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Realization of Energy Management System, Impediments on It's Path in India

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ABSTRACT: In the present era Energy Management Systems (EMS) is one of the evolving technologies in the energy sector. It gathers real time data on energy utilization. This is carried out during monitoring, assessing and visualizing energy consumption. This improves project level accomplishments and economic assessment. The major approach is to minimize the power consumption of existing systems and equipments by centralized monitoring and control of energy utilization. This paper presents principally, the state of affairs of the Energy Management Systems in India and the difficulties arising in the implementation of such approaches in India.

KEYWORDS: Power Systems, Energy Management Systems (EMS), Smart Energy management Systems (SMES), Open Access Transmission,

I. INTRODUCTION

At present entire humanity has completely turned in to energy dependent world where electricity has prime significance. Electricity has made lifestyle of human beings extremely simple and hence its consumption is rising gradually. So as to generate this electrical energy in its original form, abundant natural resources are being used. Conventionally electricity was generated only from non-renewable energy resources. However, currently renewable energy sources have come into picture. Even though renewable energy sources are utilized for generation of electricity, the arrangement and equipment required to generate electricity from them are expensive and so cannot be afforded by common man. Consequently this has led to the exhaustion of the natural resources. Hence it is indispensable to switch to innovative and better alternatives such as smart grid, smart metering, and zero energy buildings that will assist to minimize reliance on these assets by minimizing energy consumption and improving exploit of renewable energies. Also, in order to increase the efficiency of our power system Energy Management Systems (EMS) is necessary. EMS is a comprehensive contribution that combines energy, process optimization and, incorporates appropriate solution into online advanced control and optimization strategies. This paper focuses majorly on the present state of affairs of electrical energy utilization systems in India and proposes some techniques accepted, that will lead to the improvement of energy utilization and efficiency. An Energy Management System is a sequence of policies, processes and procedures to manage operational energy utilization. Energy, in the context of organizational utilization, can be defined as the direct consumption of fuel (Gas, Oil, etc.) and indirect consumption of fuel (Electricity) essential to execute the organizational tasks. It is a policy of adjusting and optimizing energy, utilizing systems and procedures so as to minimize energy obligations per unit of output while holding constant or reducing the total expenditures of producing the output from these systems. Hence, EMS leads to the judicious and efficient utilization of energy in order to maximize the profits by minimizing the operational expenditures and consequently improve the competitive positions. Energy management systems are employed by power system operators to monitor power grid operating situations and control grids in a consistent, safe, and inexpensive manner. An energy management system interfaces with the grid through a supervisory control and data acquisition (SCADA) system. The SCADA system transmits thousands of measurements at critical points of a power system in real time to the energy management system and command signals from the energy management system to field devices to take control actions. An energy management system incorporates application software such as state estimation, eventuality analysis, automatic generation control, and economic dispatch. These applications normally operate the grid in a reactive (e.g., load following) or preventive (e.g., security constrained dispatch) manner. The increased incursion of renewable energy generation on the power grid inflicts big challenges to the current energy management system proposal as renewable resources principally differ from conventional generation as their ambiguity and unpredictability. To succeed in these circumstances, energy management system technologies require evolving into a practical, look-ahead model. Advanced energy management system technology is also greatly desired at the distribution system level. The conventional distribution energy management system is much less integrated than the transmission energy management system. Operational challenges occur from the considerably increased complexity of modern distribution systems, particularly from distributed renewable resources, electric vehicles, and demand-side management. A totally integrated and intelligent distributed energy management system is a solution to meet these challenges.

