May 2007 saw a small group of South African authors at the 19th International Conference on Electricity Distribution (CIRED 2007) in Vienna.

Presentations, round table discussions, poster sessions and tutorials were arranged around six conference themes, so there were many opportunities to discuss the more than 500 papers and mix with over 1000 delegates.

The South African attendees at CIRED 2007 submit the following feedback from Vienna:

Report from Mashangu Xivambu, Eskom Distribution, Northern Region

This is the first major international conference of this type for what I have attended.

The opening ceremony of the conference was held on the 21 May 2007 where an overview of the Austrian Electricity Industry was presented. It was very interesting to learn the similarities and the differences that we have in terms of network configuration and operations.

I had an opportunity to present my paper on the impact of floating neutrals in distribution systems in the poster session of the Power Quality and EMC theme. From the questions and comments raised after my presentation, I learned that floating neutrals are a global problem, especially in countries that have a large percentage of overhead networks. The problem is not very common in countries where underground cable networks are installed.

I identified smart energy automation of distribution systems up to low voltage level as an area where we need to look in order to compete with developed countries in terms of network reliability and performance. However, that will take some time as we are still faced with the challenge of universal access.

It was also very challenging to learn about the availability power interruption statistics in Europe taking into account the SAIFI, SAIDI, CAIFI and CAIDI. Germany and France seem to be doing very well compared to other European countries. There is a lot that we need to learn from the European utilities.

I was impressed to learn that there are a lot of things that we are doing well looking at our network design standards, use of latest technology in the market compared to the European utilities. Eskom does have the potential to compete globally with leading Electricity suppliers.

Report from Janine Jagers, Eskom Distribution, Western Cape

The very interesting "Managing an Aging Infrastructure" tutorial session jointly presented by Electricity Networks Analysis, Research and Development (ENARD) and CIRED addressed some key concerns facing utility asset managers internationally, promoting the drive towards a Condition Based Risk Management Approach to support asset management.

The focus of the Network Components session, with a total of 102 participating papers, ranged from ageing, diagnostics and behaviour of cables, switchgear, power transformers and substations. Power transformers are an integral part of distribution networks and the main theme was reliability analysis and insulation diagnosis.

Insulation diagnosis focused on interpretation of moisture in oil analysis as well as the degree of polymerisation (DP) of the paper insulation. These two areas of diagnostics are actively being employed by Eskom Distribution, with a drive towards on-line diagnostics of power transformers.

On reliability, most of the contributions were based on theoretical analysis and interpretation, whereas the South African contribution demonstrated the application using actual data. In the paper "Large Power Transformer Reliability Improvement in Eskom Distribution", the transformer failures were analysed and interpreted in terms of the probability density function, the survival function and the hazard function. The paper also reported on the initiatives undertaken by Eskom Distribution to improve the reliability of its transformer fleet through modifications of the design specification. Observing the behaviour of an actual population of power transformers appeared to be of much interest to the audience and authors presenting theoretical work on the subject.

Report from Prof. Trevor Gaunt, University of Cape Town

I found that electricity distribution R&D is enjoying high interest, even compared with 10 years ago, probably as a direct result of the re-regulation of the industry during the 1990s. Distribution research has become academically respectable and is supported by substantial industry and government funding. The hottest topics are dispersed or distributed generation (DG) and power quality including interruptions (PQ), driven by and affecting the utility regulation and management. These three themes affect the network components, system development and operations considered in the other three themes. It is no surprise, therefore, that I found over 80 papers directly relevant to the present research of power systems students and staff in the Department of Electrical Engineering at UCT, and I discussed some potentially break-through research with various people from industry and universities. Although South African systems and needs differ in key respects from systems in many developed countries, the techniques and technologies are of significant interest to us.
There were 98 papers in the power quality and EMC theme. A complex relationship is developing between the cost impact of PQ, the reliability of active distribution networks, and the regulations imposed on utilities. Most PQ monitoring starts as a regulatory requirement, but increasingly the utilities are reporting operational benefits (think cost reduction!) from applying PQ data to system restoration and asset management. We can expect small but important changes in the definitions of voltage dips and short interruptions, consistent with reporting new indices.

There is a close relationship between PQ and DG, but DG is also closely related to regulation and protection, so interesting PQ, reliability and performance papers are found in several themes of the conference.

Availability and failure are often thought of as physical systems modelled by ageing and weather, but maintenance (or the lack of it) and restoration are largely human systems and respond to intervention. Customer costs incurred by both dips and interruptions are becoming increasingly important in the balance between investment, maintenance and operations. This is an interesting field for research, as well as being important to the utilities.

Our paper on the load and PQ data logger being developed at UCT attracted attention from several delegates. PQ monitoring devices and systems were presented by authors from several different countries. There is an obvious need for inexpensive and reliable data collection to support the engineering management processes.

Report from Tshilidzi Thenga, NERSA

I was most interested in the discussions of regulation and power quality, and from the various papers presented one could clearly see that South Africa is more or less on par with the rest of the world in terms of our approaches to network performance and reliability (with our own unique South African challenges that include data availability and accuracy).

It appears that utilities and regulators are in favour of prioritising the reduction of the effect of poor network performance as seen by the “customer”. This is evident form the interest in customer based reliability indices to quantify reliability in other countries. In South Africa for regulatory purposes a system based index (SAIDI) is currently used to incentivise/penalise utilities in anticipation of reduction of the negative effect that is seen by the customers. Other countries use the so called customer dissatisfaction index (CDI). Utilities however use various indices to monitor different areas of reliability.

