REDUCING THE UNFORESEEN INCIDENTS DAMAGES (EARTHQUAKE) BY USING ROUND POLES AND REDUCING THE POLE MOUNTED DISTRIBUTION TRANSFORMERS POWER

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ABSTRACT

Iran is a country that is located on one of the biggest faults in the world, which is stretched from Italy to China. It is a strong reason for disastrous incidents to happen in this area. Among all 33 natural disasters that happen consecutively in different parts of the country, earthquake is the most perilous one. About 950 earthquakes have occurred in Iran in current decade, and many fundamental facilities and vital urban plants, e.g. electricity, have encountered drastic predicaments [1]. For instance, Bam earthquake can be mentioned, in which fundamental rural and urban facilities suffered from severe damages, including the electricity network.
In this article, in addition to briefly investigation of losses occurred due to Bam earthquake on Electricity distribution networks, some proposed solutions are also presented that their approaches have been recently Developed and implemented in Mashhad Electric Energy Distribution Company (MEEDC) to Prevent and reduce vulnerability in such disasters.

THE EARTHQUAKE AND DAMAGES OCCURRED TO BAM ELECTRICITY DISTRIBUTION NETWORK

According to Tavanir, the center of electricity distribution management on Bam earthquake [2] , residential and official buildings and their facilities (Internal systems, plumbing, water, electricity and telecommunication lines…), as well as the utilities of electricity distribution network of the city suffered from severe damages including 40% damages on 318 devices of air distribution posts and dug from the base and fell of 40 to 50 transformer units (figure 1&2). Maximum vertical acceleration of earthquake which was 1.01g (g is Gravitational acceleration) near Bam Fault, great vertical displacements of electrical equipments, especially in soft soils Caused considerable damages to the medium voltage and low voltage lines. Many electrical square poles were ruined and its reasons were mostly rotation, reversal, bending of armatures (bars) of poles due to breaking concrete covers or the stirrups of poles (figure 3) or the failure of lower areas and these poles were under wire tension and the pressure and heaviness of transformers and other accessories on top of them. Falling of street lights due to the great horizontal seismic acceleration was another damage of this earthquake (figure 4&5). The investigations showed that the amount of damage to distribution lines in the Northeast, East and North of the city was much more extensive.

Figure 1. The transformers are falling and the bushings are breaking

Figure 2. The falling of transformers from the pole and the breaking of bushings

Figure 3. Square concrete pole break down in Bam earthquake

Figure 4. The breaking of electricity poles Particularly in the lower and

Figure 5. The falling of street lights

THE EARTHQUAKE VULNERABILITY FOR SOME ELECTRICITY-RELATED STRUCTURES

Nowadays, new projects are considerable comparing to the total current facilities. The designing style and used materials in new facilities play an important role in increasing or decreasing the security of them. Improving the quality of new structures and changing the kind of designing in a shorter period of time reduce the risk. In this direction, two dangerous focuses should be pointed out via obtained experiences and consequences of crisis management and identifying the vulnerable points in Bam earthquake:

1. Heavy and powerful overhead distribution transformers
2. Square concrete poles

BENCHMARKING THE EXPERIENCES OF SOME COUNTRIES

Today, the technology development and modernity of life have doubled the importance of Electrical continuity and stability of the power networks. In this regard, one of the main goals of the Custodians of electrical energy is to increase its reliability and stability. According to the Iranian plateau causing critical changes and transformations in recent years such as flood, local storms and different earthquakes and damages in the context of national disaster, doubles extensive and broad studies on the advantage of experiences and measures taken in developed countries that were successful in controlling the damages caused by natural disasters. It should be done in applying modern technologies in the field of electrical power distribution in a form that Due to problems arising from natural unexpected events in Iran the network stability is remained. According to visits and surveys conducted in different countries such as Japan, South Korea, Malaysia and even Indonesia which are mostly located in earthquake overall strip it was found that these countries widely use Round concrete poles in their electricity distribution networks and The results from numerous earthquakes in these countries represented that the vulnerability of electrical distribution networks and their damage is minimized (figure 6,7&8).

