“DISTRIBUTION DISPATCHING” THE MISSING LINK IN ELECTRICAL INDUSTRY IN DEVELOPING COUNTRIES

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Abstract

During recent years economical and service activities are transferred to private sector in Iran and the government renounced of that activities. By this deciding, the government tends to decrease financial problems on governmental budget, to increase the efficiency of servicing. The outcome included effective using of present specialists, renovating the organizational structure, and stimulating the employments. Parallel to this action in Iran, privatizing the distribution companies was also the ministry of Energy affair, which its executive goals explained as following:

A. Stablizing a legal communication with customers (electricity subscribers).
B. Improving and using of personal innovation and creation.
C. Good and suitable servicing to customers.

The recent structures and distributing way, by itself, can not meet the every day developing electricity demands, So basic change is really necessary. On the other hand, in developing countries, if changing strategies and tools of system are proportionated with social and characteristics, it will be beneficial. The writers, with regard to these important, try to survey the processes of establishing of distribution dispatching in Tehran Electricity. It is clearer that the valuable outcomes of this organization collection have improved the Qualitive and quantitive indication.

The ever-growing national transmission grid and increasing demand for electricity, calls for more sophisticated management system. In 1980, the ministry of energy arrived at the decision of dividing the whole grid into six areas. Each one containing its own Area Operating Center (AOC). The national Supervisory control center (SCC), Located in Tehran, is responsible for power plants (above 100MW) and generation scheduling and Economic operation of the whole system. Tehran Area Operating Center (TAOC), is one of six AOC’s in charge of controlling power plants (below 100MW) 132, 230 and 400KV transmission lines as well as power transformers and switching stations in an area consisting of five regional electric companies covering some central and a vast northern part of the country. Tehran Regional Electric company (TREC) as the largest Iranian electric company supplies the capital electricity needs. The indicated information in table 1. Shows the expansion activities of this company.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>% (out of whole country)</th>
</tr>
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<tbody>
<tr>
<td>Indoor stations (20/4KV)</td>
<td>Each</td>
<td>8877</td>
<td>45</td>
</tr>
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<td>12</td>
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<td>Customers</td>
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Table1: data of MV network in TREC

Beside this, large distribution network in Tehran electricity, other parameters like, network depreciation, social and political sensitiveness, high accumulation, the growth of load, lacking of systematic civil engineering and so on, cause to make more problems in distribution system. It is more obvious that controlling and conducting of this network is not possible by present traditional systems.

In a glance to control center links, lacking of medium voltage conduction centers in distribution is usually obvious as the lost link in generation and consumption process. So establishing the distribution dispatching as a basic principle is inevitable.

Fundamental changing began in Tehran electricity structural organization in 1995. Following this transformation, distribution of Tehran electricity has been transferred to seven private companies. Each of these companies has been divided to several regions due to regional expansion and number of present networks. In designing for structure of the companies, conducting and controlling of 20KV networks, a unit named “Distribution Dispatching Affairs” has been formed under supervision chief manager.

Entrance of these new organization collections to distribution structure was a good experience, which is contemplated in this essay.
INTRODUCTION

The electrical industry has played a very important role in developed economic systems and also is considered as a key factor in development plans of many countries. Thus, the important factors in the economic development, are developments of energy generation and consumption as well as assurance in rendering services with high quality.

One of the most important problems of developing countries and the countries which are rapidly being industrialized, is the price of generated energy. Regarding that electrical industry is governmental industry in the most countries such, governments by paying subsidiary and transfer costs, incur much costs in this respect therefore these governments are encountered with limitation of energy sources.

The main index of industrial development, is rapid development of energy consumption, which has caused electrical industry system efficiency to be decreased and accordingly continuous investment in this respect is always required. Due to lack of necessary coordination in macro-investment timetable in energy generation, the electrical industry generally encounters with problems and increase of costs.

During the recent decades, governmental organizations have tried to make competitive condition and oppose with limitation so that increases the productivity. With regard to such international policy, during the recent two decades, Iranian authorities have tried to grant economic activities and service rendering units to private sectors. With regard to such movement in the Islamic Republic of Iran, it was arranged that Ministry of Energy to grant distribution company to private sectors[1]. Executive objectives of this plan were arranged as follows:

- To provide necessary ground for electrical power clients to observe laws and regulations.
- To enjoy individual and group creative thoughts and increase renovation toward national self-sufficiency.

