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Nuclear Unclear:
An investigation of British Nuclear Power Policy
1945-2005

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Table of Contents

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Post hoc ergo propter hoc.

Abstract

This thesis traces the development of policy and the regulatory framework for the commercial nuclear power industry in the United Kingdom between 1945 and 2005. It is argued that throughout the whole period politicians have legitimised their decisions in terms of a scientific discourse that represents the scientific community as unified and the decisions as thus self-evident. This is illustrated by looking at the key elements of legislation relating to nuclear power in four distinct periods: 1944-8, the introduction of nuclear power; 1973-8, the mortal wounding of nuclear power; 1992-5, the decline of public funding; and 2005-8, the rebirth of nuclear power.

In each of the periods identified the key policy developments and legislative initiatives were based on pragmatic considerations. A distinction is made between two types of pragmatic considerations – reactive and proactive. While these types overlap in practice, in some cases the decisions were predominantly *reactive* and taken in relation to emergencies and global forces, and in others the decisions were predominantly *proactive* attempts to ensure a suitably balanced and priced energy mix.

Chapter 1: Background and Introduction

> "The issue back on the agenda with a vengeance is energy policy… [W]e have established a review of the UK's progress against the medium and long-term Energy White Paper goals… with the aim of publishing a policy statement on energy [which] will include specifically the issue of whether we facilitate the development of a new generation of nuclear power stations."[1]

These words formed part of the then Prime Minister's speech at the Confederation of British Industries' Interactive Conference in November 2005. With them, Tony Blair was signalling the first stages of what was to become a major shift in UK policy regarding nuclear power. The *stated* rationale for this decision to reconsider nuclear power was based on two key factors. Firstly, a wider scientific argument ("Climate change is producing a sense of urgency"[2]) and, secondly, ideas of price and energy security forcing the issue:

> "Energy prices have risen. Energy supply is under threat."[3]

> "By around 2020, the UK is likely to have seen decommissioning of coal and nuclear plants that together generate over 30% of today's electricity supply. Some of this will be replaced by renewables but not all of it can."[4]

Both of these factors must be considered in turn, in order to as to ascertain the importance which should be attached to each. The wider scientific argument about climate change, which is championed by the Intergovernmental Panel on Climate Change (IPCC), focuses on the widely-held (but by no means universal[5]) belief that emissions of Carbon Dioxide (CO_2, termed a "greenhouse gas") from human behaviour are causing the global mean temperature to rise.

CO_2 is one of the products of the combustion of hydrocarbons and carbon-based sources (the other is water vapour, itself a greenhouse gas). Since the industrial revolution in the mid-nineteenth century, most commercial power generation has used hydrocarbons (i.e., oil, coal or gas) as a fuel source and, so the argument goes, finding types of power generation which do not use a hydrocarbon fuel source will reduce CO_2 emissions and thus mitigate the damage to the global climate. Using a nuclear reactor to generate power creates no emissions of CO_2 and therefore, from a climate change perspective, this makes the nuclear option an attractive one (or, in the words of eminent environmentalist, James Lovelock, there is "no other safe, practical and economic"[6] option). Many politicians across the globe have embraced this idea[7] and emphasise the

[1] Blair, T., 2005, Speech to the CBI Conference 29 November 2005, 10 Downing Street, London. Available at http://www.number-10.gov.uk/output/Page8606.asp, accessed on 22/03/10

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] For the counter-argument see, for example: Ramanathan, V. & Carmichael G., 2008, Global and regional climate changes due to black carbon, Nature Geoscience 1, 221-227 (which agues that the IPCC modelling takes no account of the "deposition of black carbon [which] darkens snow and ice surfaces, which can contribute to melting, in particular of Arctic sea ice."); Scafetta, N., & West, B., 2008, Is climate sensitive to solar variability? Physics Today, March 2008, 50-51 (which acknowledges that "The most debated issue in contemporary science is the cause or causes of global warming," whilst simultaneously casting doubt on the IPCC's focus and Lawson, N., 2008, An Appeal to Reason: A Cool look at global warming, London: Duckworth Overlook, which argues that even if the climate science is certain, the economics of climate change are not.

