Power Replay - A New Tool for Event Analysis and Improve Operation Practices

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Today's Power sector scenario is evolving into a highly challenging environment and only a well managed strong technical base can help in maintaining the cutting edge over others. In this regard, power plant operating personnel require up gradation of skills and knowledge to build up confidence for handling emergencies in the power plant operation. This shall mitigate the loss in terms of reduction in plant outage or damage to equipments. Hence there is a need to view and review the performance of the operators during emergencies. In the present advanced control systems there are features like trend, Sequence of Events, alarms which shall indicate the reason of emergency. But there is no feature which shall replay the actual process and operator actions which has lead to emergencies in the power plant. This paper presents a novel idea of "Power Replay" which shall play back the complete sequence of events of the process in the form of mimics as seen by the operator in the Control Room. The Power Replay is designed to replay the past events as and when required with Pause and Play functions. This shall help during and after emergencies to do the root cause analysis, and to review the performance and alertness of the operators and to provide learning experience to improve the skills. Power Replay was developed and implemented at Simhadri Power station of NTPC LTD. The Station has a capacity of 4 X 500 MW units. The designed system has helped in proper diagnosis, identify operator and process malfunctions. Over a period, the use of this system has improved operation conditions by increasing the skill and knowledge of the operators, identified and rectified various process errors and enabled the DDCMIS (Distributed Digital Control and Management Information System) to become more User-friendly

Keywords: Capture, Process, Trip Analysis, Video Replay, Virtualized

S1-P2

Fieldbus Technology for Power Plant Automation

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Various technologies or methods are helping the automation in Process and Factory industries. There is a drastic change in technology from pneumatic to analog to digital to Wireless. Out of the many digital technologies available in the market, Fieldbus is widely accepted and used because of its efficiency, reduced cost and proactive maintenance feature which helps to reduce the plant down time.

Fieldbus technology can increase plant availability and reduce capital and operational costs. This paper discuss about the advantages or benefits of Fieldbus in power plants.

S1-P3

Automation of Performance Monitoring and Control System of ESP through Multi-master communication protocol

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Stringent emission norms for thermal power plants have resulted in need for better ESP (Electrostatic Precipitator) performance which can be ensured only with well maintained ESP internals and a good control and monitoring system. ESP performance is affected by various boiler parameters and properties of the coal being used. For field wise control of the high voltage energizing and optimization, microprocessor based controllers have been developed and deployed. Similar controls are available either separately or in-built with the field controller for rapping functions. For control and monitoring of the entire ESP parameters from a single point, PC (personal computer) based integrated control systems are used. The availability of such PC based systems is inevitable for the effective monitoring and maintenance of the ESP performance. Requirement is also felt for multiple PC based systems in different locations, so as to be able to control and monitor the ESP parameters from multiple locations, usually from ESP control room or the boiler control room or both, to ensure operational flexibility. The existing master-slave protocol was not able to provide the flexibility of implementing a multi-location centralized control system. The master slave protocols also had limitations with respect to the time delay involved in requesting and receiving data when the numbers of communication nodes were more in number. A multi-master protocol based control system was designed and developed to implement the requirement of ESP control at multi-level and from multiple locations. This paper discusses the implementation of a multiple-level multi-point ESP performance monitoring and control system though a multi-master mode communication protocol

S1-P4

Protecting customer investments using Evolution approach with Backward Compatibility in Total Plant Automation Systems

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Industrial Automation systems are faced with the challenge of obsolescence due to fast technological advancements. The machineries and equipment in plants and plant assets have in most cases longer life cycle times compared to enterprise systems and its aging automation devices need to continue supporting safe and reliable operation. To provide customer value and improve effectiveness, it becomes imperative for the control systems to evolve by adopting the new technologies. Hence it is essential for the Original Equipment Manufacturers and technology leaders to review their products and redesign hardware and software ensuring that the installed base can be extended well into the future. We find the evolution approach with backward compatibility could provide plant owners the ability to extend the useful life of their systems and the profitability of their investments avoiding the rip-and-replace approach. We also find that the evolution approach should offer the plant owners the flexibility to upgrade their control system based on their business and plant operational needs. This paper discusses how the latest plant automation systems protect customer investments through backward compatibility by focusing on the latest technology and evolution approach. The discussion also elaborates how customers have benefitted from the strategy.

