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AN INTEGRATION MANAGEMENT SYSTEM FOR CLEAN ROOM FACILITY

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ABSTRACT

The motto of this paper is to give a concept that all commercial and non- commercial industries by putting building management system leads to energy efficient system and produce high quality products and accuracy. It is a computer program- data base centre and integrate to the user needs to monitor and control the techno-commercial features to make reliable and efficient energy system. In the current scenario, it is going to become essential part of all industries and display the true facts which guide to make decisions. Building management system is an important tool and provides fruitful results for improvement in term of multi- area management for various activities within the clean room facilities

INTRODUCTION

During last three decades, there has been a greatrevolution in the engineering field to provide high quality products in various fields like health care, pharmaceutical, biotech and semiconductors industries with control environmental.

A clean room facility is an integration of various services and run round the clock throughout the year to create hi- quality products. The capital cost of such projects includes operation and maintenance is very expensive. All the utilities and services which support to make the best hi-quality products are the main factor of energy consumptions. The energy consumption may be reduced with building management system that has a computer-based control systemwithin the clean room facility. The selections of design for building management are subjected to location, utilities service, operational requirements, controlling and monitoring features, identification of all areas and factors and are governed by rules and regulations of states and country if any. Above all, the final design should be highly reliable and energy efficient. The system is required to integrate specialised software modules to core tasks like as energy analytics and reports, assets and maintenance management, works management, optimisation and fault diagnostics etc. A building management system comprises of software program usually proprietary using as C-Bus, Profibus and so on that integrates internet protocols and open standards with hardwareas field devices to collect information on basis required.

1.01 Building management systems are most commonly applied in bigprojects to manage energy demand with the extensive usage of electrical and mechanical equipments such aslighting control, electric power control at source and distribution networks till userend, heating ventilation and air-conditioning system, security and surveillance system, access control system, fire alarm and fighting system, lifts and elevators,water distribution networks for treated ,soft ,demineralised and reverse osmosis water, closed circuit television, other engineering systems etc .This management system is a combination of few direct digital and program logic controllers and have open communications protocols with access from anywhere in the world. This is controller based systems which can intelligently analysis and control the technical requirements of the facility as users required in one complete integrated system. Each sub-system is usually energised through the same source of power supply as installed equipments and machines either through electricity department or through standby power. An uninterrupted power supply is necessary to feed BMS infrastructure including servers, direct digital controller, field devices, operator work-stations, network communication systems even during a small duration of power outage for continuous optimisation.

1.02 BMS will have the strength to give the required information (peak energy and water consumption) hourly, daily, monthly and annual basis from user end and analysis for comparison of trends for maximum utilisation of energy in future and also to find how to make it most efficient system with the approval of authorities. It is a great weapon in the clean room facilities where there is 65% of energy consumption on the contract demand due to engineering technical requirements even when, not in function. This directly impact the cost of the products and also include extra expenditure on the project. The traditional control of temperature, humidity and make-up air to control environmental conditions in any commercial building. But in case of clean room facility, other force factor are control of suspended particles, pressure gradients, air velocities and airflow pattern cross-contamination, noise, vibration and electrostatic discharge, customising to suit the equipment and layout plan for energy conservation and other aspects at reasonable installation, operation and maintenance costs.

1.03 A clean room is very expensive facility due to the environmental conditions and critical protocol designed with and certificated through a three stage process for functional point of view. So building management system has become an essential feature to monitor and control energy saving and reduce the operational costs. The advantages of BMS is a central control system which look into all technical data in current form and suggests for improvement for given environmental conditions from time to time for optimal utilisation of support services through energy management.

2-OBJECTIVES-

BMS for clean room facility is micro-processor based systems which centralises and simplifies the monitoring and controlling of designed parameters during the entire process for result-orientation in

term of products and costs. Such facility needs high degree of accuracy in maintaining environmental conditions. BMS determinesto energy management and reduces operational cost for expensive facilities. The following result oriented details should be considered.

a) Automation Management system.
b) Environmental control conditions.
c) Load based control strategies.
d) Equipment runtime and duty cycling.
e) Optimal utilisation of the plant.
f) Actual energy consumption.
g) Customised control strategies.
h) Integration with other utilities services.

2.01 The best BMS have to be decided with the consideration of possibility of individual room control, effective monitoring and targeting energy consumption, improved plant reliability and life, effective response to HVAC-related complaints, other relevant utilities, saving time and money during the maintenance of services. BMS deals with energy demand management and comprehensive reporting through customised reports on system history and promotes compliance of overall business strategies. Basic concept of system architecture and functional structure are shown in figure-1 and figure-2 respectively.