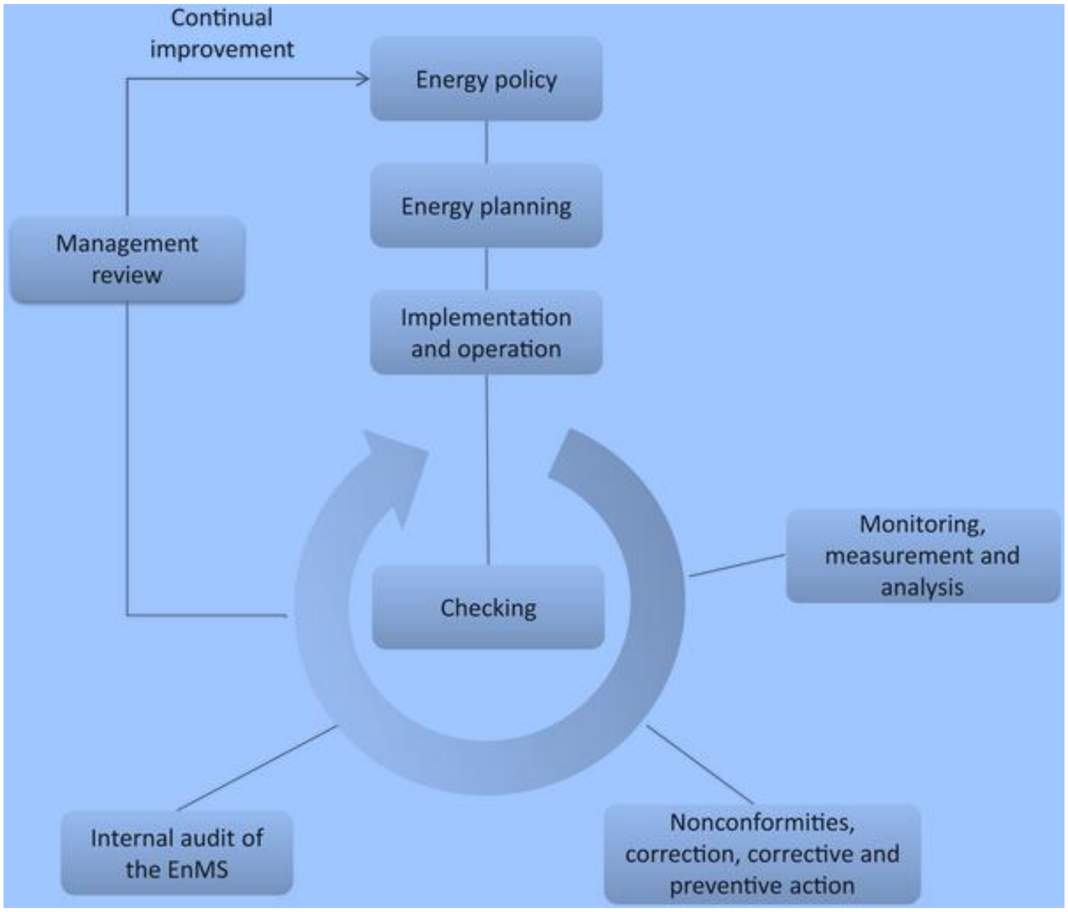

Fig 1: Basic Block Diagram of an Energy Management System

Figure1 shows the block diagram of an energy management system. This is based on an international standard the ISO 5001 for Energy Management. This International Standard determines a structure for industrial plants; commercial; institutional and government amenities and whole institutes to control their energy. The Standard is based on the standard business planning cycle "Plan-Do-Check- Act" and offers direction for institutes in formulating energy policies, programs and action plans to develop their energy utilization.

1.1 Benefits of EMS: - EMS can be used for economic dispatch of power. Power generation can be scheduled when operating costs are low so that power is delivered at minimum cost. Also scheduling generation with limited energy is too possible with the aid of EMS. EMS can play a significant role in power system security. Intelligent alarm processing and state estimation can also be utilized to identify contingency. Dynamic security evaluation can also be made with the assistance of EMS. Neural networks applications form an imperative part of forecasting and averting contingencies. EMS can assist in making and avoiding such contingencies. Chronological information can also be collected and stored which can then be processed analytically to forecast future power flow outlines. Operator Training Simulator (OTS) is a vital feature of EMS where inexperienced engineers can practice and implement numerous scenarios on a stress free atmosphere without really practicing on the grid. EMS also powers the competitiveness of the institution and also reduces the susceptibility of the institutes against energy price instabilities and accessibility of energy accordingly establishing a benchmarking procedure. EMS also permits organizations to gain convincing external visibility of energy saving actions and also presents a better understanding amid predictable energy demand and supply.

1.2 Limitations of EMS: - The present state of affairs of EMS has low consistency and belief on the data gathered. Also there is lack of technical support and guidance on the execution and maintenance side. For successful execution and accreditation, a proper certification of the measures implemented has to be executed. The legalities and practices related with these measures are extensive and consume a lot of time. Huge amount of documentation is needed for the correct implementation of EMS. This paper is presented in five sections including the introduction. Section II presents the implementation of EMS in India. Section III presents the Smart Energy Management Systems (SMES). Section IV describes the obstacles for implementation of SMES in India and finally conclusion is given in section VI.