S2-P1

Power Plant Performance Optimization by Online Fuel Analysis and Emission Monitoring

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In coal fired thermal power plants, continuous monitoring of performance of plant main equipment and its auxiliaries is inevitable. It facilitates maintaining process parameters at optimum conditions. Key performance indicators (KPI) of monitoring are the Boiler efficiency and Heat Rate. Performance analysis of KPI is based on properties of fuel used during firing. Ensuring complete combustion and at same time optimizing excess air, enhances KPI. Estimation of combustion air requirement is essential. It requires proper fuel properties. In present industry scenario, while requirement of fuel properties data is ex-ante, availability is post-ante, normally after two days. At present near history data is used forcomputation. For nth day of operation, data of n-3rd day is used. Using near history data result in erroneous estimation when there is change in fuel batch entirely or partially between nth and n-3rd day. In this paper, Artificial Neural Network Model (ANN) is applied to estimate fuel properties.

Relationship between parameters and fuel properties are modeled in ANN. It enables online tracking of fuel properties, and reduces error in estimation of combustion air requirement and optimizes excess air. It improves boiler efficiency by reducing heat wasted to atmosphere, and reduces emissions. Benefits are savings associated with increased boiler efficiency and incentives or reduced penalties associated with reduction in emission.

Keywords: ANN, Fuel Analysis, Heat Rate Optimization, Combustion Optimization, Soot Blowing Optimization, Performance Monitoring.

S2-P2

LTSH tube inspection by in-house developed Robotic inspection system

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Boiler Tube failure is the prime reason of the forced outages at Fossil power plants. The generation loss due to the non availability of the units, the compulsions to complete the inspection in the shortest possible time and the lengths of the tubes for inspection necessitate the use of robotic inspection systems in Boiler. NETRA developed robotic system for LTSH tube inspection comprises two Crawlers, one is moving on horizontal tubes and other moves vertically on guide channel. The horizontal crawler holds the vertical guide channel and moves on the top tubes. The vertical crawler is carrying three high resolution cameras for capturing wide scan of tube surfaces. The control unit comprises display screen, digital video recorder, motor controllers and tube counter. This system is used for visual inspection at different NTPC stations and produces good results.

Keywords: LTSH, Robotic, inspection, Crawler, visual

S2-P3

New technology along with current Vibration Monitoring for Power Plant Rotary Machines

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Vibration is a very key parameter for Critical Rotating machines such as Turbine, Generators and other secondary critical machines in Power Plant.

Machinery Vibration Monitoring in power plant is effective measuring tool in reducing overall operating costs. Monitoring Vibration levels over time allows the plant engineer to predict problems before serious damage occurs. When Rotating machine problems discovered early, the plant engineer will have schedule maintenance and reduce down time in a cost effective manner. We can do analysis of fault in early by using on line real time analysis & diagnostic software, which will tell specific cause and location of problem in machine. If we select right Vibration Monitoring system and software for Power plant rotary machines, over all down time will be reduce with proper planning in advance.

Today's scenario with global competition & pressure, every plant want to have 95% up time, hence maintenance planners are moving from Reactive Maintenance to Proactive maintenance.

Keywords: Turbine Vibration Monitoring, Remote Vibration Monitoring, API670 Winding Vibration Monitoring, Vibration Analysis & Diagnosis Software.

S3-P1

Designing Fault Tolerant Real Time Computer Systems with Diversified Bus Architecture for Nuclear Power Plants

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Fault Tolerant Real Time Computer (FT-RTC) systems are widely used to perform safe operation of Nuclear Power Plants (NPP) and safe shutdown in the event of any untoward situation. Design requirements for such systems need high reliability, availability, safety integrity, computational ability for measurement via sensors, control action via actuators, data communication and human interface via keyboard or display. Hardware fault tolerance can be achieved by implementing identical or diverse redundancy at the system level to perform the same task. In diverse redundancy, systems are built using different components, algorithms and design methodology that reduces common mode and systematic failures due to design flaws. One of the mechanisms to increase safety integrity of programmable electronic systems is to use diversified bus architecture for building FT-RTC systems. This paper presents a new design approach using RTC systems with diversified bus architecture and Switch Over Logic System (SOLS) for building fault tolerant real time computer systems for NPPs.

Keywords – Common Cause Failure, Fault Tolerant Real Time Computer, Switch Over Logic System

S3-P2

Automation in Control & Instrumentation systems of Kaiga Generating Station – Operational experiences.

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Safety is given topmost priority in all aspects of Nuclear power plants design, construction, and operation & maintenance activities. With the advent of automation in Control systems over the years many of the Control & instrumentation systems are fully automated with the deployment of computer based systems. The design, development, testing, installation, operation and maintenance of these systems are carried out based on the guidelines of AERB (Atomic energy regulatory board).

