SONE
Supporters of Nuclear Energy

Nuclear - The green route to secure and reliable power

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Ian Marlee
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Our Ref: ho/Discovery project pauls.doc
Your Ref: 12209

16th November 2009

Dear Mr. Marlee,

Discovery Project

I am enclosing two submissions in response to the OFGEM study of future energy security – the Discovery Project 122/09.

They have been written by two of our senior experts, Paul H. Spare and Geoffrey Greenhalgh, on the SONE Committee and are sent for your attention with the full authority of the SONE Committee.

I trust you will find them of interest and helpful in your considerations of future policy.

Kind regards,

Yours sincerely,

ALEXANDER R. CENTER
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Our Ref :ho/Discovery project pauls.doc
Your Ref: 122/09

15 November 2009

Dear Sir,

Discovery Project

I am submitting this letter in response to the OFGEM study of future energy security - The Discovery Project (122/09). The document extends to more than 100 pages and I am therefore restricting my comments to only a few sections. I am retired from paid employment but provide technical advice to SONE (Supporters of Nuclear Energy, where I am Committee Member), under whose auspices this submission is made. I must also acknowledge the assistance of Derek Birkett (retired National Grid control engineer) for some comments on future electricity supplies.

My main criticisms are explained below, utilising the OFGEM report enumeration:-

Paragraph 1.8 - Optimising security, cost and environmental benefits

It is impossible to maximise two or more mathematical quantities simultaneously, if they are interdependent. It may be politically necessary to pretend otherwise, but it is scientifically dishonest to claim that security, cost and environmental benefits can all be optimised at the same time. Over the past six years at least, government thinking has been singularly subservient to environmental considerations (eg the renaming of Departments) hence our increasing dependence upon imported natural gas, with worsening fuel poverty.

Paragraph 1.12 Function of Profitability

The support to generators' incomes offered by the Renewables Obligation will affect and distort any discounted cash flow or payback analysis. Does the OFGEM report allow for the full effect of this subsidy? A change to the ROCs must surely be considered a serious threat or 'stress'. How would the scenarios be affected if a future government eliminated the ROC after disillusionment with renewables progress?

It is not clear what pumped storage capacity is intended. National Grid in their analysis had assumed no increase of capacity and yet SSE announced plans to build two new plants in the Great Glen of about 1GW total capacity.

Paragraph 1.1, bullet point 7

Renewables (or any other power systems with very low load factors) cannot improve our established 99.98% security of supply. If we wish to avoid large scale power cuts, low-load factor renewables will require gas-fired plant backup and hence will increase our import dependency.

Scenario Analysis p8 Scenario Analysis

The scenario analysis does not consider some of the greatest threats. Also it has no error bands and implies a spurious precision that is quite unjustifiable with the large uncertainties. Potential threats that could cause serious damage include terrorist attacks of the gas supply network/disputes between Russia and other states through which pipelines run/a Buncefield level incident at an LNG storage facility.

Paragraph 2.2 'Secure And Sustainable'

In a document from a Government Agency, words will be interpreted as having their normal recognised meaning in everyday English. If OFGEM employs the term *secure and sustainable* to mean secure, sustainable, affordable and environmentally benign, the words are not being used honestly and must be replaced by a term that reflects the meaning accurately.

Paragraph 2.19 Response Times

Energy supply is so capital intensive, with projects taking up to 10 years to complete, that to speak of response times is largely meaningless. There is no substitute for electricity, unlike many commercial commodities where suppliers can respond with an alternative supply. Clearly over the past 20 years there has been limited short term commercial thinking but this has failed to support essential long-term planning, necessitating enquiries such as the Discovery Project.

Chapter 2 Question 2 - Analysing Uncertainty

The statistics of electricity production and use have been collected for decades. It is a relatively simple matter therefore to calculate the mean values for quantities such as peak demand/minimum to maximum demand ratio over a decade or so and to predict future requirements from them. In other parts of the report OFGEM refer to the 1 in 20 winter, this is a sound principle. In statistical terms, that process can be regarded as allowing for a spread of two standard deviations to represent the 95% probability cases with a Gaussian distribution.

The analysis of certain fault cases needs to combine such data with the unpredictable output from renewable generators. With some of the proposed generation mixes, it is possible to envisage a reasonable probability of summer minimum demand (approx. 40% of winter peak) being met entirely by uncontrollable renewable generation (forecast of

33GW of installed wind turbines). Secure nuclear or gas-fired base load would have to have been shut down to permit this. Has the potential damage to the UK economy from the rapid decline of wind output (attributable to either high or low wind speeds), without the regulating presence of controllable plants, been considered?

