EXPERIENCES FROM A TEST PROJECT IN NORWAY USING COMPOSITE POLES IN 132 KV OVERHEAD LINES

Erling TØNNE
NTE Nett – Norway
erling.toenne@nte.no

Vidar DALE
NTE Nett – Norway
vidar.dale@nte.no

Jan A FOOSNÆS
NTE Nett / NTNU – Norway
jan.foosnaes@nte.no

ABSTRACT

The main challenges for network companies today are implementing new technologies and become more efficient in every part of the asset management. NTE Nett, a Norwegian DSO, has during 2011 and 2012 completed a test project using composite poles instead of traditionally wooden poles in a 132 kV overhead line.

The conclusion from the test project is that composite poles are economic favorable compared to wood poles when life cycle costs (material costs, installation costs, maintenance costs, dismantling and waste handling costs) are considered.

NTE Nett will definitely consider using composite poles in other projects in the future. Especially when new lines are to be built and when old lines are to be replaced with new ones.

INTRODUCTION

NTE Nett is the distribution system operator (DSO) of the electric distribution network in the county of Nord-Trøndelag in Central Norway. The MV system includes more than 13 400 kilometers of overhead lines and cables.

The electric power system is an ageing infrastructure and the need for making reinvestments is increasing. Strict economic regulation of DSOs, forces them to search for more efficient work processes and improved technical solutions. The main challenges for the network companies today are implementing new technologies and become more efficient in every part of the asset management.

The use of composite poles in construction of overhead power lines is a relatively new technology in Europe, but is used widely in Canada, the United States and Australia.

NTE Nett has during 2011 and 2012 completed a test project involving the new technology and has experienced several benefits using the new technology, both economical and technical.

NTE has developed and tested new methods for the foundation and the installation of the composite poles. These methods have never been used in Norway before and they make it possible to use smaller machines for the foundation work and helicopters for the transport and installation work. These methods are friendly to the environment as for off-road field damage.

This paper will describe the technical, economical and environmental considerations done by NTE Nett and the experiences made in the test project.

ABOUT COMPOSITE POLES

The first composite poles were produced in Canada 2004. The inventor and producer was the Canadian company RS Technologies. Today composite is often preferred instead of traditional impregnated wooden poles, concrete or steel when new lines are to be built.

The advantages of composite poles are:

- Modular design
- Lower logistics costs
- Longer life time
- Environmentally friendly

The weight of the composite poles is about 1/3 of the weight of wooden poles with the same length. The lower weight and the modularity make the transport of the poles simpler and cheaper. The low weight allows the installers to use light machines for the installation work. The low weight also makes it possible to mount the pole constructions with the use of helicopters.

The composite poles are made of a composite material consisting of polyurethane resins and E-glass fibers. These materials provide an extremely strong pole with long life time. The poles can withstand all weather conditions and they are not flammable, they do not conduct electricity and they have low weight compared to wooden poles.

The composite poles are made of a series of modular sections. This simplifies the transport and the storage. There are eight different modules that can be assembled into different strength classes with pole heights up to 36 meters. The 170 poles delivered to NTE Nett for this test project, were packed and shipped from Canada in 7 containers (Figure 1).

Composite poles are resistant to rot and corrosion. The outer layer is UV-resistant regardless of the mechanical

effects. The poles are therefore considered to be largely immune to such effects (including woodpecker damages). The estimated lifetime is at least 80 years. The poles are delivered with 41 years of manufacturer warranty.

Figure 1 Pile of composite poles (Photo: NTE Nett)

The composite poles have high carrying capacity in hot and cold environments. The poles can be used in a temperature range from -60^0 C to $+75^0$ C. The poles are not brittle in cold weather, but show on the contrary an increased strength. The poles are not flammable and therefore they can cope with a possible forest fire.

The composite poles can absorb considerably more elastic energy than wooden poles, which provides extra protection against damage during storms and other strong stresses like icing and tree striking.

The poles do not conduct electricity. This means that it is possible to replace poles in existing lines when the line is in duty (live line work). This also increases the safety by touch and reduces the risk of voltage breakdown caused by lightning.

Almost all wooden poles currently in use today require chemical treatments to prevent deterioration. Composite poles do not need this treatment. Likewise, the manufacturing process does not produce any VOCs (volatile organic compounds) or HAPs (hazardous air pollutants). The poles are environmentally neutral, they do not emit harmful substances and they are recyclable. The use of composite poles also helps to reduce deforestation.

(For more information about composite poles, go to www.melbye.no and www.rstandard.com)

ABOUT THE PROJECT

With regards to the construction of the new 132 kV overhead line between the transformer stations Fiskumfoss, Snåsa and Bogna, NTE Nett has received a license for the use of composite poles. NTE Nett decided to test out composite poles because the actual line goes through an area with lots of woodpeckers that cause damage to wooden poles with consequent high repair costs. Figure 2 shows a pole from the old line in this area.

47 km of the line were built during 2011 and 2012. Another 10 km will be built in 2013.