Kaiga Generating Station Unit-1&2 are twin units of 220MW PHWR(Pressurised Heavy water reactor) type Nuclear Power Plant located at Kaiga in Uttarakannada district of Karnataka . These twin units are in operation since 1999-2000 and have the credit of more than 500 days continuous opearation

Many computerised control systems like PLC (Programmable Logic Controllers) , DPHS-PCS (Dual processor Hot standby –Process control system) , DPHS-RRS(Dual processor Hot standby –Reactor Regulating system) and Operator information systems like COIS (Computerised Operator Information System) have been introduced for the first time in NPCIL at Kaiga Generating Station Unit-1&2 .

This paper gives details of general principles of I&C systems of NPP, brief description of Computer based systems, major problems encountered & resolved, improvements & modifications carried out to enhance the performance of the systems and the opportunities & challenges ahead .

S3-P3

Automation in Electrical systems of Kaiga Generating Station – Operational experiences.

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In a Nuclear power plant electrical power is generated utilizing the heat generated by nuclear fission reaction in the reactor. The secondary cycle consisting of Steam generator, Turbine Generator is more or less similar to the conventional thermal power station.

Plant Electrical systems of a Nuclear Power Plant are designed for very high reliability and availability.

Nuclear power plants are built up by several layers of redundancy in Electrical power supply systems such as Power supply from grid(class-IV), Emergency diesel generators(class-III), Inverters(class-II) and battery buffers(class-I). If necessary, the emergency power supplies (class-III, II and I) allows the safe shut down of the nuclear reactor. Less important auxiliary systems are not being supplied by these backups. The majority of the required power is used to supply the feed pumps in order to cool the reactor and remove the decay heat after shut down.

This paper gives brief description, purpose and design approach of various Automatic Computer based systems used for providing reliable Power supplies during Normal and Emergency conditions at Nuclear Power Plant**.**

S1A-P1

Closed Loop Feedback System for Demand Response in Smart Grid

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In this paper, we model the smart grid as a closed loop feedback system and analysis of its dynamics from stability, efficiency and user comfort viewpoints. Appliances are modeled at detailed level including complex inter dependent appliance constraints. A Mixed Integer Linear Program (MILP) yields the efficiency-comfort tradeoff, is convexified and solved using CPLEX solver. A practical implementation is carried out by connecting the legacy appliance infrastructure with controllable plug load sensors to participate in smart grid activities. The analysis of results indicates that our model is mutually beneficial to the consumers and utility companies by flattening the demand curve over a day and automating the energy management and demand response.

Keywords—smart grid, demand response, smart plugs, plug load management, sustainability

S1A-P2

Smart Grid Technology to save the Grid from Future Blackout

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Our Electrical Grid has been defined by three components: generation, transmission and distribution. The Electrical Grid has not undergone any major changes in past years to overcome the challenges of Demand side management , minimizing transmission losses, Consumer Load forecasting, Power quality monitoring , Energy conservation and Distributed generation . The Nation's outdated infrastructure resulted in twin grid disasters of July 30 -31 2012, impacting 21 states and an estimated 600 million people and marking the lowest point in the history of the power sector. The Grid needs urgent attention. The Indian government has formed smart grid task force to study the impact of smart grid technologies and set up a smart grid vision for India. The key functionalities of the grid should be to shift the peak load through a combination of direct control and differential pricing mechanism, and robust system with self healing abilities through improved monitoring. But to achieve this goal, the Information technology (IT) infrastructure should be improved to enable two way real time communications between the producer and consumer. This will help to optimize power generation, CO2 emissions and consumption of power. The enablers are real time consumption monitoring, power quality monitoring, demand response, wide area measurement system, and micro gird. This White paper will discuss the key reasons for power grid failure and how Smart grid technology can help to modernize the Grid and save the Nation from another massive blackout.

S1A-P3

Power System Disturbances: Synchro-phasor Technology to improve power system reliability and visibility

Power system disturbances can be the result of various system events, transmission congestions, and fluctuations in renewable energy sources. In order to make the Grid smarter, a better understanding of these disturbances is needed and this will enable us to detect the system events before they result in failures. Synchro-phasor systems are used for this purpose.