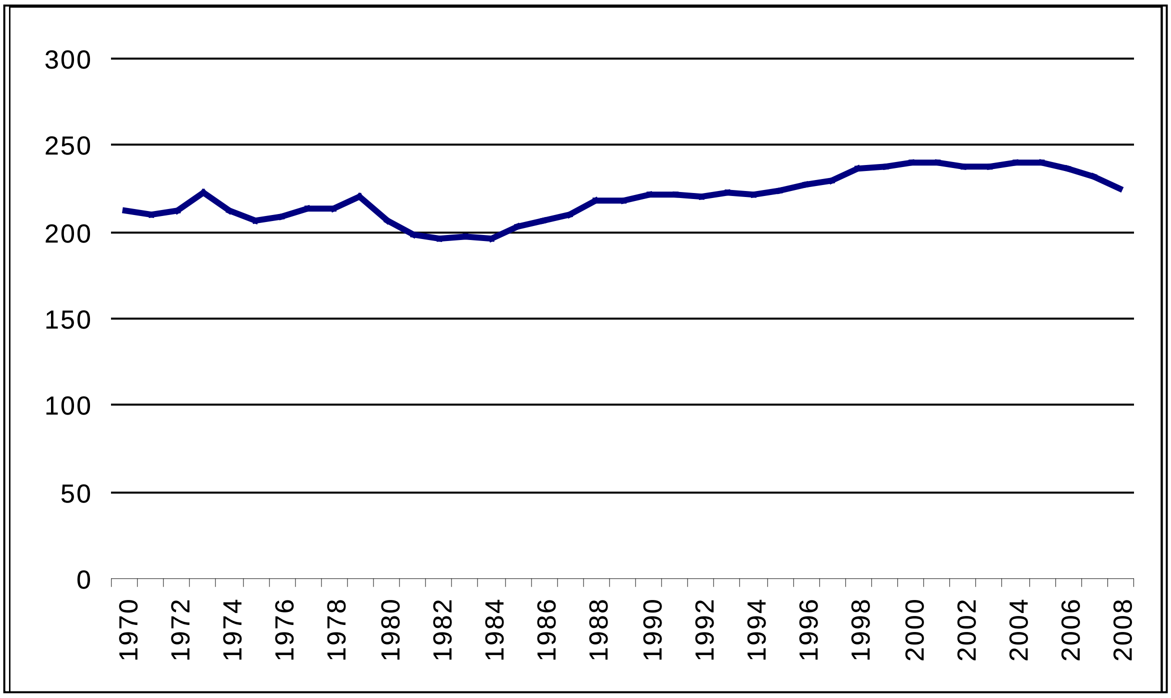
[6] Lovelock, J., 2004, Preface, in Comby, B., 2004, Environmentalists for Nuclear Energy, Paris: Editions TNR. This is not a new position for Lovelock who has previously stated that "I have never regarded nuclear radiation or nuclear power as anything other than a normal and inevitable part of the environment." Source: Lovelock, J., 1988, The Ages of Gaia, Oxford: Oxford University Press.

[7] For example, at the May 2009 meeting of thee G8 in Rome, "language used in reference to nuclear energy was more positive than previous G8 statements" Source: WNN, 2009, G8 energy ministers endorse nuclear power, World Nuclear News, available at http://www.world-nuclear-news.org/ENF_G8_energy_ministers_endorse_nuclear_power_2605095.html, accessed on 22/12/09.

zero-emission benefits of nuclear power.[8] There is equally, however, a tendency to ignore or deflate the importance of the scientific evidence that the process of mining the uranium required by many reactors produces huge quantities of CO_2[9] and further that the waste produced by nuclear reactors brings other, different environmental concerns.

The second factor to consider comes under the umbrella of energy security, although this is expressed both as security of supply and price of supply. As Figure 1.1 illustrates, the overall consumption of energy in the UK had risen from the early 1980s to a peak in 2005, when the announcement was made.

