CIGRE Study Committee C1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG[1] C1.54	***Name of Convenor: Haiwang Zhong*** *(China)*
Strategic Directions #[2]: 1,2,3	***Sustainable Development Goal #[3]: 7, 9, 13***

This Working Group addresses these Energy Transition topics:

X	**Storage**	☐ **None of them**
	Hydrogen	
	Digitalization	
	Sustainability and Climate Change	
X	**Grids and Flexibility**	
	Solar PV and Wind	
	Consumers, Prosumers and Electrical Vehicles	
X	**Sector Integration**	

Potential Benefit of WG work #[4] : 1, 2, 3, 4

Title of the Group: Assessment of system reserves and flexibility needs in the power systems of the future

Scope, deliverables and proposed time schedule of the WG:

The scope of this WG is the evolution and harmonisation of criteria and methodologies for quantifying power system reserves on different time periods and flexibility needs with special focus on systems with dominant variable RES (Renewable Energy Sources, v-RES) and inverter-based devices.

Also, to analyse the Impact on reserve assessment of CER (Consumer Energy Resources) and distributed resources will also be considered, through active participation of C6 experts.

Background:

The progressive decarbonisation of power systems entails a substantial transformation of:

- ✓ generation fleet, which will mostly rely on v-RES such as wind and PV,
- ✓ load growth rate and profile, considering e-mobility, heat pumps, green hydrogen generated through electrolysers, various kinds of storage devices, and in general deeper electrification of final uses,
- ✓ T&D network to accommodate the new forms of power generation and consumptions.

Thus, to ensure security and reliability standards, which by themselves may need to be adjusted, see prior SC C1 WG results, there is worldwide consensus on the need to enhance system flexibility, especially considering increased variability of generation and load making the “residual load” patterns much more volatile than in the past. “Flexibility” has become a pivotal concept for both system planning and operation (see, for instance, Preferential Subjects of SC C1 for CIGRE General Session 2024).

However, defining and quantifying flexibility needs, and related often large investments, in the power systems of the future, require a clear view of the upward and downward reserves to be met in different time windows, reaction speeds and effects on key system reliability parameters, as well as the combination of flexibility sources to better serve such needs. The picture is even more complex, given that most system components will be able to modulate

their injections/withdrawal from the grid, and that performances/constraints beyond active power are also relevant (reactive power, energy limitations, dynamic behaviours, fastness of response). In a nutshell, each component can be at the same time the cause and the solution of surplus/deficit energy in the grid or other system imbalances.

On top of that, system components (spread out in millions of devices) will be operated by individual actors, responding to their business cases and their own customer behaviour, through market mechanisms which have to keep pace of technology evolution and new processes.

While so far emphasis has been put on flexibility sources, the criteria for assessing flexibility needs (including reserves) have received less attention. Within CIGRE, the issue has been addressed mainly at the operational stage and in terms of reserve requirements, not considering the contributions from all other system components; see, for instance the following papers:

- ✓ "*New primary reserve requirements in the Nordic synchronous area – Designing the disturbance reserve*" - C2-203 CIGRE 2018
- ✓ "*Estimate Instantaneous Reserves Required in the Eskom Control Area*" - C2-110 CIGRE 2018
- ✓ "*Efficient procurement of extended reserves (AUFLS) with high penetration of distributed generation: Changes in AUFLS scheme of New Zealand*" - B5-124 CIGRE 2018
- ✓ "*Probabilistic Methodology for Assessing the Impact of Spinning Reserve Requirements and Demand Response Programs in Power Systems with Increased Penetration of Renewable Energy Sources*" - C4 - 202 CIGRE 2012
- ✓ "*Probabilistic dimensioning of tertiary control reserve driven by the intermittency of renewable generation in Portugal*" - C2 – 122 CIGRE 2016
- ✓ "*Implementation of New Dispatch Formulation and Software for Tertiary Frequency Control Reserves in Indian Power System*" – C1 - 10487 CIGRE 2022.

