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POWER GRID NODE AND LINE DELTA CENTRALITY MEASURES FOR SELECTION OF CRITICAL LINES IN TERMS OF BLACKOUTS WITH CASCADING FAILURES

Hwachang Song[1], Rodel D. Dosano[2] and Byongjun Lee[3]

[1]Department of Electrical Engineering
Seoul National University of Science and Technology
Gongreung-Dong, Nowon-Gu, Seoul 139-743, Republic of Korea
hcsong@seoultech.ac.kr

[2]School of Electronic Engineering and Information Engineering
Kunsan National University
Miryong-Dong, Kunsan, Jeonbuk 573-701, Republic of Korea
rodel_dosano@kunsan.ac.kr

[3]School of Electrical Engineering
Korea University
Anam-Dong, Sungbuk-Gu, Seoul 136-701, Republic of Korea
leeb@korea.ac.kr

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Abstract. *To investigate and evaluate the mechanism of how cascading failures spread in power grids, this paper presents the concept of network centrality for power systems and related two local indices. These indices can provide look-ahead situation awareness for operators concerning impending large power grid blackouts. These indices are also easy to interpret and can be used to identify the location of critical edge components in terms of blackouts with cascading failures. In this paper, results from the application of the indices to 118-bus test power system are presented.*
Keywords: Cascading failures, Complex network theory, Delta centrality index, Multiple contingency, Power grid blackouts

1. **Introduction.** Blackout history in [1,2] and descriptions of the 2003 blackout in the U.S. and Canada [3] indicated a crucial warning in power system vulnerability that led to even bigger and more damaging outages. This is a major crisis arising from those phenomena, probably forcing catastrophic events to occur that would have otherwise been unexpected if adequate control schemes had been applied in advance. In the last few years, the level of allowable capacity in a power system has been reduced; mostly due to the deregulation of the power industry, which focused more on economic features of power system operation and planning. Currently, the system is already at the point where the need to install more generating facilities for sustainable energy resources is highlighted. Thus, system planning and related implementations that take into consideration possible catastrophic events due to structural and energy resource deficits are very important.

In the literature, several works on widespread blackouts in power systems have been investigated using various models. One type is based on the cascading failure model, most of which are based on artificial systems with the intent of understanding the blackout process, such as the OPA model [4], CASCADE model [5], branching process model [6] and hidden failure model [7]. These models have previously gained a great deal of interest. Due to the continued growth of the importance of the topic, many other aspects of network