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# 农村主动型配电网优化调度线性模型与算法

# Linear optimal operation model and algorithm for active distribution network in rural areas

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英文关键词:rural areas distributed power generation models active distribution network optimization scheduling linear optimization

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中文摘要:

针对电源出力对电网损耗和电压分布的仿真研究表明，沿减小节点电压偏移和提高电网电压水平2个方向搜索可以获得最佳调度方案。为了优化调整分布式电源出力使主动型配电网供电成本尽可能小，该文在对分布式电源对配电网电压分布与线损影响仿真分析的基础上，提出了一种主动型配电网实时优化调度线性化模型和求解方法,分别通过在迭代计算中逐步缩小节点电压限值区间和求解在相同电压偏移前提下全网电压水平最高的优化计算实现最优调度方案的搜索。由简化的配电网回路电压方程，将节点电压表示为节点注入功率的线性函数，从而得到优化调度线性模型，并用IEEE33节点算例验证了模型和算法的有效性。研究结果可为主动配电网优化调度决策方案提供参考。

英文摘要:

Abstract: The active energy exchange in distribution networks of rural areas is becoming more significant with the development and access of DGs and Microgrids. Therefore, the optimization scheduling technology for active distribution networks, in which the DGs as a controllable scheduling unit involved in the distribution network OPF operation scheduling to achieve global optimization of energy management, will be the focus of research in the future rural smart distribution grid.The standing point of active energy optimization scheduling for rural distribution network with DGs, based on the research of real-time optimization scheduling for active distribution network which is achieving three objectives of the network loss as small as possible, the node voltage offset as small as possible and the cost of purchasing power as small as possible, focused on the problem of network loss and node voltage offset with DG's output showing a non-linear relationship which makes the scheduling problem becomes a nonlinear multi-objective optimization problem, based on the simulation analysis that distributed generations affect voltage distribution and line losses of distribution network, a linear model and solution methods for active distribution network real-time optimization scheduling is proposed in this paper. The simulation of generations output to voltage distribution and network loss shows that the optimal schedule scheme can be searched in two directions of reducing the voltage deviation and improving the grid voltage level. This obeys a physical principle, that is, the voltage distribution in the network is smooth, the voltage drop will be small, and the current through the line will be very small for constant line impedance. In addition, higher voltage levels lead to lower currents and net losses when transferring the same power. Thus, in this paper, the two optimization directions are achieved by shortening the range of node voltage limits and calculating the highest voltage level of the network at the same voltage deviation.Based on the above research, a optimization model was established in which maximum node voltage to the whole network was the objective, the simplified loop voltage equation was power flow balance constraint, voltage offset limits satisfying iteration reduction and DGs' output limits are the inequality constraints. Subsequently, it makes use of the features that each node voltage phase angle having little difference in distribution networks to transform the loop voltage equation directly into linear function of the DGs' output, thus the optimization-scheduling model for active distribution network was transformed into a linear programming model. Finally, according to a shrinking node voltage deviation limit value and calculating the highest voltage level of the network at the same voltage deviation, the optimal control scheme was obtained, which can also meet the two objectives of minimum voltage deviation and minimum loss.The model and algorithm are validated in an IEEE33 example, and it was proved when the DGs' output was optimized via the proposed method, the voltage distribution became even smoother, the voltage level was near normal, and the network loss became even smaller. Compared to the conventional non-linear optimization model for the distribution operation, the linear model presented in this paper can not only improve the calculation speed but also is guaranteed to obtain an optimal solution in mathematical theory.

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