Available online at www.sciencedirect.com

SciVerse ScienceDirect

Energy Procedia 14 (2012) 782 – 787

Energy Procedia

ICAEE 2011：27-28 December 2011，Bangkok，Thailand

A new reactive power planning based on system multi-scenario operations

*[a]ShiHong WANG, [b]Hong ZHANG, [a]Rui HE, [b]QingMing XIAO，[a]Jian CHEN, [a]MingChang XU

[a]*Wuzhong Electric Power Bureau,Ningxia Electric Power Company,Wuzhong 751100,China*
[b]*The Department of Technology and Information, NingXia Electric Power Company,YinChuan 750001, China*

Abstract

The reactive power planning involved in the scenario of uncertainty, by processing the scene, several scenes with the state to represent the dynamic process of system development. Traditional reactive planning for a lack of flexibility of the lack of a scene made more flexible reactive power planning ideas, its objective function will split the cost for the initial investment and volatility in two parts, pre-planning to increase by a small amount of reactive power investments, planning program more flexible, can adapt to future changes in the environment. The standard test system is used to validated the effectiveness and practicality.

*Keywords:*multi-scenario; power system; reactive power planning; multi-step optimal

1. Introduction

Reactive power balance is a fundamental factor of ensuring voltage stability. Reactive power generation, supply, and consumption are distributed [1-2]. Only when hierarchy, zoning and distribution of reactive power are properly balanced, can voltage at each nodes be maintained at a safe level. Receiving power networks which are away from load centre lack reactive power support, thus, voltage collapse which lead to disaster may take place of there is disturbance in the power system. Problems of reactive reserve shortage and reactive power location should be solved at reactive power planning stage. Reactive power planning includes two main aspects: investment planning and operation planning. Investment planning aims at deciding the type and capacity of reactive power compensation at each node. Based on investment planning, operation planning is figuring out power of reactive power source and the location of transformer taps in order to ensure that the power system are operated safely, stably and economically.

doi:10.1016/j.egypro.2011.12.1011

Traditionally, reactive power planning depends on experience of planners. Thus, it is possible that compensation nodes may not meet practical needs. [3] proposes pilot nodes concept and the algorithm of pilot nodes selection, and apply it to the selection of best allocation nodes of reactive power source. Based on power flow calculation, [4] works out reactive power compensation nodes and compensation capacity by relative location of power circle. Reactive power planning is to seek for economic compensation strategy of new reactive power sources in next few years. This kind of problems can be turned into planning problems with constraints. Quite a few methodologies at present only considered one running state of power systems and did not consider the impact caused by uncertainties increment which leads to system running state changes. Thus, the system need more investment on reactive power in order to keep system running stably and safely when future real running environment differs from expectation greatly, which leads to flexibility and feasibility of present plan. Therefore, a flexible compensation method based on multi-scenario and reactive power division is proposed, and proposed. The economy, security and practicality of the proposed method are validated by the result of IEEE 14-bus system.

2. Munlti-Scenario Technology And Reactive Power Allocation Priciple

In real power systems, how to deal with uncertainties in future environment is the key of planning. These uncertainties include network topology, load characteristic, power output and so on. Therefore, all uncertain information formed a possible future environment, which is called a scenario. Every scenario corresponds to a system operation state, breaking through traditional methods which only consider maximum-load, minimum-load and normal-load operating mode through entire network topology. By dealing with future uncertainties, multi-scenarios are formed. Multi-scenarios formed a large future environment set. Multi-scenario method is to seek for a planning method which can be adapted to most multi-scenario subsets in future environment set [5-7].

In order to prevent long-distance transportation of reactive power, reactive power compensation needs to achieve hierarchical balance. For regional characteristics of voltage/ reactive power operation and control, sensitivity analysis and electrical division is combined, and nodes with high voltage/reactive power sensitivity are chosen to be candidate reactive power compensation nodes, the choice is based on Pareto principle in the region with inadequate reactive power, in multi-scenario environment [8-10]. In reactive power planning which considers multi-scenario, not only capacitive reactive power compensation is considered to be put in, but also inductive reactive power increase is considered for voltage limit point. The principle of deciding inductive reactive power capacity is: when in fault state and minimum load situation, calculate power flow firstly. If there is a voltage limit point, then adjust location of the tap of on load tap changer. If the requirement still cannot be met, then inductive power should be increased properly. The principle of deciding captive reactive power is: calculate the minimum captive reactive power and it is installed capacity of fixed capacitor. The difference of maximum captive reactive power and minimum captive reactive power is installed capacity of variable capacitor [11-14].

3. Fexible Reactive Power Planning

Flexible reactive power planning refers to: take the impact of all uncertainties into consideration, and use the optimal planning scheme to adapt the changes in future environment in order to make the plan the best on the whole. It is flexible because present planning scheme can adapt to possible changes in future environment, minimizing the cost of reactive power shortages brought about by possible changes of power system in future development[15-16].

In flexible reactive power planning scheme, investment cost consists of two parts: initial investment C and fluctuating cost y. Multiple possible future scenarios are assumed by using multi-scenario technology and combination method, and optimal flexible planning scheme is used to adapt future environment changes, and finally optimal planning scheme is achieved on the whole in this paper.