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Research Paper

Crisis Management of Electricity Distribution Networks using Geographic Information System (GIS) and Appropriate Positioning Equipment from the Perspective of Passive Defense

Mohammad Hosein Sharif Jafari [a] , Bahareh Khojastehpour [b] , Zeinab Zarei [c]

[a,b,c] Azad Islamic University, RS and GIS group, Iran, Yazd
Express_317@ yahoo.com

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Abstract

management is assumed as evidence for creating passive defense in protection of the equipment in reducing the effects of natural disasters like earthquakes, floods, fire, and etc. Actually, the preventive efforts for immunity of national infrastructures and decreased vulnerabilities are made in order to gradually prepare conditions for their security. The electricity sector is one of the vital infrastructures in a country, and it requires immunization against any type of natural disasters and appropriate topology for the sake of reducing crisis upon occurrence of accidents in this system in terms of passive defense. Through the integration of information bank of all national important infrastructures for proper crisis management in any province, one could take some efficient measures with respect to time management and to reduce the crisis. The crisis management tends to prepare the community for prevention, readiness, rescue, and reconstruction with appropriate planning. The application of state-of-the-art technologies and computerized systems is considered as one of the paramount elements, which are required in dealing with crisis today.

In the present paper, we deal with the special capabilities of Geographic Information System (GIS) in Electric Industry in order to increase speed and accuracy to access information and thus to make decisions at time of emerging crisis and immunization of infrastructure of national electric industry through appropriate positioning from the viewpoint of passive defense.

Keywords: Crisis Management, Passive Defense, Positioning, Geographic Information System (GIS).

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1. Introduction

Crisis is an event which is caused naturally or abruptly by human beings or procedural and crisis management refers to a set of actions that are performed before, during and after the incident in order to reduce further effects of the crisis. Crisis is a stage, in which uncertainty
about assessing a situation and its important strategies can be increased, while controlling of the event and its impacts is usually reduced. Since Iran is one of the top ten disaster-prone countries in the world, and there are disasters such as floods, earthquakes, climate change and atmospheric instabilities with a high abundance in the country, an integrated system which can provide accurate and useful information for decision making in case of need seems necessary. Using GIS can increase the speed and quality of making decision about events. This knowledge is generally a valuable tool to reduce chaos and disorder in management and particularly crisis management. In the first step understanding and knowledge of effective functions of the tool is essential, and its adoption and acceptance is placed at the next stage. It is hoped that, by developing the culture of using the technology of this knowledge, we can take steps towards more effective management. [1]

2. Crisis management during occurrence of incident in the network:

GIS data allow to minimize the raise in damage caused by the crisis in the occurrence of incidents and crisis in the network by determining priority of electrifying the emergency centers as soon as possible. A set of measures can be taken in this regard as follows:

2.1-Using GIS data for grid volume estimation in lack of electricity during incident occurrence

Implementation of GIS data for the electrical grid on the 1.2000 and1.25000 maps by using these maps and specifying the affected geographical area allows us to obtain an estimation of the network size and the number of the customers who have lost power. In this case, it is required that operators collect the data for the geographic area of the crisis zone in the first moments of the crisis from other organizations and institutions. Then, considering the type of the region including residential, commercial, military, industrial, urban and rural, based on the crisis managers' recognition in the control center and proper classification considering priority, action can be taken to collect statistics of the clients in each class:

2.2- Using GIS data in resolving emergency and rescue centers blackouts in first priority

Identifying and classifying the clients allows us to take action to determine the emergency and rescue centers which are located in the crisis areas. Classification may include Red Crescent, hospitals, military centers, telecommunications centers, airports, food supply and production centers, central services offices such as electricity, water, gas, etc., governors, and other centers based on the crisis managers' advice. Then, using GIS data distribution networks and identifying the best maneuver locations to establish mentioned centers under the guidance of operational team is the first effective action in controlling crisis management.

2.3 Statistics perpetration and estimating of the size of the required utilities for repairs using GIS data

By considering various fields of descriptive information of network equipment in the GIS conceptual model of electrical networks and completing the data in GIS database in coordination with operational teams attending the crisis region the team can take action to identify damaged areas of network on GIS maps. Then, they can estimate the required installation to repair in two stages and send it to the site.

The first stage for emergency and primary network repair and electrifying the emergency and rescue centers

The second stage for basic repairs and modification of the damaged sections of the network.

2.4 Preparing network improvement plans using GIS data [2]

Designing electrical grid traditionally by attending the site requires to spend more time and cost since it should be done by attending the site, data collection from available networks, steady power grid assessment, routing and positioning of network and post establishment, and then plotting by taking into account the longitudes of the geographic location. Performing these stages, while the time is very important, decelerates the management and increases the damage caused by the crisis. However, using GIS data and its capabilities in performing all stages of design and plot allow to design without the need of attending the site, as well as maximum time savings and thereby facilitate network repair.

3. Crisis management before the incident

According to the different definitions of crisis management, a set of measures which are taken for encountering the crisis before the incident is the true sense of crisis management.

