

# Nuclear power

– not worth the risk!

CND briefing

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# Nuclear power: not worth the risk

THE energy production choices we make now can really affect how much of a threat climate change will be to our world. For this and other reasons, the UK government is rightly concerned about how to meet our future energy needs. With the closure of most of our remaining nuclear reactors in the next decade, the British public is being subjected to a sustained campaign suggesting that new nuclear power stations are safer, economic, 'ready for deployment', and vitally necessary in order to combat carbon dioxide emissions which contribute to climate change. The Campaign for Nuclear Disarmament (CND) believes that these assertions are not justified and welcomes a debate on ensuring appropriate energy supply and demand. As part of a full and objective discussion on the issue, we are pleased to be able to contribute our perspective.

Below we submit and counter some of the assertions being put forward in the current debate:

## **'It produces no carbon dioxide, and can therefore help reduce global warming'**

Nuclear power is not carbon-free when the whole life cycle is taken into account. In comparison to renewables, where the source of the energy is free at the point of generation, the process of nuclear power production is dependent on imported uranium as its fuel. Ores have to be mined; the uranium is then extracted from the ores, and processed into fuel rods which are then transported to the power plants. Mining processes, transportation, and the building and decommissioning of nuclear power stations all use oil and thus carbon emissions are produced. It is estimated that Australia's largest uranium mine, Olympic Dam at Roxby Downs, contributes 8% of South Australia's CO<sub>2</sub> emissions<sup>1</sup>. During construction and operation a nuclear power station can produce typically 5% of the CO<sub>2</sub> emissions of a gas fired plant, but this disregards the carbon emissions from decommissioning the reactors and storing the radioactive waste<sup>2</sup>.

Uranium is a finite resource just like oil and gas. The supply of high-grade ore, currently being used by the nuclear industry, is limited. It is generally estimated that there are only 50-60 years left of these kind of ores at the current rate of use<sup>3</sup> <sup>4</sup>. Lower grade ores are available but also limited. Increasing the use of low-grade uranium ores would increase the energy costs of mining, milling and refining. The energy costs of conditioning and managing radioactive wastes, from uranium tailings (a by-product material from the processing of the ore) to spent fuel, will be imposed on future generations. Investment in a nuclear programme has limits on its ability to cut carbon emissions throughout the cycle:

- During the ten year construction period;
- Paying off the carbon debt during the early years of operation, and subsequently
- Within the next 60 years as poorer and poorer ores increase the carbon emissions of mining, milling and refining;

- Into the indefinite future where carbon emissions will be incurred by generations decommissioning nuclear reactors and conditioning, storing, monitoring and repackaging radioactive waste.

Significantly, the government's own independent watchdog on sustainable development has concluded that the contribution that nuclear power could make to CO2 reduction targets would be limited. Even doubling nuclear capacity would only result in an 8% cut in CO2 emissions from 1990 levels<sup>5</sup>.

### **'Nuclear power is a sustainable source of energy'**

Nuclear power is neither renewable nor sustainable. It can be sustained only as long as fossil fuels are available for its mining, milling and refining. It makes Britain dependent on foreign reactor technology and foreign imports of uranium. Moreover the uranium mining industry has been blamed for displacement of indigenous people, degradation and contamination of the environment surrounding the mine, and increased cancer rates in the mine-workers<sup>6</sup>.

Attempts to 'create more fuel than it uses' technology in fast breeder nuclear reactors have been abandoned as unworkable and uneconomic. Britain's Dounreay fast breeder reactor was abandoned in 1994 after a long series of breakdowns and accidents.

