the A-USC application for steam conditions of 700/760°C, 25/35 MPa. Author has covered various aspects of this metal in this presentation viz. metallurgical aspect; manufacturing of tubes & pipes; the tensile & creep properties, microstructure stability & roughness of these materials; cold bending/forming, forging, weld neck flange forging, weldability, etc. The 740 H alloy is the first code approved age-hardened alloy and is a strong candidate for A-USC. However, few points still need to be addressed for this material, which are – Procedures and qualification for welding base metal in solution treated condition, weld repair protocols, a comprehensive understanding of stress relaxation, etc.
- (viii) Title : Development of Engineering and Manufacturing Technology in Taean 300MW IGCC Plant
- Speaker : Bongkeun Kim, Doosan
- Summary : The presentation started with description of IGCC technology. The author went on to describe the technologies for gasification and syngas cooling .Then the focus was shifted to Taean, which is a 300 MW IGCC plant being installed by DOOSAN. The process of Engineering development and construction for the above project was elucidated by the author in three parts; starting with Front End Engineering & Design (FEED), Process optimisation and Detailed Engineering .It was followed by a brief on engineering

development and construction activities. It ended with an overview about the DIGIT's tool used by Doosan for basic design and engineering of IGCC Plant covering its functionalities and applications in performance prediction, operation feedback etc.

- (ix) Title : Siemens USC Steam Turbines - Experience and further developments
- Speaker : Stefan Brueck ,Siemens AG
- Summary : The author discussed about the benefits of the advanced steam parameters. Author mentioned about the SST-6000 series for the advanced steam parameters. He described about HP stage bypass technique for grid support and frequency control. Then he went on to elaborate about the internal bypass cooling arrangement in HP turbine to manage the outer casing temperature so as to enable faster start up and Vortex cooling in IP turbine for reduction in rotor wall temperature. The presentation concluded with the recommended USC parameters for 1000 MW scale USC plants with single/double reheat.
- (x) Title : Recent Advancement in Steam Turbine for Higher Efficiency
- Speaker : Michael Sell ,Alstom Power
- Summary : The Author brought out the facts of enhancing cycle efficiency through improvement in parameters and thus reducing CO2 emission, for which, the material & module designs of Turbines had to be upgraded with new materials. Author also stated that in addition to this, the cycle efficiency can be improved with the help of Aerodynamic advancements such as high efficiency 3D blades, optimization of steam paths, advanced 3D profile blades for last stage blades and optimizing diffuser design. The Author concluded by stressing that path to higher efficiency is through higher cycle parameters, attention to detail in design features & optimizing steam flow path.

Concluding remarks by Session Chair

The session chair appreciated the participants and authors for their excellent contributions.

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SESSION 3A & 4A

1. Session Name : Diversity of Fuel – Renewables
2. Session Chair : Mr. CVSN Murthy, ED BHEL
3. Session Co-chair : Mr. G J Deshpande, RED West I
4. Session Developer : Mr. Balkrishn Kamath
6. Number of Papers Presented : 10

Details of Presentation

- (i) Title : Adaptive control strategies and communications for utility integration of photo volatic solar sites

Speaker : Yusuf Zafer Korkmaz

Summary : Solar PV Inverters have inherently fast acting characteristics. This is very useful for short-duration sourcing and sinking of reactive power when pooled together.

In this paper the speaker has beautifully explained how to address the communications integration and activation of adaptive control strategies for these Distributed Energy Resource sites.

Solar PV sites can operate in a number of different control modes based on grid conditions and available solar radiation. These modes can include power factor matching, power factor correction, voltage support, and net metering, among others.

- (ii) Title : Impact Assessment of Solar Radiation Databases on Techno-economic Feasibility of Solar Power

Speaker : Ishan Purohit

Summary : Solar Power Sector of the country is facing challenges like unavailability of measured solar radiation data, long term operating history of solar PV technology in Indian climatic conditions, lack of domestic manufacturing of solar PV modules, concentrating collectors and receivers, inverters, intermittent nature of solar irradiance and variability of available solar radiation databases . As a result energy yield estimation is very difficult and hence the financial feasibility of the solar power projects are difficult to be established.

The speaker has very effectively explained how using different sources of radiation data and using software like using PVsyst this risk can be mitigated to a large extent

- (iii) Title : Floating Solar PV Plant - An emerging technology for Clean Energy Deployment
- Speaker : Jatinder Chandok
- Summary : Land is very precious. Acquisition is a long drawn program. Solar Power plants need huge area land, approx 5 acres/MW
- This paper has detailed how Floating PV installations can be very viable option and with additional benefits like increase in performance of solar PV panels due to cooling effect, water conservation, reduction in algae growth.
- Speaker has also shared NTPC's plan to assess and promote this platform for increasing its renewable energy portfolio.
- (iv) Title : Recent experience of the conversion of coal-fired utility boilers to the firing and co-firing of bio mass
- Speaker : Dr W R Livingston
- Summary : In the era of coal shortage in each and every power plant, co-firing of biomass is an attractive option, environmentally, commercially and technically
- The paper discusses elaborately the retrofitting required for biomass handling and combustion in an existing coal-fired power plants.
- The speaker has shared his experience in this field
- (v) Title : Advantage of GCB scheme for a power Plant
- Speaker : Jean-Marc Willieme
- Summary : Generator Circuit Breaker before the step-up transformer is economical and efficient solution for the protection of generators and transformers.
- The speaker has very clearly demonstrated the GCBs with effective cooling and with interrupting chamber, can effectively break a short-circuit current for the life time of the power plant.
- (vi) Title : Role of Energy Storage in the Grid Integration of Wind and Solar PV Energy Systems
- Speaker : Dr KV Vidyanandan

Summary : Renewable Energy like Solar and Wind are inherently variable and intermittent in nature

This paper deals with different kind of Energy Storage System to smoothen the fluctuations arising out of variability and make the Renewable Energy more reliable

(vii) Title : Substitute to land requirement for Solar Power Plant

Speaker : Arunav Uppal

Summary : Solar highway over canals, agricultural fields raw water reservoir will generate GWs of clean energy, conserve millions of cubic metre of surface water and increase thousands of tonnes of food production providing social & economic development at the bottom of the pyramid.

