PERFORMANCE ASSESSMENT OF POWER DISTRIBUTION NETWORK IN 2013 BUSHEHR, IRAN EARTHQUAKE

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On 9th of April 2013 at 16:22:50 PM in local time, an earthquake was occurred in Dashti city of Bushehr province in southwestern of Iran. The magnitude and depth of earthquake was 6.2 (ML) and 20km from IIEES and 6.3 (MW) and 10km from USGS reports. The epicenter of earthquake was located at 51.59E-28.48L. Epicentre location of this earthquake has shown in Figure 1. The horizontal recorded peak ground acceleration (PGA) of earthquake was 0.25g.

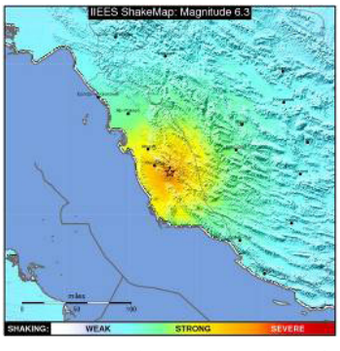

Figure1. Epicentre location of earthquake (IIEES)

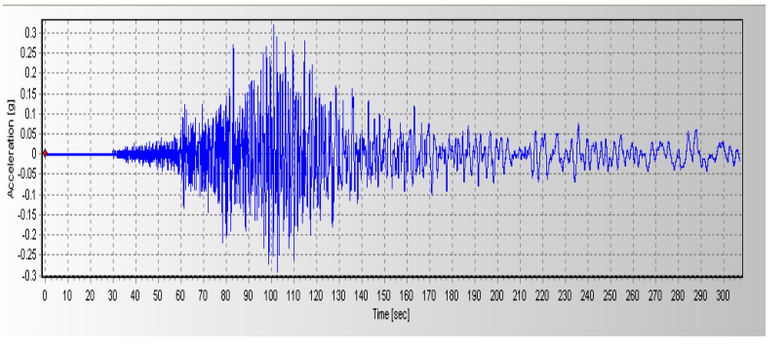

Figure 2. Seismic Accelerogram recorded in Alihoseini Station

During this earthquake, several damages and losses in buildings and other facilities were observed in Shonbe, Kaki and Khormuj cities and their around villages.

In this paper, performance of electric power distribution network in this earthquake-stricken area and seismic damages in their structural parts are presented. In addition, seismic vulnerability of some components of distribution network have been assessed using qualitative and quantitative methods and compared with their real behavior subjected to this earthquake. Finally, rehabilitation methods have been proposed and studied for vulnerable components.

Many components of electric power distribution network suffered damage due to this earthquake. A damaged overhead distribution substation has been shown in Figure 3. In this substation, failure of steel support of transformer due to earthquake was lead to overturning and falling transformer. As the other example, crushing occurred in a concrete pole of overhead 20kv distribution line has been shown in Figure 4. This failure occurred in the bottom of pole and was lead to deviation of pole from vertical.

Figure 3. Falling of overhead transformer

Figure 4. Concrete crushing in 20kv overhead pole

In order to further investigation about failures, a seismic assessment of typical overhead substation in damaged area has been performed using nonlinear dynamic analysis subjected to some recorded earthquake accelerograms (Figures 2 and 5). The results indicated that common unbraced transformers on overhead substations are seismically vulnerable and need to be retrofitted. Furthermore, the qualitative assessment of distribution poles has been performed by seismic capacity curves that shown in Figure 6. These seismic capacity curves have been developed analytically to qualitative assessments of common concrete distribution poles (Zekavati et al., 2013) and needed to be evaluated and verified in real earthquake situation. The qualitative assessment results have shown good agreement with actual observations.

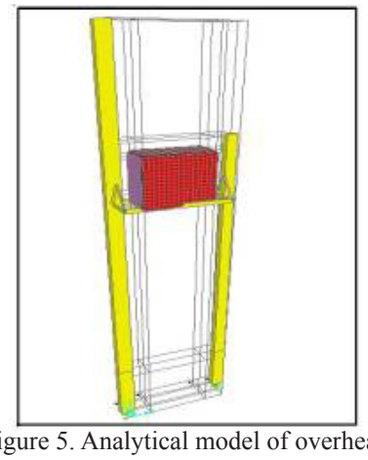

Figure 5. Analytical model of overhead distribution substation in SAP2000 software

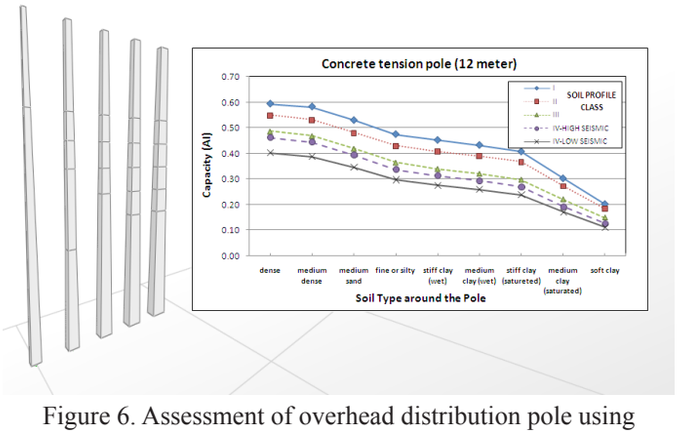

Figure 6. Assessment of overhead distribution pole using seismic capacity curves (Developed by NRI)

Finally, some rehabilitation methods and details have been proposed for investigated components in the similar situations to prevent failure and increase reliability of distribution network during the future earthquakes.

REFERENCES

Tavanir Organization Standards (2012) Guideline-Seismic Assessment & Retrofit of Distribution Network, Iran Power Generation Transmission & Distribution Management Company, Tehran, Iran

Tavanir Organization Standards (2012) Guideline-Emergency Management-Final, Iran Power Generation Transmission & Distribution Management Company, Tehran, Iran

Tavanir Organization Standards, Management and Planning Organization Office (2007) General Technical Specification and Execution Procedures for Aerial & Underground Distribution Network (MV/LV)

www.iiees.ac.ir, International Institute of Earthquake Engineering and Seismology

Zekavati A, Jafari MA, Rahnavard A, Yavartalab A and Samadi M (2013) Development of Seismic Capacity Curve (S.C.C.) For Power Distribution Concrete Poles, Cired 2013, *22nd International Conference on Electricity Distribution,* Stockholm