Deliverable D6.4:
First Field Testing

WP6: Development of the open Access TeaM Cables tool and integration of models

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Description: Report on software testing (errors, experiences, feedback) and questionnaire completed by the end-user group.

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Glossary

Abbreviation/ acronym	Description
AO	Antioxidant
BWR	Boiling Water Reactor
COMSY	Condition Oriented Monitoring and Plant Management System (Software)
EDF	Électricité de France
FRA-G	Framatome GmbH
HW	Hardware
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
MS	Microsoft
OS	Operating System
PE	Polyethylene
PH	Polymer substrate
PWR	Pressurized Water Reactor
SW	Software
VP	Virtual Polymer (Software)
WP	Work Package
XLPE	Cross-linked polyethylene

1 Executive Summary

This deliverable provides a summary of the WP6 activities organised in September-October 2021 in relation with the end users. A first end user workshop was held as a web meeting on 22nd September 2021 (see Deliverable D7.6: End-user first workshop for more details). As this first session was held remotely due to the sanitary context instead of physically as initially planned, it consisted mainly in a demonstration of the TeaM Cables tool. Software testing will rather take place at a later stage when the second workshop is organised and results will be included in D6.6: Second Field testing. A questionnaire was circulated to the workshop participants to follow up on the discussions and actions and prepare the second session. A summary of answers received is provided in this report.

The TeaM Cables Tool intends to combine COMSY (Condition Oriented Monitoring and Plant Management System), developed by Framatome GmbH, and VP (Virtual Polymer), developed by EDF.

A first specification of the TeaM Cables Tool was drafted in Deliverable D6.1, which was submitted in September 2019. The Deliverable D6.2 presents the activities made and progress achieved in WP6 for the implementation of the TeaM Cables Tool in order to document the project evolution and decisions made in the course of the SW implementation works in order to achieve the TMC objectives. In D6.3 the progress achieved in WP6 for the implementation of the TeaM Cables (TMC) Tool is presented to document the project evolution and decisions taken in the course of the software (SW) implementation works in order to achieve the TeaM Cables objectives All reports can be found at https://www.team-cables.eu/media-centre/.

2 Introduction

COMSY is the front-end software running on Windows OS platform at the customer; all data is stored in an MS Access or MS SQL Server database. For the TeaM Cables Tool, the electrical module of COMSY will be used. In the TeaM Cables Tool, the currently implemented ageing/degradation algorithms for assessment/management of the lifetime for XLPE insulated cables (as part of passive electrical systems) will be replaced/extended with the evaluation of calculation results from VP, using algorithms to be developed and validated within the framework of the TeaM Cables project.

VP is the back-end software running on Linux OS: it is a one-dimension modelling platform composed of a model data base and different calculation components. The chaining of the different parts makes it possible to develop a multi scale and multi physical modelling of the polymer ageing process. The further development and validation of the multi scale and multi physical modelling of the ageing process of XLPE in dependence of specific material properties and environmental conditions is the main objective of the TeaM Cables project.

The features required in the TeaM Cables Tool were identified in Deliverable D6.1 as the following:

- the graphical user interface (GUI) needed for cable data entry and display,
- generates the data needed for degradation calculations in VP,
- receives the calculation results (abacus/solver matrix) from VP,
- allocation/mapping of VP results to the individual cables,
- display of results, calculation of residual life time.

3 Survey to collect feedback from end users

A short survey was circulated among TeaM Cables end users to further clarify topics discussed during the first end user workshop and integrate feedback in preparation of the second workshop.

A summary of answers is provided hereafter.