Paragraph 2.29 Effect of Improved Efficiency

This paragraph makes a number of fallacious claims. Decades of campaigns have shown that improved efficiency may reduce micro consumption, but does not reduce, rather increases macro demand by reducing unit costs.

Widespread electrification of the heat sector is highly improbable as there will be formidable consumer resistance. A kWh of electricity is about four times the cost a kWh of heat provided by natural gas. What consumers will willingly accept this penalty? In addition however, it would be necessary for millions of home owners to purchase a new electrically-powered central heating boiler (about 20 kW) or install a set of independent electric heaters. There is a market for only small 12 kW electric wet CH boilers, and so a whole new industry would have to be started. A budget estimate would be £2000 for the boiler. Then there are more problems. Very few houses will have the size of wiring or main fuse rating to handle an extra 20 kW. Most houses would therefore have to be rewired and have higher rated incoming fuse protection installed by the local Regional Electricity Company. At least £1000 for these changes.

Where are your calculations of the extra TWh required for heating and electrification showing which fuels will be providing this energy? Are the logistics of the alternative fuels feasible - especially if these are low calorific materials such as firewood or wood pellets? How would the waste ash be sent for disposal - new recycling bin unlikely, given the chemical composition? What harm would be caused by carcinogens in the flue gases?

The conversion technologies for electricity in transport are quite inefficient. The fuel cell requires many steps in the electricity to road propulsion cycle. Compared with the resilient internal combustion engine that will last for years will little attention, fuel cells are delicate contrivances. What prospect is there for electric vehicles that have only one fifth the range of the IC engined car and take 12 hours to recharge?

Paragraph 2.51 Renewables Heat

If renewables heat is to be provided by renewable electricity generating equipment, additional backup plant will be needed beyond that stated above, but with greater control problems. If the renewable heat is to be provided via wood or pellets in place of gas there will be enormous consumer resistance because the quantities are so large.

It will require a fuel rate of about 2 tonnes per week to generate the 20kW heating load for a modest size house in the depth of winter. Is this seriously put forward as an option for modern estates or cities with a high density of terraced housing?

2.54 12% Renewable Heat

What quantity of energy is 12% renewables heat? What quantity of biomass or other firewood is required to generate this? Five million tonnes/ten million tonnes. What acreage of land would be taken out of food cultivation, when there is pressure to reduce food miles? How many vehicle journeys would be required to deliver such quantities of fuel?

3.37 % Use Of Capacity Factor /Too Optimistic

A figure of 15% is massively optimistic, given the published data for the output of wind turbines. Also, the use of Capacity Factor (unapproved terminology) does not reflect well on OFGEM quality procedures. The International Electro-Technical Commission specifies the term 'Load Factor'. Capacity factor is a colloquial term that has no standing but is very popular with wind turbine operators. The IEC defines Load Factor.......

Annual ratio (or as a percentage):-
watt-hours actually demanded or generated per annum
watt-hours demanded or generated per annum running continuously at full load.

Figure 3.9 De-rated Capacity Margin

This graph analysis gives a unjustifiably optimistic view of the future, because of the mistreatment of the wind power load factor. Also it has no error bands and thereby implies spurious precision.

3.40 Nuclear Output

Hinckley spelling.. the site in Dorset is Hinkley Pt B. Use 1 or 2 sigma like in gas analysis. The use of the 1 in 20 year case is effectively taking two standard deviations about the mean. The assumption with nuclear output reaching their extended dates may well be fanciful, bearing in mind their output will probably be reduced to extend their operational life.

3.44 Uncertain Capacity Margins

The text in this paragraph essentially restates my criticism of Figure 3.9. It states that many factors will vary considerably. In the light of this admission, how can Figure 3.9 be presented without any error bands or other statement about its general level of accuracy.

3.46 CCGT

What have you taken as the turn-down ratio for the typical CCGT? What allowance has been made for the shortening of life because of the unnecessary load cycling?

3.48/4.16 Wind Free Stress Test

There is a very high probability > 99% that the time of peak electricity demand WILL coincide with nil wind output. This has happened during a freezing anti-cyclone in January in recent winters. It is one of the most cogent reasons why the energy policy of the CEGB (based on sound engineering) saw no place for wind turbines in the UK. Another injurious, but less frequent event is the freezing blizzard such as occurred in the winter of 1947/48. This level of storm is a once or twice in a century event, and wind power would again be negligible as turbines were isolated to protect them in the presence of wind speeds of > 60 mph, whilst power demand would be close to a maximum with the low temperatures.

