CIGRE Study Committee C4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

WG N° C4.51	**Name of Convenor: Davor Vujatovic** (United Kingdom)
Strategic Directions #[2]: 1,2	**Technical Issues #[3]: 7,8,10**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[6]: 2,3,5	
Title of the Group: Connection of Railway Traction Systems to Power Networks	

Scope, deliverables and proposed time schedule of the Group:

Background:

The benefits of rail transport, both passenger and freight, are well documented and understood. Furthermore, the benefits of electrified traction systems over other traction systems in terms of energy efficiency, rolling stock reliability and maintenance are also known. Due to these benefits, new railway lines are often conceived and constructed as electrified railways with many existing lines being converted into electrified railways.

Electric railways and railway electrification are not new concepts. Some countries have majority of their railways electrified and railway construction and electrification are growing trends in both developing and developed countries. The requirements for growth in railway construction and electrification are driven by many factors and are generally a result of increase in transportation demand due to regional and international trade, a move towards more efficient and environmentally friendlier transport solutions, urbanisation and inter-city travel where high-speed lines rival short-haul air travel.

This growth results in an increase in the requirements for engineering excellence in this very specific area. Providing a safe, reliable, robust and high-quality power to electric railways is an area of electrical power engineering that is understood by a small number of professionals.

There are inconsistencies in the approach to management of traction power connections to utility networks and the way their impacts on the local and wider network are assessed.
The ambition of the Working Group is to share the expertise and experience gained by experts in the field with the wider engineering community. Railway traction supplies require careful planning and assessment and pose many technical challenges to both the railway electrification engineers and utility engineers required to provide power supplies for electric traction.

Scope:

The subject of railway electrification is immense. Acting as an interface between the traction systems and power network, the objective of the Working Group is to increase the understanding of system technical performance issues associated with connections of electric railways to power networks and to provide guidance in relation to the assessments of mutual interactions. It will review the existing technologies, practices and experience in managing the connections from both the railway engineer's perspective and utility's perspective.

An overview of different types and characteristics of commonly used and novel traction power systems will be provided. This will include DC traction systems, AC 50/60Hz and 16.6Hz traction systems as well as emerging systems and technologies. Each of those traction power systems will then be examined in detail to provide guidance to both railway traction power engineers and utility network engineers in relation to:

- Understanding the nature and the dynamics of the traction load and how it effects the power network and its technical performance
- Managing traction power system dynamic loading and regenerative braking
- Use of novel techniques for dynamic traction load management (dynamic load balancing, energy storage…)
- Understanding, assessment and management/mitigation of power quality issues (phase unbalance, flicker and harmonic distortion) relating to traction power systems
- Systems and special transformers to minimise phase unbalance
- Use of FACTS devices to improve traction system performance and utility interfaces
- Specific electrical protection requirements
- Understanding and managing EMC in relation to traction power systems
- Other traction system specific challenges such as management of different earthing requirements, stray current corrosion, etc.
- Determining traction system equivalents for power system studies
- Suitable ways of representing utility network for studies required to demonstrate safe and compliant operation
- Assessing network impact of multiple traction power system connections; system approach
- Managing changes in service, utility network and railway operations.

Input from SCs A3, B3, B4, B5, C6 and C1 will be sought as and when required.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule: start: December 2018 **Final Report**: December 2021

Approval by Technical Committee Chairman:

Date: 09/27/2018

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit 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 direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit