# Fault Localisation with Distributed Acoustic Sensing (DAS) – Service Experience

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## ABSTRACT

*Installing cables with direct cross-bonding, in ducts, without link box access, etc. it becomes difficult to perform fault localisation with traditional methods. Therefore, other methods were investigated for the Danish transmission grid. Distributed Acoustic Sensing (DAS) was found to be a viable option however limited experience worldwide is freely available. The paper presents the use of DAS for fault localisation on three different cables where both successful and less successful cases are presented so that the combined cable community can become wiser and more efficient in the future.*

## KEYWORDS

Distributed Acoustic Sensing (DAS), Distributed Vibration Sensing (DVS), Distributed Temperature Sensing (DTS), Fault Localisation, Fault Pinpointing, Cable, HV, EHV, Real Time, Online.

## INTRODUCTION

With the introduction of cross bonded cable systems, the design engineers introduced problems for asset departments as fault localization with standard methods became much more difficult. TDR and bridge measurements does, in most cases, not give reliable data for fault localization. Therefore, many asset departments have relied on the use of applying voltage to the screen (over the cable jacket) to pinpoint faults. However, this requires access to the screen at every cross-bonding point, i.e. a link box. Link boxes though require regular maintenance and are therefore expensive in operation, and it has on that background become common practice in the Danish transmission system to use direct cross bonding which means that screen access is not possible and all standard fault localization methods have thus become ineffective. A totally different approach therefore had to be implemented to find and pinpoint faults on cable systems in the Danish transmission grid.

## DESIGN OF CABLE SYSTEM AND TRENCH

Cables installed in rural areas cable systems are installed in flat configuration in a trench with a design as shown in Fig. 1. The three cables are separated by 400 mm and to the centre cable is taped a tube wherein an optical fibre cable is installed. The fibre cable is mainly used for communication between substations, however a number of fibres are dedicated for monitoring of the HV cable system.

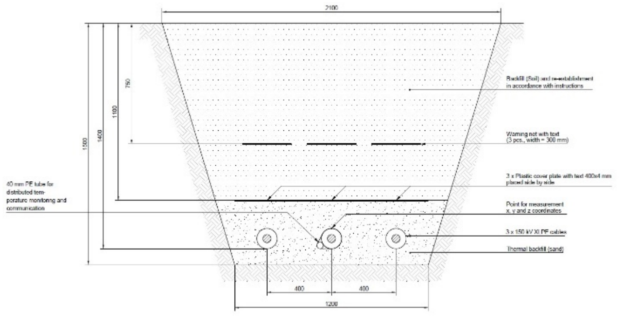

**Fig. 1: Cross sectional sketch of a trench for installing cables in rural areas in the Danish transmission grid**

This trench design has shown to be the optimal balance between cable performance, installation costs and operational (including maintenance) costs for installation in rural areas.

For cables in urban areas, problems with other utility lines, etc. may force the TSO to install the cables in ducts which makes it more difficult to perform fault localisation

Cable systems are, similar to the cable trench, designed to reach an optimum between cable performance, installation costs and operational (including maintenance) costs. Therefore, new cable systems in rural areas are designed with direct cross-bonding to the furthest possible extend, however to protect the bonding system (including screen separation, cable jacket, etc.) the first major section at each end from a substation is protected with SVLs in link boxes, Fig. 2.