Yours faithfully,

Eur Ing P H Spare MSc CEng FEI FIMechE

Committee Member and

Energy Consultant Adviser to Supporters of Nuclear Energy

This response to Ofgem's Project Discovery is submitted together with that from my colleague, Paul Spare, an energy consultant, as one of two contributions from members of Supporters of Nuclear Energy. I have extensive experience of the energy and nuclear power industries and am co-editor of Nuclear Issues.

OVERVIEW

The problem overlaying the Discovery project is that Britain does not have a viable energy policy. It has only one reliable element – nuclear – which has been tried and tested in the UK over 60 years. The contribution from renewables and energy conservation are vastly over-rated. There is no guarantee that carbon capture and sequestration can be scaled up to permit the unrestricted use of coal and gas, still less at affordable cost, and there must be doubts about the safety of storage over the long term. There are also serious concerns about the nation's exposure, both in terms of security and affordability, from its increasing dependence on gas.

In short, Government policy remains as incredible as the legally binding targets set by Europe for reductions in carbon dioxide emissions.

The Discovery project is thus being built on the shakiest of foundations. Doubts over the assumptions on which the Discovery exercise is based raise questions about the practical value of the outcome.

My detailed comments follow.

Comments on Project Discovery

The purpose of Ofgem's Project Discovery is to examine the prospects for secure and sustainable energy supplies over the next 10-15 years, so as to ensure security of energy supply, while meeting environmental concerns at an acceptable cost to consumers. For the vital sector of electricity supply none of the four scenarios proposed - Green Transition, Green Stimulus, Dash for Energy, Slow Growth - are likely to meet all of these three requirements. Ofgem itself lists 8 possible risks or challenges that could affect the outcome; the possibility that all of these challenges will be resolved favourably is remote. There must then be a high probability of extensive power cuts within the next 20 years, and/or increasing emissions and higher prices. Ofgem itself goes some way towards recognising this as in this extract from para 3.67

- *each scenario comes with real risks, potential price rises and varying carbon impacts. Britain's ability to meet its demand for gas and electricity is therefore poised to be tested over the next decade or so. Growing exposure to a volatile global gas market and ageing power plant nearing the end of its life along with the need to tackle climate change are the central challenges the country faces.*

I seems that all we can hope for is that some of the key uncertainties, in particular the price and availability of gas supplies, will be resolved in our favour.

To some extent Ofgem eases the problem by assuming that significant advances in the efficiency of use will reduce future electricity demand by between 0.3% and 1.5% per year despite, as it points out, that future demand will be increased by an expected growth in electricity for transport and heat pumps estimated at up to 61.6 TWh in 2025. As we have previously argued increasing efficiency of use is more likely to lead to increasing demand. If the UK economy recovers from recession and continues to grow at about 2%/year (Ofgem's figure), and putting the corresponding growth in electricity demand at a modest 1.5% per year this would, by 2025, increase demand to between 440 - 500 TWh, an increase of between 25% and 30% on Ofgem's assumption, which would make the task of meeting future demand that much harder.

A review of the fuels available for electricity generation, and the extent of their usage in the four scenarios shows the extent of the problem.

Renewables

It is only under the two Green scenarios that the contribution from renewables will meet the EU requirement of 30% of electricity generation by 2020, which is accepted as a target by the Government. Under the other two scenarios the contribution from renewables is only 15%.

The main renewable source is wind which by 2025 is seen in the two sets of scenarios as meeting 25% and 12% of electricity supply (up to 95 TWh for the green scenarios and up to 50 TWh for the two energy scenarios). The main problems with wind are its intermittency and high cost.

Ofgem assumes load factors for wind plant of 32%. This is optimistic. Government statistics (Dukes 7.4) show load factors in 2008 of 27% for onshore and 30.4% for offshore wind. Ofgem also gives a capacity margin for wind of 15% - this is a derating factor to reflect the risk of forced outages and the expected low availability of intermittent renewables. But by 2016 to 2018 - the critical period when electricity blackouts can be expected to occur - the wind derating factor for all scenarios falls to between 3% and 10%. This must be a cause for concern.

