2nd National Conference on New Researches in Electrical and Computer Engineering
tehran-2017

Improving power system security using corrective control actions and PSO algorithm

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ABSTRACT

Ensuring secure operation of power system is always concerned by researchers and system operators. Due to the non-linear and multi objective environments, the problem of maintaining system security is complex. In this paper, a new method was proposed to improve the security of power system using corrective control actions. The voltage and overload violations were coordinately evaluated.

In previous researches, the control actions of overload or voltage violation scenarios might worsen the other violations. In the present paper, the control actions which are planned for overloads can also improve the voltage violations and vice versa. The main purpose of the study was to detect the overload and voltage violations and recover the system by planning suitable control actions.

In order to optimize the objective function of the security problem, the PSO algorithm was used. The proposed method was implemented on the 30 bus IEEE standard system. The simulation results confirmed that the performance of the proposed method is suitable.

Keywords: Power system security, Corrective control action, PSO, coordinated security improvement

1- Introduction

Maintaining power system security and energy supply for consumers have been always the main concern of power system operators. To maintain system secretly, the power system should remain at normal working conditions. At normal conditions, total energy demand should be supplied at appropriate voltage and frequency levels and power system equipments should work at thermal constraints area. In addition, the power system at normal working state should supply security conditions under error event. This event can be defined as turbulence derived from losing equipment [1]. If the power system is not able to meet security conditions under error event but meet all other normal operation conditions, warning state or unsecure normal state will be [2]. To return to the normal state, preventive control actions are needed. When some of the power system equipments work at normal system conditions without error event presence, beyond thermal or voltage restraints, the power system state is at emergency state. Notably, emergency conditions do not necessarily indicate system collapse but is requires a corrective action [3]. Under such conditions, the power system should be return t normal state sing corrective control actions.

In the previously reported studies, various methods have been proposed to maintain system security sing control actions. Optimal load flow is one of the main methods proposed to present control actions. Various studies have explored decreasing time of problem solving, stability restraints modeling and entering discrete control variables to the problem as well as considering different uncertainties. Linear planning is an appropriate and efficient computational technique in control actions computations employed by different researchers.

Evolutionary algorithms, compared to other methods, have more advantages for control actions computations. The method presented in [2] has the advantage of decreasing computational time using solution segmentation and event selection techniques and this method was found to be superior over Benders method. Of course, the mentioned method is not comprehensive since it does not consider control equipments of distributed productions, load shedding and phase shifter. The advantage of the method proposed in [3] is that it investigates the effect of FACTS in the power system