The speaker has very convincingly discussed various ways and means through which Solar PV can be added beyond all imagination without facing the hurdle of land issues.

(viii) Title : Manufacturing Technologies for high efficiency crystalline Silicon Solar Cell and PV Modules

Speaker : Ravi S

Summary : The speaker has shared various in-house developments and continuous process and product improvements in cell and module manufacturing, which has helped in improving the efficiency of the modules and reduction in cost.

We need many such initiatives by all stake holders to make Renewable Energy as the most important arena for capacity addition in the country

(ix) Title : Solar-wind Hybrid Renewable Energy Power Plant

Speaker : Kailash Chandra Pandey

Summary : Solar and Wind Energy generation at any location are complimentary in nature. The integration of these two energy sources allows improving the overall system utilization and reliability of the energy supply.

This paper has analysed in great details installation of solar plant in an existing wind farm and bring out how the existing resources and infrastructure can be utilized in a better manner

- (x) Title : Operational Flexibility and EPC approach
- Speaker : Himanshu Garg
- Summary : In the highly competitive power market supplying power exactly as per fluctuating demand is a win win situation for both generator and customers.

The speaker in the paper stressed that optimally designed combined cycle power plants along with all auxiliaries if awarded to a single agency through EPC, can supply a power plant with flexibility for variation in generation levels and meet customer requirements at a very short notice.

Concluding remarks by Session Chair : Sh CVS N Murthy

India is targeting to add capacity through Solar PV in a big way and the world is watching this market very seriously. The "Make in India" mission can be implemented very effectively in Renewable Energy sector, reduce the cost of the project and achieve grid parity for Solar and Wind Energy in the years to come.

All the papers were of very high standard and innovative in nature. All the presenters have communicated very well and by the number of questions, I can confidently say that they have been able to generate enough curiosity among the audience. This is the main purpose of such Summit, to provoke a thought process. Combined energy of all stakeholders, when applied to find solution to any problem, it can be solved in a very short span of time.

I would like to mention that the thought of implementing solar PV project without using vast tract of land is a very innovative. Similarly, different storages and combination of different Renewable Technologies can also improve reliability and increase total output with optimized land use. Even augmentation of Renewable Energy to existing convention Power Plant is a welcome move.

Hope NTPC initiative in organizing Global Energy Technology Summit (GETS) and to continue this every year will go a long way in achieving the target of "Power to all 24x7"

It was a wonderful session and I thank all concerned from the core of my heart for being a part of this great event

SESSION 3 B

1. Session Name : Speedy and Quality Construction
2. Session Chair : Mr. A N Dave (Ex ED NTPC)
3. Session Co-chair : Mr. Arvind Kumar (Executive Director, NTPC Ltd.)
4. Session Developer : Mr. H Kundu
6. Number of Papers Presented : 5

Details of Presentation

- (i) Title : Speedy Excavation of Tunnels by Tunnel Boring Machines
Speaker : Francois Laigle, EDF
Summary : The paper starts with an overview of Tunnel Boring Machines (TBM) and their evolution over the period. This is followed by various types of TBMs used nowadays and their purpose. An overview of TBMs used in recent projects, their speeds and the problems faced in those follows. It concludes with ways to unjam the TBM and more widespread usage of these machines.
- (ii) Title : Risk and Risk Management in TBM tunneling
Speaker : Bernard Miller, Geconsult ZT GmbH
Summary : The paper start with outlining the higher risks in tunneling associated with active mountain ranges such as the Himalayas. Among ways to mitigate the risks is to carry out extensive geotechnical investigation before finalizing the TBM route to avoid costly geotechnical surprises. A good on the job consultant, proper site setup, good construction material and electricity supply further supports the tunneling process. It concludes with highlighting the ways to mitigate risks in execution of tunneling
- (iii) Title : CHP completion in 24 months

Speaker : Bharath Kumar, L&T

Summary : Faster project completion can be achieved by reducing engineering time by lesser/no approval of drawings. Standardization of modules, distances, galleries can help in faster engineering and fabrication. Faster constructability can be achieved by self compacting concrete, no counterfort, precast structures, piece large construction, modular structures and pre-cast drains. Further packaging can be modified to reduce the interfaces and help in faster construction.

(iv) Title : The Sostanj 6 Tower Boiler Case

Speaker : Heinz Lorey, Alstom

Summary : A good project team with diverse members and direct responsibility is the first step for project success. Detailed initial planning is important. Complete tracking tools for steel and materials including engineering, manufacturing, logistics and usage. Sub-vendors and contractors are also provided with access and monitoring tools of the above system. More usage of pre-fabricated structures, higher capacity machinery to accelerate erection sequence.

(v) Title : Land Acquisition and Plant Layout: Converting Challenge into Opportunity through technological advance

Speaker : Shailendra Bhardwaj & Akhilesh Poddar, NTPC Limited

Summary : The paper starts with a Brief of the new land acquisition act and CEA norms for reducing the land use per MW of plant capacity. Although the area required for Ash dyke and reservoir may be difficult to reduce, land usage may be reduced by adoption of GIS switchyards, HCSD in ash handling, optimizing CW duct layout in the main plant area. The paper concludes with showing further ways of reducing land use by importing low ash coal, placing plants near the sea etc.

