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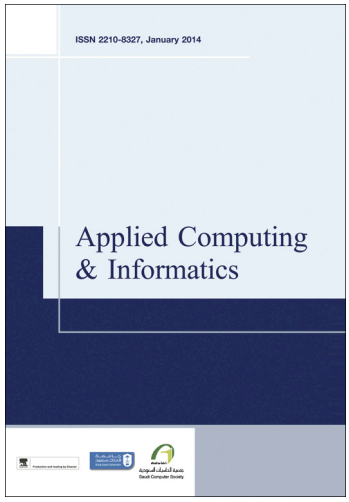

Interdependencies and Reliability in the Combined ICT and Power System: An overview of current research

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INTERDEPENDENCIES AND RELIABILITY IN THE COMBINED ICT AND POWER SYSTEM: AN OVERVIEW OF CURRENT RESEARCH

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Abstract
The smart grid vision implies extensive use of ICT in the power system, enabling increased flexibility and functionality and thereby meeting future demands and strategic goals. Consequently, power system reliability will increasingly depend on ICT components and systems. While adding functionality, ICT systems also contribute to failures, such as hidden failures in protection systems, as has been exemplified by recent power outages. It also brings new threats, such as that of cyber-attacks. To ensure effective power system reliability, the interdependencies between power and ICT systems need to be properly understood. This paper provides an overview of main interdependency categories, as well as methods that can be used to identify and study interdependencies. Based on a study of recent papers in major archival journals, we conclude that appropriate methods for identification of interdependencies between power and ICT systems seem to be lacking. In addition, current methods seem unable to both cover the power system at large, and at the same time take into account the full array of intentional and accidental threats. Based on these findings, we make recommendations for future research in this field.

Keywords:

Interdependencies, smart grid, power system, ICT, reliability, cyber-security

1 Introduction

Information and communication technology (ICT) systems are an increasingly important part of power systems. Traditionally, it is primarily the office systems that have been regarded as ICT systems, but there are an increasing number of systems for automation, control and protection that utilise ICT and are tightly integrated with the power system. Power systems with extensive ICT and smart components are often termed smart grids. Smart grids promise increased flexibility and functionality, both in normal operation and for handling of failures and unwanted incidents in the grid, and are expected to be the future power system of choice, enabling both future demands and national and international strategic goals to be met [1].

While adding functionality, ICT systems also contribute to failures, such as hidden failures in protection systems, as has been exemplified by recent power outages [2-4]. The increased complexity and use of ICT in smart grids can affect the reliability of power supply negatively in ways that are not presently fully known or understood. Technical and organisational interdependencies between the power and ICT systems cause new potential vulnerabilities, as well as common cause