

INTELLIGENT POWER SUPPLY OF INDUSTRIAL PLANTS

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Abstract- Fast growing of quantity industrial plants requires more of electric power supplies. This in turn leads to the necessity to increase efficiency of quality of power supplies within the plant. Intelligent power supply systems serve that goal by assisting to enhance controls of power distribution and its quality. This paper considers functions of the intelligent power supply system, its advantages and benefits of its use viewed through various facets, such as power management, protection, safety, security, environmental protection, cost effectiveness and sociality.

Keywords: Intelligent Power Supply, Smart Systems, SCADA, Power Management, Protection and Safety, Power Quality, Cost Efficiency.

I. INTRODUCTION

The power consumption by the industrial plants is growing from year to the year. Demand to the quality of electrical power supplies is also increasing in line with this growth. There are several various approaches to solve the problem of provision the raised capacity of electrical power and its quality. One of them is expanding existing or building new bigger power plants. Along with it, quality improvements cannot be efficient without better managed power supply systems of new or existing industrial plants [1-4].

Implementation of intelligent power supply system based on using of modern SCADA (Supervisory Control and Data Acquisition) systems is considered as the way for quality improvements. Intelligent power supply systems allow obtaining controllable, flexible and reliable power networks and achieving better results in management of power, protection of electrical consumers and equipment, increasing the power quality and safety, reducing of influence to the environment, minimize occurrence of hazard or emergency situations, minimize quantity of unscheduled shutdowns and reducing the time periods of maintenance and scheduled shutdowns, etc [5, 6].

In this article, general principles of intelligent power supply system for industrial plants and its capabilities are discussed.

II. INDUSTRIAL PLANTS POWER MANAGEMENT AND OPERATIONS

Practice of implementation of SCADA in projects of power supply for industrial plants presents following achievements in power management and operation of plants power networks:

- Reliable distribution of electrical power;
 - Flexible plant power network;
 - Logical plant loads transferring;
 - Balance of plant loads;
 - Reduce influence to the external power grid;
 - Scheduled switching of subsystems;
 - Metering and continuous control of electrical power usage;
 - Remote control of quantity and type of connected power consumers;
 - Continuous monitoring of power network conditions;
 - Automatic control of power network;
 - Soft switching between different power sources or incoming lines;
 - Remote operates of sub equipment;
 - Continuous indication of power network parameters on operators displays;
 - Alarming in non-normal conditions of power network
- Reducing number of the operator staff.

III. PROTECTION OF EQUIPMENT AND CONSUMERS

One of the main functions of intelligent power supply system is protection of network from different non-normal conditions influence of which may corrupt electrical equipment and consumers and destabilize the working process. SCADA system provides continuous monitoring of electrical parameters and in case of appearing of any outrange values performs prevention tasks to keep the normal functioning of overall network and inform operators about occurred situations. In the frame of protection functions SCADA performs following activities:

- Continuous monitoring and logging protection parameters of power network;
- Continuously remote control of equipment health levels with informing of responsible personnel about required preventive maintenance;

- Prevention of equipment damages possibly occurring due to malfunctioning of the supply system;
- Protection of power transformers (overcurrent protection, differential protection, temperature control);
- Overcurrent protection;
- Overvoltage or undervoltage protection;
- Overloading protection;
- Drives starting control;
- Loads balancing between phases;
- Phase losing;
- Phases consequences;
- Equipment faults protection;
- Short-circuits protection;
- Earth fault protection;
- Arc protection;
- Surge protections.

IV. QUALITY OF POWER

Keeping quality of power at the high level is the main role of intelligent power supply. And this also is crucial for safe and secure industrial plant operation. Capacities of the intelligent power supply system assume controlling and keeping quality of power supply at the required level. This includes the following:

- Current control (per phase, 3-phase average, neutral, max current demand per phase);
- Voltage control (per phase, 3-phase average);
- Frequency control;
- Power factor control;
- Power control (real, apparent, reactive);
- Present and peak power demand (real, reactive and apparent);
- Energy measuring and control (real, reactive and apparent)
- Control of harmonic power flows;
- Drives starting and working control.