### **'It is economic compared with renewables such as wind'**

Not once since the first White Paper in 1955 has the nuclear option delivered the promises made that it would be a truly inexpensive source of power<sup>7</sup>. At current prices the estimated cost of electricity from the most recent nuclear power station, Sizewell B, is around 6p/kWh.<sup>8</sup>

The 2002 Energy Review examined the cost of nuclear power, both current and future, in great depth. It concluded that the figures put forward by the nuclear industry were extremely optimistic and they were rejected. The then Energy Minister, Stephen Timms MP, told a House of Commons Standing Committee looking into the Energy Bill on 25th May 2004 that, 'at present the economics [of nuclear power] are very unattractive.'<sup>9</sup>

The optimistic assumptions rejected by the government's Energy Review were that<sup>10</sup>, 'reactor technology developments could reduce the levelised costs of new nuclear stations to less than 2.5p/kWh assuming series build, lower discount rates, long station lifetimes (60years) and high load factors (90%)<sup>\*</sup>.

Nuclear power has continued to be promoted in the last few years on the basis of even more wildly optimistic projections. In March 2004 the Royal Academy of Engineering repeated, without independent analysis, the industry's estimates of 2.3p/kWh for the cost of electricity from new nuclear plant as against 5.4p/kWh for onshore wind. The nuclear industry then managed even more optimistic assumptions, involving building a prototype abroad, and then building twin Westinghouse AP1000 reactors (a new type of design) in Britain: 'Those changes basically moved us to our new figure, which is about 2.5 p/KWH for a first-of-a-kind in the U.K., and about 2 p/KWH for the fourth twin.'<sup>11</sup>

<sup>\*</sup>Actual electricity produced as a percentage of the theoretical maximum continuous production.

Most energy is used directly for heating, manufacturing and transport. An April 2005 paper by research group Oxera<sup>12</sup> acknowledged that the electricity sector only accounts for between a quarter and a third of the country's CO<sub>2</sub> emissions. Its thesis was that to contribute to an economy-wide carbon reduction strategy of 1.92% per annum the electricity sector has to do better than its present 0.88% annual reduction. Margaret Beckett MP, Secretary of State for Defra, subsequently said that while improving energy efficiency and moving to renewable energy sources was the government's preferred way to tackle environmental concerns, just half of the government's targets could be met using these methods.

In fact the Oxera paper states that the 'gap' could be met by greater energy efficiency than that already 'in the programme' or by carbon sequestration (artificially capturing and storing carbon) or by nuclear power. Instead of then exploring the huge scope and greater cost effectiveness of energy efficiency, it proceeded to compare the cost of supporting wind power with the notional cost of taxpayer support for a new nuclear programme, accepting without question the industry's assumptions of a 93% load factor and a 60 year life for the AP1000. The reality is that no Westinghouse reactor has achieved a 'lifetime' load factor of 90%, the average is less than 75% not counting construction delays, none have operated beyond the age of 36, and at least eight have shut for economic or safety reasons.

Financial institutions will not take the risk of investing in new nuclear power stations. In March 2005 UBS, a leading banking and financial services group, put it this way, 'endorsing new nuclear is, to an extent, a potentially courageous 60-year bet on fuel prices, discount rates and promised efficiency gains.'<sup>13</sup> UBS also comments that the recent revival of political support would be unlikely to survive any significant technical incident that resulted in renewed popular concern.

In an age of terrorism it is not just 'technical incidents', in other words nuclear accidents, which might have this effect. No reliance can be placed on investment programmes which could be abandoned as a result of events anywhere in the world over which the investor has no control.

Meanwhile wind energy prices are continuing to fall as the technology develops. Some wind farms are already generating at less than 2p/kWh. However, it is also possible to save seven times as much carbon through energy efficiency as you can by investing an equal amount in nuclear, with the advantage that money saved is liberated for use in further carbon reduction measures instead of locked up in radioactively contaminated liabilities.

### **'It can be built in time to make a difference to global warming'**

According to Trade and Industry Secretary, Alan Johnston MP, 'If we were to come to the conclusion that we weren't making any progress [without new nuclear], we have to make that decision in plenty of time [the stations] have a 10 year lead-in'<sup>14</sup>. The earliest realistic date for delivery of power from a new UK reactor is around 2020<sup>15</sup>. During those years of construction carbon dioxide emissions would increase. Far worse, the tens or possibly hundreds of billions of pounds of capital expenditure on nuclear stations would stifle government expenditure on energy efficiency, ensuring that profligate use of energy continues unabated.

