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Seismic loss assessment: the case study of the power distribution network in Arak city, Iran

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ABSTRACT

Vital infrastructures have, nowadays, a high level of importance in urban areas. Any disruption in one of the infrastructures can cause severe impacts on inhabitants and consequently can affect the other infrastructure systems. In this regard, the electricity grid is considered to be one of the most critical infrastructures, and it has been performed vulnerable to natural hazards, specifically in past earthquakes. Iran is located in a high seismic activity region. Therefore, in this study, the seismic vulnerability of the power distribution network in Arak city has been comprehensively investigated. The power grid has three sections consisting: the electricity generation, transmission, and distribution. In this study, a seismic risk analysis was carried out on its distribution section. The obtained results show that the seismic hazard in the north-eastern part of Arak city is at the lowest level, and in the south-west region, it is at the highest level. Then, the potential damage to the network and the possible financial losses have been calculated. It was revealed that the 315 KVA transformer substations, 615 KVA transformer substations, and finally transmission lines, are at the highest seismic risk of financial damage. According to the obtained results, the probable financial losses for a return period of 475 years event for the 315 KVA transformer substations, the 615 KVA transformer substations, the transmission lines with 120 mm and 70 mm aluminum wires are, respectively, 22300000, 5717000, 270000, and 700000 U.S. dollars.

Keywords: **Probabilistic Seismic Hazard Analysis, risk-mitigation, decision making, earthquake loss estimation**

1. INTRODUCTION

Since the beginning of creation, the human being has been confronted with the issue of natural disasters, and has tried to control their effects while protecting his life from these dangers. Among natural disasters, earthquakes have unique characteristics, and in the last century, earthquake crisis management has become more critical. In recent years, on average, every five years, severe earthquakes have occurred in Iran with considerable financial and personal injuries. Iran is one of the countries where the earthquake is associated with high death tolls. The need for electricity, especially in critical situations following natural disasters such as earthquakes, is essential to carry out emergency and crisis management activities in different sectors. Therefore, there is a need for seismic evaluation of different parts of power distribution networks and their improvement in earthquake safety. The power distribution network is a vital infrastructure, and since every vital infrastructure affects a set of urban equipment, it also has a direct and indirect impact on other vital infrastructures. In fact, paralyzing one vital infrastructure causes other vital infrastructures to malfunction and consequently not able to supply the necessary power to stakeholders. Vanzi (1996) presented a model to test the seismic reliability of electric power networks. Subsequently, Rose et al. (1997) proposed a method for estimating regional economic losses for earthquake damages to power lines in which their method was further used by a number of researchers [1- 5]. Chang and Wu (2011) studied the electricity grid in China and found that most of them are near critical points and also vulnerable to external disturbances such as hurricanes and earthquakes that may cause power outages [6]. Giovinazzi et al. (2017) exemplified the potentialities of Decision Support Systems (DSSs) created in the framework of the EU-funded project, which enabled them to perform a risk assessment for Critical