EXECUTIVE SUMMARY
Session 2 – Power Quality and Electromagnetic Compatibility

SUMMARY

In Session 2 a total of 99 papers have been submitted. During the main session and the RIF 28 papers have been presented reflecting the major recent developments in the area of Power Quality (PQ) and EMC. The impact of the steeply rising integration of low carbon technologies (LCT) on PQ in the grid has been one focus of the conference. This involves new PQ phenomena, the need for new measurement methods and the amendment of PQ standards. Furthermore, PQ monitoring and automatic data analysis using machine learning and visualization techniques become increasingly important. A further focus of the conference were innovative methods for the modelling and design of earthing systems.

MAIN SESSION 2.1
Magnetic Fields, Grounding, Safety and Interference

In this block magnetic fields, grounding systems, safety and immunity of systems were covered. This year there were numerous submissions in the area of earthing systems. The influence of cable shields and other conductive connections between earthing systems was highlighted several times. The presentations included two studies on earthing impedance reduction and return current and two papers on earthing system design. An innovative method for the improved determination of the earth conductivity was presented in (0632). The earth resistivity tomography allows the determination of parameters of any three-dimensional earth models and promises a much more precise calculation of step and contact voltages. Furthermore, one presentation dealt with the determination of positive- and zero-sequence components by measurements. The block was attended by more than 60 delegates.

MAIN SESSION 2.2
Power Quality Issues of New Technologies

Both low frequency and high frequency interactions of new technolgies, like storage, EV charging and LED technology as well as renewables are covered by this block. Next to the impact of renewables in islanded microgrids, a variety of modern non-linear (power electronic) loads, such as LED drivers and EV chargers were addressed by the presentations. Particular interest has been observed for the impact of high penetration of battery electric vehicles with distributed and central charging infrastructure as well as fast charging stations on power quality. 75 attendees confirm the interest in the topic of this block.

MAIN SESSION 2.3
Power Quality Measurement, Analysis and Mitigation Methods

This block covers simulation-based and measurement-based studies dedicated to different power quality phenomena and disturbance cases. It further covered methods and devices to mitigate network disturbances as well as different aspects of instrumentation and measurement. The majority of presentations addressed distortion below 2 kHz (harmonics) and above 2 kHz (supraharmonics). The impact of frequency-dependent impedance on interaction and propagation of distortion has been a major focus. Two studies on harmonic resonance and on a sympathetic inrush exiciting a system resonance have been presented along with three papers on grid impedance calculation, measurement and impact of impedance on supraharmonic propagation. Finally, the modelling of flicker in large real medium voltage distribution networks has been addressed. More than 60 delegates followed this block.

MAIN SESSION 2.4
Standardization, System Monitoring, Handling Big Data and Regulatory Issues

This block covered new developments in standardization, large scale PQ monitoring systems and campaigns, visualization and machine learning for PQ big data as well as PQ regulation, disturbances and customer issues. Three presentations dealt with innovations in standards. Viktor Khoklov, the winner of the Best Young Academic Paper Award of Session 2, presented his paper on the application of measurement methods for the frequency range 2-150 kHz in low voltage networks (0438). His work contributes to the development of the next edition of IEC 61000-4-30. One presentation covered a monitoring campaign in GB with respect to the impact of LCT on PQ. Finally, two presentations were

dedicated to the analysis of big data by machine learning and harmonic correlation matrices. This block was visited by 40 attendees.

ROUND TABLE 15
Impact of RES and Storage on Power Quality

Speakers: Jan Desmet, Sjef Cobben, Jos Knockaert, Kurt Reynders, Coin Debruyne, Kurt Schipman and Brandon Peterson
Since the emergence of distributed energy resources affects in a considerable way the power quality in both low voltage and high voltage grids, the need to evaluate both impact and solutions was discussed during this round table. For such a specific round table, the number of attendees was quite high with an average of almost 60 atendees. After more than 30 minutes discussion, still not all questions of the audience could be answered. Next to a a kind of wakeup call for the audience it is concluded that next steps have to be taken to the E-DSO federation especially concerning both technical and legal bottlenecks, which are different for all EU member states.

ROUND TABLE 17
Emission Limits and Assessment of Disturbing Customer Installations

Speakers: Jan Meyer, Mark Halpin, Igor Papic, Robert Dommerque, Gaurav Singh, Thomas Naef
This round table presented the work of two joint CIGRE/CIRED working groups WG C4.40 and WG C4.42 on fair and justifiable methods to determine emission limits for disturbing installations in the planning stage as well as the assessment of the “true” contribution of operating installations to the total disturbance level in the network. The experts provided insights in the concepts and ideas developed by the working groups and discussed the experiences of practical implementation from the view point of PQ instrument manufacturers and network operators. Particularly the determination of grid-side harmonic impedance as well as the consequences of exceeding planning levels have been identified as challenges. More than 30 delegates attended the round table.

ROUND TABLE 19
The Future of Flicker

Speakers: Herwig Renner, Mark Halpin, Rene Braunstein, Detmar Arlt and Jiri Drapela
The aim of this round table was to discuss future options to deal with flicker phenomena. Currently, work is being carried out on adapting the P_{st} value determination in the flicker meter algorithm. Despite significant changes in the field of lighting technology (LED systems), the 60 W incandescent lamp is still used as a reference. More than 30 delegates attended. Discussion was lively with the general importance of flicker in the future being one important aspect.

RESEARCH & INNOVATION FORUM SESSION 2
Power Quality and Electromagnetic Compatibility

This RIF combined selected papers related to research in the impact of the frequency-dependent transfer characteristic of instrument transformers on the accuracy of distortion measurements. Four presentations covered the definition of a framework for measuring the frequency response as well as measurements in laboratory and field, mainly dedicated to voltage instrument transformers for MV grids. It has been shown that the definition of an application bandwidth is more robust than a calibration due to the impact of external factors, like temperature. The RIF was attended by 35 delegates.

POSTER TOURS
Session 2 had four virtual poster tours, with an average of 10 papers briefly presented and discussed per tour. The four tours covered similar topics like the main session blocks, namely earthing, PQ issues of new technologies, PQ studies, PQ mitigation, PQ monitoring and big data analysis as well as PQ regulation. Attendance was around 25 to 35 delegates for each tour.

CONCLUSIONS
Despite the change of format due to the pandemic, the overall session experience was very good. Especially the impact of modern technologies on Power Quality as well as modelling and simulation of harmonics and supraharmonics attracted a lot of attention. Even if the online format of the conference does not allow such intense interactions and discussions between attendees like an event in presence, many questions in all sessions indicate the strong interest of the audience.