A Synchrophasor system is a wide deployment of Phasor Measurement Units (PMU) and dedicated high-speed communication to collect and deliver synchronized high-speed grid condition data along with analytics and other advanced on-line dynamic security assessment and control applications. This will improve real-time situational awareness and decision support tools to enhance system reliability. Synchrophasor measurements can also be used to improve component and system models for both on-line and off-line network analysis to assess system security and adequacy to withstand expected contingencies. But to realize this great potential, each interconnection must deploy a highly reliable, secure and robust synchrophasor data measurement and collection system and develop a suite of validated, highly available, robust and trustworthy analytical applications.

This article discusses the technologies that are involved in making the Phasor Measurement unit, which is meant to build a robust data measurement and collection system. It also highlights some of the initial deployments in India and around the world that are seen to be the next generation of the Smart Grids.

S2A-P1

Interoperability and Standards - From the Perspective of Smart Grid

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The electricity business across the world is seeing a phenomenal change since the deregulation. Various legislations and acts relating to Electricity in different countries forcing utilities to make use of latest technologies to meet demand and quality power supply to its customers. To reduce CO2 emissions and meet demands, renewable energy with grid connectivity and Micro grids are evolving. The transmission utilities is also looking for betterment in visualization of network and to enhance transmission capacity by adopting WAMS using PMUs and FACTS apart from conventional SCADA systems. The distribution utilities which interact directly with consumers, the last mile in the chain of utilization of electrical energy is entrusted with more responsibilities. The distribution system has gearing up to meet the regulatory requirements and consumer stratification by adopting latest automation, information and communication technologies. For economical and successful deployments of new technologies, standard based solution is always recommended. However, lag time in development of standards is inevitable. But due to need, it may not be feasible to wait for adopting latest developments in automation since there are always many legacy systems that need to coexist. Hence there is need for interoperability standards and minimizing the delay in new standards development. This paper discusses about the interoperability and standards for Smart Grid.

S2A-P2

Restricted Free Governing Mode of Operation (RFGMO) Feature in Electro Hydraulic Governor Controller (EHGC) for Hydro Power Plants.

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Electro Hydraulic Governor Controllers (EHGC) to Hydro plants perform speed control, load control and free governing mode operation with a droop of 4% (de-loads/load the m/c automatically with the change in grid frequency) These operational features are implemented in the application software as part of the microprocessor based EHGC's.

As per CENTRAL ELECTRICITY REGULATORY AUTHORITY (CERC) regulations Restricted Free Governing Mode Operation (RFGMO) feature is mandatory for reservoir based Hydro plants of more than 10 MW capacity. For this CERC has issued guidelines for the performance of the electro hydraulic governor controllers (EHGC).

To meet with the CERC regulations, additional application software is to be included in the EHGC as per guidelines & implemented.

S2A-P3

Operational excellence through Centralized Operation of T&D Assets

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Agile communication network with decentralised substation automation and centralised control centre architecture is what ensures TATA Power to keep up its commitment of reliable and stable power to the consumers. The technology's infusion with a philosophy of unified operations has reshaped the automation schema and brought excellence outnumbering the earlier performance of our Transmission & Distribution wires.

TATA Power formulated vital inclusions in automating its substation with centralised control centre. This information intelligence blended power system operations paved way for new inception of technologies to meet the growing consumers, regulatory needs and grid disciplines.

S2A-P4

Implementation of Unified SCADA concept in Tata Power

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Present electricity scenario calls for faster root cause analysis & restoration during electrical disturbances. SCADA (Supervisory Control and Data Acquisition) with remote control of Substations from a central control centre is the upcoming solution for the same. Unified SCADA concept has brought the Substations closer to each other thereby increasing effectiveness of control. With so much of imbalance in Demand & Supply of Electricity in India, maintaining a stable continuous supply is a challenge, which Tata Power Company has achieved successfully. Automation has played a key role in achieving this thereby achieving higher availability. This paper presents the Unified SCADA system concept adopted by Tata Power- which includes the present architecture and evolution of Unified SCADA, the implementation of centralised control & the benefits of Unified SCADA. Standardization aspects of software configuration and redundant communication schemes have been maintained.

All field devices communicate to both nodal and central servers. In case of failure of central server, the monitoring and control is transferred to nodal station which can control the satellite stations under each nodal station. The Unified SCADA system has its own OTS (Operational Training Simulator) where the operation engineers are trained on different scenarios & power system conditions to handle dynamic behaviour of power grid. ICCP for data exchange with other utilities, safety tagging, network colouring and many other beneficial features are brought out explicitly. Integration of Unified SCADA with third party software's & hardware's thereby sharing data across systems and using it for Network Planning & analysis is also discussed.

Finally the paper presents the challenges faced & solutions implemented to overcome them, learning's from these implementations and improvements with way ahead.