Energy efficiency and renewable energy devices have shorter planning and construction cycles, so that an

earlier income stream can reduce the cost of the capital outlay. For instance onshore wind power plants can be up and running in less than a year. This, together with a more competitive suppliers' market, stimulates technical progress and lower costs.

### **'Nuclear Power stations can withstand terrorist attacks'**

One of the masterminds of the September 11th attacks reportedly told his US captors that the original plan called for ten airliners to be hijacked. They were to be crashed into targets including nuclear power stations. Thus the small possibility of a severe reactor accident has been replaced with the greater likelihood of an attempt to deliberately fly an aircraft into a nuclear site causing a 'dirty bomb' effect. The proponents of nuclear power have suggested that new nuclear power stations could be defended by increasing their strength, or by putting them underground, but such measures would add significantly to their cost.

We live on a small overcrowded island lying between two great continents with several thousand flights overhead each day. According to the Parliamentary Office of Science and Technology (POST) the feasibility of even intercepting such an attack appears to be low, based on the short time available between the reporting of a hijack and an airliner reaching a nuclear site, such as Sellafield<sup>16</sup>.

It is unclear whether our politicians have the stomach to install arrays of ground to air missiles and the willingness to order the shooting down of civilian airliners which appear to have gone off course in case of such an attack. As POST concludes, 'even an unsuccessful attack could have economic and social repercussions and affect public confidence in nuclear activities such as power generation.' A more appropriate response to the threat of terrorism is to remove the source of the vulnerability, and to do it as soon as possible.

It is not only nuclear plants that are at risk from potential terrorist attacks. Trains carrying spent nuclear fuel flasks could increase with new nuclear power plants if the fuel is not stored on site. Presently they travel across the country on the same lines as freight and passenger routes from the plants to Sellafield where the fuel is reprocessed. According to an independent review produced by nuclear expert John Large, analysing possible accidents and acts of terrorism on these routes, a successful attack could spread radioactivity over 100km and cause over 8,000 deaths. The review also concluded:

Even casual observations suggest that the physical security accompanying the spent fuel trains is minimal, the staffing is by regular railway personnel and there is no special security or police in attendance, and at the off-site railheads full flasks of spent fuel can be left standing in the open for several hours.<sup>17</sup>

Renewable sources of energy and energy efficiency devices present no danger of lethal radioactive discharges being emitted in the event of an accident or terrorist attack. Consequently there are also no extra costs related to securing them from this eventuality.

### **'Advanced reactors are safer than current reactors'**

Since human and technical errors can never be fully ruled out, although the probability of another catastrophic nuclear power plant accident such as Chernobyl may be very low, there is still always the smallest chance that such an accident will happen again. In the case of Chernobyl, human costs have been

very high. Radiation scientists are arguing that cancers caused by this accident may result in 30,000- 60,000 deaths, an even greater number of fatalities than the 4,000 already estimated in a report by the IAEA and World Health Organization<sup>18</sup>. Just in the UK, thousands of miles away, more than a thousand infant deaths may have been caused by the Chernobyl fall-out<sup>19</sup>.

Even less serious accidents can cause considerable financial costs. In April 2005 Thorp nuclear reprocessing plant at Sellafield was shut after the discovery of a leak of 20 tonnes of highly radioactive liquid from used nuclear fuel, which went unreported for nine months. The cost to the taxpayer of the Thorp leak is said to be more than £300 million<sup>20</sup>.

Nuclear reactors use the fission of uranium atoms to release heat, radioactivity and 'fast neutrons' that can be slowed down so that they hit more uranium atoms creating a chain reaction. Getting the heat away from the reactor while preventing the intense radioactivity from escaping is a huge challenge for engineers. To get sufficient coolant into the reactor (whether it is gas or water) it has to be pumped through at great pressure. If pressure is lost, the ability to shut down the reactor safely is vital. In the UK, the present safety philosophy demands diverse, segregated and 'redundant' (duplicated) ways of shutting down the reactors.