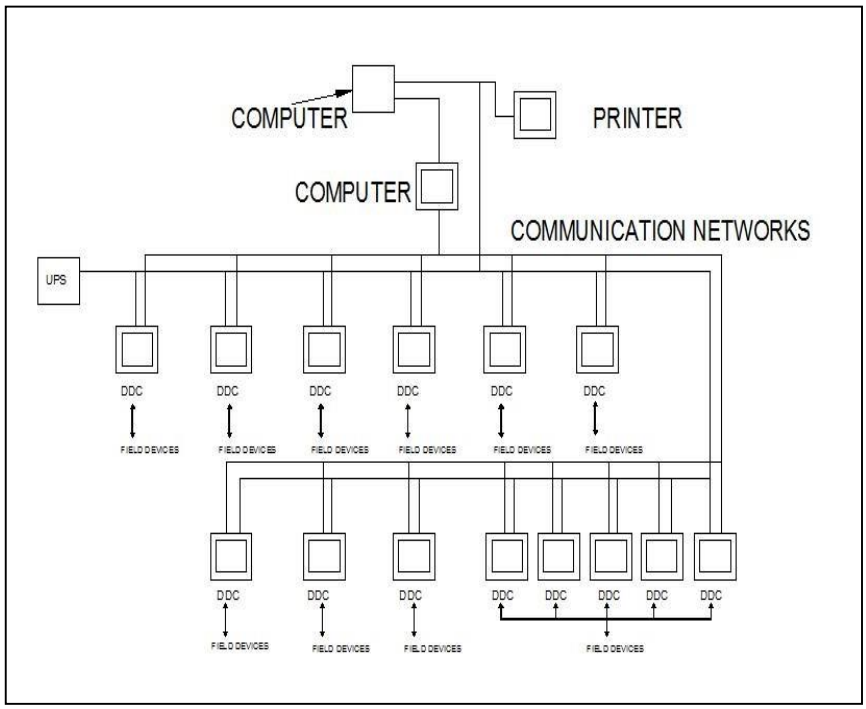

Figure-1 System architecture

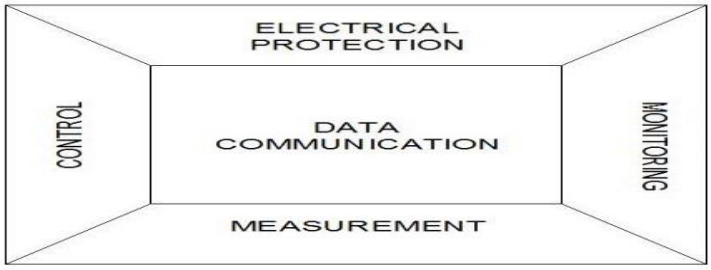

Figure-2 functional structure

2.02 All systems in support of preparation of documents are in accordance with relevant codes and standards related to technology division. Codes and standard for building management system engineering services are mentioned in table-1

Table- 1

S. no	Description/Name of organisation/institute
1	ASHRE 135 (BACnet)
2	IEC 60529"Ingree Protection"
3	ISO/IEC 14908(Lon Works)
4	IEC 62386(DALI)
5	ISO/IEC 14543(KNX)
6	Lon Mark interoperability Association Standards
7	Modbus-IDA" Modbus application protocol specificationv1.1b"
8	Modbus-IDA" Modbus over Serial Line specification and implementation Guide v1.02"
9	Modbus-IDA" Modbus Implementation on TCP/IP Implementation Guide v1.ob".
10	National Building codes of India

11	2009 international Energy conservation codes
12	Green Rating for Integrated Habitant Assessment(GRIHA)

2.03 A clean room facility generally comprises of many technical service supports to maintain the conditions to give high quality of productions. The General System engineering services are highlighted in Table-2.

Table-2

S.no	Engineering field	Features to be monitor and control
1	Electrical power	-At source voltage, current, frequency, power factor and demand load. -Energy consumption at metering device and distribution network at user end.
2	Diesel Generator set	Voltage, current, frequency, power factor and load distribution.
3	Clear room	Vibration, noise level, pressure gradients, air flow at filter-bank, air flow pattern, air velocity, illumination intensity.
4	Heating Ventilation and Air-conditioning system	Temperature, humidity, flow rate of chilled /condenser water, compressor, condenser, cooling tower, pump-sets, air handling units.
4	Fire Detection system	Identification of coverage area zone wise, cross-zone,audio and videoalarm , interlock with fire fighting system and air handling units.
5	Fire fighting system either water of gas base	Pressure, flow rate, interlock with fire detection and air handling units.
6	Lighting system	Illumination
7	Water supply network	Pump-sets, flow rate , pressure,
6	DM/DI plant	Pump-sets, flow rate,pressure, quality assurance for processing required range.