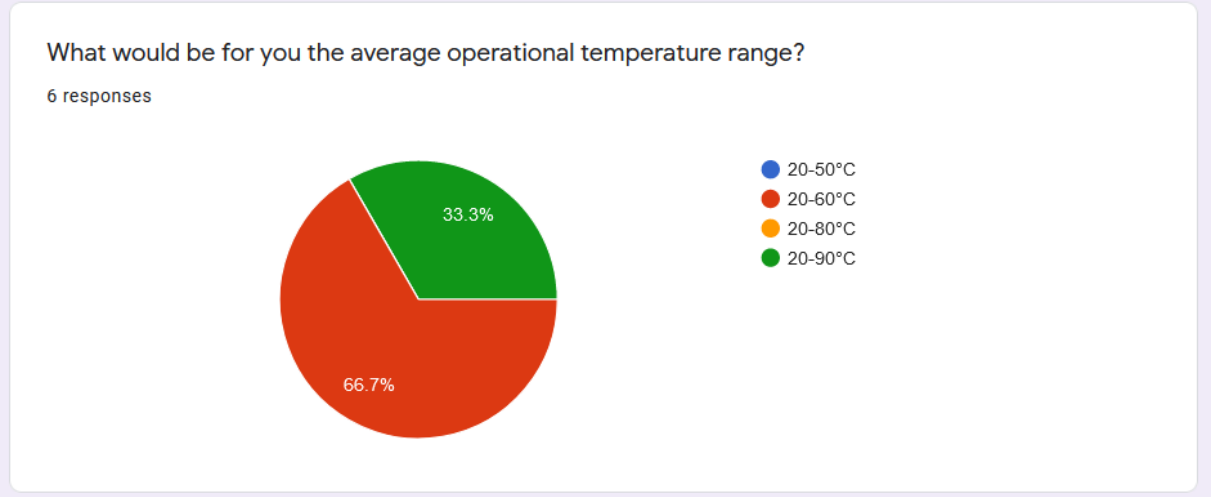

Figure 1: Average operational temperature range

The end-user feedback is in accordance with engineering experience of temperatures in operating nuclear power plants. The majority of end users considers the temperature range of 20 °C to 60 °C sufficient, this corresponds to the typical design temperature range for electrical cables in PWR. The temperature range of 20 °C to 90 °C considers conditions possible in BWR, the value is the addition of upper ambient temperatures possible above the reactor vessel additionally taking into account self-heating in electrical cables of consumers in permanent operation.

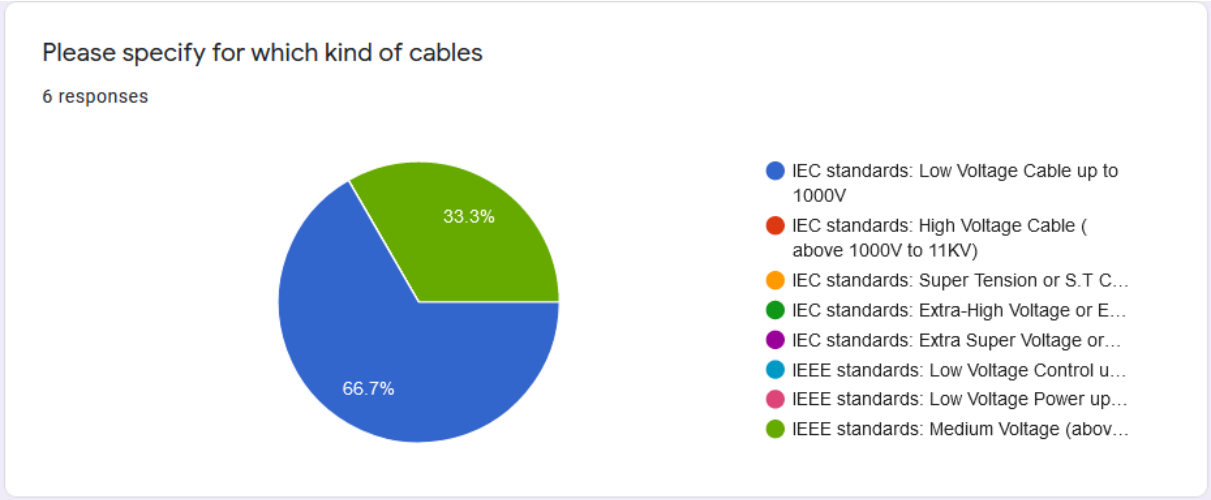

Figure 2: Cable types of interest in nuclear applications

The end-user feedback is in accordance to voltage levels in nuclear islands. Of primary interest are the low voltage and medium voltage cables. It shall be noted that medium voltage in accordance to IEEE standards (above 1000 V to 15000 V) envelopes the IEC voltage range for High Voltage Cables.

