

Today's electricity infrastructure, driven by commercial forces, will find it hard to cope when things go seriously wrong. By **David Watson**

Comment



Since Longannet power station closed in 2016, Scotland could take several days to recover from a major power failure, experts have warned



ENERGY

Market failures could see Britain suffering five-day power cuts

EVEN IN INDUSTRIALISED nations in the 21st century, the sort of electricity-grid system failure that's been seen in parts of Australia in recent years is not uncommon. And in the UK, the risk of total blackout or significant partial shutdown of the transmission network is increasing.

The rise in renewables is making failure more probable. Wind farm growth creates frequency-management issues arising from reduced system inertia, while declining network strength can cause longer, stability-risking, fault-clearance times. Then there are the challenges to match supply to demand following sudden variations in wind generation and the reduced one-hour notice of input variations from European interconnectors. Other risk factors include grid substation failure, lightning or overhead line faults and cyber attack.

For grid recovery following widespread collapse, a process known as 'black starting' is deployed where the UK is split into different areas. Being able to rapidly black-start the country is a public health priority and, rightly, a public expectation, but in Scotland, and probably London, it is unrealistic; it would take several days to

re-establish networks. So serious has the issue become that I understand it has attracted the attention of the government's Cobra civil contingencies committee.

Professional expectation for Scotland to black-start has now, I've been told, risen to five days, largely as a result of large-scale, dispatchable, on-demand generation being replaced with intermittent distributed renewables. London has experienced a similar progressive local reduction and will also take longer to recharge since much of its high-voltage grid uses cable and not overhead line transmission.

The Scottish Black Start Restoration Working Group reviewed its procedures in September 2018. These are based on local joint restoration plans that would see transmission operators powering up and stabilising local transmission islands, which would then have to be synchronised and progressively interconnected.

The group's report warns that, following the 2016 closure of the Longannet coal-fired power station in Fife, there would be 'severe delays' to restoration. Peterhead gas-fired station, now Scotland's only high-powered and high-inertia (essential to stabilise

frequency) dispatchable power station, is seeking planning permission to install 31 diesel generators, capable of full power for seven days, to secure its restart. However, it has only half the capacity of Longannet and couldn't restart all of Scotland without input from the pumped-storage capacity at Cruachan and Foyers and, crucially, from England, which arrangement is untested.

Nor would wind farms be able to black-start the grid. Main generator types in use need external power to start generating; some more recent designs are self-starting, but connecting to a dead grid via long offshore AC cable interconnections remains an unsolved problem as the turbines cannot provide enough reactive power to recharge what are, in effect, large capacitors. In any case, they wouldn't be able to meet National Grid requirements for block loading, grid voltage or frequency control.

The first local joint grid-restoration activity is to disconnect all offshore generation. Onshore wind farms can be progressively reintroduced once the grid has been re-established, but only providing they are not frozen and there is wind. As with all nuclear stations, Scotland's Hunterston and Torness could only be reconnected into a stable grid, this taking several days.

The new £2.4bn HVDC interlinks from Wales to the Hunterston area and from Moray Firth to Spittal have not been engineered to support black start as they do not include the latest voltage source converter (VSC) technology and cannot commutate into a dead network. Scotland is now literally at the end of the line and critical restart power would arrive only once the north of England grid had been re-established. Similarly, for London, the two HVDC interconnector links to France and the Netherlands cannot support black start.

National Grid confirmed in 2016 that the restoration strategy "must be adjusted" as "system strength and the number of black-start providers declines" and that black-start costs are "anticipated to increase by a 7-10 factor" over the next 10 years. While, like Ofgem, it favours the provision of up to seven new VSC interconnectors between Britain and the European mainland, these are not yet built and power availability from them would depend on market conditions. The UK is a net importer of electricity. And then there is Brexit...

The situation is clearly untenable. It exemplifies the need for proper governance of the UK electricity system to replace the present disparate, profit-driven weakening of the grid that 'the market' has caused.

Several of the engineering institutions are advocating change, including the IET, the IMechE and the Institution of Engineers in Scotland. We need to be heard. * **David Watson is a chartered electrical engineer who before retirement was manager of projects at Foster Wheeler Energy, based in Glasgow.**

< future career aspirations. We recognise the demands on your working time. Many of you are fully loaded with projects for your employers and also there is the first priority of supporting your families. However, most organisations would support outreach and permit flexible working to enable you to give one or two inspiring presentations at morning assemblies each year.

Those, like me, who are retired have a greater opportunity to help schools. Do not worry, the pupils will be amazed what you, as Grandmas and Granddads, have achieved.

May I encourage all the IET and IMechE networks to emulate the support we, in Coventry and Warwickshire, get from our local members and colleagues. And if you are doing something we could copy, please let us know.

