Integration of circularity into eco-design

Answer to question 1.15. To reach a carbon-neutral value chain in the entire process of network operators, there is need to embed circularity in their core business processes. An innovative approach needs to be adopted about the circularity of materials and the eco-design, applying extensively the concepts of resources management, recycling, refurbish, life extension and the LCA methodologies. What experience can be reported about the decision processes for asset management based on circularity? What results can we report?

LCA – Assess environmental impact

Since the 2000s, GE Grid Solutions (GS) has embarked on the path of eco-design, integrating environmental concerns into the design and production phase alongside other conventional design concerns such as customers' expectations, technical performances, cost control, etc. The objective of GS is to reduce the global environmental impact of its products, over its whole life cycle, from the extraction of the raw materials until the end-of-life, while considering all environmental indicators.

Eco-design methodology put in place is aligned with IEC 62430 "Environmentally conscious design for electrical and electronic products" recommendations. The target is to introduce environmental requirements as far upstream as possible in the design process, i.e., at the start of the product development, in order to reduce its global environmental impact compared to the product that is replaced.

The eco-design methodology is pursuing the below objectives :

• Reduce the environmental impact of the product throughout its life cycle (from components purchase, to end-of-life recycling) ;

• Comply with environmental regulations (eco-design directive, check the absence of substances prohibited by REACH and RoHS directives) ;

• Address customer requirements ;

• Issue the product environmental documentation (eco-declaration (PEP or EPD) and end-of-life manual)

• Comply with regulations, to keep ISO 14001 certification and to remain competitive on the market.

The eco-design methodology was implemented first in specific products like high voltage circuit breakers that contain SF_6, the most potent GHG with a GWP of 23500. The eco-design methodology was set to minimize step by step the use of this gas and the overall environmental impact of the high voltage circuit breaker with the final aim of completely suppressing its use with the creation of an environmentally friendly alternative.

The environmental impact evaluation of each GS product is evaluated via a Life-cycle Assessment (hereinafter 'LCA"). This technique allows GS to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling.

LCA is aligned with ISO 14040:2006 and 14044:2006 standards and includes considerations as resource consumption, emissions and waste generation from production of material, manufacturing, distribution, construction, operation and maintenance (including system losses).

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As the so-called “linear” economic model, consisting of “manufacturing, consuming and then throwing away”, is not viable in the long term in the face of numerous non-renewable energies (metals, minerals, fossil fuels, etc.), which cannot keep up with demand. Faced with a limited capacity for regeneration of renewable energies (land, forests, water, etc.), GS has to invest in circular economy approach consisting of extending the lifespan of products, reducing waste, reusing waste as a new resource.
The circular economy is a concept that is attracting more and more attention, in a society context which realizes the finitude of resources and the complexity of waste management. The circular economy requires lifecycle thinking. Like LCA, which considers a vision of the product from raw material to end-of-life processing, the circular economy takes this reasoning on a systemic scale, and on an even larger time scale.

Fig. 1: 5R’s of circular economy.

Application of the 5R’s principles to the SF_6 High Voltage switchgears :

- **Refuse:** No use SVHC.
- **Reform:** Technologies to allow a lower material intensity.
- **Reduce:** Mass of materials by optimizing design.
- **Reuse:** Reuse of SF_6, reuse of component by life extension (repair of circuit breaker).
- **Recycle:** SF_6 to move from new SF_6 (acc. to IEC 60376) to recycled SF_6 (acc. to IEC 60480).