II. IMPLEMENTATION OF AN ENERGY MANAGEMENT SYSTEM (EMS) IN EXISTING POWER SYSTEMS

Energy management system plays a crucial part in control centers of electric power systems. All the real time features of the power system and eventuality can be observed on a real time basis with the aid of an EMS. This section mainly describes how the incorporation of EMS in existing power systems has enhanced the economy, security and consumer interface features of the existing power system.

2.1 Economic Aspect

2.1.1 Economic Dispatch: - The process of scheduling generation to minimize operating cost has traditionally been called as the Economic Dispatch. In this computation, the generation costs are represented in the computer system as graphs, generally piecewise linear, and the overall computation reduces the operating cost by locating a point where the total output of the generators equals the total power that must be supplied and where the incremental cost of power generation is equal for all generators. Conventional economic dispatch computations take account of the network losses with the exploit of incremental loss factors. The modern method of achieving this is to run what is called an Optimal Power Flow (OPF) which minimizes the generation cost while taking consideration of the complete transmission system and all its restrictions.

2.1.2 Automatic Generation Control (AGC): - The essential control of generation on a power system is accomplished through the control of the electrical frequency measured at one of the high voltage buses in the system. If the frequency falls below normal there is a requirement for raise in generation and if the frequency rises above normal there is a need for less generation. The control of generation is achieved as an auxiliary control to the essential governor controls on the generators themselves that functions to preserve system frequency by raising or lowering the energy into the prime mover of the generator. This auxiliary control is known as the automatic generation control or AGC.

2.1.3 Open Access Transmission: - Open transmission system works on the design that all of the power plants should be controlled individually, and in fact they may be possessed by organizations. But, many companies do not possess any transmission or distribution equipments. The thought is to have a transmission system that gives transmission services to the energy generators which in turn directly sell their power to distribution organizations or huge loads. In such a system, the EMS does not have to have the cost data normally associated with economic dispatch. Rather, it gets bids from the energy generators to supply power to the loads and it picks the lowest bidders as suppliers of energy.

2.2 Power System Security

2.2.1 Increased Security: - The modern EMS combines Supervisory Control and Data Acquisition (SCADA) facility together with generation dispatch, scheduling and control capability. Advanced EMS's now have the elements essential to offer operators with better security analysis competence. This feature is regarded as extremely essential in operating a power system as it permits operations personnel to formulate the most competent utilization of the transmission system by loading it equal to its limit without keeping it in an insecure state.

2.2.2 Monitoring: - Alarm Processing and State Estimation monitoring the power system takes place in two means. The fundamental process of taking measurements in the substations, transmitting the data to the central computer and evaluating those values to stored limits is known as alarm processing. EMS also monitors the status of various binary devices and together these indicators make up tens of thousands of “points” that must be monitored and displayed to the operators. The foremost purpose of these knowledge based alarms is that they can filter out all but the most important alarms and then present summary alarms so the operator can presume the circumstances swiftly. In case of transmission systems, a real time mathematical model of the power system can be built employing a power flow model and a state estimation algorithm which can read various redundant measurements and compute the statistically most feasible set of status (voltage phase angles and magnitudes) present on the network. This is known as state estimation. The state estimator has the capability, given the correct set of measurements, to detect and discover measurements that are bad. The bad measurements are eliminated and reported to the operators so that they can be recalibrated.

2.2.3 Static Security Assessment: - Once a state estimate is completed the operators have a model of the power system as it currently exists. The subsequent endeavor is to analyze that model for a huge number of outages in order to decide if the system can recuperate from the outage without problems. The outage incidents or contingencies can be modeled with a power flow program by running the contingencies separately.

2.2.4 Security Constrained Optimal Power Flow: - An OPF can house a restriction that will promise that a eventuality overload is reduced. Hence this has led to a detailed program that comprises the eventuality analysis and an OPF in which all eventualities are analyzed, and all overloads are converted to restrictions and are located into the OPF. After solution it must be iterated through the eventuality analysis again to guarantee that it has identified all bad cases. The final outcome is a dispatch which assures that all contingencies analyzed are not going to result in problem.

