BYE BYE BLACKOUTS!

An international research collaboration is developing new Phasor Measurement Units to prevent power system protection from triggering unnecessary blackouts.

The National Grid, which has to balance electricity generation and consumption across the UK in almost real time, is under constant strain. Relatively small excesses in generation or peaks in demand could lead to disaster.

Fortunately, the grid is under constant observation. System Integrity Protection Schemes protect large areas of the grid and built in protection devices can disconnect vital equipment if a threat is detected. Although power cuts are an inconvenience, at least we are safe from substation fires or other serious damage to electrical equipment and infrastructure that could have long term implications for the security of electricity supplies.

But there is a big problem: these protection devices can be triggered by false alarms. Indeed overzealous protection measures play a role in a third of all blackouts.

Dr Peter Wall, of the School of Electrical and Electronic Engineering, knows how important it is to prevent false alarms.

“The costs are high,” he explains. “In 1996 a Californian blackout cost $1 billion. In 2003 blackouts in America and Italy each disconnected 50 million people.”

Manchester researchers are collaborating with other UK universities and three leading Indian Institutes of Technology to pioneer and test new ‘smart grid’ technologies to improve real-time network monitoring, protection and control.

The Advanced Communication and Control for the Prevention of Blackouts (ACCEPT) consortium draws together experts in electric power systems, satellite communications, advanced mathematics and sensor technology. These researchers are collaborating to develop advanced Phasor Measurement Units (PMUs) to monitor voltage and current waveforms in electricity grids. Abnormal waveforms in electrical networks give important clues about faults in the system. Comparing data from different points within a network can even help to pinpoint the source and nature of a problem.

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"The exciting thing," says Professor Vladimir Terzija, who leads the international project, "is that this 'clever protection' will distinguish when it is appropriate to activate power system protection."

Today, network operators take months to piece together all their data and build up the full story behind a blackout. In contrast, the ACCEPT technologies will analyse networks in real time. "We will offer predictions and suggest preventative actions to maintain network stability," says Professor Jovica Milanovic, who also works on the project. He says this predictive approach will decrease the number, size and consequence of blackouts.

But can network operators, who are all too aware of the potential failings of existing protection, trust the new technology?

"A key part of our work is the development of novel algorithms to use the PMUs to analyse the behaviour of the network," Professor Terzija assures. "We call it 'dynamic security assessment'. Like a doctor assessing a patient, our tool will diagnose any symptoms displayed by the PMUs to establish how close a power system is to a blackout and when to undertake preventative measures."

"The volume of data requiring real-time analysis is rather daunting, however. "We may need the power of super computers to give us full confidence in the ability of PMU-based blackout prevention control and protection systems," Dr Pawel Regulski admits. "However, the ACCEPT project is absolutely crucial."

Today the risk of blackouts is relatively low. But future investment in new power plants — especially nuclear plants and large wind farms — may destabilise the network. Professor Terzija concludes, "Only with a real-time, data-driven intelligent control system, like ours, will the grid continue to operate with the existing level of security and low probability of blackouts."