A Preventive Control for Contingencies Security
Wei-Min Lin, Member, IEEE, Wen-Cha Hung, Cong-Hui Huang, Kai-Hung Lu

Abstract - This paper presents an advance stratagem to prevent contingencies and solve the optimal problem of economic and security dispatch. The dispatch takes outage and limitation of technical constraints into account. In order to ensure steady state stability for accidents, preventive control algorithm (PCA) based on the generalized reduced gradient method processing a preventive contingency set jointly. The technique determines the active power dispatch and voltage of each generating unit before contingent condition so as to minimize the energy re-dispatch cost subject to dispatch, network, and security constraints. A secure process is proposed to control the power system and provide operators with emergency suggestions in deregulated market.

Keywords - preventive control, state steady secure dispatch, power system dispatch

I. INTRODUCTION

As electric utilities have grown in size, and the number of interconnections has increased, planning for future expansion has become increasingly complex. People always seek the economic ways to operate the system and ignore the contingency which is solved by OPF slowly. Unfortunately, the serious problems indeed exist. The stability-constrained dispatch of an electric power system is a difficult task for the system operator. The task becomes much more problematic in deregulated electric industries, where market pressure makes the operator reluctant to take expensive preventive actions in order to guarantee stability, unless the system is in imminent danger of instability. A good compromise between economics and security may be achieved by complementing preventive control with emergency control.

In 1962 [1] Optimal power flow (OPF) was first discussed and become a successful algorithm that could be applied for everyday uses [2]-[3]. OPF can be applied in the system planning, and in the real-time operation for power systems in the deregulation environment. [4] provided an overall introduction on the lambda-iteration method, gradient method, Newton’s method, and the Linear Programming (LP) technique for solving OPF problems.

[6] proposes a novel algorithm to calculate the optimising problem of economic and security dispatch in which DC power flow and limitation on power transmission line capacity are taken into consideration.

[7] describes the philosophy and the implementation of a preventive control algorithm for application in dynamic security assessment. It has been implemented to reschedule the generation in order to guarantee transient stability. The feasibility of the approach is shown through tests on a realistic-sized test network. The equality constraints consists in the discretization at each time step of the differential-algebraic set of equations representing the system. The inequality constraints define a time variant domain where the trajectories of the system should be contained in order to satisfy practical requirements about the performances of the system. The paper is finalized to the Transient Security Dispatch.

This paper proposes a new operation method, PCA, to prevent contingencies from resulting in serious damages when contingency occurs. PCA can reduce the contingency risk and lead power system into a security and economic operation point.

II. Model of Economic and Security Dispatch

A. Amending contingency of system model

When PCA is going to simulate uncertain contingency to implement security dispatch, it is necessity to amend system model opportunely. If every contingency always re-establish system model like Newton-Raphson method, it will spend much time. By like Newton-Raphson method, system model, Jacobian matrix, which is related to admittance matrix is amended easily, when contingency is simulated. Generally the contingencies are classified two parts: (i) generator contingency model amended (ii) transmission line contingency model amended.

(i) generator contingency model amended

From Figure 1, we can get generator contingency amended equation as follow

\[ P_G^F = P_G^{ori} + \Delta P_G \]  

Fig. 1: Generator Contingency Amended Model