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The Risks of Nuclear Power

Dear Mr Baron,

A Nuclear Position Paper and evidence reports have been published recently by the Sustainable Development Commission. (See http://www.sd-commission.org.uk/pages/060306.html). However, the case against nuclear power is far stronger than set out in the evidence reports. They omit several key references available in the open literature and some topics completely. Jonathon Porritt used the term 'risk analysis', but this requires evidence – wherever possible quantitative data obtained by appropriate methods. Three relevant criteria are the Safety Risk, the Performance Risk and the Financial Risk. Would you therefore kindly ask the appropriate Government departments for quantitative evidence of:
a) the consequences of a major radioactive release from a nuclear power plant in the UK,
b) the lifetime of the uranium resource (to the point of energy futility) with present nuclear cycles,
c) the cost of nuclear power including full insurance of all operating risks and full provision for decommissioning and waste storage.

Here are some notes relevant to each topic:

Safety Risk. This is addressed first because if nuclear power is not safe, then it merits no further consideration, regardless of any other advantages. The SDC evidence report 6) fails to mention any quantitative 'Reactor Safety Studies' for the UK or elsewhere. Yet there are at least three. These include the Rasmussen Report (WASH-1400) of 1973 for a PWR in the USA. Another is 'The Swedish Reactor Safety Study', of 1978. (See 'Swedish Reactor Safety Study: Barseback Risk Assessment', Industridepartmentet, Energikommissionen, Ds I 1978:1). Yet another is that from the GRS in 1989 for a PWR of 1375 MW in Germany. The methodology adopted for all three is that Risk = Probability x Consequences, where the Probability is estimated by 'Probabilistic Risk Assessment'. This last depends upon trying to foresee all possible chains of events through a tree-structure representing the nuclear power plant.
However, huge numbers of nuclear accidents have already occurred due to events that were not foreseen. (See http://www.prop1.org/2000/accident/facts1.htm and http://www.disinfo.com/archive/pages/article/id2165/pg1/index). Therefore the Probability is always an underestimate, and by an amount that is not just unknown, but logically unknowable. Hence the risk can only be assessed in terms of the Consequences of the various radioactive releases. According to the Swedish Reactor Safety Study, these range up to 100,000 prompt fatalities and a contaminated area of 10,000 to 100,000 km2. The area of the UK is 244,000 km2 and the area of Belarus contaminated by Chernobyl was 144,000 km2. (See http://www.sdc.by/index.php?navID=22323&langID=1). Just as Chernobyl in the Ukraine contaminated a huge part of Belarus, so a UK release could contaminate a huge part of e.g. Denmark. Yet they do not use nuclear power, so need not accept reciprocal risks.

Performance Risk. This is concerned with any CO2 reduction due to nuclear power plants. Performance short-falls can arise due to construction delays and – after start-up - design or quality faults leading to low capacity. Moreover, although nuclear 'accidents' and terrorism are mentioned in evidence report 6), evidence report 2) makes no mention of performance short-falls due to these - not just in the UK, but anywhere in the world - leading to demands for immediate shut-downs. This could occur at any stage – before or after construction start, start-up, or energy payback.

The evidence report 8) expresses the uranium reserves in terms of market economics. Yet this cannot apply without limit when the resources are finite. However, they have been quantified elsewhere using energy analysis. (See http://www.stormsmith.nl). As for all depletable fuels, there is a point at which the energy inputs necessary for mining and refining ever-leaner ores, as well as enrichment and fuel fabrication, operation and decommissioning, cleanup and waste storage, exceed the lifetime energy output. This may be called 'the point of futility'. The analysis uses data published by the uranium mining and nuclear industries, together with established chemical engineering. As the uranium ore grade fell to about 0.01%, all nuclear plants would incur fossil fuel costs and CO_2 emissions approaching using the fossil fuels directly - and then have to be replaced. The result – for uranium use at present rates – is about 50 years. Moreover, if uranium mining is to be not just energy-profitable but also money-profitable, the limit would be reached even sooner. Hence even if all the above performance short-falls were avoided, any 'new nuclear' in the UK would last less than 50 years from now (i.e. less than 40 years from the earliest possible start-up) due to effective exhaustion of the uranium resource. This is well understood within the nuclear industry, and occasionally even voiced. (See http://www10.antenna.nl/wise/389/3791.html). Moreover, because electricity is less than 20% of final energy and nuclear is only about 20% of electricity, nuclear electricity accounts for only about 4% of final energy. Hence any new nuclear plants could make at best only minor carbon reductions by 2020 or 2050. Since the more new nuclear plants were built, the shorter would be the lifetime of the uranium resource, the only rational energy policies are non-nuclear, as chosen by most countries in the world, or nuclear phase-out, as already chosen by Belgium, Germany, Italy, Spain and Sweden. (See http://en.wikipedia.org/wiki/Nuclear_power).