2.2.5 Security Analysis and Open Transmission Access: - When the transmission system is to be operated as an open system there is a diverse difficulty in maintaining system security. Initially, there is the need to permit sovereign generating facilities to get access to the transmission system in a safe manner. That is, they must contact the transmission system operator and “reserve” transmission capacity for their transaction. The reservation process will require the investigation of the system for system security while modeling the proposed transaction.

2.3 The Operator Interface and Intelligent Applications

2.3.1 Knowledge Based Expert Systems: - Knowledge based systems involve the utilization of expert system software which permits the encoding of knowledge about a power system into the computer and its management for solving individual problems. The knowledge is encoded in the form of production regulations which permit the expert system inference engine to “reason”. As such, an expert system allows one to set up the solution of a problem that otherwise would be impossible to devise as a mathematical algorithm. Expert systems are also very influential at solving diagnostic reasoning problems. Hence many EMS systems include expert systems to diagnose faults on the power system with breaker status, switch status, and relay target information. This process is made especially dominant when a model of the power system is built from the SCADA system data base.

2.3.2 Neural Network Applications: - Neural networks are an artificial intelligence means that attempts to program a computer to perform as it contained neurons alike to those observed in the human nervous system. In an artificial neural network application, the neurons are simulated by software collectively with a means of presenting the network with patterns to be learned and a means of training the network as to the denotation of the pattern. The neural network can theoretically be taught anything, however, computers cannot store and process nearly as many neural network nodes as the human nervous system and brain, and hence they are far less intelligent. The neural network research has begun to prove huge promises in those aspects of power system operations where patterns must be recognized.

III. SMART ENERGY MANAGEMENT SYSTEMS (SEMS)

Smart grid is a system to add monitoring, management, control and communication capabilities to the national electrical supply infrastructure to move electricity around the system as efficiently and economically as possible. Integrating renewable energy sources into the smart grid system facilitates in the decrease of cost of sources needed for constructing extra generators, improved power quality, reliability and realizes the customer satisfaction. Such systems are known as Smart Energy Management Systems (SEMS). The different technologies employed to realize SMES are as follows:

3.1 Advanced Metering Infrastructure (AMI): - Advanced Metering Infrastructure (AMI) is a vision for two way meter or utility communication. It has two basic elements. First, automatic meter reading (AMR) systems offer a first step toward minimizing the costs of data Collection with real-time metering information. They also helps in remote disconnection/reconnection of consumers, load control, detection of/ and response to outages, energy theft responsiveness, and monitoring of power quality and consumption. Secondly, meter data management (MDM) gives a single point of incorporation for the full range of meter data. It facilitates leveraging of that data to automate business processes in real time and sharing of the data with major business and operational applications to get better efficiency and support decision making across the enterprise.

3.2 Distribution management System (DMS): - Distribution management system (DMS) software mathematically models the electric distribution network and forecasts the impact of outages, transmission, generation, voltage/frequency variation, and more. It assists to minimize capital investment by proving how to better utilize the existing assets, by permitting peak shaving through demand response (DR), and by improving network reliability. It also facilitates consumer decision by helping to identify rate options best suitable to each consumer and supports the business case for renewable generation solutions (distributed generation) and for electric vehicles and charging station management.

3.3 Geographic Information System (GIS): - Geographic information system (GIS) technology is specially devised for the utility industry to model, design, and manage their significant infrastructure. By integrating utility data and geographical maps, GIS offers a graphical outlook of the infrastructure that supports cost reduction with simplified planning and analysis and reduced operational response times.

3.4 Outage Management Systems (OMS): - Outage management systems (OMSs) speed outage resolution so power is restored more quickly and outage costs are controlled. They reduce the cost of manual reporting, analyze past outage data to recognize enhancements and evade future outages, and address regulatory and consumer demand for better responsiveness.

3.5 Intelligent Electronic Devices (IEDs): - Intelligent electronics devices (IEDs) are advanced, application-enabled devices fitted in the field that process, compute, and transmit pertinent data to a higher level. IEDs can gather data from both the network and consumers facilities and permit network reconfiguration either locally or on command from the control centre.

