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Installation quality of cable accessories in medium voltage power distribution networks

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Cable accessories of today are well proven, easy to use, and fulfill high quality standards. However, having faced many challenges in the past, another significant challenge has emerged through ~~the~~ changes in personnel working on power distribution networks. This has resulted in new players operating in the installation of cable accessories. To ensure the quality of installation, systematic demonstration of competency of the existing and entrant installation team members is needed. By requiring a competency test, utilities/distribution network owners (DNO's) can fully capitalize on modern cable accessories, extracting the full~~ value of their investment in high quality products. This results in longer term reliability of the network, giving higher levels of customer satisfaction, whilst also reducing the cost of ownership.

Decentralization of energy production, due to new energy sources like solar and wind, has set new requirements for power distribution networks. Consumers turn into producers, feeding small flows of electricity onto networks. For example, logistics centers have covered their roofs with solar panels and industrial companies sell back their spare electricity. In the near future large-capacity energy storage and microgrids will be connected to networks.

All this will change the load diagram of the network, increasing the number of connections to distribution networks and making networks more complicated. At the same time the role of utilities/DNO's is changing towards becoming a System Operator (DSO). In this role they are required to become the manager of the distribution of power as well as all the connections to the network. This ultimately results in them being a facilitator, or project manager, of the new players like construction companies who are completing the installation of cable accessories as part of engineering, procurement and construction (EPC) contracts.

Studies point out preparation and installation

Accessories for medium voltage networks - joints, terminations and connectors - are technologically advanced and designed to make installation easy. Still, quality risks exist in the critical installation steps, specifically where jointing is done by personnel without sufficient training and experience.

The national association of utilities of The Netherlands, in its report on reliability of electricity networks in 2016[1], names internal defects as the most common cause (21%) of interruptions in medium voltage networks.

Testing institute RWE Eurotest in Germany made a thorough study of the most common installation failures during the period of 2007-2014 (Ref. 3). The report shows that in 68% of the cases of failure concerning accessories, the cause can be clearly identified. In all cases failures were caused by installation and none by structure or materials of accessories.

Experiences of German utility Stromnetz Berlin (Ref. 4) backup these reports. The company has made a case study of commission inspection of its new 10 kV power circuit. It consists of 180 joints, out of which three had installation failures, and accordingly 72 terminations of which 10 were not inside acceptable limits.

Generally, errors occur firstly during cable preparation and rely on cleaning, surface smoothness and adjusting dimensions. Secondly, they occur in assembly, when accessory or cable are exposed to dirt or moisture or are incorrectly positioned.

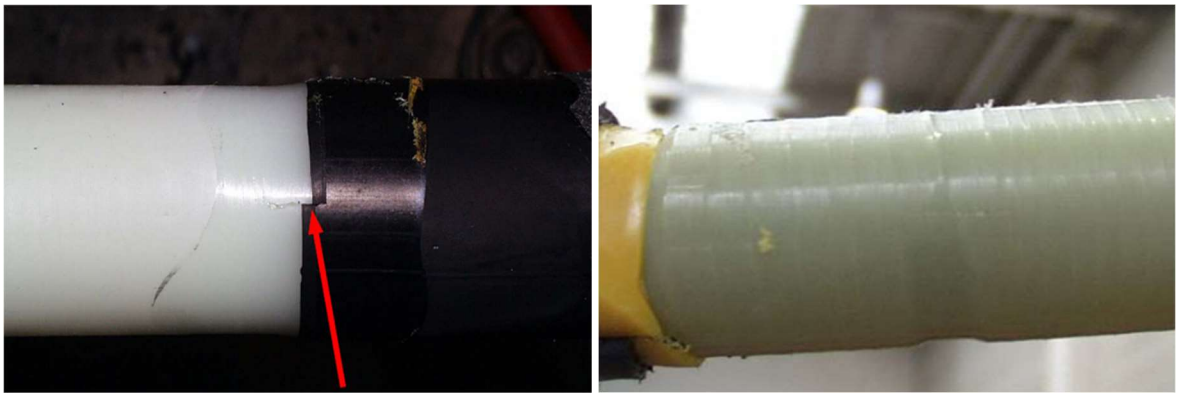

Fig 1: Examples of incorrect cable preparation

Network interruptions – SAIDI:

Statistics about interruption of networks are considered in the SAIDI (System Average Interruption Duration Index) Index.