Any movement and change in developing countries shall be effective only when strategic, technological and system change tools, to be designed and planned with regard to social, cultural, economic and political features of the related country.

Thus, establishment of distribution dispatching centers in Tehran Regional Electric Company (TREC) and its future plans have been studied.

Distribution Dispatching as Necessity Factor

At present condition, the main activity of distribution companies in Iran, is to protect and make stable and continue electrical power distribution from HV network To LV network. It can be stated that the main problem in using electrical power networks is related to power distribution network (Fig1).

One of the important factors in studying activity performance of distribution companies, is the rate of black out hours which will be confirmed by comparing black out costs in developed and under developing countries and by increasing industrialization of society, claims for compensation black out hours are increased. A simple economic review identifies that non-supplies of sufficient power and black out hours cause much loss and damage to the clients.

Upon changing the distribution companies to private companies in early 1990, expects of clients were increased automatically. On the other hand, performance of government against distribution companies was just like performance of customers against these companies and government approved special regulations according to which if required power of the clients not to be supplied without reasonable excuses then clients shall have right to receive compensation for incurred loss and damage and such regulations applied multiple pressure on distribution companies. Payment of loss and damage to clients sometimes made through bringing action to judicial centers, in some cases such action was impossible.

The efforts toward decrease of non-distributed energy as well as rate of black out hours by controlling the black out hours (which occurred by technical units reasonably or non reasonably) caused the authorities to control electrical power distribution in MV level directly and centrally. Thus, establishment of distribution dispatching became a main factor immediately upon granting distribution activities to private sectors and it was discussed and approved.

![Fig1:Black out hours of network with various voltage in 1999](image-url)
**Distribution Dispatching in TREC**

TREC is the largest power regional company in Iran and its duty is to supply required power of the capital. The data statistics indicated on table 1 shows wide activity of the said company.

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Table 1: Data of MV network in TREC

On the other hand, some other parameters such as wearing of the network system, political and social sensitivity, high accumulation of population, increase of system load, high immigration of people from other cities to Tehran, lack of specified and planned urban development, have caused multiple problems and difficulties in distribution system. So it is evident that control of the system through traditional system is not possible.

Basic changes were made in Tehran Electric organization structure, in 1992 by separating Tehran power distribution from Tehran Regional Electric and accordingly seven distribution companies as private companies were established. Each of these companies, with regard to related territory and available network, were divided into several operational regions.

According to the new organizational structure, performance of all executive operations and utilization of MV network were granted to distribution regions and accordingly a new unit called “distribution dispatching unit” was designed and established as matrix structure in each company. The main duty of this unit is to increase efficiency in guiding and controlling MV networks inside the distribution companies.

**System Changes Planning and Change Strategy**

Electrical power distribution companies particularly dispatching units, due to having some features including submit of regular and common products, necessity for balancing consumption and generation, are considered as a single organization renders service technology. Whereas, if we explain the technology in service organizations of the same service process, then change or amendment of technology as change of strategy can be selected.

On the other hand, with regard to centralization of manpower in service rendering organizations and electrical power distribution companies, any change of technology had to be made together with structural change. Thus with regard to the selected strategy for changing the combined system, it was arranged to change technology and structure (Fig2).

Therefore, the change management tried to establish specialty committee for appropriate planning. The said committee upon holding several sessions, made the objectives as follows:

**Title of long term objectives**

- To establish comprehensive and perfect data bank in manual and mechanized systems by using capability of distribution dispatching for feeding data to the operational regions.
- To amend organizational structure of distribution dispatching together with technology change.
- To establish mechanized systems by using software programs toward maneuver operations.

**Title of short-term objectives**

- To make planning for identification of network, reviving technical file keeping and updating all data.
- To provide manpower training program with regard to data technology.
- To make scheduled objectives in order to decrease non-distributed energy.
- To make planning for attracting specialized manpower with regard to complicated technology (automation).

If the long term objectives to be studied in detail, it shall not be possible to change non-mechanized system for complicated technology (Distribution automation) within one stage and rapidly. Perhaps, the most...
important reason is the nature of dispatching and impossibility of accepting any risk. Thus, according to the decision made by the committee members and emphasis of the senior management, the system change was performed within two stages:

- To change non-mechanized system for developed data system from 1995 to 1999.
- To provide necessary ground to achieve complicated technology (automation) and passing the developed data technology from 1999.

