

EXECUTIVE SUMMARY

Session 1 – Network Components

SUMMARY

136 papers were selected for session 1. The papers were divided into 4 Blocks, focusing on condition assessment, asset management and innovation on network components.

MAIN SESSION 1.1

Asset Management and Condition Assessment of Network Components

Four papers were presented orally. The monitoring of cable systems with PD was addressed with different angles. Adaptive processing was applied to the data to isolate noise and extract the pattern to possibly identify the type of fault. The question of the influence of the type of voltage on the PD showed that at least for the PILC cable the PD level was very similar regardless of the voltage sources and that the PD level and the typical sign of aging like dielectric losses were not related. Renewable energy generation is by nature intermittent and creates cyclic loading of the cable system. From a thermal point of view this cyclic loading combined with the thermal inertia of cable gives opportunity to push the power transmission limits beyond by-design static rating at the maximal temperature. A dynamic approach shows a slow temperature rise in a cable and opens frames where the cable ampacity is higher than theoretical limits. From a mechanical point of view, the cable expansion/shrinkage by 0.2% due to intermittency can create some constraint on the joint and lead to severe damages that can be avoided with mechanical protections.

MAIN SESSION 1.2

Asset Management and Condition Assessment of Substations Components

Six papers were presented orally. They covered a wide range of topics related to component asset management. Two papers concerned the topics of sensors integration and associated algorithms to derive the right information for condition assessment. One paper was devoted to accelerated ageing tests of transformer insulation. The challenge of dynamic rating with the integration of DER, was also discussed, in the case of transformers application, comparing thermal model results with field measurements. A complete asset management project, led by a DSO, was also presented, integrating predictive failure models for several types of components. Finally, and as a perspective, one paper introduced the development of digital twins to track the components behaviour during their life cycle.

MAIN SESSION 1.3

Innovation in Network Components – Cables, Lines and New Types of Components

Six papers were presented orally. The first paper deals with crossing of different data sources to improve the accuracy of real time cable rating. The use of geological and meteorological data combined with cable characteristics map and current flow measurement makes it possible to have a very good match at less than 3°C between the models and the reality. Three presentations presented different approaches for the integration of current and voltage sensors directly in cable bushing to make monitoring easier and prevent the cable system to run beyond its limits. Improvements in precision and response time throughout the design and across the measurement chain make it possible to reach requirements and meet standards for using such sensors for protection and for metering. Regarding protection, severe issues have been reported on overhead lines due to high soil resistivity preventing conventional surge arrester to evacuate the current. A new type of surge arrester based on discharge in air has been deployed locally to solve the problem. The last paper presents power electronic devices to allow power exchange between HV or MV subnetwork preventing fault propagation.

MAIN SESSION 1.4

Innovation in Substations Components

Six papers were presented orally. The development of green component concerned half of the presentations, with two papers about SF6 free switchgear, including an innovative load break switch. A new carbon free mobile energy supply was also described. Two papers concerned innovative components (increased endurance circuit breaker for capacitive load switching) and simulation tools

(overvoltage in transformers). A technical-economic analysis about the introduction of SST on the grid sparked a lively debate with the audience (with many questions asked).

ROUND TABLE 1

DC Networks

Main drivers are EV and PV integration, as well as big data centers. Speakers presented key technologies, system aspects and reported the findings of CIRED WG-2019-1 to an audience of around 90 people. In short: “DC is on the way”, starting with gathering the operating experience of LVDC distribution network and behind the meter, then low MVDC levels up to several kV. Now it's time for manufacturers participation in resolving key standards for the upcoming 3-5 years! The applications that appear as targets are DC-microgrids, hybrid ACDC grids (last mile LVDC, then MVDC), DC within buildings, factories and high-power EV charging. Needs for commercial availability of DC system integration products (protection, control, and grounding) and better coordination/knowledge sharing across research projects were highlighted.

ROUND TABLE 2

Secondary Substations for the Future

Secondary substations are playing an increasingly important and smart role in the distribution network in the energy transition context, which is already a reality. With smart metering infrastructure, intelligent integration of DER and optimization of energy flows on the LV grid, Secondary Substation will play a crucial role in the flexibility of the global distribution system. The round table brought together about 100 experts to discuss what the concept of the future secondary substation should be and to share the most advanced experiences with topics such as voltage regulation, green switchgears, energy storage management, new-generation IoT-based monitoring and local intelligence for control and management of MV and LV networks. It was clearly stated that Secondary Substations will play an growing role in the distribution network in the energy transition context.

ROUND TABLE 4

Green Network Solutions

The roundtable was intended to give an overview about the bandwidth of engineering activities towards a green distribution grid. Anticipating the variety of solutions to replace SF6 in switchgears, it is possible to state that solutions to solve this important problem now exist. Therefore, the intention was to discuss other green stakeholder aspects like biodiversity and the importance of public private partnerships by inclusion of local NGO's. The legacy infrastructure of the grid cannot be neglected, including the ecological impact of aged network components. Anticipating the spilling of dielectric fluids from cables, new solutions with self-healing fluids up to 70% of leaks could be resolved. Based on an exhaustive work done by CIGRE working group, new technologies to identify the on-site condition of complex structures like substations were shown and its utilization for grid optimization. The impact and the interpretation of LCA methods for grid components was discussed. Finally the holistic view on switchgear design and its impact to standardization was in the focus as well: defining the right mission profile and anticipating not only performance indicators and also durability indicators in future. Due to technical issues, the discussion with the auditorium was rather limited, so the intention is to push the roundtable topic to CIRED 2023.

RESEARCH & INNOVATION FORUM SESSION 1

The RIF Session included 6 presentations of innovative projects: use of AI for network fault prevention, proximity effect in high current conductors, application of power electronics bridges for smart grids, internal arc modelling, role of small amount of polyatomic molecules for interruption performance and distribution transformer design improving resilience to transient voltage stresses.

POSTER SESSIONS

64 papers splitted into 6 sessions, have been presented with interactive discussion with the audience. Attendance at each session was 40 people.

CONCLUSIONS

During CIRED 2021, the audience shared the importance of innovations in the field of network components. This innovation, traditionally guided by the seek for industrial performance, is increasingly supporting the energy transition, with adaptation to new uses of electricity and increased consideration of the environment.