Concluding remarks by Session Chair

The papers were highly relevant to the Indian power sector in general and NTPC in particular. The diverse range of papers from TBM usage for hydro power plants to CHP construction, from project management for tower boilers to ways of reducing land usage have shown us the variety and complexity in speedy and quality construction. It is hoped that such confluence of ideas will be repeated each year and help in furthering the cause of speedy and quality construction

SESSION 4 B

1. Session Name : Towards Green
2. Session Chair : Dr. S.C. Chetal
3. Session Co-chair : Mr. Thomas Joseph, ED (NETRA)
4. Session Developer : Mr. Sanjay Pande
5. Number of Papers Presented : 6

Details of Presentation

- (i) Title : Achieving Lower Cost Generation and Environmental Sustainability Through Adoption of USC CFB technology
Speaker : Gerd Heiermann
Summary :
 1. CFBC Boiler application for USC conditions
 2. Plan to scale-up CFB boiler capability to 600MWe class for demonstration in South Korea with target steam conditions at Ultra-Supercritical levels were explained.

- (ii) Title : Current status of the U.S. DOE/OCDO A-USC Materials Technology Research and Development Program
Speaker : Robert M.Purgert
Summary :
 1. Primary Technical Goals of US A-USC Materials Programs were shared
 2. Comparison between two leading candidate materials: 740H & 617 was made.
 3. A component testing facility (ComTest1400) for evaluation of advanced materials and components under coal fired, A-USC conditions.

- (iii) Title : Advanced Boiler Design
Speaker : Carsten Søgaard
Summary :
 1. BWE shared its company profile which is lesser known to India
 2. Information regarding high efficiency Danish USC units were shared,
 3. Material selection basket, singl/dopuble train auxiliaries compariosn, boiler combustion features, APH sealing design were shared.

- (iv) Title : Emerging Flue Gas Desulphurization (FGD) technologies for thermal power plants in India
- Speaker : Rajavel
- Summary : 1. Status of current FGd installations in India by BHEL was shared
2. Comparison between different FGD technologies was shown
- (v) Title : Moving Electrode Electrostatic Precipitator
- Speaker : Takamasa Kojo
- Summary : Advantages of MOVING ELECTRODE ELECTROSTATIC PRECIPITATOR (MEEP) especially for high resistivity Indian ash were highlighted.
- (vi) Title : Benson Vertical Tube Evaporator for Supercritical Pressure Once Through Boilers
- Speaker : Vishwanathan Krishnamurthy
- Summary : Key design features and potential advantages of BENSON VERTICAL TUBE EVAPORATOR DESIGN FOR SUPERCRITICAL PRESSURE BOILERS were shared.

Concluding remarks by Session Chair

Session Chairman indicated the very satisfactory session proceedings. While there was additional paper, he consciously increased the time so that audience could gain from presenter who travelled long distance to be here. The session time gone up to 2.30 hrs. . He indicated the Adv. USC units are future for fossil fuels and the same is actively pursued in India. He specifically indicated while 740H is potential candidate material, 617 is being used in Indian program as the temperature is restricted to around 700 deg.C.

He indicated happiness over the presentations and response on BHEL and Hitachi presentations on Flue Gas De-Sulphurization (FGD) and Moving Electrode Electrostatic Precipitator (MEEP).

SESSION 5A & 6A

1. Session Name : Automation for Optimized Operations
Mr. Hans-Christian Ostertag,
Head of Market Requirements and Sales
2. Session Chair : Support, Product Management,
Instrumentation & Controls, Siemens AG
3. Session Co-chair : Mr. Y. V. Rao, Executive Director (Operation
Services)
4. Session Developer : Mr. M. K. Srivastava, AGM (PE-C&I)
5. Number of Papers Presented : 12

Details of Presentation

- (i) Title : Case Studies For Advanced Combustion Optimization For Coal Fired Power Plants
Speaker : Ms. Lea Boche, Steag Energy Services GMBH
Summary : The paper starts with the discussion about complexity of combustion process in a coal fired power plant which is influenced by a huge number of manipulated variables such as primary and secondary air flows, burner tilts, excess O₂, mill loading. Important properties such as temperature imbalances, NO_x and CO emissions, slagging or unburnt carbon in ash are significantly influenced by combustion parameters. Controlling combustion in the best possible way will thus improve efficiency of the plant, increase the availability and allow a broader range of international coals to be used. The challenge for the operation is to find the optimal settings for manipulated variables for different loads and coal qualities. The solution can be an advanced combustion optimization which uses a state of the art toolbox of artificial intelligence (AI) methods based on process models coupled with specialized sensors like Flame Cameras, Vibration Sensors etc. for closed loop control.
- (ii) Title : Improved CEMS Accuracy and Reliability with Sample Conditioning Systems using Nafion Technology
Speaker : Mr. Gene Bohensky, Perma Pure, LLC, United States

