CIGRE Study Committee B5

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG N° B5.72	**Name of Convenor:** McGuinness, Sean (IE) **E-mail address**: smcguinness@epri.com
Strategic Directions #[2]: 1, 2	**Sustainable Development Goal #[3]: 9, 13**
The WG applies to distribution networks: ☐ Yes / ☒ No	
Potential Benefit of WG work #[4]: 1, 3, 4, 5	
Title of the Group: Modelling, Assessment, and Mitigation of Protection Performance Issues caused by power plants during Dynamic Grid Events	

Scope, deliverables and proposed time schedule of the WG:

Background:

Major grid disturbances may begin due to many different causes. Protection functions are used to trip the circuit breakers to disconnect energy supply and load according to the characteristics of the disturbance. Protection devices have played a major role in initiating, propagating, and preventing major power system disturbances in the past. Protection engineers have developed a very high degree of competence for designing and configuring relays to be reliable, sensitive, and secure response to short circuit events. Grid dynamics are becoming faster with decreasing grid inertia, more fast-acting power electronics devices, and more variable system operating conditions. Such events are most commonly examined using positive-sequence Root Mean Square (RMS) stability studies, but in recent times electromagnetic transient (EMT) and real-time digital simulators are also being used. In general, protections against isolation faults should be stable during other types of grid disturbances. Those should be cleared by dedicated relays or protection functions.

The working group will primarily focus on impact and response to grid disturbances of synchronous generator electrical protection, generator auxiliary plant protection, HVDC protection, inverter-interfaced large scale renewable generation plant protection (off-shore wind farms, large solar plants), and emergent systems like battery plants. Other protection devices which may impact grid stability will also be considered such as capacitor bank voltage protection, synchronous condenser reverse power protection, STATCOMs, SVC, and series capacitors.

This working group will examine the concept of modelling protection in dynamic studies. The primary output of the working group will be practical methods for transmission grid engineers to identify misoperation of protection schemes implemented to clear short circuits, particularly during dynamic grid events.

Assistance from other Study Committees, such as B4 (DC and Power Electronics) and C4 (System Performance) might be required.

Scope:

1. Review past disturbances and possible future events where protection systems may respond in an undesired or unexpected way to dynamic grid events, including:
    a. Stable and unstable power swings
    b. Resynchronisation and out of phase reclosing
    c. High rate of change of frequency
    d. Fast-ramping of power electronic interfaced energy sources such as battery energy storage and HVDC

e. Multiple consecutive circuit breaker switching or reclosing operations
f. System restoration
g. Other events

2. Survey existing utility practices for modeling or considering protection behaviour in dynamic studies

3. Asses which protection functions can be modeled in RMS transient stability and EMT simulation tools to identify credible protection issues

4. Protection function Modelling (RMS, EMT)
    a. Synchronous generator protection: primary plant protection and auxiliary plant protection
    b. Inverter and power electronic device protection: wind turbines, solar PV, battery energy storage, HVDC
    c. Modelling of special protection schemes and system integrity protection schemes
    d. Generic relay models compared to vendor-specific models
    e. Protection relay settings storage and management in RMS and EMT studies tools.

5. Methods for identifying, reporting, and visualising undesired protection operations in RMS and EMT studies

6. Methods for mitigating the risk of undesired protection response to dynamic system events

Deliverables:

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

Time Schedule: start: March 2020 **Final Report**: December 2022

Approval by Technical Council Chairman:

Date: February 16th, 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.