Figure 1.1: Primary Energy Consumption 1970-2008, MTE[10]



Coupled with this, imports of crude oil into the UK were higher in 2004 than they had been since the late 1970s, at a time when indigenous production of crude oil was lower than at any point since 1975. Figure 1.2 illustrates clearly that 2005 marked the year when oil exports fell below the level of oil imports and the UK became a net importer of oil. It is not just oil which would potentially need to be imported. In June 2004, Edinburgh-based energy consultants Wood Mackenzie estimated that, by 2015, UK gas production would have fallen to about half of the 2004 levels, while demand would have risen by twenty per cent, leaving the country in a position where "approximately 75 per cent of its gas requirements will need to be imported."[11]

Once a country becomes a net importer of any commodity, then it is to a greater or lesser extent dependent on the exporting country (or countries) in terms of the price and

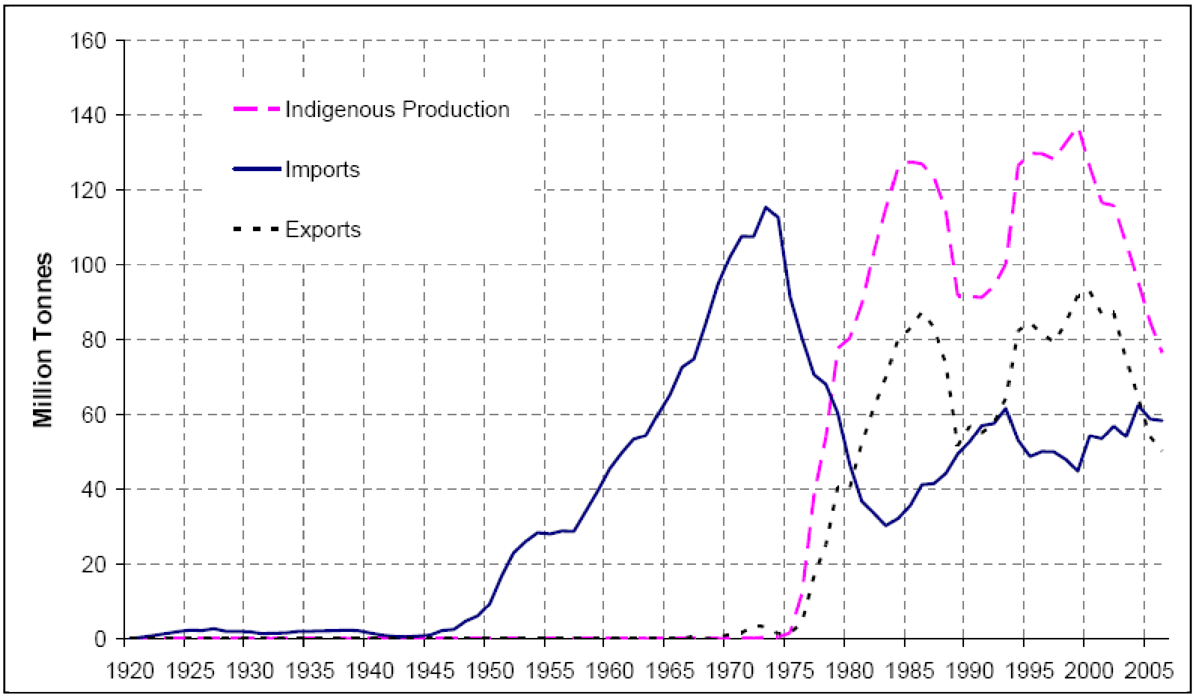
[8] G8 Energy Ministers agreed that "the use of nuclear power can diversify the energy mix, contribute to energy security while reducing greenhouse gas emissions." Source: G8, 2009, Joint Statement by the G8 Energy Ministers and the European Energy Commissioner, G8 2009, available at http://www.g8energy2009.it/pdf/G8+EC.pdf, accessed on 22/12/09, p3.
[9] The exact figures for CO_2 emissions for uranium mining are difficult to predict, but they range from 10 to 50 tons of CO_2 emitted for every ton of U^{238} produced. Source: Mudd, G M & Diesendorf, M, 2008, Sustainability of Uranium Mining: Towards Quantifying Resources and Eco-Efficiency, Environmental Science & Technology, 42 (7), pp 2624-2630.
[10] MTE = Millions of Tons of Oil Equivalent. Data supplied by the Department of Energy and Climate Change, Digest of UK Energy Statistics Table 1.1.4 (DUKES 1.1.4). Available at http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx, accessed on 22/12/09. The figures include electricity consumption by the manufacturing sector, which have fallen consistently since 1970, as the UK's manufacturing base shrinks.
[11] Wood Mackenzie, 2004, From Surplus to Shortage? The outlook for Britain's gas and power markets, Edinburgh: Wood Mackenzie Research and Consultancy.

volume of commodity that are traded. This is as true for oil and energy as it is for coffee and tea. Broadly speaking, there are two ways to reduce reliance on the imported commodity – increase domestic/indigenous supply, or reduce demand.