S2A-P5

The Research about the Application of Data Mining in Integrated Supervision and Control System of Smart Substation

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Abstract: Recently, the method of data processing on the basis of data mining has been successfully applied in the dispatch of power grid, but not yet in substation. In this paper, the method of data acquisition of an event on the basis of data mining is proposed. It can be used to solve a verity of problems which are mainly reflected as heterogeneous data, difficulties in data classification and the ununiformed data standards caused by the merging with SCADA, condition monitoring and auxiliary application in the integrated supervision and control system of smart substation. Firstly, according to the characteristics of smart substation data, this paper would be focusing on the data mining models by means of analysis attribute relationship of the database data .Secondly, the generalization and classification of data in the database according to above models would be set forth herein. Finally, an algorithm of dynamic growing data mining which is suitable for smart substation would be proposed hereafter. With this algorithm, the monitoring system shall be able to obtain the inherent laws of various data of substation, and to collect data of different devices or subsystems which caused by the same event. It will be useful to realize the functions based on panoramic data of information comprehensive analysis and intelligent alarm.

Keywords: smart substation, data mining, Integrated Supervision and Control System, growing mining

S3A-P1

TEST AND MONITORING SYSTEMS IN THE NEW GENERATION 700 Mwe INDIAN PRESSURISED HEAVY WATER REACTOR

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Indian Pressurized Heavy Water Reactor (PHWR) employs two independent and diverse fast acting shutdown systems for terminating any postulated reactivity transients in the reactor core, which are beyond the capability of regulating system, and bring it to sub critical state with adequate margin. These systems are called to act in order to protect vital reactor equipment during undesirable plant conditions and in case of a design basis event or on demand from operator. For the rest of the time they however are required to be available and fit to act on demand. Continuous monitoring/periodic surveillance of their health is essential to ensure their fitness for purpose. Test and Monitoring Systems were introduced in 540 MWe PHWR design to meet these objectives in a well controlled interactive fashion. In 700MWe design, the scope of Test and Monitoring Systems has extended to include the monitoring of containment isolation logic. The paper describes the design considerations, testing methodology employed and salient features of Test and monitoring systems.

Keywords: Test and Monitoring System

S3A-P2

ONLINE DISSOLVED GAS ANALYSIS FOR TRANSFORMERS- A TOOL FOR TRANSFORMER RELIABILITY

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Power transformers are designed to transmit and distribute electrical power. Depending on the rating or size of a transformer, replacement costs varies. Performing offline and invasive tests also add to the replacement cost. Hence, there is an increasing need to move from traditional preventive maintenance programs to condition-based maintenance. A large number of techniques are available for transformer health monitoring. However, a focused approach is required for diagnostics. Considering the long service life of a power transformer and prevalent use of human judgment (expert), there is a need to monitor the health of power transformer.

This paper presents the use of online dissolved gas analysis for monitoring of the transformer and the future enhancements in the system that can be applied for automating the process.

Performance Optimization in Power Plants

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Energy is a vital input for production and rapid growth of GDP will need to be supported by an increase in energy consumption. This is especially so in India, where large sections of the population are still without adequate access to energy. According to a survey conducted by KPMG, consumption of electricity in India, which is currently around 600 Terawatt hours per annum, is all set to double by 2020.

With the ambitious 88,425 MW capacity addition target for 12th Plan stakes are high for energy generation. The target for optimal performance on both existing and green field projects includes maximum thermal efficiency, lowest possible emissions, lowest possible cost, and readily marketable by-products. At the same time, the demand of maximum system availability for power generation and implementation of post-combustion environmental controls, such as selective catalytic reduction and scrubber systems, add parasitic loads, which reduces the plant efficiency from the original design are causing detrimental effects on the plant efficiencies . Hence with such high emphasis on energy efficiency maintaining quality of plant generation is of at most importance. The cost of generation can be reduced by optimizing the operation of the generation equipment parameters. This is achieved taking into consideration the equipment constraints and various boundaries of operations resulting in a balance between equipment health and mode of operation

Power plant optimization can be carried out by using the online optimization systems which provide the real time analysis of the various parameters and their deviation from the design thereby providing precise inputs for improvement in heat rate and material cost reduction. Broadly Optimization techniques are applied in the following areas like Combustion, Soot blowing, Steam temperature control, Steam turbine maintenance and condenser backpressure

Fossil-fired Power plants have long sought to improve heat rate as a means of improving plant efficiency and lowering operating costs. In most utility fleets today, initial improvement in heat rates can be achieved not with deployment of new technology, but with a re-commitment to best operating practices. This minimum heat rate reduction can translate into significant lowering of fuel consumption and costs. Heat rate improvement opportunities for existing units include reductions in heat rate due to process optimization, more aggressive maintenance practice and equipment design modifications. The paper captures main features of optimization based on the rich experience of BHEL in implementing and operating power plant with varying fuel and ratings.

