UNIVERSITI TEKNOLOGI MARA

DETERMINATION OF TRANSFER CAPABILITY CONSIDERING RISK AND RELIABILITY COST/WORTH ASSESSMENT IN DYNAMIC AND STATIC SYSTEM CASCADING COLLAPSES

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Thesis submitted in fulfillment
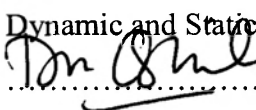of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In a restructured power system, it is important to determine realistic value of Available Transfer Capability (ATC) since this information will be used as a reference by the Independent System Operator (ISO) towards the finest decision making in congestion management especially pertaining to system security and effective electricity market. ATC is the additional amount of power that can be transferred between two areas without jeopardizing the system security and reliability. The determination of ATC must accommodate a certain amount of Transmission Reliability Margin (TRM) vital for resolving between uncertain system securities and maximizing the power transfer. In this thesis, a stochastic framework has been established for ATC and TRM determination by considering uncertainties in hourly peak loads, transmission failures and system cascading collapse. The events of worldwide major blackouts that occurred recently have emphasized on the importance of cascading collapse consideration in determining power transfer capability. The proposed research methodology involved developing an algorithm commenced with a fault occurrence and then followed by the propagation of power system component tripping events which is defined as the system cascading collapse. In this thesis, both static and dynamic operating conditions in a power system are considered in the analysis of system cascading collapse. The assessment of static system cascading collapse is performed wherein its cascaded violation depends on the violation of transmission line limit. On the other hand, the dynamic system cascading collapse is performed by inspecting the violation of generator rotor angle limit and frequency limit starting from the dynamic response of critical clearing time until the final transient stability simulation time. In particular, bootstrap technique is used to generate uncertainties of system parameters comprising with the chronological hourly peak loads, transmission line failures and system cascading collapse. The bootstrap technique is done by replicating the inherent information in order to produce new information considering various levels of system uncertainties. This thesis also introduces on the assessments of risk and reliability cost/worth based Customer Interruption Cost in relation to each case of system cascading collapse. The performance and effectiveness of the proposed techniques were evaluated through the comparison of TRM, ATC, RC and CICC results associated with the static and dynamic system cascading collapses. The results have proven that a large value of TRM is obtained based on the combined uncertainty of chronological hourly peak loads, transmission line outages and system cascading collapse. This signifies that the uncertain tripping events of exposed generator together with exposed transmission lines occurred in the system cascading collapse ultimately will cause to a considerable impact to the TRM and ATC determinations. On top of that, the results of customer interruption cost also have proven that the uncertainty of system cascading collapse should not be ignored from the TRM determination. Therefore, the proposed techniques are reliable and confer promising results in the determination of transfer capabilities, risk and reliability cost/worth of the system.

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