

LTNPQS NEWSLETTER

Issue 5 November 2014

Investigation of Economic Impact of PQ Disturbances

The economic impact of PQ disturbances is a topic that has been of interest to LTNPQS participants for many years. In recent times, PQ has played poor cousin to reliability in terms of importance and investment. This is in spite of the fact that there is considerable evidence to indicate that voltages sags (just one of many PQ disturbances), which happen more regularly and can have a similar impact to interruptions, are much more costly than outages. While there is a significant amount of technical literature detailing methods to estimate the economic impact of PQ on customers and DNSPs it is somewhat limited and far from comprehensive. The available literature can roughly be broken down into two categories. These are:

1. Literature that provides qualitative frameworks to estimate the costs associated with PQ disturbances.
2. Literature that provides quantitative estimates of economic impacts of PQ.

For the first category, much of the literature presents models that, in some cases, utilise significant amounts of economic theory and require significant amounts of data that may not be practicable. At the other extreme, the models presented are macroscopic and far too simplistic to be of any value. In the second category, there is considerable variation in the costs claimed by studies and many estimates appear to be extrapolated from small surveys. This limits the confidence that can be placed in such studies. The major problems with

determining the quantitative economic impact of PQ disturbances can be summarised as follows:

- There are many different PQ disturbances to be considered. There is also a range of customer types and equipment that will be impacted differently by PQ disturbances. This increases the complexity of analysis.
- PQ monitoring, reporting and analysis systems and methodologies remain an area of ongoing work and cannot be easily linked to economic frameworks.
- Many DNSPs find it difficult to produce a robust cost/benefit model to justify PQ monitoring infrastructure. As such, data is often unavailable to aid analysis.
- The impact of PQ disturbances may not be immediately obvious. While a deep voltage sag may immediately trip off a facility, the slow degradation of equipment caused by steady state overvoltage is not readily apparent.

Based on a recent project undertaken with United Energy to determine the economic impact of PQ disturbances on distribution network infrastructure and on customers connected thereto the following is a summary of some of the economic impacts of PQ disturbances:

- For the domestic load sector, the impact of overvoltage on equipment life is by far the dominant cost.
- For the commercial load sector, costs associated with sags and interruptions are

the most dominant. Loss of equipment life due to overvoltage and wasted energy in simple resistive loads also has a significant impact on the cost.

- For the industrial load sector, costs associated with voltage sags, supply interruptions and wasted energy in simple resistive loads have similar impact as for the commercial sector. Loss of equipment life due to overvoltage is not as important in the industrial sector as for other sectors.
- The costs associated with unbalance and harmonics are modest compared to the costs associated with overvoltage, sags and supply interruptions.

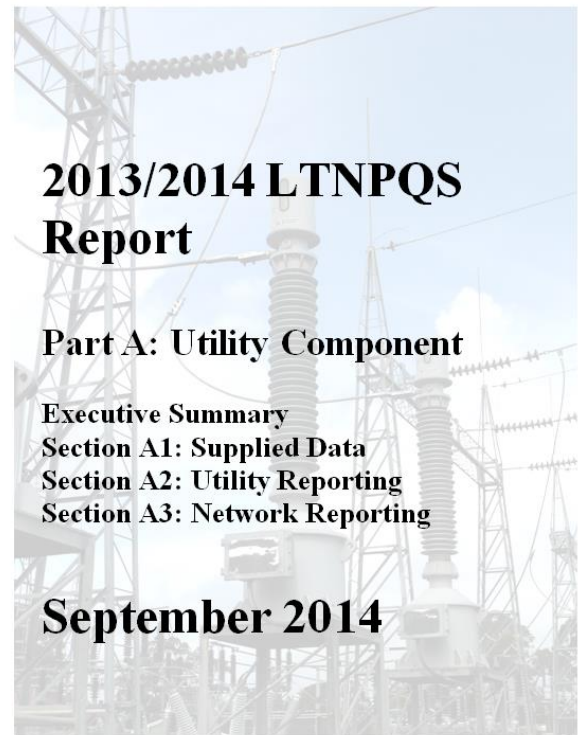
PQA intend to incorporate some of the outcomes of the project into future power quality survey reports. The addition of such data to the reports adds significant value to the project and extends the scope of the LTNPQS from a purely technical undertaking to both a technical and economic analysis.

2013/2014 LTNPQS Reports Issued

Most 2013/2014 LTNPQS reports were issued to participants in September and October. Remaining reports will be issued as data is received and processed. As for the 2012/2013 reports, these latest reports contain a large number of enhancements on previous reports and provide even further value to participants. Major enhancements for the 2012/2013 and 2013/2014 reports include:

- Incorporation of statistical methods to determine overall network compliance based on the sample of sites provided to the survey.
- Reporting of individual voltage harmonics to the 25th order.
- Reporting of flicker.

These latest reports represent the most comprehensive and innovative reports which have been issued to date. Participants should be able to use the reports to gain an even deeper understanding of the fundamental PQ performance of their networks.



AUPEC 2015 is coming to Wollongong

The Australian Power Quality and Reliability Centre (APQRC) at the University of Wollongong (UOW) is pleased to announce that it will host the Australasian Universities Power Engineering Conference (AUPEC) 2015 in Wollongong from 27-30 September 2015. AUPEC is an annual conference which has been held for over 20 years. Today the conference sees postgraduate students, researchers and practicing power engineers from across the Australasian region meeting together to share research and ideas for the advancement of power engineering for the benefit of the power industry and



Power Quality Australia
A University of Wollongong Initiative
Ph: +61 2 4221 4737
Email: pqa@uow.edu.au



consumers. The theme for the 2015 conference is Challenges for Future Grids. For more information on the conference, including paper submission guidelines and opportunities for sponsorship and exhibition, see the conference webpage at www.aupec2015.com.au

Professor Vic Gosbell and Dr Robert Barr Receive John Madsen Medal

Professor Vic Gosbell and Dr Robert Barr have been awarded the prestigious Engineers Australia John Madsen medal for 2013. The John Madsen Medal is awarded for the best paper written by a current member of Engineers Australia, and published in The Australian Journal of Electrical and Electronic Engineering. The prize paper was V.J. Gosbell & R.A. Barr, "A new approach to harmonic allocation for medium-voltage installations", *Proc. AJEEE*, Vol.10, No. 2, 2013, pp.149-156.

Technical Note No.14 – Ripple Injection Load Control Systems Published

Newly published Technical Note No.14 discusses ripple injection load control systems. Ripple injection load control is a communication method used extensively by electricity distributors to turn on and off loads such as off-peak hot water systems and street lighting. Ripple injection control systems work by superimposing a coded control signal on to the normal 50 Hz voltage waveform. This allows for one way communication with loads

without additional communications infrastructure. In most cases, ripple injection control systems are an effective and flexible method of performing this control. For residential customers, ripple injection systems allow access to cheaper off-peak electricity. The technical note is available at http://www.elec.uow.edu.au/apqrc/publication_s



Australian Power Quality & Reliability Centre

Ripple Injection Load Control Systems

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Want More Information?

If you would like more information on any of the articles published in this newsletter please contact Dr Vic Smith at the University of Wollongong on 02 42214737 or vic@uow.edu.au.