

INVESTIGATION OF THE CURRENT MAINTENANCE EXPERIENCES IN POWER DISTRIBUTION UTILITIES OF IRAN

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ABSTRACT

This paper presents the most frequently used maintenance concerns and challenges in distribution utilities of Iran. A questionnaire is devised and distributed among the maintenance experts in more than 30 distribution utilities all over Iran and their responses have been taken under consideration in this paper. The aim is to get the most out of the successful maintenance experiences within the utilities, to find the solutions on the current common challenges on the distribution system maintenance policies, and eventually to enlighten the way on the transition to the more efficient maintenance approaches such as reliability-centered maintenance (RCM) in distribution systems.

INTRODUCTION

Maintenance in power distribution systems is among the commonest operation activities to improve the system reliability and components availability [1]. Distribution utilities all over the world are always seeking the most efficient plans through the current common approaches, e.g., preventive maintenances, corrective maintenances, and reliability-centered maintenance (RCM) to not only meet their technical, but also financial constraints [2], [3].

Maintenance has always faced major technical challenges once going to be planned and adopted in distribution systems by the utilities in Iran. Although this can be mainly due to the system wide geographical and environmental conditions covering by various utilities, some common challenges and difficulties are also existed in most of them. The ever increasing trend of load growth and distribution system complexities as a consequence are the other factors associated with these maintenance obstacles in distribution utilities [4] which needs to be taken care of.

Some utilities in Iran, however, have found the efficient surviving keys to these challenges and are going well toward their profit-making targets; while some others are still overwhelmed with the same or different challenges in their maintenance planning and associated expenditures. This calls for a thorough investigation of the maintenance related activities in various distribution utilities in Iran. The authors believe that investigating the current maintenance strategies in various utilities is the first and foremost step in order to provide the constructive guidelines and solutions to the existent maintenance challenges (Figure 1).

In response, an industrial project has been guided in which a thorough maintenance investigation is performed. Some well-organized questionnaires are devised and distributed among

more than 30 distribution utilities in different provinces of Iran by which the experts and operators are invited to share their knowledge and experiences in accordance with the proposed questions. Their responses also include the merits/demerits of their current maintenance schemes in their utilities, their insights on the future maintenance strategies to be adopted in Iran, and also their personal recommendations to bridge the gaps between where they are in and where they should be, from the distribution system maintenance viewpoint.

This paper not only systematically reports the brief responses of the distribution utilities in almost all over Iran participating in the survey, but also presents some guidelines and solutions for the utilities to meet their maintenance requirements. The prepared materials within the scope of this paper also help the utilities to successfully undergo the transitions from the current to modern maintenance schemes, such as RCM.

GENERAL DESCRIPTION

To form an overview of the present maintenance practices in distribution utilities in Iran, a questionnaire was devised and distributed among a number of utilities all over Iran, both in north and south parts including the regions with different weather and geographical conditions. Since maintenance protocols vary from utility to utility and to review all the approaches, major effort was contributed to devise the questionnaire as comprehensive as possible with regards to the existent standards and national documents.

In each part, questions were asked about the maintenance policy presently in effect and the existent common or possible triggers of the system failures. The questionnaires were submitted to more than 30 utilities and complete replies were received from 16 province utilities which cover almost different parts of Iran. The responses are analyzed and put under studies in the project.

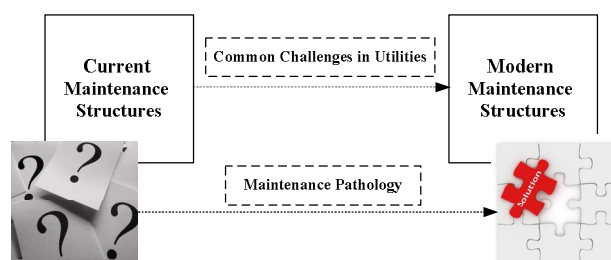


Figure 1. The overall picture of the questionnaire under study.

