

## Refurbishment of the Copenhagen Transmission Grid – Project Planning and Execution

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### ABSTRACT

*This paper presents the planning and execution of a cable project in an urban environment where tunnels are not deemed a viable option. Planning during different stages of the project is presented and a number of different obstacles encountered are discussed. It is shown that there are several important parameters which ensures a successful project. 1. Proper and thorough planning 2. Solid cable and cable system design 3. Pragmatic approach to problem solving in the field 4. A good cooperation with the civil contractor who shall solve problems in a practical way.*

### KEYWORDS

Cable project, city, urban, installation, HDD, DTS, case study, civil contractor, planning, time schedule,

### INTRODUCTION

As in many other countries, the transmission grids in the larger cities of Denmark are coming to the end of their designed life as the basic infrastructure in these grids were installed in the same period in time (around 1960-1970). On this background a major project for planning the refurbishment of the Copenhagen transmission grid was initiated with a planned project period ending in the 2030's.

The planning of the first of these projects was started around 2015, with installation work beginning in first half of 2018 and commissioning in the beginning of 2019. This paper presents how the project was planned, executed, commissioned, and it presents the first operational data.

As it will show in the remaining of the paper, all aspects of such a cable project influence each other, and it is therefore difficult to describe project planning as a step by step method as it is in reality an iterative process.

For example; the size of the magnetic field from the cables is of huge importance to the local community, and this magnetic field can be limited by installing the cables in close trefoil formation. However, as the municipality and road authorities only allow for having a couple of hundred meters of open trench at any given time, this method would require an enormous number of joints. This means that a simple requirement of minimizing the magnetic field results in the need for many accessories with all the issues and man hours related thereto. How to solve the magnetic field issue, and how that would affect the installation methods, should therefore undergo an extra iteration.

### REQUIREMENTS FOR CABLE PROJECT

#### Geography

A cable project starts by the grid planning department

finding a need to connect two nodes in the grid. In this case the grid required strengthening to prepare for the future large-scale refurbishment of the grid, where existing cable links could be taken out of service for longer periods of time. Only by performing a strengthening of the existing grid could such cables be taken out of service without impacting the reliability of supply. This strengthening coincided with the planning of converting a power plant in Copenhagen to biomass from coal, and at the same time move primary production towards district heating instead of electricity.

The new cable system was on this background to connect the two grid nodes Avedøre Værket (AVV) and Amager Koblingsstation (AMK) as shown in Fig. 1.



**Fig. 1: Overview of the grid nodes that had to be connected with this cable project.**

#### Time Line

The cable should be in operation by February 1<sup>st</sup> 2019, which meant that the installation work should be finished in under 1 year. For a cable in a rural area 10.7 km of cable could be installed in less than a ½ year, however in the city environment 1 year for installation was predicted to be very tight though possible.

#### Electrical Requirements

The electrical requirements for the cable system are listed below:

- System voltage 132 kV
- Continuous current up to 1200 A
- Yearly average current up to 400 A
- Short circuit rating of 40 kA for 0.5 seconds

#### CHOICE OF CABLE ROUTE

In a straight line, the two nodes of Fig. 1 are spaced