The Prime Minister's assertion that almost one third of the UK's existing energy supply could be lost by 2020 (and could not be met by "renewables") fed into this equation. Predicted indigenous energy supply was set to fall even further and this would lead to an "energy gap," which could currently best be filled by greater imports; thus creating greater reliance on exporting countries.

The combination of factors which presented themselves at the end of 2005, therefore, were that there was increasing pressure on developed nations to reduce their emissions of CO_2 and the UK was on course to become increasingly (and to some, worryingly) dependent on potentially unstable foreign governments for its energy supply.

Figure 1.2: UK crude oil imports, exports and production, 1920 – 2006[12]



Despite the scales of time and cost involved in their construction, and despite the problems associated both with the mining of uranium for fuel and the disposal of radioactive waste, a new generation of nuclear-power stations would likely be able to meet the criteria of helping to reduce CO_2 emissions and increasing indigenous energy supply (and, thus, energy security). The announcement in the speech of an investigation "specifically [into] the issue of whether we facilitate the development of a new generation of nuclear power stations"[13] was, therefore, the logical and practical response to the situation.

Having briefly explored the statements of intent, this thesis will focus on two themes as ways of best understanding the process of justification underlying what was, in effect, a reversal of previous policy. Firstly, the need for politicians to argue that they make decisions based on 'common sense' and what is practicable and, secondly, the ways in which politicians tend to make use of science and scientific data to 'trump' other arguments. These themes, which can be loosely allied to concepts like pragmatism and Technocratic Decision-Making ('TDM'), need to be further unpacked in turn.

In order to ascertain the possible meanings of the themes, the academic and theoretical interpretations will be considered along with the "every day" dictionary

[12] DBERR, 2007, Special feature – UK oil imports since 1920, London: Department for Business Enterprise and Regulatory Reform. Available at http://www.berr.gov.uk/files/file43846.pdf, accessed on 27/12/09.
[13] Blair, T., 2005, op cit, n1.

definition. Whilst it is acknowledged that this latter is not necessarily a standard approach in some social sciences, in law, the methods which have been employed by the court system in order to try and give meaning to sometimes obtuse legislative drafting mean that:

> "It clear… that the court is entitled to have regard dictionary definitions as an aid to construction to ascertain the natural and ordinary meaning of the words in their relevant context. It is also clear that words are to be interpreted in the way in which a reasonable commercial person would construe them; and the standard of the reasonable commercial person is hostile to technical interpretations, undue emphasis on niceties of language or literalism."[14]

What the Master of the Rolls is elucidating here is the well-established "golden rule" approach to judicial interpretation, which goes back to the mid-nineteenth century to cases such as Stephenson v Higginson (1952)[15] and Attorney General v Sillem and Others (1863).[16] Although its roots can be traced to much earlier cases,[17] the "golden rule" is usually held to have been first stated in Grey v Pearson (1857).[18] In that case, Wensleydale LJ states that "the grammatical and ordinary sense of the word is to be adhered to, unless that would lead to some absurdity, or some repugnance or inconsistency"[19] and thus, it is argued, in this discussion the "grammatical and ordinary" senses of the terms being explored cannot be overlooked.

The first of the themes to consider is pragmatism.

1.1: Pragmatism

Taking the Golden Rule as a start point, "Pragmatic" and "Pragmatism" are defined by the Oxford English Dictionary thus:

> "**pragmatic** /præg′mætɪk/ *adjective* dealing with matters from a practical point of view.
>
> **pragmatism** /'prægmətɪz(ə)m/ *noun* **1** pragmatic attitude or procedure. **2** *Philosophy* doctrine that evaluates assertions according to their practical consequences."[20]

The philosophical concept of pragmatism seems to have evolved in the nineteenth century and most (including himself) attribute the naming to the American philosopher, Charles Peirce, in an article *in Popular Science*.[21] Other philosophers (William James[22], John Dewey[23] and Ferdinand Schiller[24], for example) developed the concept of

[14] Heronslea (Mill Hill) Ltd v Kwik-Fit Properties Ltd [2009] EWHC 295 (QB) per Sir Anthony Clarke M.R. at para 19

[15] George Stephenson v Henry Theophilus Higginson (1852) III House of Lords Cases (Clark's) 638, 10 E.R. 252 per Truro LJ at 688

[16] Attorney General v Sillem and Others (1863) 2 Hurlstone and Coltman 431. Indeed, the case report explicitly uses Todd's Johnson's Dictionary, the French Dictionary de l'Academie, Burn's Naval and Military Technical Dictionary of the French Language, Falconer's Marine Dictionary (at 491-2) and Webster's American Dictionary (at 525).

