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TELECOMMUNICATION PLANNING AND MAINTENANCE FOR ELECTRICAL NETWORK IN UNSTABLE ENVIRONMENTS

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ABSTRACT

Planning for the future communication requirements of an electrical network, depends on many factors like country development, inhabitants growth, economic strength and one of the most important factors is (peace), which is not normally mentioned since instability is a temporary condition. In the case of Iraq, its environment was unstable for more than 30 years. This paper considers the circumstances that forced planning and maintenance engineers to take additional factors into consideration during their work.

KEYWORDS: Inhabitants Growth, Telecommunication Systems, Backbone System

INTRODUCTION

Historical Approach

For a long period and nearly continuous, from 1980 up to now the political, economic and peace situation were unstable in Iraq. At 1980, a war started with Iran up 1988, then the first gulf war in 1991. After that Iraq suffers from sanctions and boycotts according to the UN resolutions which continue until 2003 where the second gulf war happened. After that, many clashes and an approximate civil war happened that affect deeply all the infrastructure, which electricity is an important role.

Maintenance and Spare Parts Problem

In the 1977 most of the PLCs (Power Line Carrier which is used for communication using the high voltage power lines 400kV and 132kV as a medium) were replaced, also the step-by-step exchanges were replaced with electronic exchanges type VDZ419 (from Siemens Germany) and ECS-F (from Siemens-Albis Switzerland). The training courses were so deep and condensed. With the inherent test programs, faulty cards can be located and its faulty component (ICs, transistors, diodes...etc) then replaced. This was very helpful since it was very difficult to assign a budget for spare parts after 1980. Also different maintenance management were taken, by splitting maintenance group into two sections, the first group travels to the station (power station or substation) were the faulty equipment and replace faulty cards by healthy cards received from store. The second group is specialized in repairing the returned faulty cards and sends it back to the store for future reuse.

After 1991 with the sanction and boycott, the circumstances became worse, and many qualified engineers left their jobs due to low payment. So with the left limited-experience staff, another step have been taken by putting logical test steps written as flow-charts for fault diagnosis for most kinds of cards with manual simulating boards that simulates the signals that received from main control card of exchanges helped in fault diagnosis. This kept those exchanges working till now (for more than 30 years). The same was done with PLCs type ETI 21, ESB400 and ESB500.

Destroyed Locations and Network Expansion

Due to high priority for power generating stations and high current equipment, very low budget was left for telecommunication systems such that it is almost cancelled. So to prepare the least requirements for the new locations in the network (or to find a replacement for the destroyed locations), the following steps were taken:

- Relocation of PLC links from power lines that have more than one link to the new location, retuning of the PLC (if needed).
- A computer program was written by one of the maintenance staff engineers for frequency assignment to avoid frequency contradiction or interference (more than 300 PLC links in the Iraqi network).
- Also a database for switchyard elements and communication equipments were done that helped in finding the best choice of spare parts for the destroyed locations.
- Relocation of RTUs from the terminal substations (at the end of the network) to substations that have more than one source. Reconfiguration, wiring and software database development in the control center computers were also done by maintenance staff. Problems raised in data routing (200 baud) forces to change style of data transmission from distributed sub-channel with the PLCs, to assign a (6x200 baud) all data PLC and by microwave channels to solve congestions in many locations in the network.
- Relocation of the exchanges in the terminal substations which were replaced by remote subscriber connection. Reprogramming of the exchanges was done according to a numbering master plan.
- Local manufacturing of some electronic cards (mainly for RTUs like digital input, memory cards and other interface cards).

Test Equipment Bottle Neck

One of the most complicated problems is to keep test equipment (selective level meters for PLCs, programming devices for exchanges and data flow testers for RTUs) working this long time without a possibility of replacement. So there was no way but to repair by replacing defective or exhausted parts, or by manufacturing a new one by interfacing a laptop with the necessary hardware (interface) and program (software).

Communication Planning

A planning engineer must provide the basic necessary requirements for any location in the network (protection inter-trip, telephony, and data transmission of RTU signal to control center). That was the goals until (1998), when the Ministry of Electricity assigns a budget for communication projects. At that time a planning study was to make a jump in technology and services by using optical fiber with the power lines as an OPGW or ADLash. According to the study, a six-phase project have been planned to cover all 400kV lines with OPGW then changed to 132kV lines for two reasons:

- It was very difficult to switch off a 400kV line for long time to replace the ground wire, and
- Some lines were very long such that it needs repeaters or amplifiers which must be installed in an underground pit or on the top of the tower with the necessary power source. By finishing the first and second phases there will be a good backbone system from north to south. The rest were alternative routes to complete rings and some branches. The UN committee 666 refuses the project until 2003, when some donations became a budget for electrical

network including telecommunication. But clashes caused many towers of power lines to be destroyed causing many communication problems for control centers, since most of the communication system is PLC dependent. Due to these new circumstances another change in planning was done such that microwave links are to be used (instead of OPGW) as a backbone system with capacities enough for new services. Lower capacities assigned for the links branching from it (and without alternative routes). The first and second phases were put in service in 2013 after six years of the first study.

One of the most important condition in the design of the suggested microwave network is to keep all locations in substations or power stations, for the sake of safety of installation group, equipment (and in future the maintenance staff) and get benefit of the towers already exist which were previously used for VHF mobile maintenance line-groups, also the availability of power source.

CONCLUSIONS

- This proves that good training and loyalty gives very successful results.
- Sanction and boycott prevents planning engineer from convoying the new technology for a long time (more than 12 years). Although high experience with old technology exist, the continuous upgrading is necessary.

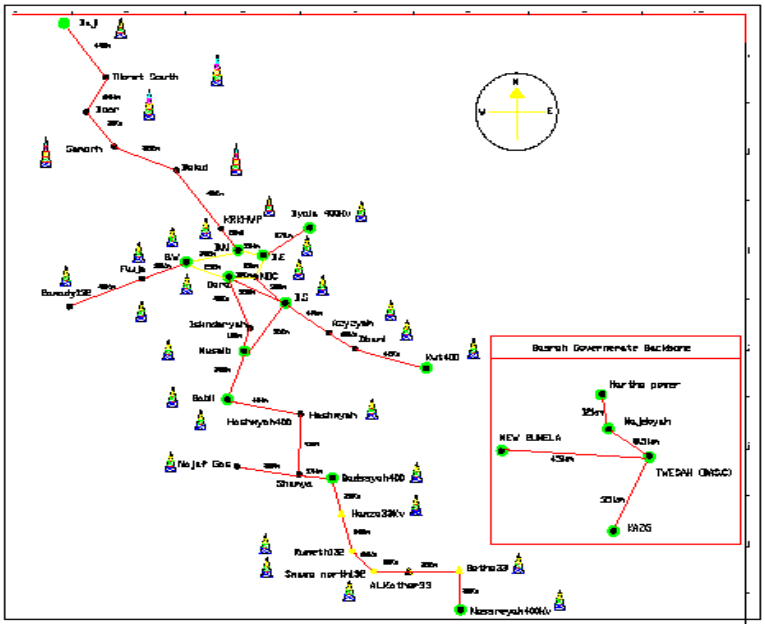

Figure 1

The above drawing shows the backbone microwave project that replaces the optical fiber planned project. All points on the path are either a substation or a power station for the sake of safety.

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