CIGRE Study Committee A1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° A1.69	**Name of Convenor:** J. Johnny Rocha E. (BRAZIL) **E-mail address**: johnny.rocha1959@gmail.com	
Strategic Directions #[2]: 2		**Sustainable Development Goal #[3]: 7**
The WG applies to distribution networks: ☐ Yes / ☒ No		
Potential Benefit of WG work #[4] : 3, 4		
Title of the Group: Hydro-Generator Excitation Current Anomalies		

Scope, deliverables and proposed time schedule of the WG:

Background:

Calculated generator excitation current often does not match measured values, mainly at rated load condition. This sometimes result in complexities with the acceptance of tested equipment as customers would normally identify the difference between design calculations and actual measured values as a deviation from the design, which is in most cases a guaranteed parameter in the technical specification.

The aim of this work group is to determine the extent of such deviations among manufacturers and customers and how these deviations was overcome to result in a successful handover of the project, despite having these deviations.

The work group will attempt to develop an analytical procedure to calculate the excitation current at no load and at rated load operating conditions, which can assist with difficult decision-making processes at final acceptance testing.

With one or two honourable exceptions in German language, the analytical calculation theory of excitation current is not easily found, neither in the most advanced electrical machine books nor in published papers and is currently constrained to manufacturer's computational routines.

Following a similar methodology as WG A1.49 Magnetic core dimensioning limits in Hydro-Generators, the objective of this WG will be to state the analytical methodology of excitation current calculation in hydro-generators. This procedure will be based on the machine's magnetic core material characteristics as well as its geometrical dimensions. Undertaking this task will be conditioned to the following premises:

- The bibliography should be in public domain;
- Develop a transparent evolution of formulation throughout the text;
- A computational program will not be delivered, although all the formulation will be programmed, and the results will be fully validated;
- As an Annex of the technical brochure, a benchmark model will be introduced with calculated results aiming to support the elaboration of customized routines.

Scope:

The methodology will be based on exploring salient pole synchronous machine singular operating conditions, such as steady state short circuit operation as well as saturation characteristic under constant armature current at zero power factor.

Hence, the first model will explore the calculation of the no-load excitation current, including the machine short-circuit characteristic; the second model will be employed to calculate the machine excitation current operating under load.

To accomplish this target, some previous fundamental investigations required:

- The winding matrix methodology to describe the armature winding magnetomotive force wave shape;
- Park's two reaction theory to review the "air-gap current transfer ratio";
- Revisit under an updated light the armature winding leakage inductance calculation procedure; and
- The backgrounds of Potier's triangle theory; among others.

Deliverables:

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

Time Schedule: start: June 2020 **Final Report**: August 2023

Approval by Technical Council Chairman:

Date: May 25th, 2020

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.