

Integrated Micro-grid optimization and control technology

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Abstract: Micro-grid is an important component of smart grid. The paper describes the level of domestic and foreign intelligence network of the status and trends, based on the experimental platform based on a Micro-grid, describes the experimental platform based on a Micro-grid and the main function of the overall architecture and key technologies in the platform, such as power technology, plug and play technology and optimization technology is analyzed, the micro power grid analysis and optimization technology integration are put forward.

Keywords: Micro-grid; power electronics ;Integrated; optimization ;control ; Agent

1 Introduction

Currently, the increasingly serious world energy situation, the power system as an important consumer of energy, structural adjustment in the energy plays an important role. Through the grid, can effectively improve the network efficiency, consumptive more renewable energy, to a certain extent, ease or even solve the energy crisis. In China, the smart grid construction has risen to national strategies. To "great efforts to develop low-carbon technologies, promoting energy efficient technology, and actively develop new energy and renewable energy, strengthen the building of smart grid Micro-grid as an important part of the Smart Grid is also important to achieve strong and smart grid means. Rely on local power generation, and failure occurs when the main grid with the main network automatically separate, independent operation, micro power grid reliability demonstrated the ability to promote the future. It also requires the primary network for information and with the interaction energy. The traditional energy management system (EMS) can not meet the needs of micro-power management.

2 The level of domestic and international research status and development trend

Given the U.S. smart grid vision, core values that the smart grid are: (1) more reliable. A reliable power grid, no matter when and where its users can provide qualified energy; (2) stronger. A secure network can not withstand the cost of paying too much physical or network attacks. Natural disasters, security will be less damage to power, and soon be restored; (3) more economical. An economic power can be fair and reasonable prices and adequate supply, to ensure the supply and demand balance; (4) more efficient. An efficient power grid will use a variety of strategies to

control costs, minimize network losses, efficient power generation, and through the provision of energy management tools to customers to optimize asset utilization.

Given the EU's vision of smart grid, smart grid that core values are: (1) High flexibility: to meet the needs of users at the same time to respond to future changes and challenges; (2) high accessibility: ensuring that all Power users can access, in particular, zero or low carbon emissions, renewable power and efficient local power supply; (3) High reliability: ensuring and enhancing safety and power quality supply to meet the needs of the digital age. Risk and uncertainty on the strong adaptability; (4) high economy: through innovation, energy efficiency management, equal competition and regulation, the highest economy. State Grid Corporation of China, the core values that the Smart Grid: First, strong and reliable, the network structure with a strong, powerful and reliable power transmission capacity and security of electricity supply; Second, economic efficiency, is to enhance network operation and distribution efficiency and reduce operating costs, promote energy resources and efficient use of electricity assets; third is clean and green, that promote renewable energy development and utilization, reduce energy consumption and pollutant emissions and increase clean energy in the proportion of final energy consumption; fourth is transparent and open that the power grid, power and user transparent sharing of information, non-discriminatory open grid; Fifth, friendly interaction, that is the way to achieve flexibility to adjust the power grid, power and user-friendly and compatible with various types of access and exit, take the initiative to promote power generation companies and users involved in grid operation and adjustment. To promote research, development and construction of our experimental platform of a micro-grid. It is a low-voltage distribution network system, including small wind, solar photovoltaic panels, storage devices and controllable loads.

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3 Overall structure

Micro-grid system in the physical facility consists of renewable energy, distributed generation, micro power grid, energy storage, inverter power electronic equipment and systems, electric cars and other important elements of intelligent micro-grid; data collection and monitoring to achieve the basic data collection, storage, management and analysis; intelligent micro-grid solution is part of the core platform to provide a data acquisition and control over, smart micro-grid solutions to the most valuable senior. The micro-grid experiment platform using advanced information technology, communications technology and cutting-edge mathematical models, statistics, simulation and optimization techniques to monitor the investigation, prediction and control of the future energy value chain. Rely on local power generation, and failure occurs when the main grid with the main network automatically separate, independent operation, micro power grid reliability demonstrated the ability to promote the future. The experimental platform will solve the challenging problem of providing energy assistance, including monitoring and prediction of power fluctuations in environment conditions; control and scheduling power supply box to meet the demand for electricity storage device; to improve reliability on the basis of energy saving sex; help reduce or transfer the end-user energy demand; based on available wind and solar electric vehicles under the optimal balance of charge and discharge and so on.