- Summary : Protecting the environment from harmful emissions of power plants requires CEMS to be accurate and reliable in long-term operation. The most common sample conditioning systems use Thermoelectric (Peltier) coolers to chill the sample and remove the moisture in the liquid phase. However, it has been shown that accuracy suffers when monitoring SO₂ or NO₂ as a portion of the sample is lost while the water is condensed. Secondly, such systems have reliability problems as the wet and dirty samples foul sampling lines and cooler elements, making it difficult to achieve good measurements. Sample conditioning systems using Nafion membrane technology have ability to preserve the composition of the gas in hot, wet, and dirty samples and guarantee accurate results over a long service life. This provides power plants the confidence to deploy an effective alternative that both improve measurement accuracy and analyzer reliability.
- (iii) Title : Study & Design of Feed Water Control Loop in Super Critical Boiler
- Speaker : Mr. Ashok Kumar Panda, Tata Power India
- Summary : As there is no energy reserve in the Once-Through System (Super Critical Units), the control system must match exactly and continuously feed water flow and boiler firing rate (both fuel and air). Transient mismatches can be severe, tending to burn out conditions in case of feed water starvation and tending towards positive pressure effects in case of excess feed water. Hence, the feed water control loop needs to be designed to control operation more tightly and to hit and maintain the set points so that the steady state and stable operation, can be achieved without oscillation.
- (iv) Title : A study and validation of IMCS with common platform for BTG in power plant
- Speaker : Yunjae Choi, Doosan Heavy Industries & Construction Co, Ltd., South Korea
- Summary : The control of Boiler, Turbine and Generator (BTG), that is, major equipment in Power Plant was operated separately by different and separate control systems which were supplied by different manufacturer till now, but this paper describes development and site validation of Integrated Monitoring and Control System (IMCS) based on common platform, which can monitor and control BTG overall. The different control system was applied at Power plant till now because characteristics such as response time and redundancy conditions depending on BTG were different, but this paper shows that IMCS

based on common platform was developed to be suitable for all BTG with different characteristic. IMCS was designed to be flexible system architecture capable of installing single, dual redundancy or triple redundancy conditions, response time, data loss-free communication and changing of response time setting, etc., so differentiated with existing controller.

- (v) Title : Advanced Operation Today: How The User Interface Boosts Operator Efficiency
- Speaker : Mr. Hans-Christian Ostertag, Siemens AG, Germany
- Summary : Managing single power stations or entire fleets today requires strong focus on operational efficiency, in particular efficient operation in the control room itself. The ability to accelerate information handling and decision making, to prevent mal-operation and to enable fast and sound troubleshooting is of primary significance when it is required to maintain and even further increase plant availability and profitability under today's regimes of high-stress, fast-ramp and load change operations. Clear and Easy to understand informative displays, advanced alarm management, Emergency Alarms, Operator Guide Messages, are some examples of what is needed to allow operators mastering the amount of information at maximum efficiency.
- (vi) Title : Virtualization in Process Control System – Possibilities and Opportunities
- Speaker : Mr. Prakash Devdas, BHEL Ltd., India
- Summary : Most DDCMIS today requires separate servers or workstations to support different applications. Some systems run one application per server to avoid the risk of vulnerabilities in one application affecting the availability of another application on the same server. The applications are tightly coupled with the hardware. At times, this results in underutilized hardware resources, inflexible and difficult to maintain systems. Virtualization can help resolves these issue by allowing a single server to simultaneously run multiple operating systems and applications. These solutions can help Automation Industry to reduce PC hardware requirements and minimize the frequency and impact of operating system and hardware changes while simplifying overall system management, improving availability, reliability and disaster recovery. Improved hardware reliability along with virtualization helps build high availability solutions too. Virtualization can also be used to address issues of hardware obsolescence and software obsolescence where in support for hardware/software may not last for more than 5

years practically.

- (vii) Title : Online Process Optimization Of Coal Handling Plant
- Speaker : Mr. Viktor Valenta, Enelex, Czech Republic
- Summary : Complete control over coal handling, active blending and homogenization can significantly cut-off losses caused by unstable coal quality and subsequent problems with boiler operation and performance. Coal quality management does not only check the coal quality, it also gives the operator the opportunity to affect the coal quality during the process which means the intended coal quality can be reached smoothly, during normal operation and without extra costs. Coal Quality Management System has to receive the information on expected input material parameters to prepare the plans, usually the average parameters of coal received. The more detailed information is provided, the more exact are the plans. It has to be mentioned that properly designed system should be able to handle the coal quality even in case the coal quality expectations are not correct. Other input information utilized is the feedback data from the laboratory analysis of the coal. The data from the laboratory usually don't come on time to be used as an input for operational management but it is always used to verify the online measurement and system maintenance as well.
- (viii) Title : Supercritical Plant DCS : Achieving Optimum Performance
- Speaker : Mr. Hiranmoy Mukhopadhyay, Larsen & Toubro, India
- Summary : Supercritical plants deserve different treatment in designing the control systems due the fast response required for its Boiler Closed loop controls. The three major considerations are Fast response time of the DCS to take care of the complex once thru operation of the Boiler, Safe operation of the process involving high pressure and temperature and Tight integration to minimize interface time among various control systems. Unified System Architecture for DCS involving same platform for Boiler, Turbine and Station Control, Adopting the Functional Grouping in line with BTG OEM's plant control philosophy and Using a plant Simulator to conduct an extensive hardware and software FAT to minimize commissioning time can help us achieve optimum performance of plant with minimum commissioning time, reduced training requirements, ease of operation & maintenance, reduction in hardware & proprietary software costs, optimized spares inventory and tightly integrated BTG control systems.
- (ix) Title : Design of a Centralized Substation Synchronizing System

Speaker : Mr. Yusuf Zafer Korkmaz, SEL INC. , Bahrain

Summary : Large substations often have complex and dynamic topologies. The voltage available on either side of an open breaker may originate from a number of sources. This has led to the development of centralized systems to carry out synchronism-check functions to synchronize all breakers within the substation. Such a system uses the status of breakers and disconnects to identify a voltage source for each side of the breaker that is to be synchronized. This paper describes in detail a synchrophasor-based approach that provides a significant reduction in the effort and cost required to design, build, and test a centralized synchronizing system. Phasor measurement and control units (PMcus) transmit voltage phasors and breaker and disconnect status to a central controller. The central controller time-aligns the data and selects the correct voltages to use for synchronizing according to the present status of the breakers and disconnects. Once the appropriate checks of the voltages are made, a close command is sent from the central controller to the PMCU responsible for the breaker that is to be closed. A primary objective is to reduce the requirement for custom logic as much as possible. The synchrophasor-based approach proposed in this paper is also applicable when synchronizing two power sources. This usually entails controlling voltage magnitude and frequency in one island, whereas synchronism check does not carry out voltage or frequency control.

