CERIS Civil Engineering Research and Innovation for Sustainability

Fire risk analysis in electrical installations

Summary

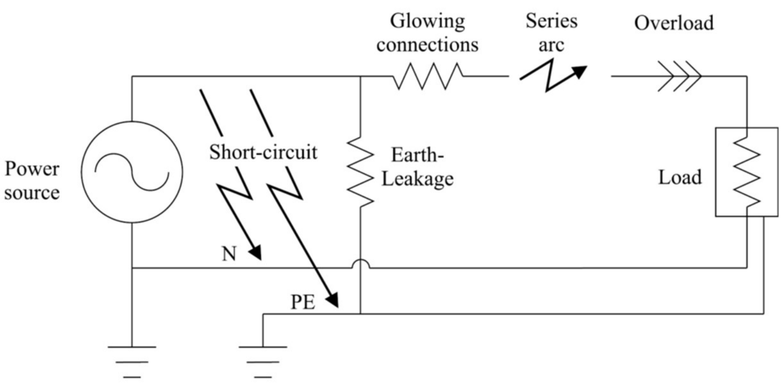
This study aims to deepen our understanding of electrical fires by investigating the mechanisms and modes of failure in electrical installations. Utilizing Fuzzy Petri Nets, it was mathematically modeled these mechanisms to showcase a practical application for risk analysis in electrical installations. The focus was on elucidating the processes leading to electrical fires and providing a robust tool for risk identification and quantification, which is invaluable for engineers, safety professionals, and technicians. This approach offers a solid foundation for implementing more effective preventive measures and informed risk mitigation strategies.

The developed methodology highlights the capability of simulating various failure scenarios and their potential outcomes, significantly contributing to the fields of safety engineering and risk analysis. By providing a detailed and clearer view of the dangers associated with electrical installations, the work aimed not only to enhance safety in such environments but also to promote a culture of prevention and awareness regarding electrical fire risks. In conclusion, the challenge of modeling electrical fires is underscored by the high number of variables and the intricate network of interactions among them. The use of Weighted Fuzzy Petri Nets (WFPN) has emerged as a powerful and efficient tool in modeling these system responses, incorporating knowledge representation, reasoning, and uncertainty management. These attributes are crucial for tackling the subject's complexity, surpassing the capabilities of traditional methods.

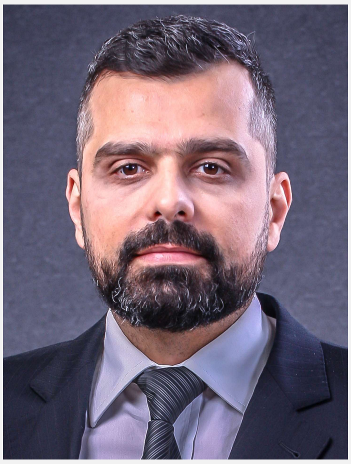
The study successfully achieved its primary goal of developing a mathematical model for the network of electrical failures leading to fires. This model, enriched by the mapping of failure modes and mechanisms, provides a sophisticated mathematical representation of the complexity and interconnectivity of elements contributing to electrical-origin fires. Specific objectives, including the identification of hazards, risk factors, and potential critical failures, were also effectively met. Highlighted issues, such as inadequate electrical connections, wire ruptures, and insulation damage, among others, have been identified as key contributors to electrical fires. These findings led to the identification of 60 factors interconnected through 34 transitions, forming a comprehensive and robust Fuzzy Petri Net capable of simulating electrical fault evolution. The practical utility of the model was further demonstrated through case studies, highlighting its potential. A generalist algorithm, developed and implemented in Matlab, facilitated these case studies, underscoring the model's applicability and reinforcing its significance in enhancing electrical safety and fire prevention efforts.

Keywords

Electrical fire modeling, fire prevention, risk assessment, weighted fuzzy petri nets.



Depiction of key electrical faults leading to fires.



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