CIGRE Study committe B4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG B4.107

NAME OF THE CONVENOR
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TITLE
Synchronous Grid forming STATCOMs with and without energy storage

THE WG APPLIES TO DISTRIBUTION NETWORKS: NO

ENERGY TRANSITION
1 / Storage
5 / Grids and Flexibility

POTENTIAL BENEFIT OF WG WORK
3 / likely to contribute to new or revised industry standards
5 / Guide or survey on techniques, or updates on past work or brochures

STRATEGIC DIRECTION
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-ofthe-art technological advances

SUSTAINABLE DEVELOPMENT GOAL
0 / Other SDGs or not applied

BACKGROUND :
A consequence of the move away from fossil fuel generation and towards power electronic interfaced renewable resources is the reduction in inertia from synchronous generators in the AC power grid. A key feature of a synchronous generator is its inherent ability to oppose a change in AC system frequency and so other means of providing this functionality are needed.

A new technology has been introduced into the transmission market in recent years to provide a means of opposing RoCoF (Rate of Change of Frequency) events. This technology is composed of a STATCOM, traditionally used to support the AC voltage, in combination with an energy storage system. This energy storage system only has a relatively small energy storage capacity compared with purpose-built transmission level long-time energy storage systems such as Battery Energy Storage Systems (BESS). Nevertheless, the energy storage device associated with the STATCOM is typically designed for repeated charging and discharging events to support the AC system frequency.

To utilise this energy storage dynamically in response to AC system events Synchronous Grid Forming (SGFM) controllers have been proposed. This type of controller will provide an inherent response to an AC system event thereby reacting quicker than a controller which is taking an action in response to a measured event, for example a grid-following controller. However, in the event of the unavailability of the energy storage unit the SGFM control concept may still be required to meet, for example, weak grid conditions. This has led to the SGFM control concept for STATCOMs now being proposed for STATCOMs that do not have an associated energy storage system, or that are designed for an energy storage system to be included in a future upgrade.

The introduction of SGFM controllers and energy storage opens up the possibility for additional ancillary services that could be added to the STATCOM to provide further flexibility to network operators.

An important aspect to consider when developing the requirements for a STATCOM with energy storage is the amount of storage needed. What are the operating conditions that determine the amount of storage, hence the peak energy and the duration? Should the storage capability be bidirectional, that is, absorption as well as supply?

The proposed work will set out to address these questions, providing guidance to future specifiers of such equipment.

From a project planning perspective, it is also important to understand what the circuit arrangement might be for such a system, as well as what the layout could look like, how much land is required, etc. Hence, the proposed work will also address these points to provide a future reference for anyone planning a STATCOM with energy storage.

Beyond the technical and planning considerations outlined above, a further important aspect is the harmonisation of requirements across different SGFM STATCOM systems and vendors. Achieving a defined and homogeneous behaviour of all Synchronous Grid Forming STATCOM systems under transient and fault conditions is important for Transmission System Operators (TSOs). This can be approached in different ways: one approach is to apply specific TSO-defined requirements, which however demands that different OEMs are able to adapt their systems accordingly. The opposite approach would be to mandate identical requirements across all systems and vendors. A balanced third way is proposed here — to define a set of basic requirements that are universally applicable to all SGFM STATCOMs, while clearly indicating which additional requirements can or should be specified by the users (e.g., TSOs/network operators) based on their individual system needs.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

The objective of this work is to generate a Technical Brochure that will provide the AC power system community with a decisive guide as to the functionality, rating, power circuit and layout of STATCOMs with energy storage. A key outcome of this work will be the definition of a set of fundamental requirements that are universally applicable to all Synchronous Grid Forming STATCOMs, regardless of technology or OEM, while also indicating which requirements may — or should — be further specified by network users/operators based on their individual system needs. Importantly, the work will seek to engage with multiple OEMs in order to reach a final outcome which is inclusive.

SCOPE :

Scope:

The intent of the working group will be to generate a Technical Brochure that covers the following topics:

1. Functionality of a Synchronous Grid Forming controlled STATCOM with additional energy storage (this will include the comparison with a grid-following controlled STATCOM with energy storage and a rotating synchronous compensator)
2. Functionality of a Synchronous Grid Forming controlled STATCOM in the absence of an energy storage system (this will include the comparison with a grid-following controlled STATCOM without energy storage)
3. Energy storage options
4. Selection of the magnitude of the energy storage
5. Potential single line diagrams for STATCOMs with energy storage
6. Potential layouts for STATCOMs with energy storage

Remarks:

The proposed work would refer to and build upon existing CIGRE work such as the definitions of SGFM defined by WG B4.87, the energy storage options discussed by WG B4.84 and will coordinate with the work already ongoing within B4.101, GFM ESS. In addition, the proposed work will monitor and, where relevant, reference outputs from related CIGRE working groups addressing the impact of Inverter-Based Resources (IBR) on protection and automation systems, notably ongoing and completed work within SC B5 and Joint Working Groups with SC C4, including B5/C4.61, B5.65 and B5/C4.79.

A liaison member from B5 will be included.

DELIVERABLES AND EVENTS

Deliverables Types

Annual progress and activity report to Study Committee
CSE
Technical Brochure and Executive Summary in Electra
Tutorial

Time schedule

Q2	2026	Recruit members
Q3	2026	Develop final work plan
Q3	2027	Draft TB for SC review

Q2 2028 Final TB

Q3 2028 Tutorial

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:
Rannveig Loken
March 27th, 2026