(x) Title : Automation Solution for Next Generation Power Station

Speaker : Mr. Manoj Dubey, Emerson Process Management India, India

Summary : Over the years, process control technologies for Power Plant applications have controlled different sections and applications, discretely. In recent years, with the advancement of technology, DCS systems are evolving towards integrated architecture – resulting in new applications, greater operational efficiency, advanced diagnostics features, and next-generation optimization tools and techniques. Wireless is another indispensable technology which finds multiple applications in next generation power plants. It offers process improvement opportunities by making possible measurement and control, hitherto deterred by remote locations, physical obstructions and barriers, and high cost of engineering and integrating technology. Application of wireless at power plants can reduce installation and maintenance costs and improve predictive intelligence. Wireless and Predictive technology which will form the automation solution for next generation power station.

(xi) Title : Achieving Operational Excellence by Innovative Automation and

Optimization Solutions for Power Plant

Speaker : Mr. Rahul Nargotra, Schneider-Electric, Singapore

Summary : Power Utility Industry is of utmost importance to the development of the Indian economy and to meet the infrastructure growth plans of the new populist government. The last ten years, have seen an unprecedented growth of power capacity in India, with several new large size super-critical power stations being set-up across the nation. Several of these new power stations have adopted the supercritical power plant technology, with higher efficiencies and lower greenhouse gas emissions to meet the growing demands for power whilst reducing the impact on the environment. Utilizing the state of the art new Automation solutions, the power plants are able to achieve higher levels of automation with inherent high reliability and availability of the units with the latest control systems. In addition to this utilizing Operator training simulator the plant operators can achieve higher level of operations utilizing the simulator across the plant life cycle from design all the way to commissioning and then training of their personell.

(xii) Title : Substation Automation – Push from Conventional to full Digital Technologies

Speaker : Mr. Himadri Endow, Alstom T&D India Ltd., India

Summary : For substations above 220 kV including that of HVDC Bi-pole, the grid in India has seen over nine fold addition in terms of MVA/MW capacity in 26 years since the end of the 7th plan period. At the end of the current 12th plan, the capacity of AC substations is projected to be 6,69,801 MVA with another 22,500 MVA coming from HVDC Bi-pole stations [1]. In terms of CAGR this translates into a growth of 8.56% till the end of the 12th plan. With a massive plan of integrating and evacuating renewable energies, this growth in capacity is set to rise during the 13th plan ending in 2022. The demands and expectations of a substation's operation is continually evolving with the complex flows and the security needs that have come to characterise the modern grid. The evolution of standards have helped to ease many issues relating to engineering, safety, security, self-healing based availability, refurbishments and life-cycle costs. In adopting these standards, the future full digital substation should ideally adapt legacy multi-generational devices. It should be able to build on them to provide new generation technologies required to optimally manage the substation assets as well as play a focal part in supervision and control of the complex grid flows. This article looks at the choices available to the utilities to migrate from conventional technologies and harness the full power of the digital substation, the business case for doing so, and ending with a few case histories.

Concluding remarks by Session Chair

The session chair appreciated the participants and authors for their excellent contributions. He spoke at length about the importance and relevance of various papers presented in this session to the automation in power industry. He further added that integration of power plant operations and power plant business has become a reality by adoption of latest technologies in power plant automation. Today's automation technologies and solutions have integrated the operations of varied power plant processes, from fuel supply, power generation, plant performance, emission monitoring & grid connections.

He concluded with suggestion that NTPC shall think about adopting latest technologies presented in these papers after giving due consideration to the advantages provided by them and their cost benefit analysis.

SESSION 5B

1. Session Name : Energy Conservation
2. Session Chair : Mr. Thomas Weinandy (Baldor Electric)
3. Session Co-chair : Mr. A K Sinha (NTPC)
4. Session Developer : Mr. Subhash Thakur
5. Number of Papers Presented : 06

Details of Presentation

- (i) Title : Plasma ignition and combustion stabilization technology for low grade coals
Speaker : Mr Michael Hong: VP, Magtech, USA,
Summary : Plasma ignition and combustion stabilization uses coal but not oil to serve exact the same ignition functions plus extra benefits, such as simultaneously running ESP system and less NOx generation. The advanced plasma ignition system would be used reliably and productively at the Pulverised coal power plants burning the low grade coals and significantly improve their operational productivity by virtually eliminating all the fuel oil consumption and related expenses.
- (ii) Title : Advanced Demand Response management system opportunities & technology choice for electric utilities
Speaker : Mr Himadri Endow, Alstom, India