Advanced Tool for Energy Fingerprint for Power Plants

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Automation has a crucial role to play in improving the power plants productivity, energy efficiency and safety. A variety of advanced solutions/products are available in market to improve the base level performance of power plants. The level of automation can be different from plant to plant. Therefore, to estabilish the need for automation and application of advanced solutions, it is best to first establish the base level performance of plant and subsequently estimate benefit potential from such applications. In this work, an advanced tool for energy assessment, benchmarking, opportunity identification and optimization in utility and captive power plants is developed. The tool facilitates systematic and quick opportunity identification for energy efficiency/productivity improvements along with cost-benefit estimates in a typical power plant. The tool (i) calculates various key performance indices (ii) recommends measures/proposals to improve efficiency and (iii) performs cost-benefit analysis to prioritize the proposals. The scope of this tool is not limitied to performance assessment but also mapping the identified opportunities with advanced tools/solutions/products for improved operation, automation and control.

S1B-P1

Thermal Power Plant Data Validation and Reconciliation using Auto-Associative Neural Network

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Performance analysis and optimization of thermal power plant is highly dependent on the accuracy and quality of the measurement data. Inaccurate measurement or faulty sensor affects the performance analysis calculations and optimization models drastically. Hence, data validation and reconciliation is a critical part of any performance calculation or optimization. The major objectives of a data validation and reconciliation are to filter out bad data and suggest plausible replacements for the same. Most of the literature on this problem is based on statistics and heat and mass balance and least square error minimization. In this paper, an artificial neural network based technique known as Auto-Associative Neural Network (AANN) is used to provide a solution to this problem. The method can eliminate use of complex modelling of the process plant and provide fast and reliable replacement for faulty measurement by use of proper training data.

Keywords: Data Validation, Data Reconciliation, Auto-Associative Neural Network (AANN), Artificial Neural Network (ANN), training algorithm, training data, instrument fault, faulty sensor, sensor data correction, Curvilinear Component Analysis (CCA), Principal Component Analysis (PSA)

S1B-P2

OT-IT Integration for Enhancing Operational Intelligence

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Pace of change in modern business is sky rocketing and that the complexity of operations is increasing just as quickly. Operational intelligence refers to methods and technology for getting an insight into the business and discovering insights for IT as well as for the entire enterprise. Operational intelligence enables
organizations to:

- Gain a deeper understanding using all relevant information, especially from machine data.
- Provides facility to develop business solutions on the available data.
- Improve overall performance & efficiency.
- Reveal important patterns and analytics derived from correlating events from many sources.
- Leverage live feeds and historical data to make sense of what is happening now, to find trends and anomalies, and to make more effective decisions based on that information.
- In today's era a large industry requires insight into the past to make informed decisions today that influence tomorrow.
- PI system's real-time data and event infrastructure connects the right people with the right information at the right time, so they can analyze, collaborate and act.
- The benefits of PI system help in achieving excellence in the following areas:
- Business and process analytics and dashboards presenting Key Performance Metrics for operational decision support.
- Real time information to efficiently cater to load variations.
- Condition-based maintenance to monitor critical components of equipment, control costs, and avoid reliability issues. Simple modeling, monitoring of material and energy, balances to identify areas for increased efficiency.

S1B-P3

SECURING THE INDUSTRIAL CONTROL SYSTEM NETWORK

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In this paper we discuss in brief how Industrial Automation and Control Systems (IACS) have become increasingly prone to deliberate or accidental attacks. The attacks in the recent past have highlighted the criticality and the continuous need of protecting the operational integrity and availability of control networks to ensure environment safety, personnel safety and safe functioning of the manufacturing process.

Various standards have been drafted or issued to highlight IACS security measures when connected to external networks especially in an integrated collaborative manufacturing environment. The security measures include behavioral training and security awareness along with the minimum security features, viz Access Control, Auditing, Account Management, Security architecture, Antivirus, Patch management, Disaster Recovery methods, Hardening, etc that are provided to protect the control system assets and networks.