This intermittency also requires back-up supply from coal or gas stations which being required to operate more flexibly to manage variability in wind output would impose extra costs (or loss of profit) on the plant operators, no doubt giving rise to claims for a Government subsidy.

There could also be problems with the cost of maintenance of wind turbines and their possible operating life time, which for offshore wind may be only around 20-25 years; wind farms now in being, or about to be built, may need to be replaced by 2025.

The capital cost of onshore wind is taken as £1200/kW and £2800/kW offshore, compared with £2000/kW for new nuclear plant. By 2025 the cumulative investment costs for all renewables is given as between £71 billion and £30 billion for the extremes of the 4 scenarios.

With the support given to wind under the ROC and Climate Change levy, which increases the cost of wind supply to the consumer to about 5 times the cost of nuclear electricity, any substantial contribution to electricity supply from wind generation is likely to breach the requirement of an acceptable cost to consumers. In addition as Ofgem itself points out "*Under some scenarios, the current environmental targets - including the EU renewables target and Government carbon budgets - are not met or are at risk of not being met.*"

Gas

Gas is used for both heating and electricity generation. For electricity the percentage of total supply in 2025 met by CCGT stations is put at from 19% and 28% for the Green Transition and Green Stimulus scenarios, (72-77 TWh) and from 53.5% to 57.4% (214-211 TWh) for Dash for Energy and Slow Growth.

As output from the North Sea continues to decline, from 58.3bcm in 2010 to an assumed 26.1bcm in 2020 there will be an increasing dependence on gas imports(for heating and electricity), which could rise to 90 bcm by 2020. Ofgem recognizes that there are potential supply shocks, particularly in maintaining gas supplies through a severe winter. It also adds that *Gas import dependency could* (surely will?) *be exacerbated by growth in gas-fired power generation to replace lost nuclear and coal-fired capacity.*

The major problems with this reliance on gas are cost and availability of supply. Ofgem does not appear to recognize the threat of peak oil. It assumes oil prices will only rise to about $90/barrel by 2025. Others take a different view. The Deutsche Bank in a recent report puts the expected cost of oil in 2016 as $175/barrel.The authoritative report on Global Oil Depletion by the UK Energy Research Centre estimates that the date of peak production lies between 2009 and 2031 with *" a significant risk of a peak before 2020".* Shortages will lead to rising prices, and there will be ever-increasing moves to substitute oil by gas, which will drag up the price of gas. It must also be the case that peak oil will inevitably be followed by peak gas. Some put the date of this at around 2020.

There are other uncertainties which could jeopardise an over-reliance on gas imports. These include problems with supplies from Russia; outages at the Bacton gas import terminal; loss of LPG supply to other markets prepared to pay higher prices, decline in Norwegian gas production; doubts about supply through the Nabucco pipeline, (which may never be built); and increasing competition from demand in Europe where the UK is at the end of the pipeline.

Coal

Surprisingly, from the point of view of reducing carbon emissions, coal still plays a significant part in Ofgem's scenarios in 2025, generating from 26 TWh (Green Stimulus) to 55 TWh (Dash for Energy). Even more surprising is the contribution expected from coal plants with carbon capture and storage. The probability of this technology ever being accepted is remote, yet by 2025 Ofgem believes that it will, in their Green scenarios, contribute over 50 TWh.

Nuclear

Given the potential problems with the other fuels it is surprising that Ofgem foresees a declining contribution to electricity supply from nuclear power. Under the two Green scenarios this falls from 67.3 TWh in 2010 to 57.8 TWh (7590 MW) by 2025 with even steeper falls under the Dash for Energy to 33.4 TWh, (4390 MW) and no more than 21.3 TWh (2790 MW) under Slow Growth. The assumption, that by 2025 only Sizewell B (1180MW) will still be in operation, implies that only between 1 and 4 new nuclear stations will be in operation by 2025. This seems an astonishingly lethargic approach to providing the secure, carbon-free source of electricity which will be urgently needed.

SUMMARY

SONE does not quarrel with the idea of attempting to assess the range of possibilities over future energy security. It sees considerable merit in getting a grip on the trio of objectives – security of supply at affordable cost while minimising carbon emissions – which should comprise any relevant, modern energy policy. But for that exercise to be useful it has to be based on a realistic current energy policy. This we do not have. It follows that any exercise based on a flawed policy is likely to produce even more flawed conclusions. SONE has serious and deeply held reservations about the Discovery project.

Geoffrey Greenhalgh

SONE Committee Member
Co Editor – "Nuclear News"