The following actions can be done in regard to the crisis management before the incident in an electrical grid:

3.1- Geographic positioning of (electrical) emergency vehicles under normal circumstances:

Since the distribution network operational team must be dispatched within the shortest possible time at the scene, the proper positioning of them under normal circumstances is of great importance. In this respect, according to the number of operational teams in each region, GIS analysis, using GIS software links and records operation incidents, we will be able to identify the most eventful section of the network and take action for positioning the emergency team in the center of gravity of their load with convenient access to desired locations.

3.2 The prediction of mobile equipment and their proper positioning under normal circumstances in order to be used during the crisis

Some of the effective predictions in the crisis management are providing mobile capacities such as mobile generators and transmission stations or mobile distribution. These facilities can be utilized in the normal conditions of network over the years and by appropriate distribution in the network and applied to establish the vital centers at the time of the incident. Therefore, location identification

based on the appropriate distribution in the network with regard to disaster-prone regions, requires appropriate analysis of the network for which GIS analysis is very effective. Besides, using GIS software link and recording operational incidents make a contribution to positioning the equipment.

Naturally the reconstruction and standardization of all the electrical installation, in a way that it defends all the facing crises is not completely possible, but we should take a step in this way and progress faster.

3.3 The role of automatic positioning of emergency vehicles using AVL system and GIS analysis in crisis management

The emergency vehicles administration and management can be crucial in critical situations and disasters. Knowing the instantaneous position of the emergency vehicles makes it possible to dispatch them to perform repairs in the shortest possible time from the best access route to the scene. Tracking rescue vehicles can help those involved in crisis management to have a proper outlook and therefore act better in administrating and managing the relief supplies, as well as timely aid to people and damaged areas; moreover, by using relief supplies, we make an integrated management in the crisis management committee. Regarding the capabilities of GIS software and its graphic interface, by creating a link between AVL and GIS software, the instantaneous position of the emergency vehicles can be displayed in the GIS. This process would not only lead to directing emergency teams to proper route in relation to the electrical networks, but also by using GIS analysis, the repairs can be done with regard to priorities. [4]

4. Investigating the economic effects of using GIS in crisis management and passive defense

According to the raised issues and the role of GIS in the crisis management, economic effects of this issue are important from several perspectives.

4.1 Undistributed energy reduction due to the reduction in the duration of network power outage

Crisis management with the aid of GIS analysis in the crisis management center allows us to attempt to electrify some parts of the network which are possible to work. Also with optimized management of event systems, network repair in the minimum time will be possible, and finally this will reduce network blackouts and undistributed energy, as well as preventing wasting money in energy sale, which can be calculated according to the energy sale price and the extent of the incident.

4.2-Manpower reduction in identifying and repairing the damaged parts of the network using GIS analysis

Since, by tracking emergency systems through the use of AVL system and displaying their position on GIS maps, it would be possible to have an appropriate management for sending them to the desired location; besides the costs of dispatching various emergency systems, contractors and employees due to the lack of awareness of the location, the size of the incident and systems sitting situation in relation to the desired location can be reduced and controlled under a proper management. [4]

4.3 Economic effects of passive defense

About economic justification of the costs of implementing passive defense, it is sufficient to mention its costs in case it is not executed:

A) If the passive defense provisions are not observed, then the providing, purchasing, supplying and support costs of the active protection system will be doubled
B) The cost of stopping productions and economic cycles due to bombarding critical and vulnerable centers
C) The enormous costs of reconstructing the facilities and equipment of the destroyed critical and sensitive centers
D) The cost of self-sufficiency postponement and being dependent again

5. Education and culture building

Recognizing and applying the regulated strategies and instructions of the crisis management, teaching them to the staff and implementing them on probation, in collaboration with the staff of the company, are techniques which are highly effective in the field of passive defense, and their vital role is clearly visible in military attacks and natural disasters. [3]

Authorities, decision makers and all those who are involved in policy making of the passive defense implementation, are required to be trained according to their needs. The training become possible by holding various training courses at civilian and military training centers.

In this regard, the crisis manager at the company headquarters, as the first rank in-charge of crisis management, in addition to the mentioned training, should have complete familiarity with GIS software and using GIS communication with other software for suitable analysis and required reporting at the time of crisis. After that, the experts of the dispatching unit and 121 units of power management operation, who are more likely to encounter the crisis dimensions than the other members, must have adequate training. [5]

6. Conclusion

Spatial/GIS data is really essential for defensive and security applications, by taking into account the passive defense considerations. One of the advantages of using GIS during crisis, is the simultaneous and integrated access to all spatial and statistical data in the desired range. Correct and timely data are the most important part of any effective emergency management plan.

In this paper, attempt has been made to express the most appropriate strategies to deal with crisis dimensions in the shortest possible time using GIS data, by identifying the different dimensions of creating crisis in electrical distribution networks (electrical grid).

Also by proper analysis of the current network status using GIS data, the events have been predicted and prevented from their occurrence or adequate predictions for taking the most suitable decision during the incident have been done, thereby the amount of damage can be reduced.

7. References

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