With regard to simultaneity of system change and separation of distribution companies, it was decided that the long-term objectives in proportion to first process of the system change, to be divided between power distribution companies affiliated to TREC. The objective of this action was to join the companies in performance of the general plan. On the other hand, experimentally performance of the plans within wide area was not logic and economic.

**Management Software of MV Network Operation**

The most important principle in distribution dispatching research plan in Iran is to achieve network specifications and gather static and dynamic data on distribution network and try to update them. Thus, activities of the working group were planned in three groups: gathering data, recording incidents and establish planning for repair and maintenance in dispatching of Tehran East-south distribution company. Features of the provided software (Fig3) are as follows:

- To administer all written and pictorial data of distribution networks (including database and geographical maps).
- To Make software for recording capability and controlling random and planned activities together with black out or non black out, disconnection of feeder, disconnection of a switch or element. Network calculations are performed on maneuver drawing and also limitations of defected or black out area are specified.
- To present various, schematic, pictorial and written daily, or weekly and monthly reports for different applications including preventive and corrective actions, network analysis and other management reports.
- Management reports: To take preventive and corrective actions, make planning for repair and maintenance and gather static data of network on the basis of provided forms.
- To gather data of network on the basis of provided forms, and dynamic and static data banks of network (written and pictorial).

**Establishment of Complicated Technology (method of gradual of establishment distribution automation)**

Regarding that control centers render service under traditional method, change of system for work teams in order to enter data to complicated technology in network operations is necessary. Some primary actions [3] for gradual installation of the automation plan, have been taken as follows:

1. To specify new objectives of operations in distribution networks for future. In order to render services continuously, restoring quality and selecting appropriate structure of protection, it is necessary to provide connectable and disconnectable loaded switches and study distribution network structure as well as method of automation in different countries throughout of the world.
2. To install and develop distribution network on the basis of suitable structure by considering specifications of new equipment in standards of power stations and distribution networks for automation.
3. To determine priorities of work performance in different levels of automation for testing general model and algorithms to enter data developed technology in distribution companies which have different systems and accordingly by achieving suitable results and reviewing strong and weak points, the approved model was presented to all distribution companies for study and performance.
4. Different levels of automation system installation plan, were specified as follows:

- To monitor output of 20 KV supper distribution stations (receiving dynamic data)
- To monitor 20KV/.4V stations (receiving dynamic data)
- To control remotely 20KV/.4 V stations (by connecting and disconnecting breaker)
- To control remotely the maneuver points ( connectable and disconnectable switches )
- To use defect detectors to identify the defected point or area

**Monitoring outputs of 20KV supper distribution stations in distribution company of Ghom city**

Scope of work of the said project consists of installation and putting into operation a remote control operational station in supper distribution dispatching center of Ghom and other related points for transfer of data to operational stations located out of the central unit. The said data is
related to condition of transformers, output of 20 KV feeders including transformer temperature, transformer load, output voltage of transformer, feeder load of 20 KV, feeder voltage of 20 KV in stations of Ghom. Installation of the said system is in such a way that the said station is used only to indicate data of the covered network and it is not possible to control the network and change any structure in distribution dispatching center by the said system.

The appropriate results of this action was indicated in quality of rendering services to clients by which necessary data is received from 20Kv feeders situation in distribution dispatching control particularly when the load resulting from online maneuver is changed and accordingly this system provides appropriate assistance for protection and stability of the network. By using the collected data in control center (static and dynamic data) and the applied software and also by presenting suitable analysis for improvement voltage profile along the movement path of the feeders, quality of voltage is increased and voltage drop in the network is decreased.

By using monitoring system installed in dispatching center of Ghom, when shortage of load distribution capacity is occurred, then operator control center plans appropriate load distribution according to priorities of the clients. When valuable findings were achieved by performance of the plan in distribution dispatching of Ghom, then it was arranged to install 20 KV output monitoring system in other electrical power distribution companies of Tehran as well as dispatching centers.

**Monitoring and controlling remotely the 20/. 4KV stations in distribution dispatching**

The main factors (which make necessity to perform project of monitoring and controlling the stations remotely in central Distribution Company) are as follows:

- Central electrical power distribution company is located in a heavy traffic area where performance of maneuver required long time and caused long time black outs, dissatisfaction of clients and also increase non distributed energy.
- When there is a defect, in order to get necessary data from the defected place, it is necessary to check all parts of feeder and accordingly the testers cause the time and man power activities to be wasted.