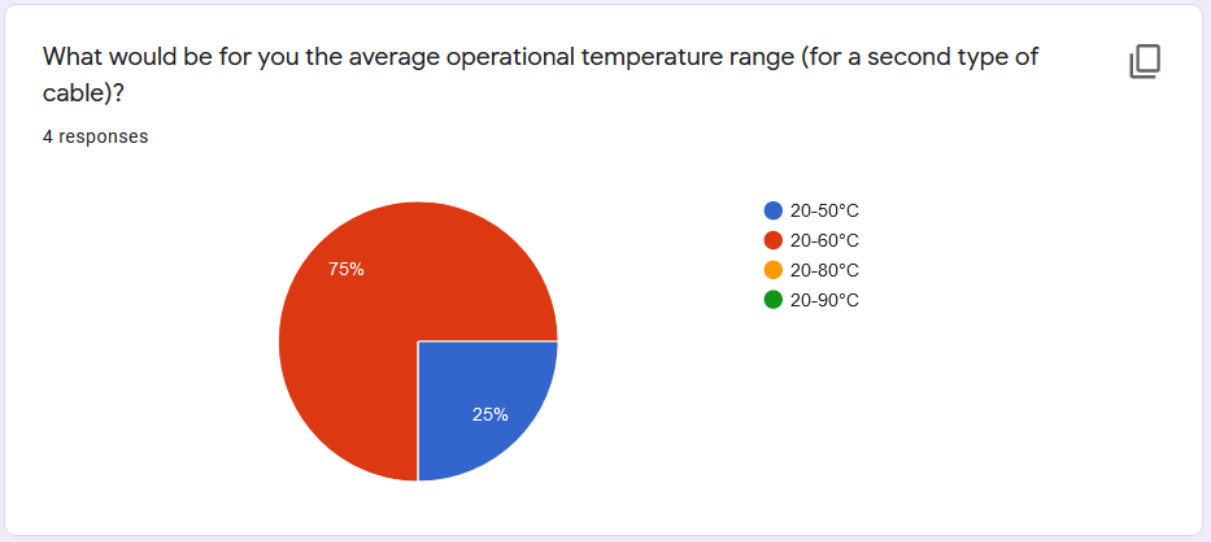

Figure 3: Alternative average operational temperature range

Considering the survey result, the standard VP abacus incorporated into the TeaM Cables Tool will consider the temperature range of 20 °C to 90 °C.

Remark: The upper temperature limit of 90 °C is in accordance with the rated maximum continuous operating temperature allowed on the conductor for XLPE insulated cables in IEC cable standards. Higher temperatures for short durations reflecting emergency (abnormal) periodical operation will not be considered in the TeaM Cables Tool and the VP abacus.