General Findings

- The answers to many of the proposed questions display a considerable spread. This may be not only the consequence of different practices, but also of different interpretations on some of the concepts introduced or policies followed.
- Many utilities scheduled maintenance based on the time-based maintenance approaches and irrespective to the components criticality in system technical and economical performances.
- The procedure of RCM is not generally adopted in distribution utilities although most of the experts and operators know its important role and effective technical and economical performances but do not know the procedure and how to approach.

Response Evaluations

Q1-Current Maintenance Guidelines' Effectiveness

- Around 56 percentages of the responses agreed on the fact that the performance and effectiveness of the existent nation-wide maintenance policy and user guides published by the governmental agencies are of medium quality, and 19 percent believed that the performance is not that predicted before. Hence this means that an effort has to be made to modify the policies so that it can be applied in an effective manner.
- More than 75% of participating maintenance experts in different utilities of Iran confirmed that the adoption of a unique nation-wide guideline in various utilities with different geographical and operational conditions cannot be the efficient and effective approach to the current concerns.

Q2-Condition Monitoring Deployment Rate

- Most of the responses received were totally on the conclusion that the current condition monitoring infrastructures used within the maintenance policies are sufficiently enough and well-organized.

Q3-Predictive Maintenance Technology and Condition Monitoring Effectiveness

- Around 72 percentages of the responses pointed that they are somehow using the modern predictive maintenance approaches and equipments (most in a usual and not well-effective manner). This well initiates the need for the restructuring of maintenance policies in the utilities considering these modern technologies.

Q4-Reliability and Accuracy of the Available Data

- One of the most important and basic challenges, with which most of the utilities are faced, is the shortage and scarcity in the required reliable and accurate data and information on the previous practices or the current condition of the systems for the future analysis. More than 62.5% of the respondents confirmed the scarcity of reliable data on their system under territory.

Q5- Comprehensiveness of the Data and Information Recorded in Data Management Systems

- The all-inclusiveness of the gathered data and information via the data and energy management systems in distribution utilities were questioned whose answer was to confirm that the available data and information are all-inclusive enough for the analysis, while based on the previous question might have low reliability and accuracy level.

Q6- Maintenance Managers/Crew Knowledge and Expertise

- One of the most important concerns in distribution utilities in Iran is the experts' knowledge and expertise which can directly affect the maintenance quality and performance. The responds to this question was diverse which highlights the fact that the distribution of high-quality and well-instructed maintenance crew does not follows a single trend.

Q7-The Consistency of the Number of Faults in the System and the Utility Outage Management Personnel

- More than 65% of the respondents confirmed the fact that there is a shortage of maintenance and outage management experts and crew in distribution utilities nationwide, compare to the number of the faults occur and outage statistics weekly reported. This fast maintenance management due to the mentioned shortage may lead to the inaccurate or insufficient maintenance of the faulted equipments or inaccurate inspections which may trigger further problems.

Q8-Maintenance Crew Wide Expertise Needed to Deal with the Diverse Range of Faults and Outages

- It was concluded that in some provinces and regions, the required maintenance experts with wide range of expertise due to the diverse ranges of faults are available while in some others there are not. This implies that the available knowledge and expertise of the successful utilities have to be somehow forwarded to the rest of utilities.
- It has been found as an important consideration in some utilities that the roles of maintenance crew and experts have been periodically changed within the utility; that is their job varies frequently due to some operational or other reasons. This situation may lead to some un-expert or weakly-qualified persons assigned to the maintenance decisions which may trigger further problems.

Q9-Maintenance Budgets and Financial Constraints

- Obviously concluded, more than 88% of the answers stated the insufficient amount of maintenance budgets as the main and major concerns which restricts the maintenance procedures to be well performed. This really calls for thinking about and to maybe restructuring the financial resource allocation schemes to different operational activities usually performed in

distribution utilities.