The regulators around the world seem to be opting for regulatory models that favour incentivising and penalising players in the supply of electricity in order to improve quality of supply and reliability, and utilities are accepting these models as effective means of economic regulation.

Our paper on the evolution of regulatory standards generated some positive feedback from delegates who indicated that South Africa is moving in the right direction in terms of power quality monitoring and reporting.

Report from Robert Koch, Eskom corporate consultant - power quality

Areas of particular interest at the conference were developments in power quality standardisation, the contracting power quality emission levels, network planning/design impacts of power quality standards, and international surveys of power quality levels.
The presentation of the CIGRE/CIRED JWG C4.103 guidelines for calculating harmonic, flicker, and unbalance emission limits is an important development in the contracting of power quality levels between electricity suppliers and customers. The recommendations (recently adopted by IEC national committees in the form of three IEC technical reports) provide methods of allocating emission levels that are fair and consistent for all installations connected to public MV, HV, and EHV networks.

An important debate in Europe at the moment is the revision of the European “minimum” power quality standard (EN 50160). The developments in the latest draft South African NRS 048 standard have drawn much interest by European regulators, as aspects such as voltage magnitude, voltage dips and interruptions are more comprehensively addressed. In particular, the South African process of developing quality management requirements for voltage dips drew several requests for more information, given the concern that a single set of minimum standards for voltage dips could not be set for the many different networks in Europe. Another interesting debate was the specification of minimum standards based on absolute limits instead of probabilistic assessment criteria in an environment where many of the underlying power system parameters (e.g. network loading, customer emission levels, and network contingencies) are of a probabilistic nature.

An interesting development in Italy is the proposed implementation of regulatory minimum fault levels for MV networks. As fault levels play an important role in the management of power quality, this provides an interesting new dimension to consideration of “minimum” power quality levels.

Results presented on voltage dip performance on MV networks in Italy also show an interestingly high level of correlation between line length and voltage dip performance (a phenomenon not apparent in South African rural networks). The high level of common interest in power quality regulation in South Africa and Italy resulted in an agreement to compare the underlying factors related to “first-world” and “developing-world” networks.

Report from Rheff Kelly, Eskom, Industry Association Resource Centre

I presented a paper during a round table discussion written with Bernard Meyer on Eskom’s approach and philosophy with regards to safety, risk reduction and the internal arc classification (IAC) of primary and secondary switchgear. The results of internal arc testing as well as key design solutions were presented in the paper, based on his involvement in the collaborative partnership between Eskom and various switchgear and MV/LV substation manufacturers towards specifying and obtaining secondary switchgear having full IAC in accordance with IEC 62271-202.

On the subject of IAC and specification, the key message conveyed by both users and manufacturers was that a co-ordinated and comprehensive review of the hazards, the causes of failure and the possible solutions for mitigating the effects of insulation failures is always required to reduce the associated risk. The use of supplementary measures to complement IAC can often assist in reducing the risk to a tolerable level. There is sometimes a tendency amongst users to over specify – often at great cost to both the user and the manufacturer. Manufacturers and users agree that the guidelines of the ISO/IEC Guide 51 on how to incorporate safety aspects into standards are useful in addressing this often contentious topic.

In the session on network components, it was evident that the use of both on and off-line condition monitoring techniques to assess the state and behaviour of network plant is becoming increasingly important when making investment decisions relating to equipment maintenance, refurbishment or replacement. Condition monitoring of cable circuits, accessories, switchgear and transformers, together with various tools and methods used for the assessment of the ageing condition of key plant components featured strongly. Condition based maintenance (CBM) and programmes such as condition based risk management (CBRM) are being increasingly adopted by utilities in order to prioritise and optimise expenditure.

The implementation of comprehensive distribution management systems (DMS) incorporating SCADA and other operational processes together with distribution automation (DA) featured strongly in the session on network control. Network/grid operators are under increasing pressure to improve their reliability of supply and especially to reduce customers’ durations of supply interruptions in order to meet the regulatory and operational requirements.

The extent to which DA (and associated remote control equipment) is applied to secondary distribution feeders is determined by the cost and the expected benefit in terms if the reduction in the duration of supply interruption. It is evident that most network operators do not automate each and every switching point on secondary feeders as significant improvements in outage durations can be achieved by automating key selected switching points (such as the N/O point and various points in between).

As a result, certain customers stand to benefit more than others – based on where they are located on the feeder, but the measured performance indicator being the system average interruption duration index is always reduced. In time it is anticipated that increased regulatory requirements will be imposed on supply authorities in the EDI with the aim of improving and benchmarking quality of supply.

A number of papers in session 5 on power distribution system development also focussed on optimising the MV distribution network configuration at both the design and strengthening stages in order to increase operational flexibility – with the overall aim of improving quality of supply. Various life cycle costing studies that included the cost of unserved energy incurred during system interruptions were presented confirming that the up-front capital expenditure is not the only issue when making investment decisions.

Conclusion

The themes and many papers at CIRED were directly relevant to electricity distribution in South Africa, but the conference had a distinctly European flavour in its location, the details of the papers, an apparent focus on systems in developed countries, and the composition of the delegates. The third Chinese International Conference on Electricity Distribution in Guangzhou in November 2008 (www.ciced2008.org.cn) is being arranged around the same six themes as CIRED, is also likely to be relevant to South Africans, and will be a very different cultural experience.

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