Financial Risk. This is that the cost of nuclear electricity is greater than claimed. As well as incurring external costs, nuclear power receives at least four distinct financial subsidies.
a) R & D funding. This has amounted to $ 1 trillion in Europe alone to date.
(See http://re-access.com/rea/news/story;jsessionid=aWiyO3cA2JI6?id=19012). Moreover, it continues to be allocated mostly to nuclear (See http://eu.greenpeace.org/downloads/energy/EUsubsidiesReport.pdf p3) – including under the EU Framework 7 programme. (See http://www.essfnetwork.org/documents/ FP7 critique final final 16.03.05.doc). Since other energy technology options bring much better returns, this represents a very large opportunity cost.
b) Euratom funding. (See http://eu.greenpeace.org/downloads/energy/EUsubsidiesReport.pdf p3 and p18). This means that – regardless of the risks - capital is made available and at below-market rates only for nuclear projects. Not only is this a market distortion but the costs must show up somewhere. For some reason this EU fund is allowed to violate EU rules.
c) Insurance limits. (See http://eu.greenpeace.org/downloads/energy/EUsubsidiesReport.pdf p24). No nuclear plants can obtain insurance against all the risks of operation. This suggests that the insurance industry has already made its own risk assessment. Therefore they only operate under special provisions, limiting their liability to levels far below those from foreseeable 'accidents'. (See Safety Risk above). The best-known such provision is the Price-Anderson Act of 1957 in the USA, while that in the UK is the Nuclear Installations Act of 1965, including later amendments. (See http://www.dti.gov.uk/energy/nuclear/safety/liability.shtml). This amounts to an infinite subsidy. (See http://www.dti.gov.uk/expenditureplan/expenditure2001/annex_c/table_c2/c2_dti.htm 'unquantifiable').
d) Waste Storage. Since the half-lives range up to 4.5 billion years, nuclear wastes have to be stored essentially for ever. (See http://no-nukes.org/nukewatch/summer99/isotopes.html). This cannot be met by any type of 'sinking fund' because the operator can simply declare or even just threaten bankruptcy - as in the case of British Energy - and walk away from their liabilities. (See http://eu.greenpeace.org/downloads/energy/EUsubsidiesReport.pdf p9). Moreover, some of the costs of such waste storage are of energy, which – being indestructible – cannot be discounted. Hence the present value of any such costs over infinite time is infinity. This is a second infinite subsidy.

The evidence report 4) admits to having considered only the 'direct' cost elements. Yet the true cost of nuclear electricity cannot be quantified without taking account of the above subsidies (as well as other externalities). However, since two of the subsidies are infinite, the true cost of nuclear electricity is also infinite.

The evidence report 4) says that new nuclear might involve a fixed or minimum sale price for nuclear output over many years. Yet the costs of electricity from biomass and wind are competitive today and still falling. (See e.g. http://en.wikipedia.org/wiki/Wind_power). Such a price regime would thus deny the consumers the option of lower costs – even if the nuclear plant was shut down prematurely for any reason. Incidentally, the highly predictable variability of wind is as nothing compared with the unpredictable nature of nuclear. Almost all the UK generation capacity available at short notice – hydro and pumped-storage of 1320 MW – is committed to covering the loss of Sizewell B of 1250 MW. (See http://www.tyndall.ac.uk/research/ theme2/final_reports/it1_30.pdf p 62). While the operator might have to supply replacement electricity, they could buy it for less while still selling at the fixed price. This would represent a gross distortion of the market, be a burden to all consumers, and reduce the competitiveness of the UK.

Although the safety, effectiveness, and financial risks of nuclear power can all be quantified, no such assessments have yet been published for the UK. However, I have carried out a quantitative study 'Energy Solutions for 60% Carbon Reduction' using energy savings and renewables supply. This was submitted to Government for the 2002 Energy Review and has since been published together with all the working files at http://www.energypolicy.co.uk The model is embodied in simple spreadsheets, affording full transparency of both logic and data, that may be run on any PC. This shows that there are ranges of solutions – so providing flexibility - using current energy technologies (i.e. not nuclear or carbon sequestration). These include energy savings, energy efficiency through large-scale combined heat and power, and renewable energy supply from biomass and wind turbines. Moreover, Part II proposes a framework for ensuring the delivery of the UK carbon commitments through Energy Service Companies subject to absolute Carbon Emission Obligations.

If contacted by email, I will gladly send an electronic copy of this document, to facilitate the use of the embedded web links. I am also ready to answer any questions, either in writing or face-to-face.

Yours truly,

Gordon Taylor, B.Sc, M.Sc, M.I.Mech.E.