From the Technical Director’s Desk

Voltage Unbalance in Distribution Networks: How much do we know?

A great deal of understanding of steady state voltage in LV and MV networks is now possessed by the Australian Power Quality and Reliability Centre (APQRC) through the Long Term National Power Quality’s Survey (LTNPQS). Voltage unbalance (VU) measurements are also a part of the survey. However, due to limitations of some of the instruments used at LV levels, the established method of calculating VU has been found to be wanting at some sites. At MV, the picture is somewhat better as there are more dedicated PQ monitors that can give true negative sequence VU. However, at MV, the issue of voltage transducer accuracy comes into play. For example, a metering class (class 0.3) VT, with two phases working at the two positive and negative extremities of the voltage magnitude accuracy range, can lead to a negative sequence VU level of nearly 0.2% ignoring any phase angle inaccuracies. When all system measurement inaccuracies are put together, the error will be larger. Given that we are trying to meet planning levels as low as 1.8% this is a serious concern. Therefore, on the whole, it is difficult to place much faith in reported VU levels unless greater attention to measurement practices is adopted.

Apart from dealing with measurement issues, there is also a need to establish the sources of VU. The allocation of VU following any recommended method is of little value unless we are in a position to determine the individual emissions made by an installation. At LV, there are usually only a few three phase customers and measurement for compliance is simple if there is no background VU (not the case in practice). It is well known that three phase induction motors are the load type worst affected by VU. This load also compensates for existing VU while slowly losing their operating life because of excess heat. In theory, the capital and operating costs of a compensating devices should be paid for by someone which raises the question - where does this happen in the case of induction motors? To make matters more complex, VU does not arise only due to loads, it also arises as a result of the asymmetrical system impedances. Even when an installation is perfectly balanced, VU can occur due to the balanced currents of the installation flowing through an asymmetrical supply system. In the most general case, the POE of an installation can exhibit VU which arises due to the installation itself, the asymmetrical supply line and any background VU. In this case, separation should be carried out before compliance of the installation is assessed - not a trivial task!

Recent research at University of Wollongong goes some distance in trying to understand the complexity of the VU problem in MV systems but these outcomes need to be applied in the field to verify the methodologies developed. There is a long way to go to deal with networks which are dynamic where real time assessment is required. In addition to this the data intensiveness of various methodologies can become a hindrance and new estimation techniques will have to be determined to deal with missing and sometimes noisy data. I invite those who are interested to communicate with the APQRC to see how we can move forward together to address many of the unresolved problems associated with VU.

APQRC Secures Further Funding from Industry

The APQRC will receive almost $1 million funding from industry sponsors over the next three years which will improve power quality and reliability to households and businesses throughout New South Wales. This funding for power engineering activities at the University of Wollongong takes the University’s relationship with industry sponsors to an historic 20 years of continuous funding – unmatched by any other university in the country. Continued over
The Centre has become recognised nationally and internationally for its expertise in the power industry – and specifically in the area of power quality. As part of the latest agreement, funding will be used to continue to employ two full-time academics at the Centre. It will also be used to supplement a scholarship aimed at encouraging high calibre electrical engineering students to undertake postgraduate studies and consider an academic career in power engineering.

**APQRC Staff Visit Top Indian Universities**

In December 2013, APQRC staff members visited two premier institutions in India namely Indian Institute of Technology (IIT)–Bombay and IIT–Madras. The APQRC staff members thoroughly discussed the past/ongoing research activities undertaken by the Centre. Also, a staff member from IIT–Bombay visited UOW and highlighted the strengths of Power Electronics and Power Systems (PEPS) group at IIT–Bombay. These collaborative visits were supported by the University Internationalisation Committee (UIC) and the Faculty of Engineering and Information Sciences at the UOW (under the UIC International Links Grant Scheme).

Renewable energy resources such as wind and solar photovoltaic systems are becoming an integral part of the electricity networks all over the world. The emerging trend of intelligent/smart grids aims to simplify the complexities associated with network operation involving such distributed energy resources. However, the structured framework facilitating participation of renewable energy resources in competitive electricity environments needs to be developed.

The economic impact of power quality and reliability also needs to be assessed. The collaborative research activities between the UOW and IIT–Bombay aim to contribute in these areas.

In order to establish institute level collaboration, the APQRC staff members met the officials concerned at IIT–Bombay and had a very fruitful and positive discussion, which may culminate in a long standing relationship between the two institutions. UOW and IIT–Madras have already been actively pursuing institute level collaboration in different areas. Accordingly, the APQRC staff members identified synergies, especially in the areas of power quality and power systems, through interactive meetings with the researchers at IIT–Madras. It is envisaged that collaborative research activities will be undertaken, by the researchers at both institutions, in the areas of mutual interest.

**APQRC Investigate Power ‘Saving’ Devices**

APQRC expertise in bringing direct benefits to electricity consumers was demonstrated recently when under commission from NSW Fair Trading APQRC staff conducted tests on a claimed energy saving device which showed those claims to be false. The device tested was effectively a power factor correction capacitor and as such will not save domestic consumers any money on their electricity bills. There are many such devices in the marketplace today and extreme care should be taken with regard to the claims made by many of them.

**APQRC to Host AUPEC in 2015**

The APQRC and the University of Wollongong have been selected as the venue for the 2015 IEEE Australasian Universities Power Engineering Conference. This annual conference brings together a range of academics, industry experts and students in the power engineering field. The conference will be held in late September 2015.

**Upcoming Events**

25 – 28 May 2014: ICHQP 2014, Bucharest, Romania

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