The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Nuclear Britain

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One of the most significant decisions facing the UK this year is what to do about the ageing fleet of nuclear power stations. The UK pioneered civilian nuclear power generation with a young Queen Elizabeth II opening the world's first public grid connected power station on 17th October 1956. Calder Hall's four 50MW reactors were finally shutdown in 2003 after generating 70TWh of electricity and more than two tonnes of weapons-grade plutonium over it's 47 years of operation.

Whilst this old power plant's electricity contribution was modest in the grand scheme of things it's recent closure is representative of the fate facing the rest of the fleet in the near future.

This photo is my local nuclear power station, Oldbury on the East bank of the Severn Estuary, 15 miles north of Bristol. Opened in 1968 it is scheduled to close during 2008 with the loss of 435MW from its two reactors.

Oldbury Nuclear Power Station

Click image to enlarge.

Lets have a brief look at where we are now and what the future might hold.

An important thing to remember about nuclear power plants is that they share a lot in common with fossil fuel plants. They generate electricity by using the heat given off by radioactive fission to raise steam which is then used in normal steam turbines.

Each of the two reactors at Oldbury for example generate 815MW of thermal output, of which only some 218MW emerges as electricity indicating a thermal efficiency of 27%. This is an important point to be aware of when looking at primary energy consumption comparisons. When nuclear is included in a table of primary energy with coal, gas and petroleum it is this thermal output which is listed not the electrical output. This can be confusing since when primary electricity sources (like wind and hydro) are listed in the same table their electrical output is listed. This has the effect of making these primary sources of electricity appear approximately three times smaller than they effectively are.

The British nuclear fleet is now split into two categories. There are the nuclear legacy sites which are now under the control of the Nuclear Decommissioning Agency (NDA) and the eight modern sites which remain under the control of British Energy. The NDA have responsibility for 20 civil nuclear sites including decommissioned research facilities, fuel plants, fusion research, storage sites and the Magnox fleet. 15 of those sites are managed by British Nuclear Group and Westinghouse under NDA contracts. These were until recently both British Nuclear Fuels (BNFL) group companies but the sale of Westinghouse to the Toshiba Corporation has recently been agreed to the surprise of many outsiders considering the current uncertainly surrounding the nuclear industry in the UK.

Magnox is short for Magnesium non-oxidising and refers to the alloy of magnesium and aluminium used as a cladding for unenriched uranium metal fuel. The design was initially created to produce weapons-grade plutonium but later larger reactors were exclusively used for civilian electricity generation. It is said that North Korea used the Magnox design developed from the declassified blueprints of Calder Hall to generate plutonium for their nuclear weapons programme.

The decommission schedules are set in motion now with the end of the Magnox era clearly in sight, due significantly to the fact that the fuel assembly corrodes in water, limiting storage and the required fuel reprocessing plant is also at end of life. The decommissioning project is extremely complex since no consideration was given to decommissioning during the design and build in the 50's and 60's. This was a phase of nuclear R&D resulting in many one-off designs and very poor records of site inventories, how the site was used and in some cases a lack of design drawings! Such problems are not expected when the British Energy sites are decommissioned. A wealth of information is available at the above linked websites.

	Build Date	Capacity MW	Published Lifetime	Decommission Age
Hunterston A	1964	360	1989	25
Berkeley	1962	276	1989	27
Trawsfynydd	1965	390	1991	26
Hinkley Point A	1965	470	2000	35
Bradwell	1962	242	2002	40
Calder Hall	1956	194	2003	47
Chapelcross	1959	196	2005	46
Sizewell A	1966	420	2006	40
Dungeness A	1965	450	2006	41
Oldbury	1967	434	2008	41
Wylfa	1971	980	2010	39