[17] See, for example, Becke, Assignee of Wm. Ashton, an Insolvent Debtor v Smith (1836) 2 Meeson and Welsby 191, Elizabeth Warburton v James Loveland, Lessee of George Ivie, Henry Ivie, and Others (1832) VI Bligh, NS 1, and possibly the Irish case of Latouche v Lord Dunsany (1802) 1 Sch. & Lef. 160

[18] John Grey and Others v William Pearson and Others (1857) VI House of Lords Cases (Clark's) 61

[19] John Grey and Others v William Pearson and Others (1857) VI House of Lords Cases (Clark's) 61, per Wensleydale LJ at 106

[20] Elliott, J., ed., 2001, Oxford Dictionary, Oxford: Oxford University Press, p581

[21] Peirce, C.S., 1878, How to Make Our Ideas Clear, Popular Science Monthly, January 1878. Peirce claimed that the idea came to him while studying Kant.

[22] James, W., 1904, What is Pragmatism, in James, W., Writings 1902-1920, The Library of America. James argued that "There is absolutely nothing new in the pragmatic method. Socrates was an adept at it. Aristotle used it methodically. Locke, Berkeley, and Hume made momentous contributions to truth by its means."

[23] Dewey, J., & Boydston, J.A., 1976, The Collected Works of John Dewey, Carbondale, IL: Southern Illinois University Press

pragmatism further, spurring Peirce to rebrand his original idea as "pragmaticism" in order to differentiate it from these developments. Dewey's ideas of what pragmatism might mean built on the earlier work of both Peirce and James[25] and he believed that the most interesting and useful version of pragmatism could be termed 'instrumentalism' or 'experimentalism.'[26]

The fact that, within a short period of time, Peirce's idea had been broadened to such an extent that he felt the need to distance himself from what it had become, gives an indication of how widely the idea of pragmatism would be stretched by the end of the twentieth century. For that reason, the area on which this thesis will focus is that of political pragmatism.

Political Pragmatism

The idea of political pragmatism as a separate concept from the other variants of pragmatism is no more a new concept than pragmatism itself was in the late nineteenth century. Professor Thompson attributes its modern origins to "the work of early twentieth-century African Americans such as W. E. B. Du Bois and Carter G. Woodson",[27] but accepts that they would probably no more have described themselves as *political* pragmatists[28] than F.C.S. Schilling would have described himself as a *pragmatist*. She claims that political pragmatism "differs from classical pragmatism" and requires attention to be paid to "the consequences of ideas and action."[29] What Thompson appears to arguing is that political pragmatism, as she sees it, is taking the exercise in exploring the consequences of all possible actions, which Peirce suggested,[30] and putting a practical use to it. Roberto Diego takes on the idea of political pragmatism effectively demanding the most practical course of action, although he gives it rather negative connotations:

> "Political pragmatism … [is] the idea that the proper action is the one that is most likely to work. The idea of principled action based upon moral premises is anathema to political pragmatists who live in a precarious world where only '"what works' is the hallmark."[31]

What we are left with, therefore, is a basis for decision making in which the perceived success of a measure is possibly of greater importance than the details of the method itself – in other words, for political pragmatists it is "what works" that is the measure by which actions are primarily judged; as opposed to the underlying philosophy which led to the action.

Although many use "pragmatic" as a shorthand for registering their disapproval of decisions they feel are somehow not particularly far-sighted,[32] it is also possible, as Professor Jacobsohn suggests to use the term in a laudatory fashion, *viz*.:

> "The pragmatist… is likely to be seen as modest, unpretentious and tolerant – possessed, in other words of all the qualities considered virtuous in a liberal