Keywords: Cybersecurity, Industrial Automation, Control Systems, Access Control, Security Architecture, Disaster recovery

S1B-P4

Software Quality Assurance for Computer Based I&C Systems

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Technological advances have led to smaller, lighter, and more reliable Computer based Systems (CBS) that are used increasingly in Nuclear Power Plants (NPP) applications. When CBS is to be used to perform some function in NPP, it needs to be reviewed to assess the quality of CBS so as to ensure the correctness of implementation and safety of operation. The process of review is determined by the development life cycle of the CBS. The review is carried out by Independent Verification and Validation (IV&V) team. The IV&V activities are performed in accordance to the IV&V procedure which also fulfills the regulatory requirements of Atomic Energy Regulatory Board (AERB) for CBS. To support the assessment of Quality of CBS, a software system is developed to capture the measurements and present results so as to facilitate the assessment of Quality of CBS. This will enable the assessment of variety of application by various engineers and will give confidence for completeness of assessment process.

The work involved-

1. Identification of quality factors important to the CBS.
2. The development of checklists with respect to each phase and the assignment of quality factors to each of the questions in checklist. (This involved the development of question bank with respect to the quality attributes to be measured for every work product)
3. Development of software package for capturing data for the database and computing CBS metrics from the database so as to enable correlating of metrics to quality factors to determine the extent these factors have been reached.

S3B-P1

Hybrid renewable power systems – prospects, challenges and projects

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Local or regional electricity supply systems which incorporate different, independent generation technologies (hybrid systems) find a wide range of applications globally on geographical islands as well as for remote/off-grid sites and residential districts. Hybrid systems can also support decentralized generation in a well-developed infrastructure. The main focus for Hybrid systems utilising Renewable Energy Sources (RES) is on combinations of wind, hydro power or photovoltaics (PV) with diesel generators as backup. Biomass/biogas and combined heat power (CHP) systems are currently niche applications. Hybrid systems range from small integrated systems with a capacity of few kilowatts (kW) up to large systems providing power of several megawatts (MW). Small scale hybrids consisting of wind, PV, batteries and small diesel gensets are gaining visibility on the market. They can be easily integrated into remote buildings or facilities or be designed as container solutions without the requirement for additional on-site works. Such systems are mainly applied by customers operating non-critical applications like irrigation systems, advertising spaces, street lighting or supply of small, single buildings.

Medium scale hybrid systems in the range of 100 kW to 50 MW are usually found on islands to supply villages, small commerce and industry districts or as grid-connected decentralized power supply systems. Existing installations integrate wind, PV, hydro power and diesel fuelled generators. They may also be grid connected with limited capacity instead of relying conventional backup power. Large scale hybrids of more than 100 MW are scarcely developed and would be suitable for integrated grid-connected central generation for larger islands or for large scale remote industry facilities. Various drivers push the development of hybrid systems in parallel. The main drivers for all fields of applications are the increasingly attractive economics, availability of renewable energy sources and the need for appropriate power quality.

The future market potential and the rising fossil fuel prices compared to decreasing costs of power from Renewable Energies are the main economic drivers. More than 1.2 bn. people still have no access to electricity with a share of about 50 % living in Sub-Saharan Africa. Also in Asia several hundred million people are still lacking a reliable electricity supply. Hybrid systems are well suited to establish the needed local power systems fast and efficiently because of their scalability

PV system costs have experienced an unprecedented slump during the last decade and with 45 €ct/kWh (1800 full load hours by 2050) it is expected to reach similar cost levels as wind power. In contrast the oil and gas prices are expected to increase for the next decades with an annual growths rate of 2-3 %. It can also been shown, that in many regions with low grid availability considerable RES potential is suitable for electricity generation. But remote areas and rough environmental conditions challenge not only the technical design concepts but also the economics of the hybrid system operation. The installed capacities are usually small compared to utility scale power plants but service and maintenance are equally needed. In many cases a lack of skilled local service providers additionally challenges the reliability and the operating cost of hybrid components.

S3B-P2

AUTOMATION OF SMALL HYDRO POWER PLANT

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The potential source of small hydro power are at the base of existing Irrigation dams, anicuts, Canal drops and Hill streams which can be developed to meet the increasing energy demand.

Operation of Hydro power plant involves understanding the operation of hydraulic Turbine, Generator and their related equipments. All features may not be included in every plant and will depend on type of plant, water source, Turbine and Generating unit installed and power evacuation arrangement. All most all the Hydro power plants are remotely located and accessibility and communication facility are extremely difficult.