Magnox Power Stations

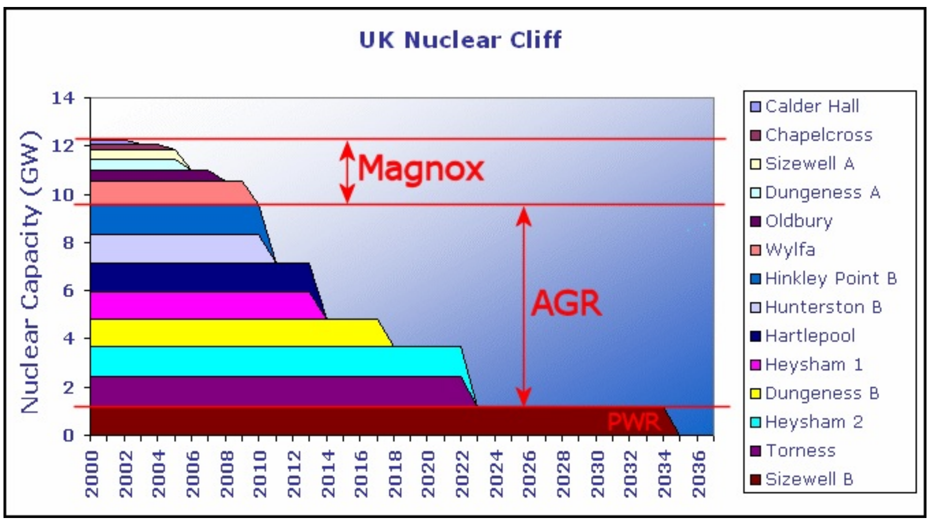
Less certain however is the future of the more modern British Energy sites comprising of seven advanced gas-cooled reactor (AGR) power stations and one pressurised water reactor (PWR). British Energy was privatised in 1996 with what was then seen as the commercially viable British nuclear interests. The private venture didn’t turn out to be particularly viable though with the government forced to invest £3bn in 2004, assume liabilities worth between £150m and £200m p.a. over the next ten years and reclassify the company as a public body. The 1996 privatisation had netted just £2.1 billion.

Whilst the current AGR sites do have decommission dates in the near future they are under review. Dungeness B was recently granted a 10 year extension from 2008 to 2018 and a similar extension is being considered at Hunterston B.

	Build Date	Capacity MW	Published Lifetime Decommission	Age
Hinkley Point B	1976	1220	2011	35
Hunterston B	1976	1190	2011	35
Hartlepool	1983	1210	2014	31
Heysham 1	1983	1150	2014	31
Dungeness B	1983	1110	2018	35
Heysham 2	1988	1250	2023	35
Torness	1988	1250	2023	35
Sizewell B	1995	1188	2035	40

British Energy AGR and PWR Power Stations

This graph illustrates the generating capacity lost as the power stations are decommissioned.



Click to enlarge. (Source: DTI, Nuclear power generation development and the UK industry)

In 2004 the 11.9GW of nuclear capacity generated 80TWh, consumed 6.3TWh resulting in a supply of 74TWh (21%) of the 343TWh total supplied electricity. This represents a 77% plant availability compared with 67% for coal, 72% for gas and 62% across total plant capacity. (DUKES 5.6 & 5.7)

We clearly have an energy gap today as aging nuclear and coal plant are decommissioned, North Sea gas depletes and renewables seem unlikely to fill the gap so the legitimate question is what part does the British nuclear industry play in filling this gap?

The options are:

- Decommission everything as scheduled and build no more (a 7GW capacity reduction within 8 years rising to 10.7GW by 2023)
- Decommission everything as scheduled and build replacement (requiring 10.7GW of new capacity by 2023 including a challenging 7GW within 8 years)
- Apply significant extensions to the AGR infrastructure and build no more (2.3GW capacity

reduction within 4 year years but most of the remaining 9.5GW available beyond 2020.
- Apply significant extensions to the AGR infrastructure and build replacement for decommissioned Magnox (requiring 2.3GW within 4 years but not much more before 2020)

There are many considerations including cost, safety, waste management, uranium reserves, UK energy gap, geo-politics, CO_2, grid architecture, local skill set, security etc... and for some reason or other the nuclear debate unfortunately tends to attract extremely polarized points of view making constructive discussion difficult.

The government is re-evaluating whether to build new nuclear plant with a decision (in principal at least) expected this year. I'd like to end with this question taken from the government's current Energy Review consultation. It asks:

> The (2003) Energy White Paper left open the option of nuclear new build. Are there particular considerations that should apply to nuclear, as the government re-examines the issues bearing on new build, including long-term liabilities and waste management? If so, what are these, and how should the government address them?