- Summary : Demand side infrastructure can bring in much better return on investment with far less capital outlay and faster deployment cycle, while achieving the same target objectives that can be met by conventional supply side infrastructure. There is reason to believe, response performance of DR is comparable if not better than conventional reserves. Add to this the growing realisation of reducing reliance on fossil fuels. DR can very well form a part of the renewable purchase specifications drawn up under the aegis of the National Action Plan for Climate Change (NAPCC).
- (iii) Title : Application of high-efficiency motor and energy-saving system in thermal power plant
- Speaker : Mr Minglun Sun, Shangai Electric, USA
- Summary : Two solutions which enhance motor efficiency itself and improve related system efficiency have been recommended. Increasing the active material (electrical steel and current conducting material), the loss of motor can be reduced even more than 40 percent, which can increase the motor efficiency more significantly for motor rating lower than 500HP.
- (iv) Title : Precipitator auxiliary power savings using switch mode power Supplies
- Speaker : Mr Jason Horn, Stock Equipment Company, USA
- Summary : High frequency SMPS can provide the same output power with lower losses. Full implementation of SMPS across the entire ESP will offer biggest advantages in power conversion efficiency and collection efficiency. In addition to full implementation of buck converter SMP across the entire ESP, partial or staged installation plans can be utilized to yield the necessary improvements while optimizing project costs.
- (v) Title : Efficiency improvement by improving coal flow and minimizing Material handling losses
- Speaker : Mr Anand Krishnamurthy, GE, India
- Summary : This paper discusses the impact of coal flow, auto-oxidation and material handling losses on plant efficiency and suggests mitigation measures such as inhibiting Coal oxidation by addition of aqueous emulsions(by spraying during coal conveyor transfer), suspensions or solutions of chemical inhibitors etc., with background principles and case studies to overcome the issues.

Concluding remarks by Session Chair

The papers were highly relevant to the power sector. Paper on plasma ignition highlighted elimination of elaborate oil ignition system resulting in cost saving as well. Benefits of using high efficiency LT motors was deliberated as 46% of the energy generated is consumed by these motors. Advantages of single winding two speed motors were also highlighted. Application of direct drive motor for ease of O&M and vibration reduction, Use of SMPS in electrostatic precipitator for better ESP efficiency and energy conservation were

highlighted.

Paper highlighting application of Demand response particularly in the renewable generation was presented. Spray of additives for dust suppression, improved coal flow and suppression of spontaneous combustion was also deliberated.

SESSION 6B

1. Session Name : Advance Computations
2. Session Chair : Dr Vivek V Ranade, , Dy Director , NCL, Pune
3. Session Co-chair : Mr. A K Ahuja, ED(CP&BE),
RED(NCR),RED(NCR), NTPC Ltd.
4. Session Developer : Dr P K Jain, GM(NETRA)
5. Number of Papers Presented : 5

Details of Presentation

- (i) Title : Numerical and Experimental Investigation on Heat Recovery Steam Generator during Start-Up Procedure using ASIMPLE
Speaker : Mr. Kim Hyo Jun,
Doosan
Summary : Advancement in technology has made it possible for us to carry out the transient analysis through dynamic simulation of complex system like HRSG start-up operation. A dynamic simulation tool helps to understand the transient behavior of the system, a priori, thus allows for better process control and operator training. Looking forward, we expect the tool to be used for much complex processes like start-up/shutdown control and operation of coal based plants.
- (ii) Title : COMPUTATION SCIENCE AND ITS APPLICATION FOR POWER PLANT PROCESS IMPROVEMENT IN NTPC
Speaker : Shri Sujay Karmakar & Shri J S Chandok, NTPC NETRA
Summary : Paper discussed case studies and improvement achieved by using CFD modeling and Artificial Intelligence. A validated CFD model was used to understand the abnormality in the flow pattern and take corrective action. The second set of case

study was to understand the relationship between cause and effect using huge operating data base to arrive at a real time operator advisory, incipient fault detection and predictive monitoring for efficient plant operation using Artificial intelligence methods like ANN, Pattern recognition, Fuzzy and Genetic Algorithm etc.

- (iii) Title : Automation of power plant piping engineering- using 3d plant design technologies
- Speaker : Mr C.Vaithianathan
- Summary : It dealt with the complex process of automation of power plant piping engineering by BHEL. 3D plant design commercial softwares are available in the market which can provide the piping routine and layout. What makes the presentation interesting is how the available software was integrated with user defined function to identify the correct routing and derive pressure loss, insulation, and stress analysis for that section.
- (iv) Title : NUMERICAL SIMULATION OF HORIZONTAL PNEUMATIC CONVEYING USING CFD-DEM
- Speaker : Mr Vinod Dhiman
- Summary : It discussed about the numerical simulation of horizontal pneumatic conveying using CFD-Discreet Element modeling by ANSYS. It explains that DEM model can be used to simulate various flow regimes in pneumatic conveying. Here polyethylene pellets of constant size were used. The next challenge will be to arrive at appropriate drag laws applicable for the ash we produced in our plant so that it can be effectively used for predicting the flow behavior of the ash
- (v) Title : BEHAVIOUR OF TUBULAR POWER PLANT COMPONENTS FOR REMAINING LIFE ASSESSMENT
- Speaker : Mr M K Samal
- Summary : It dealt with another important aspect of any plant i.e., remaining life assessment through investigation of fracture behavior of thin wall tubular component. It has been shown that Finite Element Analysis results compared well with experimental results to predict the load-deformation behavior of the specimens

Concluding remarks by Session Chair

Advance computation and software tools play important role in optimization of resources through improvement in efficiency and reliability. The papers presented involve different software computation and simulation tools applied to various fields like dynamic simulation of start-up in HRSG, automation of 3D piping layout, improvement in flow characteristics in ducts of power plants, estimation of residual life of tubular components, horizontal pneumatic conveying etc

SESSION 7A

1. Session Name : Optimising Resources
2. Session Chair : Mr. Jaap P.J. Ruijgrok (Managing Director, ESI Eurosilo)
3. Session Co-chair : Mr. Saptarshi Roy, (RED (NR), NTPC Ltd.)
4. Session Developer : Mr. Goutam Halder/ Dipankar Biswas
5. Number of Papers Presented : 10

Details of Presentation

- (i) Title : MODERN SOLUTION FOR PUMP PROTECTION VALVES IN WATER SYSTEM
- Speaker : Mr. Andreas Schmidt, VAG, Germany
- Summary : The Author has brought out the Benefits and developments of valves with Hydraulic Actuators of VAG, in case of pump failures, or other unexpected scenarios. They are a smart combination of non-return and isolation valves in just a single one.
- The Author has also shown possibilities to ensure a safe and reliable function and highlight developments for valves and their actuators, for making the plants safer, more reliable and energy efficient. These valves do not just protect a pump, increase the plant's overall safety and reliability but also reduce resistances which keep the plants' own energy consumption at a minimum.
- (ii) Title : FUTURE PROOF SOLUTIONS FOR LARGE SCALE COAL SILOS
- Speaker : Mr. Richard Spaargaren, ESI Eurosilo, Netherlands

Summary : In his presentation the author has emphasized need of coal storage system with minimum foot print, keeping in mind, less availability of land due to new land acquisition act.