7	Hot water generation	Pump-sets, flow rate, pressure, temperature at outlet and users end.
8	Compressed Air system	Pump-sets, flow rate, pressure at outlet and users end.
9	Scrubber system	Pump-sets, flow rate and process cycle.
10	Process gas pipe lines	Pump-sets, flow rate, pressure at outlet and users end , pressure difference
11	Neutralisation system	Pump-sets, flow rate ,
12	Lifts and elevators	Pump-sets, flow rate and process cycle.
13	Accesses control system	Video, biometric and other features with user demand for zone wise.
14	Security system	Video, biometric ,barrier
15	Surveillance system	Camera ,vehicle under and over scanners, Video, biometric road blockers
16	Entry/Exit protocol	Camera and biometric cards
17	Communication system	Telephone , Lan and Doran network
18	Server	Voltage, current, frequency, power factor and load distribution.
19	Environment control	Any material disposal both liquid and gases form after neutralisation to outside shall be permissible limit.
20	Storage system both liquids and gases	Capacity, levels at various stages, alarms

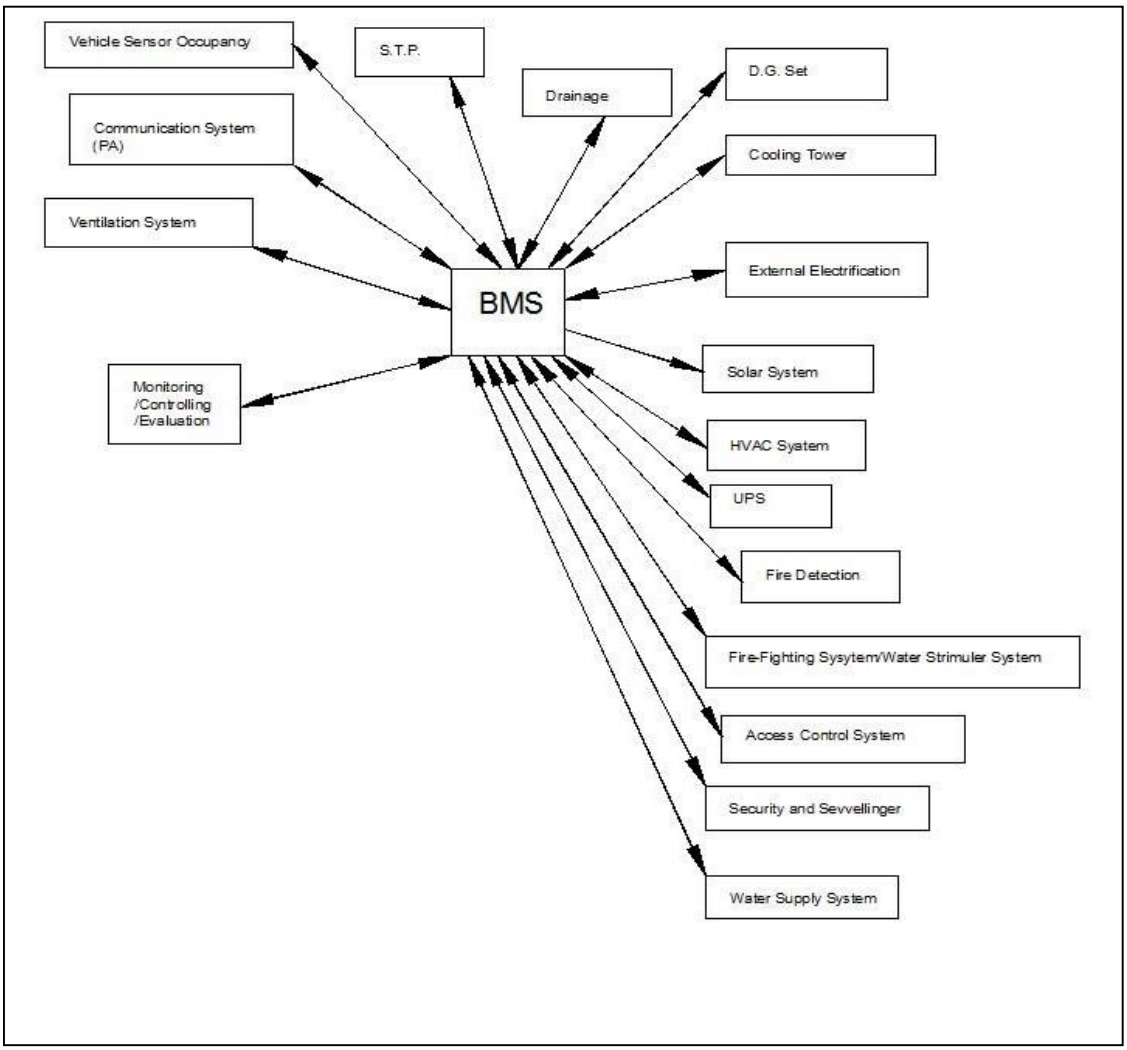

Figure-3 Block diagram for building management system

2.04 BMS are based on common features and segregated into in four sections for one goal that is effective energy management. Table-3 indicatesthat the role of operator, management, processing and fields device functions for automation required for any BMS.