Figure 6. Indonesia Electricity Grid

Figure 7. Japan Electricity Grid

Figure 8. South Korea Electricity Grid

OFFERED SUGGESTIONS TO REDUCE THE VULNERABILITY

The 1st Solution: Studying former incidents, such as Bam earthquake, electricity distribution networks through the city look problematic in a resistance against the earthquake viewpoint. For instance, almost all square concrete poles have been ruined due to the Bam earthquake, while round concrete poles tolerate the earthquake lateral inertia. Thus, replacing the square concrete poles by round ones is one of the suggested solutions. (please see Figure 9)

Figure 9. Using the round poles on Grid

The 2nd Solution: Installing heavy transformers in high position is another problem in this case. It has been proved experimentally that considering the lateral earthquake power, the heavier the facilities and accessories on the poles are the less resistance and tolerance of them is. Reducing the power and the weight of the overhead distribution transformers is a proper strategy to solve this problem. Currently this strategy is performing in Mashhad Electricity Distribution Network. [3] (please see Figure 10 &11)

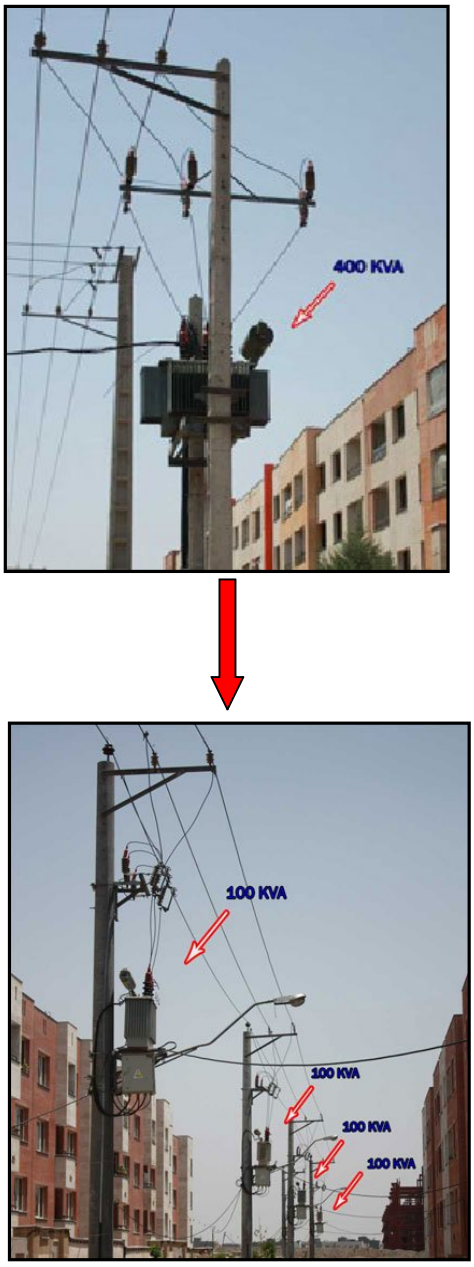

Figure 10. Use less power transformers 100KVA instead of using a high-power transformers such as 400KVA

Figure 11. Use less power transformers ٥0KVA

CONCLUSION

As you know, electricity energy is one of the unavoidable necessities of human life that even its short time damage can stop public servicing and can even cause greater losses and damages. For this reason, the phase of prevention and reducing its effects and vulnerability is one of the fundamental issues of today's electricity industry.
On the other hand Iran, due to its Tectonic position, witnessed a destructive earthquake every so often that cause damage to infrastructures and vital arteries that according to Comprehensive development of construction and infrastructure facilities such as power distribution networks, it is essential to have serious step toward planning and preventing the damages caused by natural disasters. So the Custodians of power distribution networks should take necessary measures in prevention section by careful planning if an accident occurs, fewer complications and failures may happen. These measures are usually hardware that according to the mentioned cases the designers should have special look at applying round beams in electricity distribution networks. Of course, this change of attitude has happened in Mashhad Electric Energy Distribution Company today and the round poles are broadly used in development and rehabilitation of distribution networks currently.

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