

Editorial

Protection of Future Electricity Systems

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1. Introduction

The electrical energy industry is undergoing dramatic changes; the massive deployment of renewables, an increasing share of DC networks at transmission and distribution levels, and at the same time, a continuing reduction in conventional synchronous generation, all contribute to a situation where a variety of technical and economic challenges emerge. As society's reliance on electrical power continues to increase as a result of international decarbonisation commitments, the need for the secure and uninterrupted delivery of electrical energy to all customers has never been greater.

One of the important areas, sometimes overlooked, is power system protection, which is a safety-critical component of all electrical systems. The fast and reliable detection of abnormal conditions, as well as the identification and prompt removal of faulty components, help in preserving system integrity and minimise the potential negative impact on the rest of the grid. The consequences of a major failure of the transmission system protection, likely leading to system backout, are difficult even to imagine.

Therefore, there is a pressing need for innovation and a new, long-term strategy in power system protection. We hope this Special Issue makes a useful contribution towards this goal. We present 10 interesting papers that cover a wide range of topics, all related to protection system problems and solutions.

2. Short Review of Contributions

Adaptive protection: The idea of adaptive protection, where relay settings are modified in response to changing system configuration or operating conditions, has been present in the technical literature for quite some time. While in the past its practical application was not perceived as critical and was also limited by technological constraints, the development of numerical multifunctional relays accompanied by digital communications, as well as increased system-fault-level variability, has enabled adaptive protection to progress to practical applications. In this issue, we include two papers [1,2] which propose adaptive solutions for both high-voltage transmission systems and distribution-level microgrids.

Protection of DC systems: There are many situations where DC electricity systems are preferable to AC systems, especially when considering rapid advances in power electronic converter technologies and the utilisation of energy sources which naturally produce DC power, such as photovoltaics or batteries. Both HVDC and LVDC systems are being developed, and the protection of such networks has a separate set of challenges in terms of ultra-fast fault detection and classification requirements, fault-ride through capabilities, and DC fault current breaking. Therefore, we are pleased to present four papers [3–6] that tackle various aspects of DC network protection.

Enhanced/unconventional protection-systems: There is always a plethora of papers that aim to improve the operation of conventional protective methods, either by utilising advanced processing techniques or by taking advantage of emerging technological developments (e.g., distributed sensing technologies). This issue is no exception. You will find



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some fine examples of unconventional thinking and innovation in most of the presented papers (e.g., [3,5,7,8], to highlight a few).

Protection of superconducting transmission systems: Due to the introduction of superconducting cables, long-distance, superconducting electricity transmission has recently become a reality. Due to their unique physical characteristics, such cables require special attention when it comes to protection. We are pleased to present one paper [9] which specifically addresses this new, exciting area of research.

Lightning protection: Last but not least, we present one paper which addresses an important aspect of lightning protection in building integrated photovoltaic modules [10].

3. Conclusions

We sincerely hope the papers included in this Special Issue will inspire both academics and protection system practitioners to further develop much-needed solutions for the safe operation of future electricity systems. We strongly believe that there is a need for more work to be carried out, and we hope this issue provides a useful open-access platform for the dissemination of new ideas, as well as a catalyst for further protection innovation.

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