In order to optimize resources, the Author has proposed silo storage system having less foot print so that water and air pollution can be avoided. He has also explained the working principle of in-feed and out-feed system. It has facility of blending of domestic and imported coal, Fuel management system and Fire protection system

The Author also offers a reliable system for storing non-free flowing bulk materials such as FGD-Gypsum, Fly ash and limestone.

(iii) Title : DEVELOPMENT OF MAGALDI DRY BOTTOM ASH HANDLING SYSTEM

Speaker : Mr. Fulvio Bassetti, Magaldi, Italy

Summary : The Author has introduced Dry bottom ash handling system and explained its working principle and its benefits over other conventional systems. The Author has claimed that the overall efficiency of the boiler improves, due to recovery of energy from unburned fuel in bottom ash, ash sensible heat and flame radiation through boiler throat, so that Coal consumption savings and CO₂ emission reduction is possible. Dry bottom ash handling system requires Zero water usage. Hence, no water treatment system is required.

(iv) Title : IMPROVING PLANT EFFICIENCY BY USING MODERN ANTI FOULING FILLS

Speaker : Mr. Richard Aull, Brentwood Industries, USA

Summary : The Author has emphasized that when cooling tower return water temperature decreases, condenser back pressure decreases and then turbine output increases.

The Author in his presentation addressed the issue of improving plant efficiency by the installation of fills that will improve the cooling tower cooling efficiency while maintaining cleanliness.

One modification is to replace existing tall splash fill sections with modular droplet fills. Another, is to replace fouled cross-fluted fill sections with vertical or offset vertical anti-fouling fills. The Author has presented along with the economic considerations of cost and payback due to the more efficient operation of the power plant.

(v) Title : POWER GEN USING PET COKE: A CFB BOILER TECHNOLOGY SOLUTION

Speaker : Mr. CR Subramaniam, Thermax, India

Summary : The Author has highlighted Internal Recirculation CFB technology has been established as better technology for firing Petcoke and Washery Rejects. The low velocity separation improves the reliability due to less risk of erosion and refractory failures.

The Author has explained two case studies, one each for 100% Petcoke fired Internal recirculation CFB which paved the way for effective utilization of Petcoke as Steam generator fuel with emission control and other is for Washery rejects fired Internal recirculation CFB.

The Author has stated that with the help of IRCFB, low emission of SO_x, NO_x can be met without any external systems like FGD or SNCR.

(vi) Title : ADVANCEMENT IN AHP TECHNOLOGIES

Speaker : Mr. Ashwani Perswal, United Conveyor Corporation, USA

Summary : In his presentation Author has discussed various ash conveying options available to power plants seeking to get rid of storing ash in ash ponds. These technologies include Continuous Dewatering Systems, Vibratory Ash Extractor system and Pneumatic Ash Extraction systems for Dry Bottom Ash Handling etc. The Author has also explained selection of suitable Dry Bottom Ash Handling for a particular plant.

(vii) Title : VALUE OF FLEXIBILITY IN OVERALL ELECTRICITY MIX IN INDIA

Speaker : Mr. Kenneth Engblom, Wartsila, Finland

Summary : Author in his presentation cautions that focusing heavily on base load, coal plants will lead to inefficiency and inflexibility. The problem will be exacerbated by the planned addition of renewable energy into the grid, in line with our "National Action Plan to Mitigate Climate Change". The intermittency and unpredictability of renewable energy generation will add to the problem of variability. The Author presented a case for changing the traditional mix and pruning down the base load coal plants to about 80% of the planned capacity, replacing the balance 20% with flexible peaking plants. The benefits of this optimized or hybrid systems are clearly visible and quantifiable.

In a nutshell, Author has stated that relying only on base load coal plants to meet India's growth needs would be fraught with risks and would lead to inefficiency. A hybrid mix of coal and flexible gas plants, in the ratio of, say, 80:20, would make the system flexible, more efficient, more capable of absorbing clean renewable energy into the system, and bring the country closer to realising the vision of "24 x 7 power supply for all".