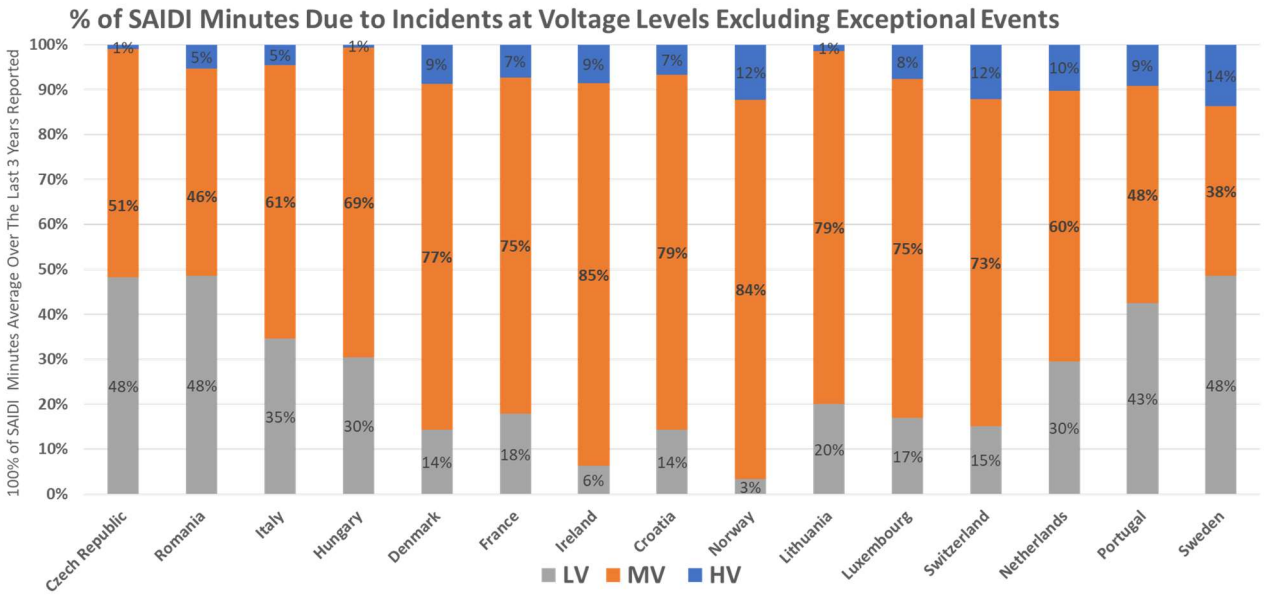

Fig. 2: Saidi distribution by voltage class for European Countries.
(Ref. 1 / CEER Benchmarking Report 6.1 on the Continuity of Electricity Supply - Data Update 2015/2016)