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[24] Schiller, F.C.S., 1910, Riddles of the Sphinx: A study in the philosophy of humanism, London: Swan Sonnenschein & Co.
[25] Hickman, L.A., Alexander, T.M., eds., 1998, The essential Dewey, Vol. 2: Ethics, Logic, Psychology, Bloomington, IN: Indiana University Press, p ix
[26] Hlebowitsh, P.S.,2006, John Dewey and the Idea of Experimentalism, in Kidal, C., et al, eds, 2006, Acknowledging the Fiftieth Anniversary of John Dewey's Death, Education and Culture, Vol 22(1)
[27] Thompson, A., 1996, Political Pragmatism and Educational Inquiry, Philosophy of Education 1996
[28] Thompson, A., 1997, What to Do While Waiting for the Revolution: Political Pragmatism and Performance Pedagogy, Philosophy of Education 1997
[29] Thompson, A., 1996, op cit., n27
[30] Peirce, C.S., 1910, 'Additament,' comments on 'Neglected Argument for the Reality of God' CP 6.490
[31] Diego, R., 2004, Political Pragmatism vs. Practical Action, Available at http://www.robdiego.com/pragmatism.htm, accessed on 21/12/09.
[32] See, for example Sull, D., 2009, Pragmatisms Fatal Flaw, Financial Times, August 28.

society."[33]

This thesis will argue that political pragmatism can thus be aligned more closely with the first of the OED meanings, and thus to the idea of practicality ("a practical matter, a practical feature or aspect of an affair"[34]), and the following chapters will explore whether this fits the examples of nuclear-related decisions much more accurately.

The second area which will be explored in the following chapters is that concerning the use of science, scientific data and scientific rhetoric by politicians as a rationale for the decisions they make regarding nuclear power.

1.2: The Use of Science

> "Scientific data and techniques do enter into political decisions and governmental programmes, where they have a variety of effects."[35]

As will be shown in the main body of the thesis, the prime tool utilised by both decision makers and those who oppose them is 'science'. From the first public speech on atomic energy, when Clement Attlee claimed that "scientists agree… we cannot stop the march of discovery" to the Copenhagen Conference of the Parties to the Kyoto Protocol (COP 10) in December 2009, the use of scientific data has to a greater or lesser extent helped to define the debate surrounding nuclear energy. As with the pragmatism, therefore, a useful starting point would be to look at the definition given by the OED:

> "**science • n. 1** the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment. **2** a systematically organized body of knowledge on any subject. **3** *archaic* knowledge."[36]

> "**scientist • n.** a person who is studying or has expert knowledge of one or more of the natural or physical sciences"[37]

Science, therefore, has been seen at times as both the search for understanding and knowledge about a particular topic and the knowledge itself. In John Gribbin's *Science*,[38] he suggests (as do many others) that science, or more specifically "*Western* science,"[39] started to become a separate and identifiable discipline in the middle of the fourteenth century, with the work by Nicolaus Copernicus on astronomy and Andreas Versalius on anatomy.[40]

Yet whilst science claims to offer universal objective truths, scientific explanations have not always been accepted unquestioningly but, rather, viewed with mistrust by non-scientists. Thomas Kuhn,[41] for example, argues that science works within a set of assumptions which are taken for granted and that, rather than science progressing by a series of small steps, this paradigm remains intact until suddenly replaced by another paradigm in a "scientific revolution." Before the eighteenth-century Enlightenment period, the belief in and use of science as we understand it today was often the trigger for religious intervention, particularly in the Christian world. Clearly, the UK never felt the full force of the Inquisitions suffered elsewhere in Europe in the sixteenth and seventeenth centuries but, nonetheless, many people regarded (and still regard) science as somehow

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[33] Jacobsohn, G.J., 1977, The "Pragmatic Dogma" of the Political Thicket: The Jurisprudential Paradox of "One Man, One Vote" Polity, Vol. 9, No. 3 (Spring, 1977), pp. 279-301:279
[34] Elliott, J., ed., 2001, op cit, n20
[35] Ezragi, Y., 1980, Utopian and pragmatic rationalism: The political context of scientific advice, Minerva, 18 (1) March 1980, pp111-31:111
[36] Elliott, J., ed., 2001, op cit, n20
[37] Ibid.
[38] Gribbin, J., 2002, Science: A History 1543-2001, London: Penguin Press
[39] Gribbin, J., 2002, op cit, pxix (italics in original)
[40] The publication of De Humani Corporis Fabrica by Versalius and De Revolutionibus Orbium Celestium by Copernicus were both published in 1543. Source: Gribbin, J., 2002., op cit, pxvii
[41] Kuhn T.S., 1970, the structure of scientific revolutions, Chicago, IL: University of Chicago Press

incompatible with religious belief in general and Christianity in particular.[42] Dr John Habgood[43] who, on his appointment as Archbishop of York in 1983, was described as "perhaps the highest-ranking prelate anywhere with a professional background in science,"[44] had previously written of the "uneasy truce" which had developed in the conflict between science and religious belief, and suggested further that it might not be a permanent ceasefire.[45] The LSE's Professor Worrall takes Habgood's arguments further, arguing in 2004 that:

> "Science and religion are in irreconcilable conflict…. There is no way in which you can be *both* properly scientifically minded *and* a true religious believer."[46]

It should not be thought, however, that, since the Enlightenment, there has always been an unquestioning support for scientists or any other type of 'expert'. In 1877, the three-times Conservative Prime Minister, Lord Salisbury, said:

> "No lesson seems to be so deeply inculcated by the experience of life as that you never should trust experts…. They all require to have their strong wine diluted by a very large admixture of insipid common sense."[47]

This links back to the point made earlier regarding a constant, and consistent, desire of politicians: to reduce the often contested and usually complex data provided by 'science' to simple 'common sense' terms which can then be used to provide justification for a pragmatic decision. This may be for undisclosed political reasons, but is also due to the fact that science is often too abstract to be used for policy formation.

A considerable amount of scientific research, can be classed as "blue-sky" or fundamental research; that is, research which "essentially aims at improving our understanding of Nature"[48] and which is "typically curiosity-driven."[49] Fundamental research, however, is generally contrasted with applied or pragmatic research which is "designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake."[50] Richard Posner, the US Appeal Court Judge and "most cited legal scholar of all time"[51] who has written extensively on pragmatism:[52]

> "urges that political and legal decision makers should be guided by what he calls 'everyday pragmatism.'"[53]

In his treatise on pragmatism, Peirce identified that those who we regard as scientists

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[42] Professor John Draper, for example, argued in 1874 that "The antagonism we thus witness between Religion and Science is the continuation of a struggle that commenced when Christianity began to attain political power." Source: Draper, J., 1874, A History of the Conflict Between Religion and Science, New York: D Appleton & Co, piv

[43] Technically the Rt Rev and Rt Hon. the Lord Habgood PC. Dr Habgood gained his PhD in Physiology at the University of Cambridge in 1952 and was subsequently a lecturer in Pharmacology before taking the cloth in 1954.

[44] Boffey, P., 1983, Religion and Science: Archbishop of York: Prelate started his career as scientist, Gainesville Sun, Gainesville, Florida. 17 December, p1B.

[45] Habgood, J., 1963, The Uneasy Truce between Science and Theology, in Vidler, A.R., ed., Soundings: Essays concerning Christian understanding, Cambridge: Cambridge University Press, pp.23-41

[46] Worrall, J., 2004, Science Discredits Religion, in Peterson M., & Van Arragon, R., eds., 2004, Contemporary Debates in Philosophy of Religion, Oxford: Blackwell Publishing, p60

[47] Cecil, Lady G., 1921, Life of Robert, Marquis of Salisbury, London: Hodder & Stoughton, p54.

[48] Petit, J-C., 2004, Why do we need fundamental research? European Review (2004), 12:2:191-207

[49] UL, 2008, Fundamental Research, Leiden: Universiteit Leiden. Available at http://www.research.leiden.edu/about/fundamental-research.html, accessed on 16/02/10. This would include the research undertaken by Röntgen, Becquerel, and Pierre and Marie Curie which underpins the whole of the nuclear industry, sand is discussed in more detail on Chapter Two.

[50] LBL, nd, What is applied research? Berkeley, CA: Lawrence Berkeley National Laboratory/ US Department of Energy, Available at http://www.lbl.gov/Education/ELSI/research-main.html, accessed on 16/02/10

[51] Shapiro, F. R., 2000, The Most-Cited Legal Scholars, Journal of Legal Studies, University of Chicago Press, vol. 29(1), pp. 409-26. Whilst any suggestion of bias is unintentional, it should be noted that Posner was the founding editor of the Journal of Legal Studies.

[52] See, for example, Posner, R. A., 2003, Law, Pragmatism and Democracy, Cambridge, MA: Harvard University Press.