4 Main function

Integrated Micro-grid analysis and optimization platform to achieve the following main functions:

- 1) to provide micro-grid monitoring system that allows access to solar power, wind power, energy storage devices, electric vehicles and other distributed energy equipment, and can access smart appliances.
- 2) to provide basic system operation status monitoring, and real-time data and historical data for statistical analysis
- 3) Coordinate control of smart appliances, electric cars, and its own power generation and energy storage devices, micro-power level to achieve the energy management control and operation optimization.
- 4) to provide micro-power integrated platform that provides micro-and micro-grid power between the main network and the energy exchange between the reasonable scheduling.
- 5) user behavior and intelligent home appliances for statistical analysis of electricity, system optimization and artificial from the point of view, to help electricity customers better manage energy use strategies to reduce electricity costs, load shifting.
- 6) micro-grid load forecasting, renewable energy output forecast, unit commitment, economic dispatch and other advanced features.
- 7) to provide intelligent building management system (IBMS) in the cooperative control interface, the total energy in the mi-

cro-grid and optimize the management level, air-conditioning, elevators and other control strategies to optimize.

5 Key Technologies

5.1 Power Electronics

(1) inverter technology

Zhongwei microgrid power such as wind power systems, photovoltaic systems, fuel cell systems generally grid through the inverter, inverter: General, including tracking controller, the output power controller, with control, protection and filtering functions, with micro-grid in the interface between power and static power converter. In the micro-grid system, you can use different structures inverter Pu Tuo, depending on the technical boundary conditions:

- 1) frequency inverter 50HZ: Pu Tuo simple structure, high reliability, large in size and weight, maximum efficiency is 95%;
- 2) Inverter with High Frequency Transformer: expensive, small size, light weight, maximum efficiency is 91%;
- 3) No transformer inverter: light weight, the voltage transfer ratio up to 1:3, the maximum efficiency of 91%;
- 4) Resonant Inverter: control complex, the maximum efficiency is 95%; Inverter and the network must meet: the output voltage and grid voltage with the frequency, phase, same amplitude, the output current and grid voltage with frequency, with the phase (power factor is 1), and power quality standards.

5.2 Plug and play technology

Build a loosely coupled applications, not only decoupling between modules and interfaces between modules have corresponding norms, by component management platform for unified management of all modules (loading, unloading, start, stop, etc.). When the need for a module, such as state estimation module upgrade, just put a new module directory, the component management platform will automatically load the module, the test is correct, the termination of the original module to run; that the software upgrade process, the entire system can be run as usual, simple software upgrade, follow the rapid development of power demand. Plug and Play control is through a certain means of control to meet the micro-power random access and exit. So that can meet the load demand, but also micro-grid and large power grids to reduce the impact. Control of the past, many of the plug and play is based on the starting power electronics, design of micro power control system, more obvious limitations, the control is limited to a single component, the micro-grid and a number of small micro-power fluctuations, the ability to track changes to achieve stable operation. However, many micro-power micro-grid and volatile, do not be able to track changes, to achieve stable operation. At the same time due to lack of communication, the device can only be fighting each other. Agent technology can be used for micro-power micro-grid and multi-coordinated control. Multi Agent Micro-structure and hierarchical control network shown in Figure 1.

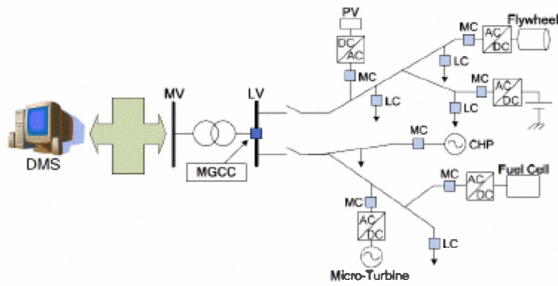


Figure 1 Multi Agent Micro-network control structure and hierarchical control

Multi-Agent Technology (Agent) can also micro-grid and distribution management system (DMS) to coordinate control. At present, is a micro-grid frequency and voltage control. Requirements of micro power grid, the output voltage automatically tracks the grid voltage changes. Micro-grid control centers and multi-DSM shown in Figure 2.