- (viii) Title : OPTIMIZATION OF CHP USING LATEST TECHNOLOGY
- Speaker : Mr. Dipankar Halder, NTPC Ltd
- Summary : The Author in his presentation elaborated some of the latest development in the conveying technology which can be implemented to optimize an in-plant coal handling plant.
1. Optimisation of belt width which in turn will optimise both mechanical and structural cost of coal conveying system
 2. Route optimisation of coal handling plant from unloading area to coal bunker by providing Horizontal curve trough belt conveyor, Pipe conveyor, Cable belt conveyor, Sandwich conveyor system, .
 3. Coal transportation from mine to plant by conveying system.
- Using the combination of above three options, the coal handling plant can be optimized and the cost of coal handling plant can be reduced.
- (ix) Title : MEMBRANE BASE TECHNOLOGY IN WATER TREATMENT PLANT
- Speaker : Mr. M. Natarajan, BHEL
- Summary : The Author has emphasized that Membrane based (state of the art technology) treatment system offers many advantages over the conventional water treatment plant like lower chemical consumption, less waste generation, less foot print, provides consistent outlet water quality, can handle wide range of feed water quality. Author in his presentation covered various features like material selection, ease of maintenance, to optimize Layout & O&M cost and various challenges faced during commissioning etc., in the membrane based water treatment system supplied to various power plants with the help of case studies.
- (x) Title : REUSE OF TREATED SEWAGE IN THERMAL POWER STATIONS
- Speaker : Mr. Y.V.V.Satyanarayana, SFC Environmental Tech., India
- Summary : The Author has explained that to meet the demand, Thermal power stations are looking for alternative sources of water. Desalination water and sewage water are some of the alternative sources available. Out of these, sewage water is one of the cheapest and reliable options available. With the availability of modern sewage treatment technologies, it is very easy to treat the sewage to required quality. The Mahagenco, a state owned power generation company of Maharashtra, has taken initiative to set example for reuse of treated sewage in power plants. Mahagenco, has also generating power from Biomass.

Concluding remarks by session chair:

The session chair appreciated the participants and authors for their excellent contributions.

SESSION 7B

1. Session Name : **RELIABILITY, SAFETY AND SECURITY**
2. Session Chair : Mr. Jaap Van Kampen, Head, Generators Technology & Materials, Siemens, AG Mulheim
3. Session Co-chair : *Sh. S.N.Ganguly, ED to CMD and Executive Director (Corporate Communications & Law), NTPC Ltd*
4. Session Developer : *R.Sarangapani, AGM(PE-C&I)*
5. Number of Papers Presented : *Ten(10)*

Details of Presentation

- (i) Title : Nanotechnology in High Voltage insulation systems for Turbo-Generators
Speaker : Jaap Van Kampen
Summary : In this paper, the author had described the use of nano technology to improve the insulation properties of high voltage insulation. It also details out the result of the tests conducted for the properties of new material. The application of specially treated spherical SiO₂ nano particles as part of the well proved epoxy mica ground wall insulation, can improve the electrical properties of the insulation systems.
- (ii) Title : Increasing transformer reliability by proactive management of bushing
Speaker : Bruno Schnider
Summary : This paper describes the concept of condition monitoring as applied to transformer bushings & how the reliability of the transformer reliability can be improved by systematic risk assessment, thereby even reducing unnecessary maintenance costs associated with a ritualistic bushing replacement during overhauls.
- (iii) Title : Technology oriented security system for Power utilities
Speaker : Ralph Mueller
Summary : In this paper, the author describes the threats to infrastructure facilities in the power market affecting the security and the mechanisms available through the use of technology mainly access control, surveillance cameras, perimeter protection, in an integrated solution. Similar to the central control room of a power plant for all its generation related operations, the command & control

center is presented as a control room for security personnel for managing all security operations with all data available on large video screens on maps for situational awareness. This is an emerging trend in security of all critical infrastructure including process industries.

- (iv) Title : Cyber security for Critical Infrastructure
- Speaker : Mohit Rampal
- Summary : The author, in this paper, describes zero day vulnerabilities & their impact on infrastructure and the changing landscape in IACS(Industrial Automation and Control System) threats. The author has propagated a well known technique in software quality assurance, termed as fuzzing, as a panacea to the cyber security vulnerabilities hovering in systems controlling critical infrastructure. The author has clearly brought the proactive approach of fuzzing technique in contrast to the known reactive approaches of mitigating cyber security vulnerabilities. ISO model of FTTM is also presented.
- (v) Title : Safety Requirements for R&M of Boiler Protection System
- Speaker : Alok Kumar Sinha
- Summary : The author has described the safety engineering aspects of boiler protection through the use of IEC 61508. Safety integrity requirement or level is presented as defined in IEC 61508. (SIL_1 to SIL-4) as a concept for quantifying the safety levels of protection devices and the system as a whole. IEC 61508 /11 adapts a risk based approach & guides in determining the safety integrity requirements to be implemented for safety functions.
- (vi) Title : Supercritical Power Plants and the need for integrated valve specifications
- Speaker : Rana Bose
- Summary : The paper discusses the design aspects of valves taking into account the exit velocity requirement under various conditions. Four case studies have been presented. New materials has also been covered. The paper pitches for an integrated valve specification to get the benefits of an overall systems approach to valve design.
- (vii) Title : Making smart substations even smarter
- Speaker : Jun Chuang
- Summary : The paper details the technologies encapsulated in the IEC61850 standard for improving the reliability of substations. Some of these are faster & near real time communication protocols (eg GOOSE) diagnostics, self recovery tools.

The objectives are minimizing error probability, detecting errors faster and optimizing error recovery. The entire scheme of IEC 61850 is presented in a very simplistic, clear & holistic manner.

- (viii) Title : Predictive Analytics and Decision support for improved plant efficiency
- Speaker : Lea Boche/ Vedika Agarwal
- Summary : This paper describes the technique of statistical process control as an early warning system for detection of incipient faults. The paper propagates the advantages all typical empirical techniques have over first principles based methods for early warning. Case studies related to FD fan, condenser have also been presented. Example of Jharsuguda plant has also been presented.
- (ix) Title : Defense in Depth: A multilayered approach to Cybersecurity of IACS
- Speaker : R. Sarangapani on behalf of Dr. Ragnar Schierholz as co-presenter
- Summary : The paper describes the cyber threats to IACS (DCS) due to advent of commercial off the shelf systems & delineates the mitigation methods with three main aspects, design, policies & procedures and the enforcements. Security standards and the certification process are discussed.