Q10-Maintenance Management Based on Equipments Life-Cycles

- It is quite reasonable to focus the maintenance resources on the equipments with more years being under operation rather than those new ones. The reason is due to their different failure probability and aging conditions and roles in the system performance. However, more than 60% of the utilities in Iran do not put any consideration on this important and basic requirement.

Q11-Utility Owner and Managers' Support and Consideration to the System Maintenance

- The responses to the question well confirm the current semi-positive viewpoints of the utility managers nationwide to the maintenance role and its importance in improving the outage frequency, durations, and energy not served as well.

Q12-Detailed Investigation Forms of Maintenance in the Current Guidelines and Nationwide Standards

- More than 50% of the participating maintenance experts in the electric utilities believed that there would be no need to the detailed analysis of components' various factors in periodic inspections and maintenance activities. They believe that the detailed forms and documents, a maintenance practitioner has to fill in, are too much and this may lead to his inaccuracy or wasteful time consuming in place.
- Some other experts believe that the maintenance policies and structures have to be set individually for each region or each province electric foundation or based on the geographical and environmental regional conditions.
- Almost all the experts agreed on the current maintenance analysis and data gathering approaches to be automated and computerized.

Discussions

Based on the responses received and the analysis done, once can categorize the main current challenges in maintenance planning of distribution utilities in Iran as follows:

Required Data and Information for the Maintenance Scheduling

One of the most important and obvious deficiencies in distribution utilities is confirmed by the experts and operators to be the inaccessible, insufficient, or inaccurate data or historical information of the system under control. This well necessitates structuring and implementing some well-organized maintenance software in distribution utilities by which not only the reliable and accurate data of system under control can be employed, but also it can be possible to get the most out of the information on the maintenance scheduling of different system components with different aging and operation conditions especially the system critical components.

Maintenance Policies and Practices Applied

The practices adopted in distribution utilities all over Iran are mainly based on a nationwide maintenance guideline and standard. The effectiveness and efficiency of this guideline has been under question by more than 70% of the experts participating in the analysis which well calls for a thorough scrutiny on the aforementioned guideline. Some drawbacks and advantages can be pointed out extracted from the responds in the analysis. The main advantages are as follows.

- Unifying the maintenance activities and preventing from the unnecessary or not-organized policies.
- Gaining some accurate and in time knowledge on the faults and how they are originated, improved, and affecting the system.

And the major drawbacks can be pointed out as:

- Delving into a huge amount of details in the guideline adoption and the large number and great amount of diversity in the associated forms and documents to be filled once inspection is done.
- Ignoring the different geographical and environmental conditions of each region for the maintenance by the associated utilities.
- It cannot be practically implemented in some parts and sub-sections or it is not designed in accordance with the common number of maintenance crew employed in utilities.
- Ignoring the priorities in maintenance scheduling and practices neither in system fragile parts nor in the components.

Maintenance Adoption and Operation Crews

- Customer dissatisfaction due to the planned outages by maintenance activities and their possible long durations can lead to the imperfect or hasty adoption of maintenance plans.
- Inability of some maintenance groups to do the on-line maintenance due to its expensive price is another issue raised.
- The previously installment of some undeniable number of imperfect or non-standard equipments in the system and their frequent failures make the maintenance crew constantly working on them rather than improving their efficiency.
- The insufficient amount of the utilities' financial budgets on maintenance will make it quite difficult for them to implement and get the most out of the new maintenance and monitoring technologies.
- There are no appropriate and effective criteria in distribution utilities in Iran to perform an efficient allocation of financial resources for maintenance.
- There are no special criteria to assess the performance of the maintenance activities commonly done on the components.
- The disqualification is found as a major concern in some of the maintenance outsourcing companies in some regions.

