SUBMISSION FROM DEREK G BIRKETT

Security of Scotland's Energy Supply

Personal Introduction

The author has had a lifetime of working experience in the electricity supply industry, retiring at the millenium after twenty years as a grid control engineer under both state and privatised operation. Previous experience on shift were on coal and hydro plant for a decade, with the CEGB and NofSHEB. A further decade was spent on project installation and commissioning at five power station locations across the UK of which two were coal and three nuclear including Dounreay PFR. The latter experience gave chartered status on a basis of an engineering degree from Leeds University.

Upon retirement, commitment was given as a technical witness for two public inquiries opposing wind farm applications as well as being an independent witness at the strategic session of the Beauly/Denny public inquiry. In 2010 a book was published entitled 'When will the Lights go out?' leading to public presentations, three of which were held in London.

http://www.scotland.gov.uk/Resource/Doc/917/0088330.pdf (page 72)

Basic Principles

As a commodity electricity cannot be stored to any degree and must therefore be produced on demand. As an essential service to modern society its provision is highly dependent upon a narrow field of specialised technical expertise. The unified GB Grid is a dynamic entity, inherently unstable. Transmission interconnection of various supply sources provide security and enable significant capital and operational savings. However bulk transmission of power brings power losses, mitigated by siting generation in proximity to consumer demand. Maintaining system balance on a continual basis is critical for system security, not just with active power but also reactive power that enables voltage (pressure) levels to be maintained. This latter concept has little public understanding in common with many other aspects of electricity supply. A comprehensive analysis of these problems has been issued by National Grid

http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/System-Operability-Framework/ (select System Operability Framework - SOF 2014)

Conventional sources of generation now reaching the end of their working lives have significant mechanical inertia and provide rapid and flexible sources of this reactive power that sustains power flows and short circuit fault levels thereby strengthening the grid system against potential faults. Significantly wind and solar do not provide this support as also does microgeneration within the distribution network and interconnection links to adjacent grid systems. These supply sources connect through power electronics. This field of expertise is highly complex and one of many areas of

innovation having to be introduced in order to accommodate renewable power sources. The scale of this innovation is of concern. We are not alone as US circumstance indicates.

http://instituteforenergyresearch.org/greatest-threat-power-grid-govt/

System requirements

The realisation that Longannet power station may cease generating in the coming year brings together a number of technical issues that expose vulnerabilities hitherto not realised or understood by the political establishment. Since privatisation new generating capacity installed in the UK has essentially been short term with technologies of combined cycle gas turbines (CCGT) and latterly wind resource having operational lives of twenty-five and twenty years respectively (Sizewell nuclear power station being the single exception whose inception pre-dated 1990). In the case of renewable wind technology, studies have indicated an economic life of between twelve and fifteen years whose retiral from service will increasingly merge with gas turbines, now reaching the end of their operational life.

http://www.ref.org.uk/publications/280-analysis-of-wind-farm-performance-in-uk-and-denmark

Existing technologies of nuclear, oil and coal are also reaching the end of their operational lives having been built through the late sixties and seventies of the last century. Such elderly plant is of increasing unreliability. Replacement capacity no longer has a manufacturing base in the UK and burgeoning international demand for generation plant suggests project delays where site power station project expertise in the UK is limited. With investment uncertainty there has been no declared intent for fossil-fired replacement where a gestation period of five years can be expected. With nuclear resource this gestation period is much longer and so far little progress beyond site clearance at Hinkley Point has been made. It was 2008 when intent for a nuclear programme was announced.