Over the years considerable development in the automation system for small hydro has emerged and there is a need to provide State of the art Automation System for control and monitoring of the plant so as to render the hydro power plant to be operated as an unmanned station or atleast to reduce the Man/MW ratio considerably.

Darrieus based Vertical Axis Wind Turbines for Residential Areas

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In this paper, a study relating to explore efficiency of installing a vertical axis wind turbine (VAWT) in residential areas is presented. VAWT's are designed to adapt to the varying and low wind speed. Further they are monitored from any calamity by continuous monitoring through use of sensor (anemometer) and microcontroller. The installation of VAWT's on roof tops could considerably cut down the electricity bills.

Keywords – vertical axis wind turbines (VAWT), horizontal axis wind turbines (HAWT),microcontroller, anemometer, and alternator.

POWER MANAGEMENT SOFTWARE FOR HYDRO POWER PLANT

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The present paper covers the Power Management Software which has been designed to suggest to the operator the applicable power generation schedule that maximizes the weighted plant efficiency. The indigenous software comprises two parts viz. offline declaration of the next day's capacity to address the maximum possible plant load schedule for each 15 minutes block of next 24 hours duration & online scheduling of the present day scheduled generation to suggest operator a set point for all the available units such that the plant efficiency for the current block of 15 minutes.

The various inputs considered in the module includes Current head and tail race Level , binary status for next day's availability of units, Upper generation limits, Discharge rates of each unit, elevation Vs capacity table , Past year water inflow data to start with, which is later self-regenerated and discharge Vs Power, Efficiency Vs Power curves.

S4-P2

High-Precision Sensors and Automated Process Units For Power Plants

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With the increasing complexity and integration in power generation, automation in measurement and control by use of sensors and manufacturing of process water by using automated plants with measurement control has gained tremendous importance. In this paper, the principles and practice of measurement of dissolved oxygen and density/concentration are described with examples from the power sector. Besides, two examples of automated process units of relevance to the power industry are described.

S4-P3

Electricity in India - Fulfilling Demand through Positive Measures

Dravida Seetharam

Grid 20/20

India is revered as one of the wealthiest countries in the world. It is blessed with terrifically industrious people, a resource-richness, and a will to succeed.

Yet, without a stable supply of electricity, made economically available to all of India's inhabitants, this amazing country will remain hamstrung with respect to achieving its maximum potential. In contrast, most leading nations of the world that possess electricity service stability have and will continue their advancements, thus competitively distancing from India in some respective fashion.

Electricity is a fundamental resource that must be presented to any population desiring to succeed in a world driven by technology. However, India has been plagued by localized blackouts, an inadequate power infrastructure, crippling power shortages, limiting power quotas, and an apparent policy paralysis that has stymied solutions in the past. Thankfully, the winds of change are beginning to blow in favor of the desperate upgrades needed within India. The generation, transmission and distribution sectors are all receiving increased attention from India's electricity leadership.

Privatization of electricity distribution is seemingly underway in India (Khurana, 2013). And, in part due to the largest blackout in world history (i.e., July 2012), India is now welcoming various solution providers from within its borders, and from the international community. The time is now for the establishment of smart grid solutions that will lift India's electricity service shortfalls to acceptable delivery levels. Now is also the time to prepare this great country for a future that will enjoy growth at all levels once the staple service of electricity is sufficiently and consistently provided.

S4-P4

Importance of on-line coal flow monitoring and its impact on coal combustion

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India has seen tremendous growth in the generation industry for the last two decades and it is projected that an additional of nearly 45% of the existing capacity has been proposed to be added in the current five year plan. Indian power plants are posed with challenges of handling high ash coals (~45%) and the fluctuation in both heating value of the coal used as well as the ash content from time to time depending on the type of coal being used causes frequent problem of lower combustion efficiency, increased slagging and fouling as well as failure of boiler tubes. The highly abrasive nature of coal and the varied coal quality results in varied degree of material damages in pulverizer roll components which in turn affects the coal particle size fed into the boiler. These conditions necessitate the requirement of automated coal balancing system for the real time monitoring and controlling of coal flow through individual burners.

While the advanced laser and microwave based sensors have been proven for their application in precise coal particle flow measurements in western countries, the same need to be adopted in Indian plants. The automated flow control system comprising adjustable type orifice plates located at the individual mill outlet pipes controlled by an integrated logic control unit system enables real time control of coal flow supplied to various burners. The advantages of on-line coal flow monitoring through such systems includes uniform heat flux in at different elevations of the boiler, improved flame stability, reduced unburnt carbon in ash and improved efficiency of the boiler.