3.6 Wide Area Measurement Systems (WAMS): - Wide-area measurement systems (WAMS) present accurate, synchronized measurements from across large-scale power grids. WAMS consist of phasor measurement units (PMUs) that give precise, time-stamped data, together with phasor data concentrators that cumulate the data and execute incident recording. WAMS data plays a crucial part in post disturbance analysis, confirmation of system dynamic models; FACTS control verification, and wide area protection systems. Future implementation of wide-area control systems are supposed to build on WAMS. Hence Smart Energy Management Systems can control consumption, onsite generation and storage, and potentially electric vehicle charging. Energy Management Systems are in use today in large industrial and commercial facilities and will likely be extensively adopted with the rollout of smart grids

IV. IMPEDIMENTS ON EMS PATHWAY IN INDIA

4.1 Project Funding: - One of the major difficulties in the implementation of EMS projects in India is the lack of capital on the part of the utilities for energy efficiency projects. Capital in terms of both money and physical resources required for implementing EMS projects are very inadequate. Utilities have to distribute the already scarce resources accessible to different business units within the utility according to priority.

4.2 Payback Period: -The payback period for EMS projects extend into years since the huge investments involved in them. This demonstrates as obstacle to those utilities which have end use products and need quick payback of their investment.

4.3 Tax, Split Incentives and Planning cycles: - Persistently there is total mismatch amid the utilities planning cycle for up gradation and the state's energy policy cycles. This proves a restriction for the utilities to go for energy efficiency projects unless there is a need to do so. The business units which consent the implementation of EMS projects are not the ones that are honestly involved in the energy usage. Hence decisions regarding their implementation are taken after considering the advantage of the whole organization which may occasionally sideline the energy efficiency projects.

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4.4 Lack of knowledge: - The method of capital recovery arrangements in a utility can deeply affect the utilities interest in promoting industrial energy efficiency projects. This take places mostly in the case of smaller industrial companies. Also companies are not able to spare time to train its employees on new EMS technology or don't have proper technical expertise to execute energy efficiency projects.

4.5 Availability of technology: - Scarcity of energy consumption data and tools to estimate energy data can demonstrate restraint for execution of EMS projects. Also new EMS technologies are expensive to implement.

4.6 Price Trends: - Unpredictable energy prices can lead to uncertainty on return from capital invested on new energy efficiency projects and primarily a restraint for small utilities.

V. CONCLUSION

Energy Management System (EMS) is one of the fast evolving technologies in energy sector. Which have the prospective of altering the energy scenario of the country. The technology functions by gathering of real time data of electrical parameters and building intelligent systems which utilizes this data to build systems which can forecast contingencies in advance. Also EMS assists in effectual scheduling and generation of power at minimum operational cost and highest efficiency. Presently there are few impediments into executing EMS in energy demanding industries. Though, with advancement in technologies, these impediments can be conquered and successful implementation of EMS is achievable. EMS is implemented in combination with Smart Grids known as Smart Energy Management Systems (SEMS). This has resulted in the execution of EMS on a countrywide basis.

REFERENCES

[1] A Brief Review of Electric Power Energy Management Systems, Bruce F. Wollenberg, University of Minnesota.M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[2]. W.C.Turner, Energy Management Handbook, Wiley, New York, 1982.

[3]. W. Lee, R. Kenarangui, Energy management for motors, systems, and electrical equipment, IEEE Transactions on Industry Applications; vol. 38, no. 2, March/April 2002, pp. 602-607.

[4]. L.C.Witte, P.S.Schmidt, D.R.Brown, Industrial Energy Management and Utilisation, Hemisphere Publication, Washington, 1988.

[5] Definition of Energy Management, www.emanz.org.nz/what-energy-management

[3]ISO50001,www.unicert.co.uk/contact/energy/overview1.ht m

[6] Power Sector Data, http://powermin.nic.in/en/content/power-sectorglance-all-india

[7] help.leonardo-energy.org/.../201941411-What-are-thebenefits-of-energy-management

[8] BPS-Internet-of-Things-Smart-Energy-Management1015-1, www.tcs.com/.../BPS-Internet-of-Things-SmartEnergy-Management-1015-1.pdf

[9] energies-06-02262,www.mdpi.com/1996- 1073/6/4/2262/pdf.

[10]IoCT-Part1-06RESG, ieeecss.org/sites/ieeecss.org/files/documents/IoCTPart1-06RESG.pdf