Derrick Willer MBE CEng MIET

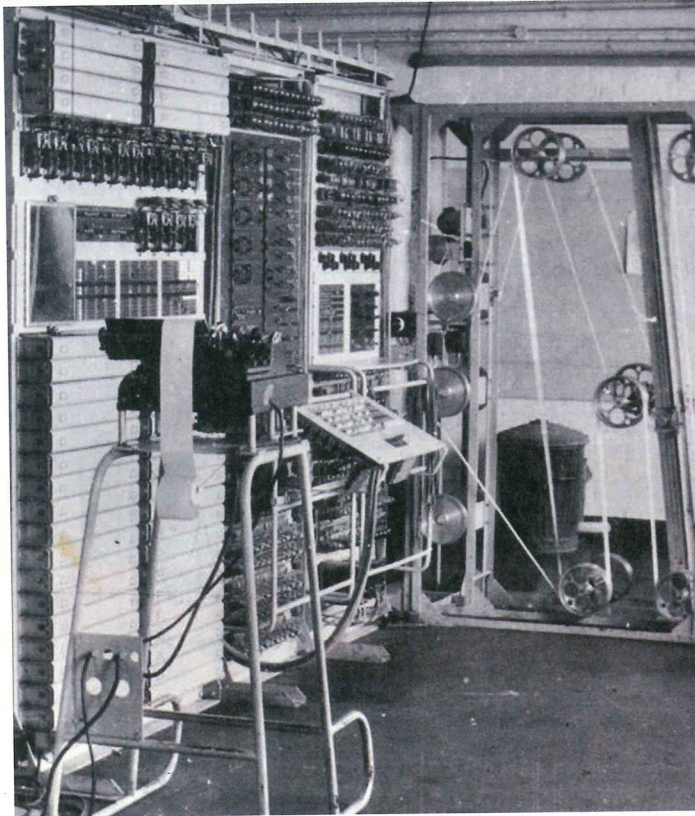
IET Schools Liaison Officer

CREDIT FOR COLOSSUS

The article about GCHQ in the May 2019 issue of *E&T* implies that the Colossus computer was developed at Bletchley Park. It wasn't (although it was used there); it was built by the Post Office Research Station in Dollis Hill, London. My late father Dr Arnold Charles Lynch FIEE (1914-2004) worked on the optical reader for the punched paper tape that the messages to be decrypted were on. This could read 10,000 characters per second, although in practice it had to be run at half that speed because otherwise the tape was liable to break.

My father said absolutely nothing about Colossus until its secrecy was breached via the USA in the mid-1970s, and very little about it until the 1990s when more information about it became public. Until then many countries' intelligence services were using encryption equipment similar to the Enigma, Lorenz and Geheimschreiber machines, and the great secret was that GCHQ could read the messages.

My father said that it was the Post Office that proposed to build an electronic computer for decryption, and that initially the Bletchley Park people were not interested. This was because many of them were amateur radio enthusiasts and had bad experience of the reliability of valves, and could not imagine an apparatus with 2000 valves in it



Colossus at Bletchley Park: Tommy Flowers and his Post Office design team deserve greater recognition, say readers

working for long. The Post Office had much experience of using valves in telephone repeaters (amplifiers placed at intervals along long-distance telephone cables) and knew that they were extremely reliable provided that their heaters were kept working continuously rather than being turned on and off frequently.

The Post Office built the first Colossus on its own initiative and invited some people from Bletchley Park to come and see it. The visitors said, "It looks promising, but let's see if it is still working in a week's time". It was, at which point the Bletchley people said, "How soon can we have ten of them?"

The Bletchley Park Museum has a working reproduction of Colossus built by several of the people who worked on the original, and also lots of information about the people who designed and built it.

Cedric Lynch
By email

I was disappointed that whilst mentioning Colossus, the article on the centenary of GCHQ in the May 2019 issue of *E&T* made no

mention of its designer, the late Tommy Flowers. Mr Flowers was in all respects equal to Alan Turing in his personal contribution to shortening World War II. He sadly never received any real national recognition for his work (possibly due to security considerations) except a belated MBE. Perhaps an article in the future may act as recompense?

Joe Hulse MIET
Isle of Wight.

PLASTICS - DON'T BUY THEM

The photo used in 'Plastics with Potential' (April 2019) says everything. The state of the world's oceans and the environment generally could be massively improved by one simple measure; by banning the sale of water in plastic bottles. This hugely lucrative (and wholly artificial) product is literally strangling the life out of the planet.

Why such a product should even exist in the wealthy West where we take the quality of our tapwater for granted beggars belief. Thirty years ago, I would have found it impossible to understand how such a 'product'

could exist, and I would suggest that it could easily be made to disappear tomorrow if the will existed.

Don't buy it. By doing so, you are killing our planet more surely than spearing a turtle. No technology needed.

Matthew Taylor IEng FIET
By email

IDENTIFYING WASTE

It seems to me, with so many different plastics going for recycling, that the personnel dealing with this at the first stage must have great difficulty in identifying and sorting. To make this process easier and more definite, all containers should have a code mark, perhaps moulded, identifying the material.

Clearly this would need to be established by the industry as a whole, but would be a step in the right direction and make the sorters' job easier. For films the coding could be repeat-printed and again could help. It would help me greatly if I had to identify the many, many types of plastic and the thousands of different container bottles.

Harry Rosenbaum
Matlock, Derbyshire

HVDC CLARIFICATION

David Watson's Comment column in the April 2019 issue of *E&T* warning of potential failures in the UK electricity market and possibility of five-day power failures states that the Moray Firth to Spittal HVDC link has not been engineered to support black start as it does not include the latest voltage source converter (VSC) technology.

Having worked on the project I can confirm that the Caithness Moray HVDC link is indeed a VSC, and that one of the reasons behind selecting the technology was the black-start capability that it brings.

While undertaking final stage 2 commissioning in late 2018 we successfully tested the link's black-start capability by energising a clean bar at Spittal AC substation with the Spittal HVDC converter in inverter mode. The Blackhillock end of the link in Moray is electrically close to Peterhead power station in Aberdeenshire. I hope this clarifies.

Richard Hanson
Head of HVDC engineering and operations, Scottish & Southern Electricity Networks, Inverness

Quote Of The Month

'What we need, and what we're calling for, is a very clear change in the law to make parties and campaigners say on the face of their advert, who they are, who's paid for that advert and who is promoted.'

Louise Edwards director of regulation, the Electoral Commission