Investigation and Mitigation of HV Cable Joint Failures in Thailand Metropolis

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ABSTRACT

In recent years, MEA has experienced a series of HV cable joint failures on 115kV subtransmission lines. To cope with the problems, MEA had to replace all those joints even though they were newly installed with the new ones. This paper aims to share the results from the investigation on the failed joints. The knowledge engineering and management approach were applied to elicit the insight on failure mechanism. It was found that the major causes of failure were attributed to the specification of the joint itself as well as the jointing techniques adopted by the jointers. This brought up the utility with the new procedure for the acceptance of the jointing products from the supplier as well as the proper training of the jointers on particular jointing product. Consequently, MEA could improve the quality of their jointing works.

KEYWORDS

Cable joint failure; HV cables; Knowledge management.

INTRODUCTION

As a distribution utility serving customers in Bangkok and other responsible areas, Metropolitan Electricity Authority (MEA) needs to provide electricity with appropriate level of reliability and quality. The strategic approach to achieve this goal is to strengthen its substransmission and distribution network by underground (UG) cabling. This is either by adding more UG cabling circuits or converting its overhead (OH) lines to UG cables. Recently, MEA announced its 10 (ten) years plan to convert existing OH lines to UG cables on the main roads in Bangkok which accounts for 127 km of road length. The UG circuits are designed to installed UG cables in the reinforced concrete ducts or tunnels and jointed cable sections in the manholes which placed underneath the road surface. All the cable installations are made in the night time where light traffic taking place. The installation jobs are executed by either utility staff or contractor. Installation and Acceptance Tests in accordance with relevant IEC and IEEE are later carried out to verify the cable material integrity and workmanship quality.

However, during the recent years MEA has been facing a series of cable failures upon the voltage withstand tests or on the system voltage soak tests. Almost all the failure occurred at the cable joints. Furthermore, such problems occur mostly on the high voltage (HV) cables, very few with medium voltage (MV). Joint failure particularly took place in 115 kV circuit. Investigation has shown that there were several factors contributing to the breakdowns of cable joints: joint specification, installation condition, jointing procedure, jointer skill, and test methodology.

Hence, the aim of this paper is to present the development of knowledge model from the detailed investigation of the failed joints in 115 kV circuits installed in Bangkok, Thailand. The knowledge engineering and management approach including both CommonKADS methodology and after action review (AAR) technique were applied to elicit the insight on failure mechanism. The possible causes of failure were then identified and reported. Finally, new knowledge was developed in the form of the new procedure for the acceptance of the jointing products from the supplier. Furthermore, the knowledge model developed in this paper could be used to construct the practical and proper training modules suitable for each particular jointing product.

KNOWLEDGE MANAGEMENT APPROACH

Knowledge is the whole body of data and information that people bring to bear to practical use in action, in order to carry out tasks and create new information [1]. It can be categorized as theoretical (concept) and practical (process) knowledge or as verbalized (explicit) and “embedded in head” (tacit) knowledge. Business success depends primarily on how well the organization can utilize these knowledges on real jobs. Knowledge management (KM) approach provides a set of techniques and tools for creating, retaining, transferring and utilizing knowledge. KM draws from existing resources that organization may already have in place; good information systems management, organizational change management, and human resources management practices. For utility business, KM is hence a process whereby an enterprise methodically gathers, organizes, analyzes and shares knowledge relevant to its business environment and operating disciplines [2].

CommonKADS Techniques

The CommonKADS knowledge model [1] is a technique that helps to clarify the structure of a knowledge intensive business task. The knowledge model of an application provides a specification of the data and knowledge structures required for the application. The model is developed as part of the analysis process. It is therefore phrased in the vocabulary of the application, meaning both the domain and the reasoning task:

- *Domain Knowledge* specifies the domain-specific static information and knowledge objects that we want to talk about in an application, for example cable, joint, and termination.
- *Inference Knowledge* describes how domain knowledge can be used to carry out a reasoning process, describes the basic inference steps that we want to make use of the domain knowledge.
- *Task Knowledge describes* what goals and application pursue (e.g. classification, diagnosis, assessment), and how these goals can be realized through a decomposition into subtasks and inference ultimately.