

Energy Sustainability and Energy Efficiency in Disaster Management

Gamze Gürsu*, Aysu Şahin, Nevin Taşaltın
Maltepe University

Abstract

Due to its geological, tectonic, meteorological, seismic, topographic, and climatic structure, our country is frequently faced with natural disasters such as landslides, especially earthquakes, such as floods, rock falls, etc. Our country ranks third in the world in terms of human loss in earthquakes and eighth in terms of the number of people affected by earthquakes. Disasters affect community life and lead to loss of life and property. The first stage after a disaster is during the disaster affected victims, health services, food, and shelters. In disasters, power generation plants, energy transmission lines, substations and transmission equipment become inoperable due to destruction. Therefore, one of the most important needs in disasters is the supply of electrical energy.

Centrally managed electricity networks are developed to supply electricity over long distances with high voltage, pass through different geographical conditions and are based on a complex structure to balance changing demand and supply. In addition to restructuring the electricity system according to new needs in line with contemporary technology and digitalized methods and including a new production-consumption structure that focuses on the consumer, its durability and reliability against disasters that grow and become more frequent with climate change should also be taken into account. Electricity generation facilities and transmission and distribution infrastructure have varying degrees of vulnerability to natural disasters. During a natural disaster, three main types of events can lead to system failures: transmission and distribution grid failure, generation facility failure, and fuel-maintenance supply chain disruptions.

Keywords: electricity networks, disaster, energy sustainability, energy efficiency

Introduction

During a natural disaster, three main types of events can lead to system failures: transmission and distribution network failure, generation facility failure, and fuel maintenance supply chain disruptions.

Table.1: Risk status of electricity generation facilities, substations and transmission and distribution networks against natural disasters (The World Bank, 2019)

Species	Earthquake	Hurricane	Flood	Tsunami	Fire	Drought	Over-temperature
Thermal Power Plants	High	High	Medium	High	High	High	Medium
Hydroelectric Power Plants	High	Low	Medium	Low	High	High	Medium
Nuclear Power Plants	High	Medium	Medium	High	High	High	Medium
Solar-Power Plants	Low	High	Medium	Medium	Medium	Medium	Very Low
Wind Power Plants	High	Medium	Low	Medium	Very Low	Very Low	Very Low
Transmission and Distribution Lines	Medium	High	Low	Medium	High	Medium	Medium
Substation	High	High	High	Medium	High	Low	Medium

These safety risks are taken into consideration when designing electricity generation facilities. Nuclear and hydroelectric power plants cause much greater damage and Unlike other energy infrastructures because they can cause losses is evaluated. Therefore, their safety is handled with great care and Their designs are subject to high standards.

• In natural disasters, all points of the electrical system pose different risks. For example, in a flood disaster, transmission and distribution lines are slightly affected, but It can be said that the transformers in the network may be highly affected.

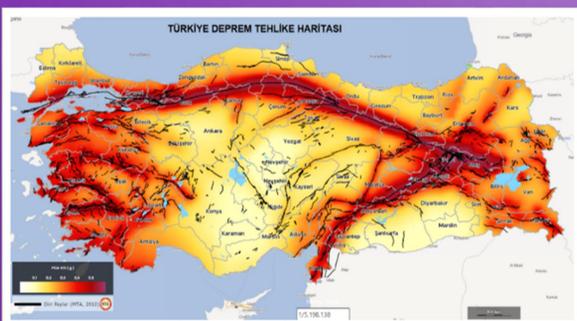
• Solar power plants have less damage than other power plants in an earthquake disaster. It can be concluded that it will be affected.

• It is known that transmission distribution lines and transformers are most negatively affected by the forest fires that we frequently experience in our country. Therefore, natural disasters They have different effects on the electrical system. In this context, the electrical system holistic disaster management strategies and planning to ensure reliability is needed.

• Turkey is one of the geographies where the largest earthquakes have occurred throughout history is one. In addition, natural disasters triggered by climate change and global warming Its incidence and impact are in our country as in many parts of the world. has increased (GFDRR, 2015).

• According to the research of the World Meteorological Organization covering the last 50 years, climate The number of disasters caused by these conditions has increased 5 times since 1970. Report. It reveals that more than 2 million people lost their lives in these disasters. According to research, the most negative effects of climate change are One of the regions that will be affected is the Eastern Mediterranean, which includes our country. It is the basin.

