SEMAS: Smart Energy Monitoring and Analysis System

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The process of energy data (parameters) monitoring and analyzing as an element of geographically distributed power system is connected, first of all, with the development and testing of algorithms for efficient process control, manufacturing, electrical systems and networks. Given the wide range of energy data, complexity of formalizing relations between them, and as a consequence, the objective function of objects management in general, the most effective, and sometimes the only real way to increase efficiency (reliability) of the test operation of technological and electrical facilities and systems, as well as reducing the cost of operation is to improve the means and methods of monitoring and analysis on the basis of mathematical modeling using intelligent information processing technologies.

From the existing complex power plants monitoring systems the most adequate systems based on standard technology of energy flows automated technical accounting, but they has disadvantages in terms of system intelligence complex lifecycle management (related set) technology and electrical facilities. The full study (setting, commissioning, operation, diagnostics, testing, etc.) technological and electrical installations and distributed energy systems based on them require significant time and cost, it is often inefficient identification parameters and characteristics of the equipment in local areas difficult to obtain an overall assessment of the state of energy network. Therefore, the creation of a new widely available (national coverage) technologies for efficient and long-term monitoring and intelligent analysis of the technological processes, production, electrical systems and networks is very important for energy, engineering, transport and other sectors in the country.

Centralized storage of monitoring and analysis results of technological and electrical facilities parameters in the practice of distributed complex systems management can provide new scientific and practical results and contribute to the development of new techniques to detect deviations in the power equipment, the formation of effective operation methods of distributed energy systems based on observation history and forecasting. Monitoring and research of the equipment energy performance in the active-adaptive networks that are based on distributed generation, will provide a holistic picture of information and energy and create effective network management modes.

One of the proposed project significance factor is also the possibility to introduce in the educational practices of the federal state budgetary educational institution of higher education

"Perm National Research Polytechnic University" (PNIPU) new and improved quality innovative educational programs for engineering, scientific and managerial personnel in the aviation, energy and aerospace, network companies, housing and communal services and related industries.

2. Aims and expected results. The key aim is the formation of engineering, research, and educational solutions to assess the state of technological processes, production, electrical systems and networks based on effective monitoring and analysis energy data.

The main expected results of scientific research should be:

1. Set the local and global efficiency criterion intelligent system monitoring and analysis of complex technical systems energy data.

2. Conceptual model of effective monitoring and analysis of complex technical systems energy data.

3. Technique of smart technologies using to improve the efficiency of energy data monitoring and analysis.

4. The method of constructing HIL simulation and experimental systems, processes, facilities, electrical systems and networks based on dynamic multi-mode simulation model.

5. The software package for modeling elements of technological processes, production, electrical systems and networks on the basis of an information system with a modular reconfigurable architecture, and support advanced protocols for collecting information.

6. Laboratory and research complex of modular devices and automated system components for collecting and processing information about objects of technological processes, production, electrical systems and networks.

7. The model of knowledge representation about the state of distributed processes, manufacturing, electrical systems and networks.

8. The complex of interrelated formal procedures integrated logistics support in distributed power systems.

9. Recommendations and methods for evaluating the effectiveness of the decisions on the application of advanced energy-saving technologies.

3. The main tasks. Actuality the problem of increasing the efficiency of geographically distributed energy systems based on remote monitoring intellectualization necessitates solving scientific and applied problems:

- Unification of technologies for collecting energy and process data;

- Harmonization of protocols and communication interfaces, data transmission methods between systems of the upper and lower levels;

- Unification of program blocks data processing and analysis;

- Creation on the basis of existing approaches to the construction of a cross-platform accounting systems monitoring technology devices and networks (up to several tens of thousands of units);

- Development of the intelligent system monitoring and energy data analysis architecture;

- Selection of criteria and construct a model of efficiency for complex technical systems remote monitoring;

- Analytical review and scientific substantiation of approaches to the intelligent technologies using to improve the efficiency of distributed technical systems remote condition monitoring;

- Development of algorithms and protocols for collecting measurement, geographic and attribute information for the formation of knowledge representation model about the state of distributed complex power units;

- Research and development of long-term monitoring in real time network model, taking into account uncertainty;

- Development of modular reconfigurable architecture software using the latest protocols for collecting information;

- The development of seminatural and simulation models of power and process equipment technique construction;

- Creation of stable local information networks for data collection.

4. The key participants and their roles. The project is a complex and interdisciplinary, with the participation of leading specialists of the microprocessor automation equipment department of PNRPU, specialists of scientific-educational center of energy conservation (NOTSES) and other departments PNRPU, researchers at the University of Applied Sciences Hamburg (Hamburg, Germany) and specialists Envidatec GmbH (Hamburg, Germany), which is PNRPU industrial partner.

Hamburg University of Applied Sciences is a leader in problems of approaches to monitoring and technical diagnostics of electrical systems research.

There is a need to carry out research elements of the material and technical base: an active laboratory-adaptive networks (PNRPU, microprocessor automation equipment department), the laboratory of the automated electric in the microprocessor automation equipment department, energy monitoring laboratory SmartJEVisLab, developed jointly with the University of Applied Sciences Hamburg Envidatec GmbH.

An integrated approach that combines Russian and European experience, allows you to use both already available in the department of microprocessor automation equipment department laboratory facilities, and energy monitoring developed by the laboratory to simulate

various modes of monitoring the parameters of the simulated power system, various debugging options for technical performance, configuration and composition of structural elements. Network poster complex will provide both HIL testing and software testing (developed data processing algorithms), iteratively complementing each other in the mode of access through the Internet.

5. The market perspectives. The results of the research and development allow reach the level of multi-functional monitoring and energy options analysis development.

Application of intelligent monitoring technology and analysis of energy data will reduce costs and time for development, testing and implementation of new energy equipment by 5-10%, and the cost of its subsequent operation to 20%.

Overall, the results of research and the experience gained will be used to improve methods and means to improve the efficiency of production processes, manufacturing, electrical systems and networks, that is, improving the efficiency of energy supply areas (social effect), industrial sites (economic impact).

From the standpoint of international importance to develop intelligent system monitoring and analysis of energy data will provide a competitive advantage in relation to the proposed foreign analogs of similar systems and approaches in general, that is, to develop domestic energy, utilities, manufacturing, based on import substitution of domestic technologies.

Conclusion. The innovative potential of the task is to develop a system of remote monitoring and intelligent analysis of the distribution systems energy parameters, providing the ability to create stable local networks for measuring objects, industries and territories due to the power equipment information consolidation of the various types.

The unification of technologies for collecting energy and process data involves the production of standard and universal for each type of standard monitoring units equipment (power plants, heating equipment, etc.). These units must be performed in series and take into account all the features of measurement, control and monitoring of certain type power plants Mass production will reduce the cost of the equipment and to unify the principles of development, which is especially important for reducing the cost of equipment.

Unification of protocols and communication interfaces, data transmission methods between systems of the upper and lower levels can reduce the costs of creating testbed for research during the experimental and industrial operation of the equipment, including separate units. This decision will allow one to carry out a complex top-level data collection from multiple units of the various types power equipment.