

DISCUSSION MEETING

STUDY COMMITTEE C2

System Operation and Control

SUMMARY

Date

Chairman: Jayme Darriba Macêdo
Secretary: Flávio Rodrigo de Miranda Alves
Special Reporters: Miguel Bernardo (PS1) and Greg Hesse (PS2)

1. INTRODUCTION

The 2022 discussion meeting of Study Committee C2-System Operation and Control was held on August 30th, 2022 in Amphitheatre Bordeaux, Level 3, at the Palais des Congrès, in a full day session.

The scope of SC C2 covers the technical, human resource and institutional aspects and conditions for a secure and economic system operation of power systems in a way that is in compliance with requirements for network security, against system disintegration, equipment damages and human injuries, and security of electricity supply.

Unbiased and high-quality knowledge dissemination to the power systems community by CIGRE Study Committees is a strong pillar for the development and performance of power systems, especially in the rapidly changing environment created by the energy transition, the availability of synchro-fasor data and the increasing use of advanced and intelligent methods in power systems operation planning and real time operation. This applies not only to current but also to future power systems. The Preferential Subjects (PS) of the 2022 CIGRE Session attracted papers that describe the changes in the control room and how these changes affect operator training as well as the techniques that will create a new generation of methodologies and supporting tools for operational planning. SC C2 had 2 PSs and 50 papers coming from 24 national committees.

An overview of the main conclusions of each PS is given next.

2. RUNNING OF THE MEETING

The Discussion Group Meeting was chaired by the Study Committee Chairman, Jayme Darriba Macêdo, from Brazil, with Miguel Bernardo, from Portugal, and Greg Hesse, from Australia, as Special Reporters and Flávio Alves, from Brazil, as SC C2 Secretary.

3. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 1

Preferential Subject 1: System Control Room Preparedness: Today and in the Future

- Operator training, situation awareness and decision supporting tools,
- Effective and efficient use of synchro-phasor data in power system operation,
- Advanced and intelligent methods applied to power systems operation.

Special Reporter: Miguel Bernardo

This preferential subject focuses on the three streams that enable system operators to be better prepared: focusing on training and awareness having some of the required tools to assist in the decisions; clear effective use of synchro-phasor systems and advanced and intelligent methods applied to the power systems operations.

In Preferential Subject 1, 28 papers from 17 national committees were presented. In addition, there was one NGN paper from Brazil. PS1 received 28 contributions. During the contribution session, 4 contributions (questions 1, 2, 3 and 6) were not discussed since the contributors were not present.

The prepared contributions covered all the three sub-topics starting on the “operation training, situation awareness and decision supporting tools” mainly focusing on simulation of real-life conditions for operator training including also the psychological aspect of operator training tools. There was a general opinion that there needs to be more analysis done on the psychological aspect although some contributors expressed the opinion that the main focus should be on learning output not on experiencing real life conditions.

Under the second sub-topic “effective and efficient use of synchro-phasor data in power system operation”, there was a general opinion that more is better. However, given that financial resources are limited in TSOs there were more pragmatic approaches mentioning a few methods such as linear programming, swarm optimization and graph theory algorithms

The last sub-topic was regarding Artificial Intelligence (AI) advancements and maturity, this generated some different points of view mainly around the maturity of AI and if it will ever be intelligent enough to operate independently. However, there was a general consensus that AI should at the moment be used to simplify and pre-process information available to dispatch operators and trust on the tools needs to be developed to further progress on their integration in control rooms. There was a general view that intellectual property regarding should be kept from the developer of the algorithm. However, transparency and clear explanation on its behaviour should be widely available.

In the spontaneous contributions part, PS1 had a total of 10, they covered mostly the AI use and consolidated the ideas from the prepared contribution question 1.8. There were also a few contributions on the quality of the simulators today and how vendors still need to provide better solutions or further development since the functionalities have generally remained the same since the first simulator training equipment.

4. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 2

Operational Planning Strategies, Methodologies and Supporting Tools

- High share of grid-connected and distributed power electronic interfaced resources including hybrid AC-DC systems,
- Advanced and intelligent methods applied to power systems operational planning and day-ahead programming,
- Impact of low demand and other predictable extreme operating conditions.

Special Reporter – Greg Hesse

As power system operators our challenge is to continue to ensure the safe, secure, reliable and economic operation of the power system, while facilitating the changes that are demanded to decarbonise the grid. We must continue to fly the plane while we rebuild it!

To meet this challenge we need to fully understand the new technologies being deployed across the grid, we need to anticipate where, and in what form, extremes of power system operating conditions will occur in the future, and we need the tools to assist us in managing these rapidly changing circumstances we find ourselves in.

In Preferential Subject 2, 19 papers from 17 national committees were presented. In addition, there were two NGN papers, one from Russia and one from The Netherlands. PS2 received 22 contributions.

Under sub-topic 1 the importance of considering a variety of technical solutions was highlighted. A mix of grid forming and grid following inverters may provide an appropriate mix of technologies, especially for incorporating battery energy storage systems into system restoration plans.

The main theme of discussion for sub-topic 2 was flexibility. Discussions highlighted the need for flexible approaches to operational planning analysis, flexibility in communication across the supply chain, flexibility in how work with the Artificial Intelligence community and flexibility in our organisational and institutional arrangements.

With more advanced tools, including artificial intelligence and machine learning tools, the importance of continuous and ongoing feedback to validate the performance of the tools was seen as critical to retaining trust in their use.

In relation to communications and collaboration it is clear that this needs to happen both horizontally, that is between TSOs, as well as vertically, between TSO and DSO and extending to the customer. This extends to two-way vertical communication and collaboration. New co-ordination challenges exist in relation to weather dependent energy systems, resilience, risk preparedness, data exchange and cyber security. Within Europe the need to co-ordinate across multiple product markets, energy, reserves, ancillary services, is seen as especially important.

Under sub-topic 3, a number of approaches to address a range of extreme conditions were canvassed. The need to better understand the impact of extreme weather on generation, network and customers was considered. The potential to modify network topology to enhance network capability triggered a more extensive discussion through the spontaneous contributions.

The two NGN presentations, covering algorithms for optimise network topology and black start from offshore wind farms, prompted significant discussions from the spontaneous contributors.

Spontaneous contributions further explored the practicality and scope of topology optimisation as well of the resilience and robustness of analysis tools under extreme conditions. One contribution highlighted real-life demonstration of system restart capability from distributed energy resources.

6. CONCLUSIONS

The Group Discussion Meeting of SC C2 during the CIGRE Session have once more revealed the challenges and the increasing complexity that system operations is facing and will face in the future. There are major areas where developments are happening:

- Importance of focusing on simulation of real-life conditions for operator training including also the psychological aspect of operator training tools.
- About effective and efficient use of synchro-phasor data in power system operation, there is a general opinion that are more pragmatic approaches such as linear programming, swarm optimization and graph theory algorithms, depending on the network topology.
- Artificial Intelligence (AI) is generally seen as a helpful function in control rooms but more advancements and maturity need to occur and should be mainly used to simplify and pre-process information available to dispatch operators. There also needs to be transparency and clear explanation on its behaviour.
- Flexibility, in all aspects of system operation, will be needed to meet the challenges of decarbonising the power system.
- Mechanisms to provide ongoing validation of AI and other advanced tools is necessary to maintain trust in the tools.
- Topology optimisation, special protection schemes and other tools to extend the capability of the power system have a key role to play, but care is needed when the characteristics of the power system are changing rapidly during the energy transition.

In conclusion, system operations and control will keep on developing innovative solutions and concepts to operate the system today and in the future.