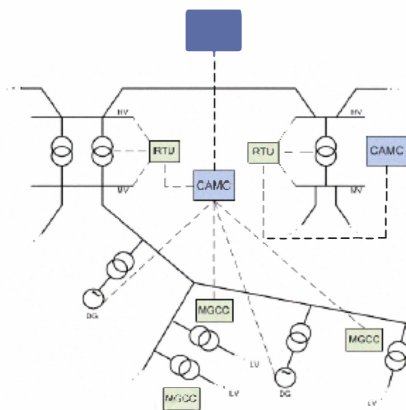


Figure 2 more micro-power relationship between the control center and DSM

Multi-Agent-based micro-grid control and optimization of decision-making, mainly divided into three layers: the first layer is mainly to ensure reliable operation of micro power grid to meet the supply and demand balance; the second layer optimization of power quality control, reduce the frequency and voltage fluctuations; the third layer economic optimization, the marginal cost optimization. The current studies were focused on the frequency and voltage control. Multi-Agent Technology (Agent) of the micro-grid control and optimize decision-making shown in Figure 3.

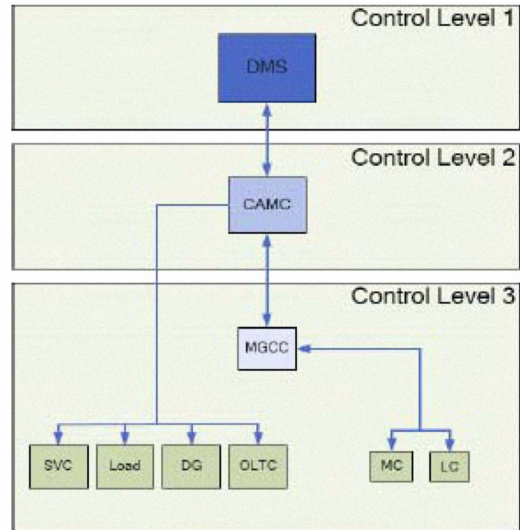


Figure 3 Multi-Agent of the micro-network control and optimization of decision-making

5.3 Agent-based control of micro-grid operation optimization

Most of the existing cooperative task solving system optimization are based on Intelligent Agent technology to build. Here are a new idea - through the system automatically to improve the micro-grid dynamic reconfiguration dynamic adaptability, it can solve many micro-power micro-grid operation and control optimization problems. Can solve the micro-grid and distribution management system (DMS) coordinated control problem. Gai ideological composition of solving system allows each intelligent Agent dynamically and automatically between the grid and micro grid according to the changing environment to take two operations Agent integration and decomposition of the task Qiujie generate a new structure to adapt to environmental changes and can be re- to adapt to the new structure the solution structure of the current environment, and this reconstruction is based on intelligent Agent itself. environment is the Intelligent Agent and other exchange of information between. Here, we use the time to record a logical tree structure of Intelligent Agent Intelligent Agent to communicate with other processes. This structure is very suitable for the query statistics. Agent by the time the logical query tree and the statistics, you can choose the integration of operations with it the best Smart Agent. This stage is the fusion and decomposition of Intelligent Agent operation stages of preparation.

Decision-making: we can see from the chart, decision making is to enter the general description of the ideal structure and compare the current organizational structure to determine, whether made to maintain or adjust the current structure of the current organizational structure of the decision.

6 Conclusion

In the initial stage of micro power grid, the user interaction management mainly for factories, commercial buildings and other large users and the new district. With the development of smart grid, smart device configuration will be more comprehensive, interactive mechanism of supply and demand will be more mature, resident awareness and energy conservation will also continue to improve the overall quality, when it will be gradually promote the breadth and interaction of supply and demand depth. Smart Grid solution as a whole to a specific implementation, the integrated optimization platform, micro power control technology, to ensure grid security, economic and quality at the same time, strengthening the power of the interaction and compatibility, both to solve practical problems, and consistent with network development, has broad application prospects.

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