

## REPLACEMENT STRATEGIES FOR CUSTOMER MINUTES LOST REDUCTION IN MEDIUM VOLTAGE CABLE NETWORKS

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### ABSTRACT

Stedin has adopted risk-based asset management. The analysis of supply interruption figures due to MV cable failures shows an increase of the CML above the acceptable level. Using Stedins business risk model it is shown which grids contribute to an unacceptable risk. The risks relate to the business values quality of supply, financials and image. Improvement strategies include replacement of poor cables and joints and condition based replacement using PD-measurements. The strategies are ranked with the business model and boundary conditions. Finally an optimal strategy can be chosen.

### KEYWORDS

Risk based asset management, MV grids, PILC, Customer minutes lost, Replacement strategy.

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### INTRODUCTION

Modern societies are more and more depending on a reliable supply of electrical energy. A supply interruption can have large economical consequences and the grid operators should strive for an interruption frequency and duration as low as possible. Due to the ageing of grid components, mainly cable, the trend is that the number of cable failures is increasing. To prevent a significant increase in supply interruptions on and off line cable diagnostics are applied to monitor the cable condition. However, the total number of cables in the Stedin supply area is too large to be monitored. Additional analysis of performance indexes such as Customer Minutes Lost (CML) and Customer Average Interruption Frequency Index (CAIFI) is used to find areas of with a performance below the acceptable level. For grid operators the customer minutes lost is a performance index for the number and duration of supply interruptions. As a distribution grid operator Stedin uses the CML and the yearly number of supply interruptions for the worst served customer as quality indicator in its risk model.

Stedin has adopted risk-based asset management according the PAS55 standard [1]. The analysis of supply interruption figures due to MV cable failures of the last couple of years shows an increase of the CML above the acceptable level. To mitigate the increase on CML in the Stedin supply area a project has started in which a replacement strategy has been developed. In this paper the analysis of the performance indexes will be discussed.

The results of the analysis will be evaluated with the aid of Stedins risk model. For areas with an unacceptable risk level, alternative strategies will be presented which are ranked with the risk model. The paper ends with an estimate of the CML reduction per strategy and together with the ranking a replacement strategy will be proposed.

### RANKING MV NETWORKS

As discussed in the introduction key performance indicators contributing to the customer quality of supply are the customer minutes lost and the number of interruptions. In figures 1 and 2 these numbers are shown for a five year period for the highest scoring HV/MV substation. External failures due to third party activities are excluded from the figures.

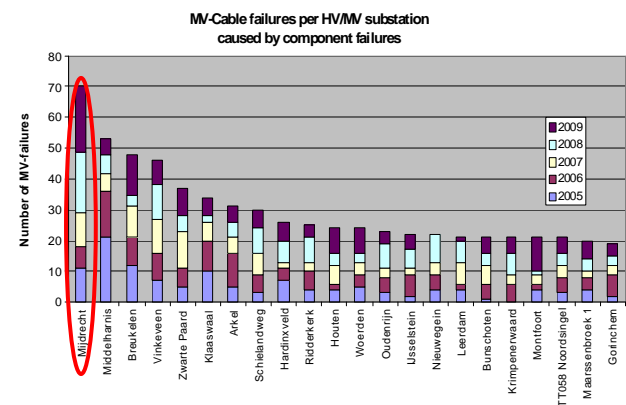


Figure 1: ranking of interruptions for HV/MV districts

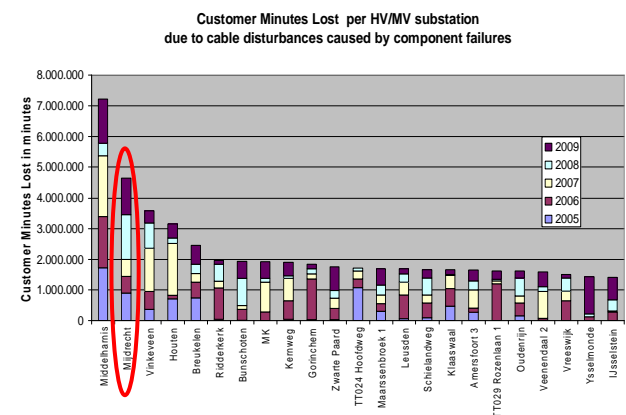


Figure 2: ranking of CML for HV/MV districts

In figure 1 and 2 it is indicated that a significant number of interruptions and contribution to the CML occurs in the Mijdrecht area and the surrounding substations Vinkeveen and Breukelen.