V. SAFETY AND ENVIRONMENT PROTECTION

The next important advantage of intelligent power supply is obtaining high level of personnel safety and reduction of negative influence to the environment. From view of the increasing personnel safety and environmental protection levels the smart systems can perform the following functions:

- Prevention from access to the power system of non-authorized personnel;
- Prevention from opening of live cubicles and switchboards;
- Prevent from unauthorized switching on of system during maintenance;
- Alarming and information of personnel about the danger;
- Permanent monitoring and control of power system, thus reducing possibilities of emergency situations;
- Automatic control of system shutdown, thus preventing equipment from the damage of and staff from accidents;
- Smart control function during emergency situations;

- Smart operation of plant networks, in its turn allows to optimize operation of power production plants that reduces the impact to the environment;
- Improved quality of power also assists in achieving better level of equipment electromagnetic compatibilities and reducing influence of electromagnetic fields to the environment.

VI. ENSURING SECURITY OF POWER NETWORK

The next important aspect of plant operation, which also is seriously improved, is security of plant's power supply. Security assumes performing wide range of functions from prevention of unauthorized connections up to the tracking of permitted switching devices and equipment access. The main roles of intelligent power supply system are presented below:

- Different secured levels of access to the power supply control and operation;
- Prevention of unauthorized access to the system equipment;
- Determination and informing/alarming about unauthorized connection to the power supply system;
- Archiving and securing of all data;
- Logging of all operations and events;
- Securable remote control of power supply network.

VII. DATA COLLECTION

Big place in reliable, flexible and cost effective management of industrial plant's power supply system take analyzing of working data and planning of power network's operations. In these terms, intelligent power supply systems enable successful management of plant's networks. Below indicated are major advantages provided by implementation of intelligent power supply for better networks operation:

- Collection, storing and archiving of network parameters and events;
- Analyzing of collected information;
- Applying analysis results for planning;
- Creation of flexible consumers working schedules based on collected data and analysis results;
- Determination of average power utilization by each network's branch, and in case of rising-up of this data informing of operators about possible not permitted connection to the network;
- Application of statistic data for budgets planning;
- Flexible presentation of expenses schedules;
- Creation of different reports for various operation intervals and calculation of average values of network parameters and operation markers;
- Analysis of plant operations and determination of peak loads;
- Registration of all protection systems events, equipment breaks with subsequent using this information for planning of maintenance and development of spare parts strategy;
- Creation of schedules of events.

VIII. COST EFFECTIVENESS

Implementation of intelligent power supply system at the initial stages requires additional financial recourses comparing with traditionally installed and operated systems. But described in previous sections technical advantages will provide refund achieved in short time period. Cost effectiveness of smart systems implementation is achieved by the following benefits:

- Flexible management of energy consumers allows to lower power plants operations and save natural resources;
- Enhanced effectiveness of electric power utilization;
- Flexible switching off of unused equipment;
- Planning and scheduling of operations avoid to waste energy;
- Lower the number of unscheduled plant shutdowns;
- Increase the intervals between scheduled shutdowns;
- Quick and easy faults determinations;
- Continuous control of network allows to implement the predictive and preventive equipment maintenance strategies;
- Reduced maintenance time;
- Continuous power quality control avoids the brake of equipment.

IX. SOCIALITY

Application of the intelligent power supply systems at modern industrial plant networks has reflection to the social aspects of the life presented below:

- Improved protection of the environment by:
 - decreasing effects of human mistakes;
 - minimizing negative electromagnetic effects through systems of control;
- Minimized accidents levels;
- Facilitate involvement of qualified staff, thus enhancing educational demands;
- Involves scientific management into the power supply operations.

X. CONCLUSIONS

Implementation of intelligent power supply systems at industrial plants gives carrying out flexible power management. It allows to achieve balance between the production grow without increasing of power supply from power plants. Additionally improvement of plant's networks gives huge advantages and benefits from different views. It allows increasing protection equipment and environmental, personnel safety and network security form one side and collect statistical information required to the better and flexible management and budgeting from another side.

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BIOGRAPHIES



Arif M. Hashimov was born in Shahbuz, Nakhchivan, Azerbaijan on September 28, 1949. He is a Professor of Power Engineering (1993); Chief Editor of Scientific Journal of "Power Engineering Problems" from 2000; Director of Institute of Physics of Azerbaijan

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