The third generation reactors currently being promoted are not to be confused with the 'inherently safe' reactors that were advocated after Chernobyl<sup>21</sup>. The idea of the 'inherently safe' reactor was that no matter what happened the reactor would contain the radioactivity within it and nothing would escape. Such 'passively safe' concepts would allow a case to be made for abandoning the present safety philosophy. Third generation reactors, a development of previous designs that contain some passive features, are not inherently safe, yet their proponents still want the licensing regime relaxed. We don't know if third generation reactors are safer because none have been built or operated anywhere in the world.

Third generation Westinghouse AP1000 reactors proposed by BNFL are untried and untested, omit safety features regarded as essential for Sizewell B, and introduce new 'passive' features such as a huge tank of water on the roof. These do not actually prevent accidents, but merely assist the conduction of heat from the containment of the reactor after an accident. The AP1000 violates the basic safety principles of Britain's nuclear regulators<sup>22</sup>.

These explain that a plant must be capable of tolerating a range of faults without unacceptable consequences, by inherent safety in the design concept, defence-in-depth (multi-layered emergent problem identification and resolution), and the provision of effective safety systems. The design should make the best use of diversity, redundancy and segregation in the structures, systems and components, which are important to safety. The AP1000 is based on the earlier 'AP600' a 'simplified' version of the Pressurised-Water Reactor (PWR) motivated by the need to cut costs. The 'simplification' involved stripping 60% of the valves, 75% of the pipes, and 80% of the control cables from a similar sized PWR.

The nuclear industry wants the licensing regime relaxed because their design is unlikely to get a license. Its novel safety features would be assessed 'strictly', and this requires a great deal of operational data to demonstrate their effectiveness. This data would need to be gathered on the components and the way in

which they interact, not just in normal operation, but in fault conditions. As neither the AP600 nor AP1000 have ever been built and operated there is no operational data available to inform the judgements of the Nuclear Installations Inspectorate on the reliability of the novel features upon which they depend.

The same approach applies to the European Pressurised-Water Reactor (EPR). Until operational experience is gained, from the two EPRs under construction, claims for greater safety are unsubstantiated. Industry lobbying has succeeded in the government asking the Health and Safety Executive to consider the scope for 'pre-licensing' as a means of speeding up the licensing process.

### **'New reactors produce much lower volumes of radioactive waste'**

All radioactive waste is potentially dangerous to human life – causing leukaemia and other cancers. It is usually categorised as low- intermediate or high-level waste. As the level increases, so do the dangers. High-level waste can kill anyone coming into contact with it – or just getting too close to it – often in a matter of days.

The nuclear industry argues that, 'The AP1000 produces much lower waste volumes than earlier reactors. Replacing all the current UK nuclear capacity with AP1000 reactors would only add 10% to the UK's nuclear waste inventory.'<sup>23</sup> This is highly misleading because it is the highly radioactive waste that represents the greatest hazard, and this kind of waste would increase almost fivefold, and be spread around the country at the different sites.

Because the advocates of new nuclear reactors recognise that reprocessing makes the whole operation even more uneconomic, they may well plan to store all the highly radioactive spent fuel on-site for their operating life. There is currently approximately 4,700 tonnes of spent fuel from the Advanced Gas-cooled Reactors (AGR) and Sizewell B, the equivalent of 8,250 cubic metres of packaged spent fuel.

If a planned programme of ten AP1000s goes ahead and they operate for 60 years, they will add approximately 31,900 cubic metres of packaged spent fuel to the UK's existing inventory of highly radioactive heat-emitting spent fuel.