Generation Mix

Electricity cannot be stored on any scale so the importance of a viable generation mix is critical as all technologies have distinct operational characteristics that complement one another. Distortion of a viable generation mix is rapidly in prospect. Loading response capabilty, start-up times, fuel availabilty and demand requirements all combine to impede an instantaneous supply requirement that has to absorb rapidly increasing intermittent renewable resource. In the case of wind this accommodation can be extreme and comes at excessive cost as explained in detail by Prof Hughes.

http://thegwpf.org/images/stories/gwpf-reports/hughes-windpower.pdf

UK Electricity Supply has in recent years compromised the requirement for economic and secure energy supplies in their haste to replace fossil-fired generation capacity from renewable sources. The immediate casualty has

been inflated cost to the consumer on a scale that is unsustainable. A recent paper from the Centre for Policy Studies expounds the serious predicament the nation now faces, preceded by a useful summary.

http://euanmearns.com/renewable-energy-the-most-expensive-policy-disaster-in-modern-british-history/

Future Policy Direction

For both technical and economic reasons present policy cannot continue. Renewable intent has to be drastically constrained. The situation arising when grid instability becomes manifest would have no immediate panacea as choice of withdrawal with current low generating capacity margins would be severely constrained. Re-introduction of coal-fired capacity allied with CCGT investment is needed to secure energy supplies for the future. Reliance upon a single option is short sighted as emphasisd by the necessity for maintaining an appropriate generation mix. Recent CfD awards have favoured bids from coal generators. Refurbishment of existing coal plant provides a short term option but longer term new supercritical build is needed.that should not be stymied by any requirement for carbon capture and storage (CCS). Crucially coal enables fuel storage at site in excess of a year, unlike gas supplies where with any constraint, power generation would have to compete with limited industrial use and predominant domestic supply. Safety concerns would deny short term domestic disconnection. Another consideration with the use of gas for electricity generation has, upon conversion, half its heat value dissipated.

On the international scene coal capacity has been rapidly expanding with China being the main prime mover. There pollution concerns are restraining future growth but intent elsewhere is growing, particularly with less developed nations anxious to raise living standards where inadequate transport infrastructure encourages widespread coalfield resources to be exploited by power generation. The scale of this planned expansion would dominate other sources for world electrical supplies.

http://asia.nikkei.c om/Politics-Economy/Policy-Politics/Modi-looks-to-double-coal-production-by-2020

https://foreignpolicy.com/2015/04/08/japan-bets-on-nuclear-and-coal-for-future-power/
http://www.thenational.ae/business/energy/southern-africa-looks-to-prosper-from-rich-coal-resource

http://pakobserver.net/detailnews.asp?id=248196
http://www.icis.com/resources/news/2015/04/13/9875162/coal-to-dominate-polish-power-supply-to-end-of-decade-despite-eu-goals/

For developed nations advances with nuclear technology have promise but have yet to be available on a commecial scale. Even so both Japan and Germany are facing strong domestic resistance towards nuclear exploitation whose consequences defy any rational explanation for maintaining the status

quo. The German predicament undermines the whole concept of relying upon widespread interconnection between EU member states, quite apart from the massive cost involved.

http://af.reuters.com/article/energyOilNews/idAFF9N0WF01U20150413

The Scottish Situation

Inevitably international realities reflect on national policies. Scotland is part of a unified Grid that covers the GB mainland. EU policy not only drives renewable exploitation but whose intent promotes significant interconnection between member states. Both policies come at huge cost for the consumer whilst providing a commercial opportunity for utilities. Under current arrangements, funding is not borne by the taxpayer but by the consumer where subsidy for investors is based upon energy delivered. Scotland now has in prospect more wind capacity than the rest of the UK yet with only a tenth of the population. However UK consumers also have to pay for transmission infrastructure subsumed through bulk tariffs that are passed on to the distribution utilities.

Investment uncertainty for conventional plant indicates no power station construction is in prospect for Scotland, despite expected de-commissioning of nuclear and coal capacity over the coming decade. Reliance will then have to be placed on imported supplies. In broad terms long term output from onshore wind is for two-thirds of the time less than 30% of capacity. For a third of the time it is less than 10% of capacity. Given the scale of consumer demand this not a healthy situation. Neither is a circumstance where wind alone becomes the dominant supply source then becoming vulnerable to system faults.

Communication

Comment has already been made on the significant divide when confronting technical issues. A well written blog from the US may help understanding with two further items at the end of the article.

http://judithcurry.com/2014/12/11/all-megawatts-are-not-equal/

Derek G Birkett 30th April 2015