Figure 2 Woodpecker damages on an old pole in the area (Photo: NTE Nett)

DEVELOPMENT OF NEW SOLUTIONS

With regards to the use of composite poles instead of wooden poles, there was a need to test new solutions. The first part of the project (19 km) was implemented in 2011 as a R&D project. The project was not put to tender, but it was performed as a research project within the NTE Group.

NTE has developed new methods for the foundation and the installation of the poles. This was the first time these methods were used in Norway. The use of smaller machines and the increased use of helicopters are friendly to the environment as for off-road field damage. Pictures from process of preparing and mounting of poles are shown in Figure 3 to Figure 7. Figure 6 is from the same project, but the pictures are taken at another time and place than the others.

The project was carried out within the NTE group because that would provide some advantages:

- It was easier to test new methods / materials in the project.
- The competences generated in the project can provide competitive advantage externally (competences retained in NTE).
- The operating workers will get the necessary skills for the new working methods / materials.
- It was a unique opportunity to become even better in cooperation between the companies of the NTE group.

The project was completed successfully. New methods for the foundation of composite poles and more efficient methods to assemble all the poles with the use of helicopters have been developed during the first part of the project. In the second part the methods were tested and improved.

Figure 3 Foundations are ready (Photo: NTE Nett)

Figure 4 Using helicopter for transport and placing of preassembled poles (Photo: NTE Nett)

Figure 5 The poles are placed (Photo: NTE Nett)

Figure 6 Fixing the pole (Photo: NTE Nett)

Figure 7 Preassembling of the poles (Photo: NTE Nett)

REPUTATION

Through the project, NTE has received a lot of positive media coverage. There have been several reports in newspapers, magazines and TV. Also other network companies in Norway and Sweden have shown great interest in this project.

The authorities have also shown positive interest. NVE (The Norwegian Water Resources and Energy Directorate) has been on an inspection on the project site. Their main remark was that there were significantly less vehicle driving damages in the field compared to the traditional line construction. Composite poles are also preferred to use close to sources of drinking water and in wetlands since composite poles do not emit harmful substances. These are important environmental advantages in favor of composite poles.

LIFETIME COSTS OF COMPOSITE POLES COMPARED WITH THE WOODEN POLES

Lifetime costs for composite poles and wooden poles have been compared. 50 years period of analysis is used for the calculations. This is considered to be the normal life time of a wooden pole. The life time of composite poles is considered to be at least 80 years, but to be very conservative this was not taken into account in the calculations. The calculations are done with 4.5 % real interest and the costs are referred to cost level 2011.

The operation and maintenance costs for wooden poles are related to rot control, repairs due to decay and repairs of woodpecker damages. NTE Nett estimates these costs to be about 4,000 NOK/km*year in average for their 66-132 kV lines.. The operation and maintenance costs for a wooden line in this project is estimated to be 5,000 NOK/km*year. There have been many repairs on the existing line due to woodpecker damages, and parts of the line are in difficult terrain, resulting in increased costs. The composite poles are considered to be maintenance free.
To exploit the advantages with composite poles, the tower height and span length was increased compared with the wooden poles. The number of poles was because of this, reduced with an average of 2 poles per km of line compared to wooden poles. This resulted in reduced costs of NOK 105,000 per km of line.

Table 1 shows calculated lifetime costs for the two different types of poles.

Table 1 Lifetime costs (1000 NOK/km)

Costs	Wood	Composite
Purchasing poles	158	306
Operation and maintenance (discounted)	98	0
Reduced construction costs due to fewer poles	0	-105
TOTAL	**256**	**201**

(1 Euro ≈ 7,4 NOK)

Based on this, the solution with composite poles is a cheaper option than the alternative with wooden poles when lifetime costs are considered. The difference for this project was NOK 55 000 per km of line. For the whole project (47 km) the savings was about NOK 2,585,000. The savings would be even bigger if the expected longer life time of composite poles was taken into account.

The composite poles have lower weight and less volume during transport compared to the wooden poles (about 1/3 for both weight and volume for a 21 m pole used in this project). Wooden poles of this dimension must be imported from other countries than Norway, so the difference in environmental impact because of transportation from the producer to the plant is not necessary so big. When it comes to transportation off-road on the building site, weight will influence the costs and the environmental impacts. These impacts are associated with great uncertainty and are not included in this analysis.

CONCLUSION

The results from this project indicates that composite poles are economic favorable compared to wood poles when life cycle costs (material costs, installation costs, maintenance costs, dismantling and waste handling costs) are considered.

NTE Nett will definitely use composite poles in other projects in the future.

REFERENCES

[1] V. Dale, J. A. Foosnæs, and E. Tønne, "Experiences From a Test Project in Norway Using Composite Poles in 132 kV Overhead Lines," presented at the Nordac 2012, Espoo, Finland, 2012.

[2] T. Pynten, J. A. Foosnæs, J. G. Hernes, and E. Tønne, "Finding maintenance project to priority " presented at the Cired 2011, Frankfurt, Germany, 2011.