

## EXECUTIVE SUMMARY

### Session 1 – NETWORK COMPONENTS

#### SUMMARY

Session 1 presented 152 papers at CIRED 2019. The papers were divided into 4 Blocks, focusing on condition assessment (CA), asset management (AM) and innovation on network components.

#### MAIN SESSION 1 - BLOCK 1

##### ***AM and CA of Network Components – Cables, lines and associated components***

The 7 papers presented in the block 1 were related to asset management and conditions monitoring with methodologies using various raw data sources (sensors, in field inspection, remote inspection) and adequate treatments to reveal risks of critical states or physical damages thanks to PDs, abnormal leakage current or changes of the cable environment. Simulated or real typical defects have been associated to detected events in lab or in field, showing level and limits of detection. In all the methods presented, the accuracy degree is linked to the availability and quality of asset parameters and initial recorded data to build, assess and improve continuously the analytical, numerical or AI based models.

#### MAIN SESSION 1 - BLOCK 2

##### ***AM and CA of Network Components – Substations, switchgear and transformers***

The following topical subjects were addressed: ageing behaviour of MV substations (systematic processing of data from German DSOs show linear ageing trends for the electrical components, no bathtub curve: significant implications for the maintenance strategy), new condition assessment solutions for smart secondary substations (BIDELEK 4.0 initiative), PD monitoring for the installed base of MV air insulated switchgear, evaluation of voltage control solutions for LV networks (reactive power management, transformers with OLTC or LV regulators), retrofit of compact substations with overloadable Tier 2 low losses transformers (same sizes as existing ones thanks to higher temperature insulation system) and integration of sustainability in the asset procurement decision making (paper 0835: best young academic award for S1).

#### MAIN SESSION 1 - BLOCK 3

##### ***Innovation in Network Components – Cables, lines and new types of equipment***

The 5 papers presented in the block 3 were related the emergence of new hardware and software solutions aiming at reducing the environmental foot print over the life cycle and/or at a system level. Different approaches are presented with a smart selection of raw materials in cable and accessories, the improvement of losses through optimised design and accurate ampacity calculation tools.

#### MAIN SESSION 1 - BLOCK 4

##### ***Innovation in Network Components – Substations, switchgear and transformers***

The return of projects experience over the past 3 years has been presented for the g<sup>3</sup> gas mixture for HV switchgear, including gas management over the whole life cycle. For MV switchgear two types of SF6 alternatives are proposed: use of natural gases which may raise questions about increase of filling pressure or use of fluorinated mixtures which may raise concerns about toxicity and end of life management. Two innovations in MV switch breaking technology have been presented (shunt vacuum interruption and improved puffer): both have the potential for cost-effective SF6-free MV secondary distribution switchgear. Thanks to technology progress, smart features are now available for MV switchgear installed in very harsh conditions (case of subsurface vaults). New distribution transformers fitted with OLTC and pre-insertion resistors are proposed for intermittent connection to the grid (solar plant application). Specifications of prospective smart solid state transformers have been defined within the LV Engine project.

#### ROUND TABLE 15

##### ***New components for MV and LV DC network and integration in grid planning***

The RT discussed new components and their grid integration to set up MV and LV DC networks. As drivers



are identified the growing number of sources of renewables (PV, Wind), active DC loads (EV) and electricity storages which work internally on DC as well as a lot of already existing electronic equipment. The components could be connected via a DC network, enabling more flexibility for grid planning and operation and therefore increasing the hosting capacity. Raising efficiency is in this context not the main driver for DC. The topics grid integration of LVDC networks including protection challenges, new energy LVDC system development and trends in China, DC grids in context of network planning and DC-power switching using power electronics solutions (HCB, SSCB prototypes), were presented by experts from university, utility and manufacturer area. Proposed use cases were e.g. LVDC for last mile applications, smart transformer to DC (SST), DC homes and -buildings, industrial applications and intelligent lightning. As barriers were stated the lack of clear business cases, reliability, standardisation and regulation issues, components and system experience in design process and operation. Therefore, a step-by-step process with techno-economic modelling, design for efficiency & safety and in-field implementation & operations was discussed to facilitate new DC or hybrid AC/DC customer supplies in the transition to LVDC distribution networks. It is not clear up to now if, when, and in which area (industrial environments, public distribution grids or on customer side after the meter) DC distribution grids will be established first.

## **ROUND TABLE 17**

### ***Alternatives to SF6: Feedback from field application in MV networks and perspectives***

The RT was dedicated to discussing field experience on SF6 alternative products in MV distribution systems. A total of 13 submitted papers have been perceived being relevant for this RT, but there was a lack of papers really covering field experiences. In a final step 6 papers were selected to be briefly presented by one of the authors, representing manufacturers and users, to prepare the base for the RT discussion. A lively debate, including the audience, touched a variety of topics around SF6 alternatives, e.g. the variety of different technological approaches and precariousness in terms of EHS, its level of maturity and market availability, manufacturers' future portfolio strategies, the European regulatory propositions. The RT discussion did not show any convergence ambitions for a common SF6 alternatives strategy, both from industry and DSOs.

## **ROUND TABLE 19**

### ***New sensors and algorithms for condition assessment of network components***

The RT discussed the utilization of sensing technologies and algorithms to convert data in useful information for the asset manager. The speakers were representing manufacturers of equipment, users of the technologies and academic researchers. In general, it can be concluded that there are sufficient sensing technologies available. A major challenge here is the optimization of life cycle costs of sensor systems to be implemented in the distribution grid. The second big challenge is the utilization of the amount data generated by sensor systems. Here different philosophies can be applied: centralised or cloud-based computing.

## **RESEARCH & INNOVATION FORUM SESSION 1**

The Session 1 RIF included 6 presentations of innovative projects : 2 of them about fault current limitation (modelling and test techniques of saturated core fault current limiters, fault current limiting circuit-breaker in distribution system) ; study of the frequency-dependent transmission losses of the grid up to 500 kHz ; comparison of the linear and non-linear behaviour of power inductances for switching power supplies ; comparative study on turbulent flow structure under air, CO2 and SF6 gas blasting ; decomposition of SF6-free gas mixture by energy impact.

## **POSTER TOURS**

2 tours for each of the 4 blocks were completed. Each of the papers received by the session had an opportunity to display and present their poster. Attendance for each tour was between 20 and 40 persons.

## **CONCLUSIONS**

During CIRED 2019, the audience shared the importance of innovations in the field of network components. This innovation, traditionally guided by the ongoing search for industrial performance, is increasingly supporting the energy transition, with adaptation to new uses of electricity and increased consideration of the environment.