As can be understood from the above discussions, the current

nation-wide maintenance guideline in Iran has some major drawbacks which need to be effectively managed very soon. The most important and effective solution to the above introduced concerns can be the annual meetings for both the utility managers and maintenance operators. This can effectively change the former party's viewpoints on the role of maintenance in power system performance and their economical benefits out of a well-organized maintenance framework. It can also provide a possibility for the distribution utilities to improve and exchange their experiences and successful or unsuccessful practices.

OUTLOOK

Further development is concluded to be still required in distribution system maintenance management among which can be itemized as follows.

- Reliability-centered maintenance step-by-step explorations and introduction to the utilities' maintenance experts and operators through workshops and technical meetings.
- Recognition of the necessity of maintenance priority for the system critical components.
- A well-organized resource allocation framework for the maintenance of various components in different utilities.

CONCLUSIONS

From the survey done on the maintenance practices in 33 distribution utilities in Iran, 16 responses were received and put under consideration in this paper. It has become evident that many utilities in different parts of Iran have not yet adopted maintenance practices beyond those of scheduled maintenance activities based on periodic inspections. It has been found that there are some major problems with the utilities' managers and asset owners' perspectives either on the understanding of the role and effectiveness of maintenance on

the system performance or on the amount of budget and financial resources on the maintenance. This common perspective has to be modified.

Major concerns have been identified and some effective cures have been also introduced through the analysis, some of which can be seen in Figure 2. It cannot be denied, however, that the optimized maintenance strategies especially RCM models, would provide the highest savings and also the highest flexibility in system operation. So, the need for a gradual transition to these strategies is imperative, however complex they first appear to be.

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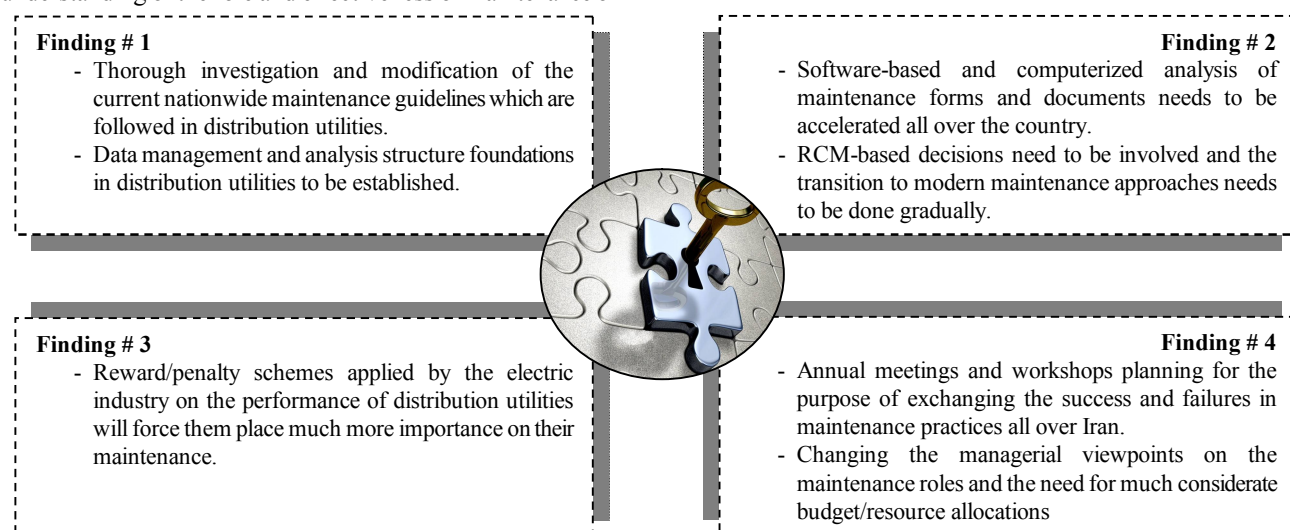


Figure 2. Solutions introduced in the paper through a survey in response to the maintenance performance analysis of distribution utilities in Iran.