CIGRE Study Committee B1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° B1.87	**Name of Convenor:** James Pilgrim **E-mail address**: japil@orsted.com
Strategic Directions #[2]: 1,2	**Sustainable Development Goal #[3]: 9,11**
The WG applies to distribution networks: ☒ Yes / ☐ No	
Potential Benefit of WG work #[4] : 3,4	
Title of the Group: Finite Element Analysis for Cable Rating Calculations	

Scope, deliverables and proposed time schedule of the WG:

Background:

The SC B1 2020 Annual meeting formed a Task Force to review the guidance provided in the Technical Report IEC TR 62095 on the solution of cable rating problems by finite element (FE) analysis. It was noted that the report has not been significantly updated in many years and may not fully meet the needs of modern users. Much of the guidance in the document was written at a time when FE studies were undertaken only by a small group of experienced analysis engineers, or by researchers. Many such users would need to create their own numerical codes to build and solve the models; although some software tools were commercially available, they often required a high degree of training and were not always easy to use. It was comparatively rare for FE studies to be commissioned in cable projects, and the computational power required to solve such models restricted the cable rating cases where FE was used.

In the 2020's, the situation is very different. User-friendly software tools are widely available, and standard laptop computers are capable of solving models that in the late 2000's had to be solved using a dedicated server computer. It is now increasingly common for purchasers of cable systems to request that parts of rating studies be performed using FE, most notably in situations where IEC 60287 does not easily allow the problem to be solved. This means that the number of users solving cable ratings via FE is much higher, and their specific experience is (on average) less than would have been the case 15 years ago.

On this basis, the type of guidance needed is now different to that offered by IEC TR 62095. While much of the information contained there is still valid, there are many gaps which could be filled by new work from CIGRE. The work completed by the Task Force has identified that there are no current plans within IEC for a major update of this standard, although some minor changes may be made after 2023. Consultation with users from the countries represented by the TF has concluded that the existing TR 62095 does not sufficiently meet the needs of many users.

Scope:

1. Conduct a review of published papers and reports on the topic of finite element analysis for cable ratings.
2. Evaluate the information needed by different user groups (utilities/developers, cable suppliers, contractors, consultants, researchers etc).
3. Develop guidance for 'purchasers' on how to correctly specify FE modelling for cable rating purposes (inputs needed, definition of cases to be solved, quality control, contents of reports).
4. Provide guidance to FE users on:
    a. When FE is needed, and when analytical methods will suffice.
    b. Correct model set up for common cable rating cases, including assessment of 2D vs 3D models.
    c. Means of verifying that a model has been implemented correctly and is not adversely affected by any modelling assumptions.
    d. Handling the calculation of cable electrical losses, including the advantages and disadvantages of multiple-physics modelling vs a simpler analytical/FE approach.
    e. Implementation of transient/variable loading scenarios
    f. Handling of convective and radiative heat transfer, including the use of empirically derived convection coefficients.
5. Provision of a small number of worked examples which are sufficiently detailed to be replicated by independent users.
6. By solving the same case using different tools, meshes etc, define the expected 'tolerance' around the true answer.

Remarks:

Assessment of need for IEC 62095 to be renewed and relevant input from B1 community are included in a short technical report that summarise the preliminary work undertaken by the Task Force. This report, circulated to SC B1, is available to the WG as bases for the proceedings.

It is important to note that the Scope does not include elementary discussions on the finite element method; the guidance provided to users will assume general competence in the use of commercially available software tools. The purpose of the TB will not be to teach the reader how to use FE tools, but instead to focus on application to cable rating problems. The guidance providers to 'purchasers' of rating studies is to be produced in a manner that can be understood without specific knowledge of FE tools.

Deliverables:

☒ Technical Brochure and Executive Summary in Electra
☒ Electra Report
☐ Future Connections

☐ CSE
☒ Tutorial
☒ Webinar

Time Schedule: start: November 2021 **Final Report**: November 2024

Approval by Technical Council Chairman:

Date: October 17th, 2021

Notes: [1] Working Group (WG) or Joint WG (JWG), [2] See attached Table 1, [3]See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work. [4] See attached Table 3

Table 1: Strategic directions of the Technical Council

1	The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management
12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.