• Statistics and our experiences since the early 2000s reflects the consequences of climate change. earthquake in Turkey and the painful consequences of natural disasters, earthquakes and natural disasters in many cities of Turkey. It is clear that there should be a new structuring and urbanization resistant to disasters. (Disaster and Emergency Management Authority of Turkey, 2023).

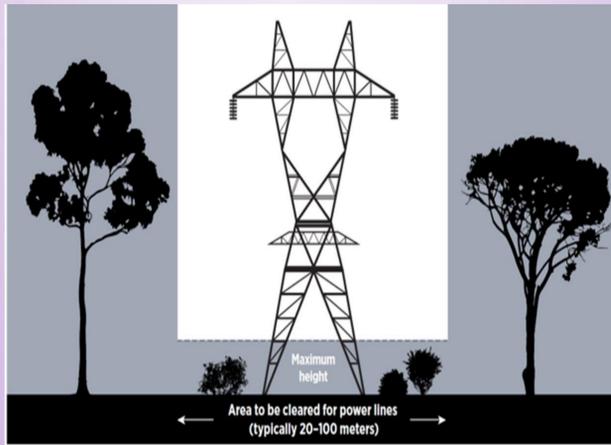


• In addition to earthquake resistance and disaster resistance of buildings and cities Besides, they must be compatible with a new electrical system and digital technologies, and It is important that they meet all parameters that take sustainability into account. Renewable energy sources are both effective against the negative effects of climate change. For protection and because it is local, cheap and does not require raw materials These are resources that should be encouraged and disseminated. Again Within the scope of structuring, these resources will affect our cities and energy system. It also serves to make it resistant to earthquakes and other natural disasters.

• The energy sector is affected by various events caused by climate change likely to increase vulnerability. Increasing frequency of drought and As temperatures increase, nuclear and thermal energy efficiency also increases. has increased. (Mideksa and Kallbekken 2010). Climate change also causes floods It will also affect the frequency and hydrological outcomes (Döll and Schmied 2012).

Exposure of the global power system to natural hazards and risks

• Traditionally, vegetation management around power lines has been It is based on the protection of the cover. Usually six to 15 in both A meter buffer is used. Edges of medium voltage lines, low growth The region is limited around transmission lines. (10 to 50 on each side meters) (Energy Queensland Limited, 2019).



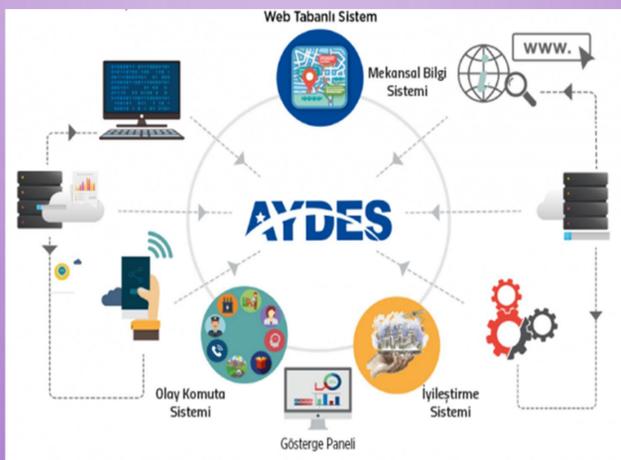
Disaster Management and Decision Support System (AYDES)

• AYDES, built on Geographic Information Systems, provides decision support mechanisms that can manage all resources effectively It is a web-based application.

• AYDES, which is also the IT infrastructure of Turkey Disaster Response Plan (TAMP), It basically consists of 3 components.

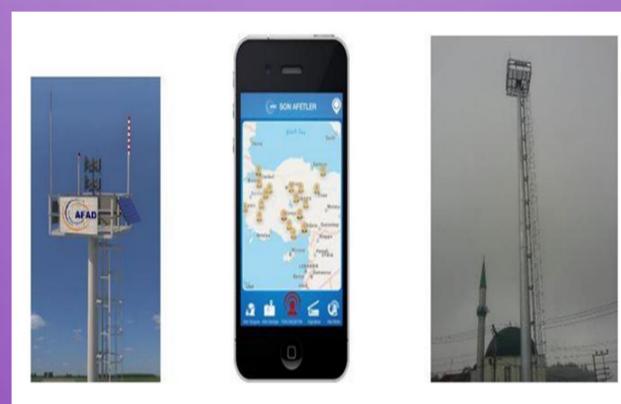
1. Incident Command System
2. Spatial Information System
3. Healing System

System Components of AYDES (Turkey Country Report, 2019)



• In order to ensure communication between relevant institutions in disasters and emergencies Emergencies as a pilot in Ankara, Eskisehir and Zonguldak disasters and emergency centers and METEOROLOGY - TAEK- GDF - DSI - TRT. An uninterrupted and secure communication system has been established between

Early Warning and Alarm system



Emergency logistics warehouses

• Ensuring transparent tracking and monitoring of provincial emergency centers and 23 emergency logistics warehouse networks provides great added value. entities. These logistics warehouses are scattered throughout the country.