### **'There are acceptable ways of getting rid of radioactive waste'**

We cannot 'get rid' of radioactive waste; some of it will remain radioactive for thousands of years. Dumping it means relinquishing control of it so that it may enter the biosphere in the future. Public acceptance of radioactive waste management facilities is more likely if the problem is seen as finite because no more radioactive waste is being created, but proposals to manage the nuclear waste legacy should not be described as 'solving' the problem. Moreover, the 'clean-up' programme for tackling the waste and decommissioning from the last 60 years of civil nuclear power is set to cost us more than £56 billion<sup>24</sup>. The government appointed Committee on Radioactive Waste Management stated in its draft report, 'If ministers accept our recommendations, the UK's nuclear waste problem is not solved. Having a strategy is a start. The real challenge follows.'<sup>25</sup>

### **'The development of nuclear energy can take place alongside other measures'**

A new generation of nuclear power stations can be built only with taxpayers' money, the private sector won't carry the risk. The government will not spend this money twice – it will either invest massively in nuclear

generation or invest massively in energy-saving and alternative power. As the Sustainable Development Commission puts it:

Nuclear would lock the UK into a centralised energy distribution system for the next 50 years when more flexible distribution options are becoming available... and undermine the drive for greater energy efficiency.<sup>26</sup>

In Finland, once the decision to build a fifth reactor had been taken, plans to phase-out coal production and electric heating were forgotten and targets for wind and biomass energy are being missed, resulting in an increase in carbon dioxide emissions. Governments have to demonstrate that they are supporting the most cost effective, as well as sustainable ways of achieving their policy objectives. Investment in reducing demand for electricity is not only more immediate in its effect, it is far more cost effective. Furthermore, money saved through demand reduction is available for reinvestment in energy efficient measures rather than contributing to greenhouse gas emissions or becoming 'locked up' in radioactive materials that will burden future generations.

### **'Large power stations are needed to 'keep the lights on''**

Aided by regulation and government targets for renewable energy and carbon reductions the energy system in a liberalised market is likely to reduce dependence on large power stations. Innovation is leading to smaller and smaller scales of electricity generation becoming more viable, and it is these that are likely to become the most relevant and resilient options over the next twenty years. It can be achieved using technology that is already available. By 2020 millions of homes and offices could have their own electricity generators, such as solar roofs, roof-top wind turbines and micro-CHP (Combined Heat and Power). Electricity supplies will come from renewables, some decentralised, some offshore. Input from nuclear and coal will have declined and gas will remain the most popular fuel for heat and electricity<sup>27</sup>.

### **Conclusion**

Climate change is a global emergency and the UK's choice of energy policy must be considered in this context. A UK choice in favour of new nuclear power stations as a 'quick-fix' will encourage other nations to choose this option too. Clearly the more nuclear facilities and radioactive materials there are about, the more there is a risk of accidents, nuclear weapons proliferation and threats of nuclear terrorism.

Nuclear power is being promoted on a flawed prospectus. It is hopelessly uneconomic and cannot be sustained without large public subsidies. Because nuclear power was developed out of military beginnings it has been cosseted, allowed to fail and repeatedly revived. The 2002 Energy Review concluded that concerns about the unsolved problem of long term nuclear waste disposal, and perceptions about the vulnerability of nuclear power plants to accidents and attack may limit or preclude its use<sup>28</sup>. The threat of terrorist attacks has increased the vulnerability not just of individual nuclear power plants, but nuclear reactor investment programmes. Climate change is too important a challenge to entrust to a nuclear power industry which has little to contribute. Renewables and energy efficiency are more robust, resilient and faster means to achieve government objectives of reducing greenhouse gas emissions.

The Sustainable Development Commission was correct to conclude that:

The UK could meet our CO2 reduction targets and energy needs without nuclear power, using a combination of demand reduction, renewables, and more efficient use of fossil fuels combined with carbon capture and storage technologies<sup>29</sup>.

A credible attempt to tackle climate change by the UK government will need to put the same attention into reducing emissions from the sectors of transport and industry, not just the electricity sector to which nuclear power belongs.

