Eco Designs in Power Cables – a Case Study

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ABSTRACT

ECO design can be defined as "a concept of taking into consideration the environmental impacts of the materials, resources, and end-of-life scenarios at the front end of a design project and making choices that reduce the impact of the product on the environment" [1].

This paper compares traditional designs versus ECO ones, e.g. on CO_2 footprint of manufacturing and construction simplicity. The ECO designs are qualified according to standards as IEC60840 NEN-HD620 and NEN-HD632.

KEYWORDS

ECO Design, CO_2, Extruded cable, Type Testing, MV

INTRODUCTION

Distribution system operators (DSO) and Transmission system operators (TSO) are paying more attention on the sustainability aspects of power cables. This trend is on the rise and already a significant portion of the tender allocation is based on these criteria. Prysmian Group has picked up the challenge and is proposing a structured approach to this tendency by introducing its own ECO design. The improved design will be benchmarked against a traditional design found across the Netherlands and Europe in terms of design and CO_2 data of materials and process required for their production.

ECO DESIGN METHOD

The ECO Design approach presented in this paper is based upon Lifecycle Design Strategy (LiDS) [2] that support product developers to identify product modifications that could make a power cable more eco-effective throughout the whole life span. LiDS has been translated into seven design guidelines:

1) Use recycled and not scarce materials
2) Use as less material as possible
3) Make the product easy to manufacture
4) Make the product light in transport
5) Look for low environmental impact during use
6) Aim for long life time
7) Have end of life in mind

These LiDS guidelines enable to explore product developments beyond being cost effective within the present cable standards and industry practices. This set of principles makes a qualitative comparison of the ecological impact of alternative designs possible.

However, it also turns out that LiDS is paradoxical, almost by definition. One example to illustrate this, is the fact that a bigger conductor will reduce the environmental impact during use as the electrical losses and therefore the related CO_2 foot print will be reduced (supporting LiDS #4), but will require more material (contra-dictionary to LiDS #2).

Therefore, there is also a need for a qualitative method to compare traditional and alternative eco-designs. By performing an LCA study it is possible to understand the differences between a traditional design and an Eco-design in detail and in depth. Nevertheless there is a practical business limitation to perform an LCA – which is a thorough but quite elaborate exercise - for all existing products and possible alternatives.

To overcome the above mentioned issues, a set of objective and relevant measurable criteria parameters has been defined looking at the most relevant ecological issues of today, being climate change mitigation and circular economy promotion. This set has proven to be useful and meaningful in comparing designs on basic eco-impact:

a) Linear weight
b) CO_2 foot print of materials
c) CO_2 foot print of manufacturing processes
d) Circularity index

The LiDS guidelines and the eco-impact parameters provide cable industry and DSO's tools to move towards cables with less ecological impact. Although the present imperative that alternative eco-designs shall be compatible with the existing power networks, limits to explore more than just incremental product improvements.

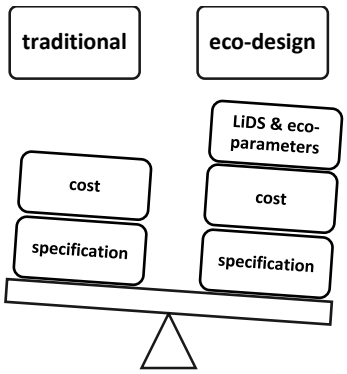

Figure 1 – There are more parameters to consider with ECO Designs

In the next section, a more detailed comparison is presented between traditional and ECO Designs.

CABLE DESIGNS

In this section, two types of cable designs will be discussed. The traditional design common in the Netherlands and Europe and the proposed ECO Design. These considerations are based on a single core medium voltage cable types.