• Fully equipped warehouses with first aid emergency support, including positioning. Tents, blankets, food supplies, etc. in earthquake risk areas. makes it easier to distribute (Peer Review of Turkey, 2015)



Conclusion

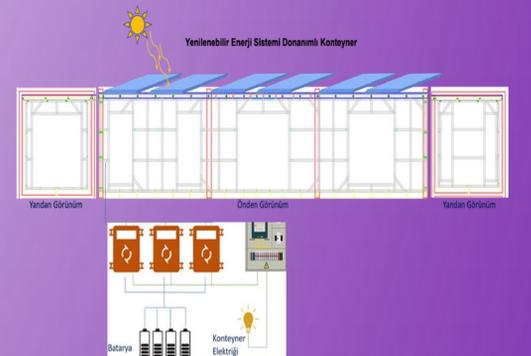
• Within the scope of disaster management, meeting the energy needs that will occur after the disaster meeting, ensuring the sustainability and efficiency of energy Emergency planning and implementation in case of disaster is extremely important It is important. Energy distribution companies, earthquakes on the earthquake map of our country "high capacity generator" they installed in high-risk areas should increase its number.

• There is a separate unit for alternative use in emergency situations, especially in big cities. Establishment of power plants and electricity transmission and distribution lines is required. Electricity to the streets with powers ranging from 25-150 kVA Installing generators that will provide telephone connections to the external panels of these generators.To place sockets where charging needs can be met and to prevent disaster at any time. Transferring fuel to these generators at regular intervals with the thought that It is necessary.

• Electricity from renewable energy sources (solar, wind, thermal, etc).

residential buildings, public-university-industrial establishments locations and related inventory information in a single digital file, available to the public It should be located in an environment that can be easily accessed via the mobile application. Solar energy has a high potential due to the geographical location of our country. .

• In our country, the sunshine duration is approximately 2,800 hours per year. Lighting, heating, operating small household appliances, charging phones to be done etc. solar energy to meet the electricity needs in areas Energy can be produced with energy system, such as battery systems high-performance energy storage systems where energy can be stored Containers need to be produced and disseminated



References

- The WORLD BANK. 2019. STRONGER POWER Improving Power Sector Resilience to Natural Hazards. <https://www.afad.gov.tr/turkiye-deprem-tehlike-haritasi>
- Mideksa, Torben, and Steffen Kallbekken. 2010. "The Impact of Climate Change on the Electricity Market: A Review." Energy Policy 38 (7): 3579–85.
- Döll, Petra, and Hannes Müller Schmied. 2012. "How Is the Impact of Climate Change on River Flow Regimes Related to the Impact on Mean Annual Runoff? A Global-Scale Analysis." Environmental Research Letters 7 (1): 014037.
- Energy Queensland Limited. 2019. "Vegetation Management Strategy."
- Turkey Country Report | VR2019A ADRG National Progress Report On The Implementation of The Hyogo Framework for Action (2013-2015).
- GFDRR. 2015. Europe and Central Alisa (ECA) Risk Profiles: Turkey. Accessed on 02-Sep-2022. Available at: <https://www.gfdr.org/sites/default/files/Turkey.pdf>
- <https://www.sbb.gov.tr/wp-content/uploads/2023/03/Turkiye-Recovery-and-Reconstruction-Assessment.pdf> Accessed on 22-Sep-2023.
- Peer Review Turkey. 2015. 2015-2016 Programme for peer reviews in the framework of EU cooperation on civil protection and disaster risk management.
- Disaster and Emergency Management Authority of Turkey. (2023). "Turkey Recovery and Reconstruction Assessment." Retrieved from <https://www.sbb.gov.tr/wp-content/uploads/2023/03/Turkiye-Recovery-and-Reconstruction-Assessment.pdf>, accessed on 22-Sep-2023.