Central electrical power distribution company has taken necessary actions to study primary establishment automation system experimentally on 20/4 KV stations since 1998 and at the end of 1998 it was possible to gather data and transfer the data to electrical power distribution dispatching control center through radio systems and also connect and disconnect of MV switches in 20/4 KV station was successfully performed.

By performing remote control projects of MV stations, it became possible to send maneuver operations control orders by computer through control center.

After installing over current relays on breakers, trouble-shooting operations are minimized. By performing the said project, there is no need for annual loading and all data in control center is accessible through computer. Immediately upon occurring any defect in the system, control center is informed by alarm systems in this project.

At present the said system is being development in other distribution stations in central distribution company (about 10% of total stations).

**To Correct Dispatching Affairs Structure In Change Process**

Along with the change of technology in dispatching activities, which have been designed and executed for long term, structural modification was also applied as catalyzer in different process in the system. The first application was made upon establishment of distribution companies and accordingly dispatching affairs were established and operated under direct supervision of managing director. The next step was to transfer dispatching executive affairs to the regions, which was significant assistance for dispatching operations.

By making detail and comprehensive manuals to achieve appropriate condition and promote efficiency in controlling MV network, duties of distribution dispatching and method of communication with operational regions and local control center were identified.

In making this manual, hard efforts have been made to prevent interference of duties and responsibilities and provide reasonable discipline.

It is evident that, fulfillment of system change in long term plan without enjoying specialists experiences in new structure of dispatching affairs in order to analyze incident, accidents, statistics, data and following up establishment, automation, is not possible.

Thus, upon holding several meetings with the chart change committee, following structure was designed and executed in 1998 (Fig4).

![Fig4: new structure for changing system](image)

**Effect Of Joint And Separate Factors On Performance of Distribution Companies**

Electrical power distribution companies are being evaluated annually in Iran. In this evaluating system, some simple and uniform factors and indices are used. The said factors are mainly about performance process and less attention is paid to output or input of the systems. Thus all companies are evaluated equally. It should be noted that any evaluation can be different from other and it is evident that with regard to development of technology and evaluation procedures, present procedures can not meet necessary requirements in this respect. Thus it is necessary to look for suitable
procedures so that can increase efficiency and productivity.

Effective factors on distribution companies can be classified as follows:
- Type of network and period of its operation.
- Easy access to resources (equipment, manpower and financial source)
- Social and economic conditions.
- Type of clients.
- Factors relating to beyond the organization (such as laws and policies).
- Effective conditions in rendering services (geographical conditions, traffic and applied technology).

It is evident that with regard to the objectives assigned for the evaluation, it is possible to achieve different factors by using the above said factors. Some of these factors may be joint within the company and some of them to be unique. Such as difficulty of transportation and impossibility of repairing defected points during daytime for some regions of Tehran electrical power center and such factors have direct effect on black out hours per capita. On The important matter in the joint factors is that it should not be considered minimum efficiency limitation for all companies because different factors may affect on the factor in each company and each factor has its special role.

Amendment of Factors by Using Data Envelopment Analysis
One of the modern methods for evaluating efficiency of the units is similar to different conditions of data envelopment analysis (DEA). DEA model is a mathematical planning method, which was presented in 1978 and has been widely used for efficiency evaluation of different institutes during the last decades. Summary of method of operation in DEA model is as follows:
- To provide list of effective factors on input and output.
- To plan input and output different combinations by considering object of the evaluation.
- To explain factors for productivity part.
- To consider experimental importance factors for each company.
- To determine efficiency and inefficiency limitation for each company and amend related factors by software.

In fact application of DEA, not only causes the evaluation to be appropriately performed and related economic sources to be suitably used. Primary actions and related studies in this respect have been started in one of the regional electric company of Iran.

Conclusion
One of the most important reasons for establishment of distribution dispatching is to establish regulations observing culture in Iran. The said process, which completed within five years, is indicative of high quality management who anticipates future appropriately. One of the reasons of such success is to plan structural and technological improvement in distribution dispatching by considering all factors and conditions and prevent any idealism factors. By identifying type of the change as a strategy, caused that the project executors, in order to achieve developed technology and automation, to pass developed data and not to be in a hurry in this respect and to perform all necessary studies and researches. The main reason in this respect is the technology and structural condition.

It is evident that it is possible to import technology immediately but arrangement of manpower and change of culture in application of developed technology requires sufficient time, which had to be considered. It should be noted that valuable findings particularly decrease of black out hours is clear (Fig5).

REFERENCES

Fig5: Average black out hours per cutomer