DISTRIBUTION NETWORK MONITORING

SETTING UP A MONITORING PROGRAMME

Ergon Energy is establishing a system to monitor network power quality and reliability using approximately 2000 monitors distributed across Queensland.

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The reasons to set up a monitoring programme have been explained in part one in the series on Distribution Network Monitoring. In this part, discussion will focus around what parameters should be measured, the monitors used, the monitoring system set-up and data analysis.

PARAMETERS MONITORED

Before embarking on a monitoring programme, it is important to establish what parameters are going to be measured and to what standard of measurement (to be discussed later in this part). At Ergon Energy it was decided to monitor the following parameters:

- Sustained interruptions
- Momentary interruptions
- Steady-state voltage levels
- Voltage unbalance
- THD
- Voltage Sags
- Voltage swells
- Power frequency at selected sites including remote generators
- Current (at selected sites including zone substations)
- Power factor (at selected sites including zone substations).

The monitor or monitors to be used can be chosen once the parameters to be measured have been decided.

Whilst much of the network is monitored by SCADA for interruptions, Ergon Energy still have circuit breakers and reclosers that are not monitored, and hence the need to monitor for interruptions. It is yet to be established, but it is anticipated that all interruption data will be fed into the SCADA system and analysed by the trouble call system that identifies the likely tripped protection device. This way a more comprehensive monitoring of interruptions is possible so as to allow a quicker restoration, particularly if customer calls are slow to be received.

Steady state parameters such as voltage are captured with 10 minute average values to comply with AS/NZS61000.4.30 and sag/swell event data is captured if the supply exceeds a ±10% limit. Class A measurements were not seen as a priority and so Class B instrument measurement accuracy was decided as sufficient.

MONITORS

The monitors chosen for Stage 1 of the programme are the EDMI Mark 6 meter (see Figure 1). These meters are a revenue meter with power quality capability or what could be called a "smart meter". This meter has subsequently been superseded in the EDMI product range by the Mark 10 meter.

The Mark 6 was chosen because of its inherent reliability and long life without the need for recalibration. They were also a fraction of the price of specialist power quality instruments and have high security because of electricity market rules.

Approximately 450 meters were deployed through Stage 1 with another 1600 to be installed in Stage 2 of the programme. An extensive tender process for Stage 2 monitors is almost complete.

MONITORING SYSTEM

The Mark 6 meters have been deployed in a weatherproof polycarbonate box and primarily installed on overhead distribution substation poles as shown by Figure 2. These units communicate by GSM or CDMA modems. The CDMA modems will be replaced with modems that communicate via Telstra's NextG network as the CDMA network is being closed in February 2008.

The modems in the monitoring units presently dial in every 7 days or if event data exceeds a certain number of events in a time period. Ergon Energy is in the process of swapping to packet data transfer by GPRS and the new 3G HSDPA. Meters are given an ID and password and transmit small packets of data regularly. This system is shown at the bottom of Figure 3.

This system allows data to regularly flow throw to the data warehouse so stored data is up to date as possible. This is particularly important for monitoring outages and also allows real time identification of voltage regulator failures if they occur

A data warehouse is required to store all the data collected from the monitors. This requires large storage capacity as 2000 meters will transfer approximately 12.8 Gigabytes of data per year. This warehouse needs to be established on a dedicated server as much of the data analysis requires considerable computing power.

A data mining tool is then needed to analyse the data.

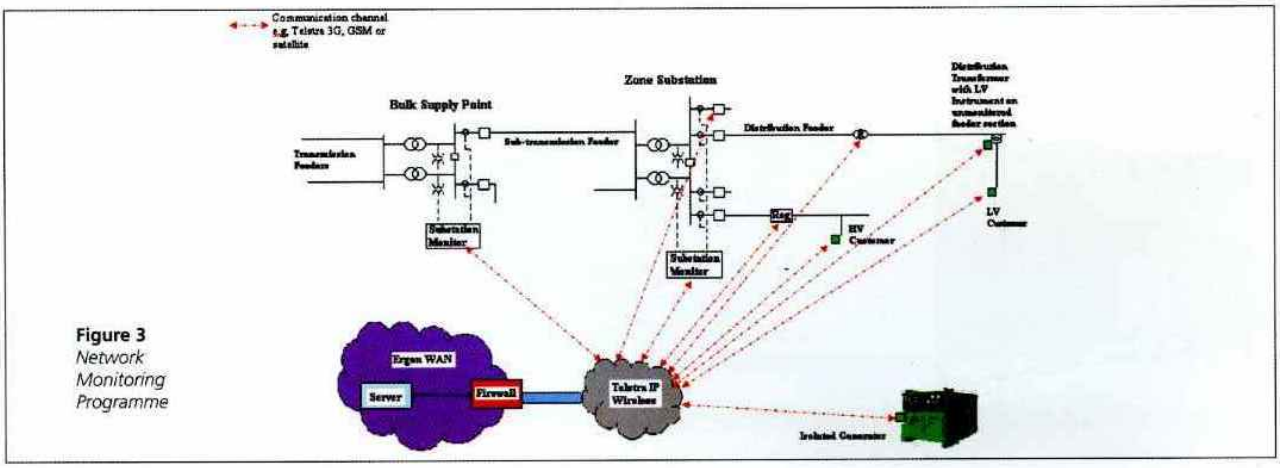

Figure 3
Network Monitoring Programme

Figure 1
EDMI Mark 6 Meter

Figure 2
Monitor installed on a distribution substation

Ergon Energy is presently using a mining tool developed in-house called PQMiner in conjunction with Electrical Power Research Institute's (EPRI) PQView.

DATA ANALYSIS

Data collected from the monitors needs to be compared against a standard to see if the electricity supply is acceptable or if problems exist or are emerging. Ergon Energy has developed a Network Performance Standard that pulls together the requirements of Queensland legislation, the National Electricity Rules, Australian and International standards and codes of practice. The standard provides a benchmark to justify actions for improvement and provides a basis upon which complaints and disputes can be resolved.

The in house data mining tool allows identification of poor performing sites for all monitored parameters. These sites are then prioritised for action.

Alarms are being established to identify problems as they occur but this is in the early stages of development. It is anticipated that reports will be scheduled to run numerous times during the day which will allow problem sites to be identified so immediate action can be taken.

Links to the SCADA system have not yet been implemented but, as explained previously, it is planned that interruption data will be fed in, so the trouble call system can analyse the data to determine the extent of the interruption and the likely open protective device.

The data mining tool also analyses monitor availability and provides reports on monitors that are no longer communicating so repairs can be implemented.

SUMMARY

The first task in establishing a Network Monitoring Programme is to establish the parameters to be measured and what standard of measurement. The monitor or monitors can then be chosen based on this.

A communication system needs to be established, a data warehouse and a data mining tool set up. The data mining tool allows the objectives and benefits of the programme to be realised.