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# RESILIENCE OF CRITICAL ENERGY INFRASTRUCTURE: A MULTI-CRITERIA ASSESSMENT OF THE ŽILINA HEATING PLANT

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**Abstract** – This case study, developed within the APRIORI project, focuses on assessing the resilience of a district heating system as a key element of national critical energy infrastructure. The object under analysis is the Žilina Heating Plant, one of the largest district heating facilities in Slovakia, supplying heat and electricity to approximately 20 000 households and essential public institutions. The study examines the resilience of district heating systems considering technical, organizational, environmental, and security perspectives, with particular emphasis on risk identification and threat assessment. Identified threats include technological failures, fire hazards, environmental impacts, cyber threats, and intentional attacks, as well as long-term challenges such as infrastructure ageing and dependence on fossil fuels. A structured multi-criteria decision-making approach, using TOPSIS, was applied to evaluate the severity and priority of the identified risks. The criteria reflected key dimensions of district heating resilience, including probability of occurrence, repair costs, transmission and supply losses, restoration time, and impact intensity. The results confirm that the Žilina district heating system is a critical element of regional infrastructure, whose continuous operation is essential for energy security, public safety, and social stability. While the system benefits from experienced personnel, established emergency cooperation, and partial technological modernization, vulnerabilities remain in areas such as fuel dependency, automation level, and environmental burden. The case study demonstrates that resilience enhancement in district heating systems can be effectively achieved through a combination of traditional preventive measures and advanced technologies, including automation, digital monitoring, predictive maintenance, and cybersecurity protection. The findings contribute to the validation of the APRIORI resilience assessment methodology and provide practical recommendations applicable to district heating systems in other European regions.

**Keywords** – *Critical Infrastructure resilience; district heating; energy security; multi criteria analysis; resilience assessment; risk analysis*

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