In addition, it has also been observed in the on-going activities of WG C1.45 "*Harmonised metrics and consistent methodology for benefits assessment in Cost-Benefit Analysis (CBA) of electric interconnection projects*", that the possibility of sharing reserves can be one of the main benefits associated to the implementation of a new interconnection project. Harmonising the understanding and the practices related to reserves, therefore, is a fundamental step for the achievement of such benefits and justify projects.

Thus, this WG aims at filling this gap focusing on criteria and methodologies for quantifying system flexibility needs, including reserves in different time periods.

Purpose/Objective/Benefit of this work:

The objective of this WG is the analysis and classification of different flexibility needs, including different kinds of reserves, in terms of time windows, their performance, how they are quantified, and functional requirements expected by grid operators. This will yield benefits for both system planners and investors in flexibility assets, since a clear knowledge of flexibility needs is the basis to define and undertake the necessary investments in flexibility assets: from battery storage to demand response, retrofitting of existing or connection requirements of new generation assets and flexible network solutions relying on electronically controlled equipment, such as HVDC, FACTS, DLR (Dynamic Line Rating).

Scope:

The working group will investigate and report on:

1. Screening of current reserve definitions and categorisation in various jurisdictions with possible differentiation between isolated and interconnected systems, emphasizing different time windows, performance and functional requirements
2. Definition and interaction of concepts of system reserves at planning stage vs reserves at operational stage.
3. Description of expected evolution of reserve criteria considering systems with dominant variable generation fleet and inverter-based devices, with their potential grid forming capability.
4. Proposal of harmonisation of reserve nomenclature, since currently there are different terminologies adopted in the various jurisdictions.
5. Descriptions of methodologies for computing, estimating or dimensioning the various flexibility needs, including reserves, considering activation time, duration and other KPIs. Overview of computational models to quantify reserves.
6. Description of possible suitable market designs and mechanisms to procure flexibility services adopting national or cross-border perimeters for reserve sharing
7. Case studies on reserve computations
8. Summary of the activity and formulation of guidelines for flexibility needs assessment in power systems with massive presence of v-RES generation

The outcomes of the WG analysis will be presented in a technical brochure and the Executive Summary in an article of Electra magazine.

In addition, the outcomes of this WG could serve as an input to IEC TC 8 "*System aspects of electrical energy supply*" for a possible standardisation of reserve assessment starting from the CIGRE guidelines arising from this WG.

Remarks:

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Deliverables:

☒ Annual Progress and Activity Report to Study Committee
☒ Technical Brochure and Executive Summary in Electra
☐ Electra Report
☐ Future Connections
☐ CIGRE Science & Engineering (CSE) Journal
☒ Tutorial
☒ Webinar

Time Schedule:

- Recruit members (National Committees, WiE, NGN) Qtr 3 2024
- Develop final work plan Qtr 4 2024
- Draft TB for Study Committee Review Qtr 4 2025
- Final TB Qtr1 2026
- Tutorial (at CIGRE General Session) Qtr 3 2026

• Webinar	Qtr 2 2026
Approval by Technical Council Chair: **Date**: August 13th, 2024	

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

WG Membership: refer Comments at end of document

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.

Comments:

1) CIGRE Official Study Committee Rules: WG Membership

https://www.cigre.org/GB/about/official-documents

a. Only one member per country: by exception of SC Chair, WiE and NGN nominees.

b. WG nominees by NCs must first be supported by their National Committee (or local SC Member) as an appropriate representative of their country.

c. Acceptance of the nomination is granted by the SC Chair and advised to the WG Convener.

2) Collaboration Space

https://www.cigre.org/article/GB/collaborative-tools-2

CIGRE will provision the WG with a dedicated Knowledge Management System Space.

The WG will use the KMS for drafting collaboration, capture and retention of discussion and meeting records.

Official country WG Members will be sent registration instructions by the Convener.

Official country WG Members may request the WG Convener to allow additional access for an extra national subject matter specialist to aid in the work at the national level, including NGN members.