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VALIDATING CABLE "DIAGNOSTIC TESTS"

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ABSTRACT

Diagnostic Techniques are increasingly employed by utilities to manage their infrastructure assets. These are sophisticated techniques being applied to complicated and diverse real world networks. Consequently there are many concerns that these techniques a) are not accurate and b) damage the system by, at the very least, robbing other areas of vitally short resources. Thus there is a compelling need to develop and deploy simple and robust analytical techniques that can address these problems. These evaluation approaches would then identify the effective programmes such that support could be strengthened to these areas, whilst minimizing the resources deployed on approaches that are ineffective.

KEYWORDS

Cable, Accessory, Diagnostic Tests, Reliability

INTRODUCTION

Utilities the world over, and especially in North America, are facing a significant future challenge to maintain and renew their underground (cable) assets. These ageing assets (>20% of the presently installed cables are older than their design lives) are leading to ever increasing failures (Figure 1) whilst, at the same time, the power delivery requirements of some of these cables are increasing. Immediate replacement of these aged cables is not practical – the cost would be enormous and the resources required (manpower and materials) are simply not available. Thus asset management strategies are increasingly being used to help address the issue, such that the replacement of the ageing infrastructure is managed.

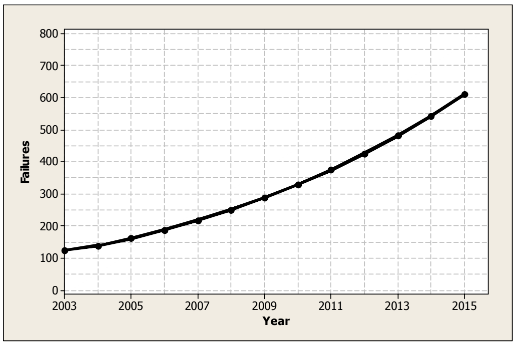

Figure 1: Example of increasing failure rates

A central component of the approach to asset management is the availability of appropriate information on underground assets. Although it is well known that old and unjacketed cables are the least reliable group, not <u>every</u> old or unjacketed cable is at *"death's door"*. Thus extra information is needed if a utility is to undertake *"smart maintenance",* that is, replacement of only those cables that will likely impact the near future reliability. This information is invaluable in helping to determine where maintenance and replacement funds should best be spent. Performance modeling supported by good quality and reliable diagnostic information can be a powerful tool for establishing a) the correct level of resources and b) the most effective way that they may be employed.

It is therefore clear that if we rely on diagnostic information to have an effective asset management programme, then we need to be certain that the information gathered is both relevant and accurate. We find it convenient to term this the Diagnostic Yield. In this area, most practical engineers recognize that results from diagnostic tests are not perfect (accuracy close to 100%). However, certain assurance is needed to ensure that the funds used to conduct diagnostic tests are well spent. They must deliver higher value compared to replacement and repair strategies based on chance selection. To this end, we have examined a number of ways to test and validate diagnostic information against the true system performance. As there are a large variety of diagnostic techniques at a utility's disposal, we have further concentrated on the methods that are 'technique independent" and applicable to all cable systems.

It is not the intention of this paper to dwell on the well known issues associated with either the diagnostic techniques themselves or their interpretation. Instead this paper focuses on a number of the methods we have developed to assess how well diagnostic information on cable systems relates to the performance of a specific system. Primarily this means comparing the predictions from the diagnostic information with real life both before and after the diagnosis. The paper will look at three main approaches:

- Direct Comparison - do the cables identified as "Bad" fail in service or, perhaps more importantly and rarely addressed, do the "Good" not fail?
- Performance Ranking - consideration of the whole continuum of performance (not just "Good" and "Bad") as measured by diagnostic data and correlation/validation with service experience.
- Diagnostic Outcome Maps – how the failures in service are affected by selection, testing & maintenance actions.

The implications of the Diagnostic Yield upon the economic value models for Diagnostic Testing will also be discussed.

SAGE

The process of employing diagnostics to increase the efficiency of reliability improvement contains four elements