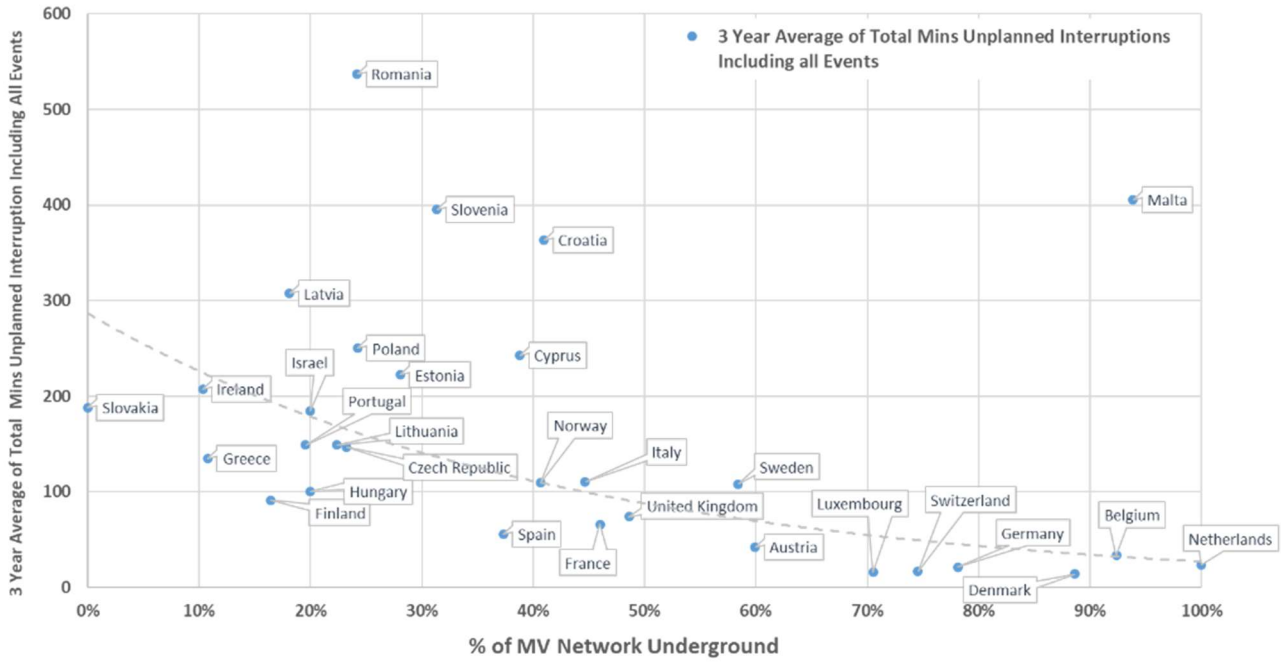

Fig. 3: 3 Years average of total minutes Unplanned Interruption vs. % of MV Underground Network

(Ref.1 / CEER Benchmarking Report 6.1 on the Continuity of Electricity Supply - Data Update 2015/2016)

Consequences of Product Failures

Fig. 3 shows the impact on SAIDI by incidents at MV voltage level. From the national association of utilities of The Netherlands report (Ref. 2), the data tells us that in the Netherlands (100% underground system) there are almost 8 times as many component failures on the LV network as seen on the MV network, but this has half the impact on customers.

Utilities focus on measurement and training

Utilities/DNO's know, that a single installation error can accumulate interruptions, which raises the total cost of ownership (TOC) of the network. The challenge is to identify the error immediately at commissioning, not years later. This has raised a growing interest in new technology solutions developed to measure installation quality. An excellent example of this is partial discharge diagnostic systems with analysis, which helps to identify errors immediately after installation as well as predict future failures. Today, commissioning tests prior to network operation are a common practice. However, as it is a developing technology and there are many varieties of cable and accessories, each tested scenario needs to be treated on its own merits and often with expert analysis required to interpret the results to provide meaningful actions.

As the reports and studies above show, it appears that the number of installation errors is increasing. In the field there will be a mix of utility employed installers, external contractors, and installers with multiple tasks including gas, water and electricity. As in the past, Installers where specialized on jointing electrical cables only. Today's trend is going towards a more generalist installer who may be tasked with installations for Water, Oil & Gas Applications also.

Importance of Cable Jointing Training

The content of training varies in general utility electrical education institutions, utility training schools and certification courses. Manufacturers of cable accessories provide training programs, workshops and seminars that are welcomed by utilities and their contractors. In those, intensive training concentrates on accessories and provides best possible skills and practices to implement high quality installation. With such a variety of training providers, helping to upskill the installer, assessment of Jointer skills becomes the assurance that the training has achieved the required end result.

Modern cable accessories and trained Jointers

Many utilities set requirements to minimize installation errors and include training to an overall project or scope of work, by setting training as a subject within tenders for the cable accessories products. Outside of tenders some network owner/operators require a certification of installers, and never allow non-certified installers to work on their network or the project. Other approaches include attendance at a product training session provided by the manufacturer or an approved training organization.

Manufacturers continue to develop easy-to-use accessories and tools, applying up-to-date technology and materials. Still, even the most simplified product can never compensate the need of installation training and systematic testing of competency. Cable accessories are products manufactured in a factory, produced in a serial manner of constant quality, but in contrast, installations in the field and the professional who does the work can vary greatly.

By nature, marginal installation errors may appear at commissioning, after a year, or several years later. They can have a major impact on the Total Cost of Ownership (TCO) of the network, not only in the form of repair costs and repair time, but also in measures of system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI). That is why high quality of accessories and their installation is essential.

References:

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Disclaimer: The present information paper reflects the best knowledge of Europacable experts at the moment of its publication. It is intended as a tool among others to inform about the mechanical forces and movements in underground cables and cable accessories. It is not a legal or legally binding document and is not intended as a substitute for each manufacturer's or user's or installer's own assessment and decision making. Europacable declines any and all liability for any measure taken or not taken on the basis of this information paper. This paper is for general informational purposes only.