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*This briefing was also submitted to the government's April 2006 Energy Review Consultation.*

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- <sup>1</sup> Friends of the Earth Adelaide <http://www.adelaide.foe.org.au/cgi-bin/blosxom.cgi/issues/nukes/>
  - <sup>2</sup> Sustainable Development Commission, (March 2006), *The role of nuclear power in a low carbon economy*. Para 2.1.1. This concluded that although nuclear power can currently be considered a low carbon technology, a number of concerns remain over its long-term energy requirements from 'back-end' liabilities, and the potential impact of increasing the use of low-grade uranium ores.
  - <sup>3</sup> Dr Jim Green, (Sep 2005), *Nuclear Power no solution to climate change*, Friends of the Earth
  - <sup>4</sup> World Nuclear Association, Uranium Resources factsheet available at <http://www.world-nuclear.org/factsheets/uranium.htm>
  - <sup>5</sup> Sustainable Development Commission, *ibid*
  - <sup>6</sup> <http://www.wise-uranium.org/>
  - <sup>7</sup> Helm, D, (2003) *Energy, the State and the Market: British energy policy since 1979*. Oxford University Press
  - <sup>8</sup> PIU Energy Review Working Paper, (2001), *The Economics of Nuclear Power*; p3
  - <sup>9</sup> House of Commons Standing Committee B, Tuesday 25th May, Column 92 8  
<http://www.publications.parliament.uk/pa/cm200304/cmstand/b/st040525/am/40525s01.ht>
  - <sup>10</sup> DIT initial contribution to the PIU Energy Review, July 2001
  - <sup>11</sup> *Evolutionary reactors said best to meet budget, schedule demands*, British Nuclear Fuels plc's (BNFL) reactor design expert Richard Mayson quoted in *Nucleonics Week* /Volume 45/Number 19 / May 6, 2004
  - <sup>12</sup> Oxera, *Plugging the carbon productivity gap*, April 2005 paper
  - <sup>13</sup> UBS Investment Research Q Series – *The Future of Nuclear*, March 2005
  - <sup>14</sup> Alan Johnston MP, quoted in *Financial Times* article, *Nuclear power gains an edge*, May 13th 2005
  - <sup>15</sup> G. MacKerron, (September 2004), *Nuclear Power and the Characteristics of Ordinarity – the Case of UK Energy Policy*, NERA Economic Consulting.
  - <sup>16</sup> Parliamentary Office of Science and Technology (POST), (July 2004), *Assessing the risk of terrorist attacks on nuclear facilities*.
  - <sup>17</sup> Large & Associates, (27 March 2006), *Risks and Hazards arising in the Transportation of Irradiated Fuel and Nuclear Fuel Materials*, available at <http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/7487.pdf>
  - <sup>18</sup> *New Scientist*, 06 April 2006, 2546 p.11
  - <sup>19</sup> According to a study by John Urquhart presented at the 8th Irish & UK Local Authorities Standing Conference on Nuclear Hazards, *Chernobyl 20 Years On, Nuclear Costs & Energy Futures*, 23rd March 2006
  - <sup>20</sup> Paul Brown, *Sellafield radioactive leak to cost £300m*, *The Guardian* 13th June 2005 available at <http://www.guardian.co.uk/nuclear/article/0,,1505005,00.html>
  - <sup>21</sup> Jack Barkenbus, (February 1988), *Prospects for inherently safe reactors*, *Energy Policy*, page 49.
  - <sup>22</sup> *The Safety Assessment Principles for Nuclear Plants*, P68 (HSE/NII May 2000)
  - <sup>23</sup> BNFL Westinghouse AP1000 *Reactor technology today, for tomorrow* (leaflet circa May 2004)
  - <sup>24</sup> Nuclear Decommissioning Authority Strategy Report available at [http://www.nda.gov.uk/documents/nda\\_final\\_strategy\\_published\\_30\\_march\\_2006.pdf](http://www.nda.gov.uk/documents/nda_final_strategy_published_30_march_2006.pdf)
  - <sup>25</sup> Committee on Radioactive Waste Management, Draft report 5th January 2006: *Managing our Radioactive Waste Safely*, document no. 700.2
  - <sup>26</sup> *Sustainable Development Commission., ibid, Para 3.3*
  - <sup>27</sup> For a scenario for 2020 see Hewitt, C., *Power to the People: Delivering a 21st Century Energy System* IPPR. (2001)
  - <sup>28</sup> *The Energy Review – A Performance and Innovation Unit Report* – Feb 2002 Para 7.79 and Box 5.1