Table-3

S. no	Management functions	Processing functions	Operator functions	I/O functions Field devices
1	Data analyses	Technical data and specificrange, interlocks, characteristics.	Operation	Measuring
2	Documentation	Safety alarm, closed loop control and recording.	Alarming	Signalling
3	Engineering	Back up control, calculation and supervision	Reporting	Signalling
4	Maintenance	Peak limit ,operating cycles and counting hour for individual	Help	Switching
5	Networking	Time program ,set point range and man operation	Sharing	switching
6	Decision making	Reviews	Current trends	Positioning

2.05 Life cycle of BMS becomes important and must be in considered with compatibility policy and selection of hardware and software with proven record. Building management systems play an important role in day to day activities for clean room facility. The BMS may be briefly over viewed through day to day essential activities in the plant room as listedin Table-4.

Table-4

S. No	Day to Day role of building management system in clean room facility
1	Control of clean room system and required services /utilities
2	Time scheduling for optimal use
3	Control application programming for process requirements
4	Trending and logging of operational details for stability purpose
5	Real time monitoring of all serviceperformance
6	Graphic user interface for monitoring and tuning
7	Fault management and alarming and analysing the reasons behind such faults.
8	Event management to see the variation of parameters
9	Energy management to save energy as much as possible
10	Load based control strategies
11	Equipment runtime monitoring and duty cycle
12	Automated changeover of failed equipments and alarm
13	Customised control strategies on feedback and integration with other service

14	System maintenance .
15	Certification schedule and reports
16	BMS equipment life cycle for replacement and enhancement
17	Operating and maintenance costs including billing costs

2.06 To make a good and functional BMS, system documentation is very important in havingfunctional descriptions, schedules,control system engineeringdrawings, latest technical details,advanced software and hardware components and field devices compatible to the usersneed.The functional description is the first step to formulate the system in which overall layout plan of facility and the requirements, control and operations sequences strategies. The system engineering for planning the devices to be connected at the point of use, control system drawing for network architecture and connections to controllers are done at final stage and mayalsobe put to make user friendly graphic interface system. So that in one go the complete picture of building management can be planned in all respect, for execution. Before the start of planning we should be aware of the life cycle of BMS equipments that are to be required in the operation for replacement otherwise the system will be held, so special care is to be taken for finalisation of such equipments.

Table-5

S. No	BMS Equipments	Life cycle
1	Field controllers	15-20 years
2	Field devices	15-20 years
3	Computer hardware	3-5 years
4	software	3-5 years

2.07 Prepare a compact building management system for a clean room facility, is verycomplicated task because of multi-disciplinary fields. Each fields are working on different procedures, protocols, applications, measuring and testing procedures, controlling data with permissible limit as per standard norm. The experts and manufactures are of different opinions to graphic trends and control of facilities features and may have separate controller with the selection of required parameters which are to be monitor and control.

2.08 From the above figures and tables, it is easy to understand how to prepare good building management system as per required conditions. Direct digital controls are generally plan with input/output summary of AI/AO &DI/DO, control schematics and strategy. The cost of Direct digital controls and communication networks with relevant software for different field devices are very high due to accuracy and efficiency.

3. CONCLUSIONS AND FUTURE DEVELOPMENTS

The paper presents the implementation, methods and obtained results of a software and hardware educational tool developed for a renewable energy management system. The monitoring and control processes represent an essential part in the energy management systems and the obtained experimental stand contains the necessary components of a functional model. The objectives were; the control through the internet browse of the electrical power consumers and the monitoring of their behaviour and of other system parameters such as the state of the battery, the system temperature of the light level.

The experiment involving the development boards and breadboards was successful as the main circuit changed often, as the work was progressing and the changes were easily performed. The communication between the server part and the client was successful, but in the future it has to be optimized as sensors and other devices are attached. Also a future development is represented by a database for the web application, and a new user friendly type of interface, for a better understanding of problems. The database can also be including as a part of the management system and will contain more information regarding the system properties and functionalities.

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