CIGRE Study Committee A1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

WG* N° A1.56	**Name of Convenor** : **Richard Perers (Sweden)** **E-mail address**: Richard.Perers@norconsult.com
Technical Issues # (2): X	**Strategic Directions # (3): 2**
The WG applies to distribution networks (4): No	
Title of the Group: Survey on Lap and Wave Windings and their Consequences on Maintenance and Performance	

Scope, deliverables and proposed time schedule of the Group:

Background:
The stator winding is one of the key components in a hydro-generator. The layout of the winding i.e. choice of slot number and winding configuration greatly influence the characteristics of the generator. In large hydro-generators the winding often consists of Roebel bars. The connection of the bars can be made as a lap winding or as a wave winding.

The bar of a wave winding has more than twice the circumferential span compared to a bar of a lap winding. Moreover the circumferential distribution of the current circuits is often more concentrated in lap windings compared to wave windings. These characteristics result in some differences regarding installation, maintenance, overhang lengths, losses, eccentricity forces, etc. A lap winding is trivial to connect but the wave winding can be non-trivial to connect, especially for fractional slot windings and/or windings with many parallel current circuits. In some cases material savings and installation time reduction can be obtained with wave windings depending on pole number, slot number and number of parallel current circuits.

The focus of this WG will be to describe the different characteristics of lap and wave windings and give a guideline for the optimal choice with respect to the considerations described above.

Scope:
In particular this WG will focus on

- Advantages and disadvantages of lap winding vs wave winding.
- Describe different chording techniques to achieve special electromagnetic characteristics.
- Overhang lengths for lap and wave windings (space is often critical for rehab projects).
- Differences in eccentricity forces and equalizing currents with lap and wave windings for each number of parallel circuits.
- Maintenance and replacement of bottom bars.
- Collect knowledge about specific problems regarding lap and wave windings.

Deliverables : Report to be published in Electra or Technical Brochure with summary in Electra

Main Tasks and Time Schedule: Start: January 2016 **Final report:** June 2018

Milestone	Date
TOR approval	January 2016
Forming of team	February/March 2016
Draft questionnaire 1	September 2016 (to be presented at Paris meeting)
Comments by members and experts	December 2016
Final questionnaire	March 2017
Draft report 1	August 2017 (to be presented at Vienna meeting)
Comments by members and experts	December 2017
Final report approval	April 2018
Document ready to be published in Electra	June 2018
Tutorial	August 2018 (to be presented at Paris meeting)

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman :

Date : 12/01/2016

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2
(4) Delete as appropriate

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 within distribution level and to the upstream network.
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 (cf. 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	Interactive communication with the public and with political decision maker