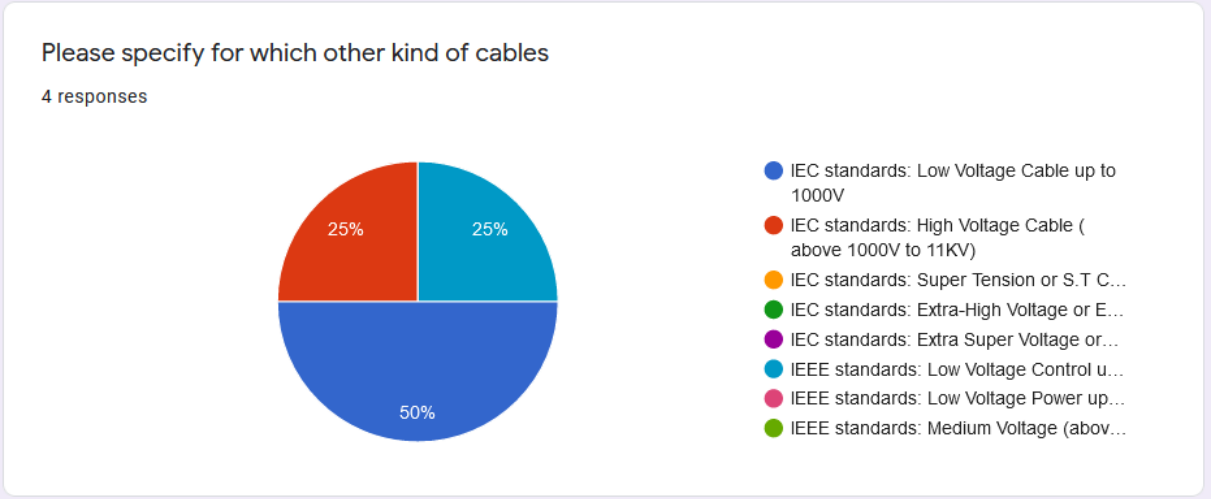

Figure 4: Alternative cable type of interest in nuclear applications

In addition to the information received with figure 2, this figure reflects the “origin” of the plant’s design. Red for European plant designs (IEC High Voltage Cable is enveloped in IEEE Medium Voltage, see figure 2), and light blue for US plant designs, where cables with rated voltage of 300 V and 600 V are common within the Low Voltage Power and Control Cable group.

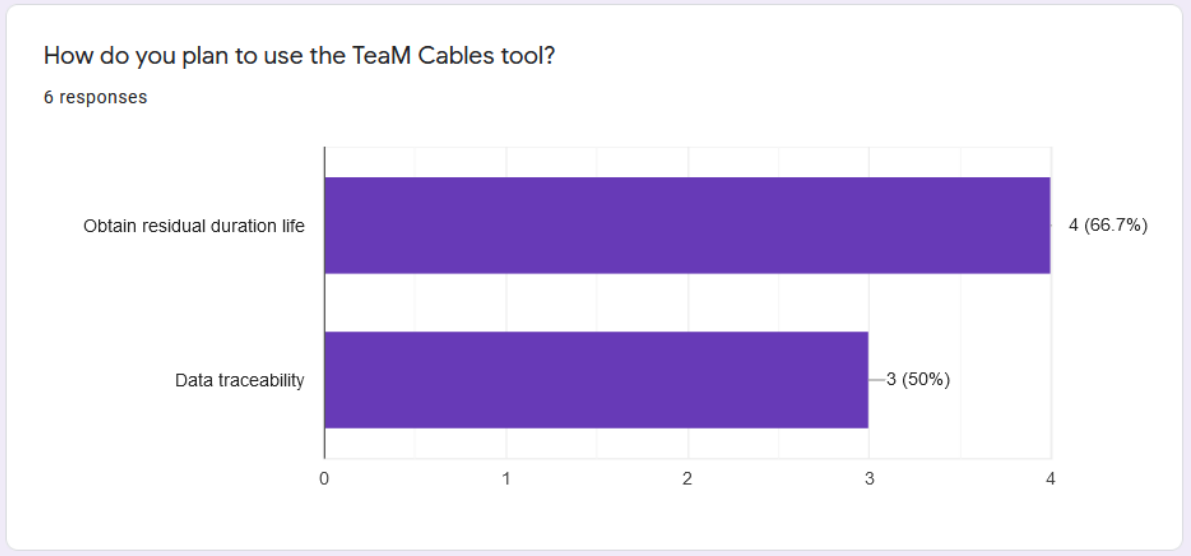

Figure 5: Use cases for the TeaM Cables Tool

The end-user feedback received to the above questions was expected. In context of Ageing Management, the end-user group not only intends to use the TeaM Cables Tool for the estimation/assessment of the residual lifetime of the cables in the plant but also for tracing changes/degradation in the cables, replacement planning and reporting.

Remark: In the end-user workshop a comparison between features/functions in COMSY and the restrictions in TeaM Cables Tool was presented. TeaM Cables Tool will have a limited/restricted functionality in comparison to the features available in the COMSY platform, see table below.

Table 1: Comparison of features

Important Features (not complete)	COMSY	Team Cables
Multiple plants or databases	X	-
Basic user interface	X	X
Document management	X	X
Mechanical component assessment	X	-
Electrical components assessment	X	VP / XLPE only
Civil components assessment	X	-
Operating Experience feedback	X	-
Active components assessment	X	-
Automatic commodity grouping GALL/IGALL	X	-
Risk Based assessment	X	Read only
Examination data management / Trending / Outage planning / Import	X	Read only
Material- / Equipment-/ other libraries	X	_

Figure 6: Information on the end-of-life criteria included in the VP abacus

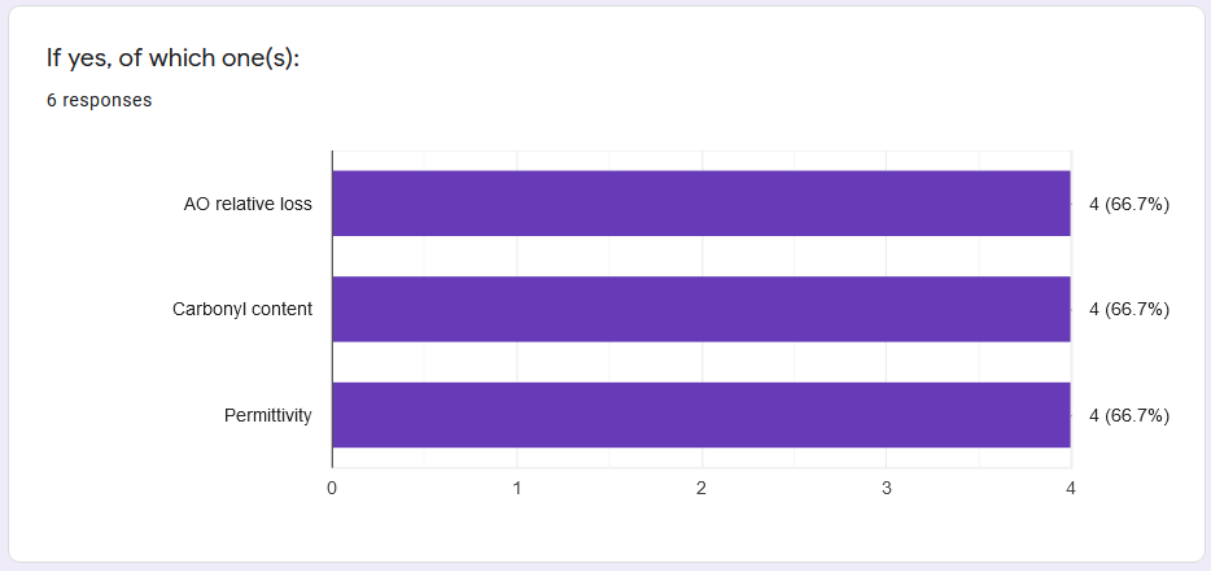

Figure 7: End-of-life criteria included in the VP abacus

The feedback presented in figures 6 and 7 reflects the “working environment” of the end-user group. In the nuclear industry the results obtained from ageing management programs have to be submitted to the authority for approval in order to maintain/preserve the qualification of the equipment (and the operating licence of the plant).

In this context the methods applied and the end-of-life criteria are also subject to approval by the authority.

The end-user group needs to understand the VP ageing model and the end-of life criteria.

Remark: For the second end-user workshop a dedicated presentation on the VP ageing model and the end-of life criteria is planned.

4 Next steps

Revision of previous specifications will be provided in the next WP6 report D6.5: Software improvements.

Then the software testing and feedback from the second end user workshop to be held early 2022 at Framatome in Germany will be included in D6.6: Second Field testing.