[53] Somin, I., 2004, Richard Posner's democratic pragmatism and the problem of ignorance, Critical Review, 16 (1), pp1-22

are somehow "different" to other people and, further, that there is a tendency towards isolationism among the scientific communities:

> "Every physicist, and every chemist, and, in short, every master in any department of experimental science, has had his mind molded [sic] by his life in the laboratory to a degree that is little suspected."[54]

What Peirce is alluding to is the role played by scientists as the experts who gather empirical evidence to support (or dispute) theories. However, as with the other terms considered, 'science' is a contested area and it should not be assumed that there is currently an homogeneous community of scientists, either in what they believe, or in how they behave. Indeed, such a thing may never have truly existed. Professor Nowotny, writing in 1980 about the 1977 Austrian referendum on nuclear power, states that:

> "The fictitious 'scientific community' has long since given way to numerous communities, pluralistic in their status claims and codes of professional conduct as well as in their competence."[55]

This is not to say, however, that politicians will not use the idea of some sort of "unified" (and simplified) science as a means of putting opponents onto weaker ground, or simply to make a political point. Neither does it necessarily follow that scientists will not move beyond the realms of their expertise to become advocates of a particular course of action. In a speech given almost exactly a year after announcing the forthcoming energy review at the CBI conference, the then Prime Minister Tony Blair gave a speech to the Royal Society in Oxford in which he claimed that the Stern Review,[56] published the previous week "set out, unanswerably, the scientific case that our actions are changing our climate"[57] and argued that "the brilliant light of science"[58] would light the future of the country.

The Stern Review, chaired by Lord Stern of Brentford[59] actually said that "an overwhelming body of scientific evidence now clearly indicates that climate change is a serious and urgent issue,"[60] and the causes are "mostly attributable to human activities,"[61] but the Review adds the caveat that:

> "Attributing trends to a single influence is difficult to establish unequivocally because the climate system can often respond in unexpected ways to external influences and has a strong natural variability."[62]

This is clearly not quite as "unanswerable" as the Prime Minister made out in his speech and, as mentioned above, arguments about the influence of humans on the global climate are ongoing and are increasingly becoming less muted.[63]

One of the constraints which politicians have placed on their reporting of scientific data is the fact that the majority of politicians and, indeed, the majority of the audiences to which they are speaking, do not have a scientific background. This has as an inevitable

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[54] Peirce, C.S., 1905, What Pragmatism is, The monist, Vol 15, No 2, pp161-181. This point is revisited in Chapter Two with discussions of the remote siting of the two NIRNS laboratories in Warrington and Culham.
[55] Nowotny, H., 1980, The Role of the Experts in Developing Public Policy: The Austrian Debate on Nuclear Power, Science, Technology & Human Values, 5 (2) 14.
[56] The Stern Review on the Economics of Climate Change was published on 30 October 2006, and is available from the HM Treasury website at http://www.hm-treasury.gov.uk/stern_review_report.htm.
[57] Blair, T., 2006, Speech to the Royal Society, Oxford. Available at http://www.number10.gov.uk/Page10342, accessed on 22/03/10.
[58] Ibid.
[59] Lord Stern of Brentford was previously Professor Nicholas Stern, and had been the Head of the Government Economic Service. Source: OCC, 2009, Stern Team, Office of Climate Change. Available at http://www.occ.gov.uk/activities/stern.htm, accessed on 12/03/10.
[60] Stern, Lord, 2006, The Economics of Climate Change: The Stern Review, Cambridge: Cambridge University Press, p2
[61] Stern, Lord, 2006, op cit, p4
[62] Stern, Lord, 2006, op cit, p5
[63] See, for example, the comments of Australian MP Dennis Jensen who has been reporting climate change science as "dubious to say the least" since early 2009.

consequence the fact that much of the complexity of scientific reports is "lost in translation."[64] This is especially true when considering the specifics of nuclear power generation. In 1999, Professor Worcester proposed five ideas which he argued could form the basis of a guide to study the interaction between science, scientists and society[65] and, since politicians and their audiences all form part of the wider society, some of his points are worth exploring.

The first key point that Worcester makes is that the British public tends to assume that a scientific advance is likely to be detrimental rather than beneficial, unless they are told the purpose behind it.[66] This was illustrated by the fiasco which surrounded the publication of an article by Dr Andrew Wakefield in the *Lancet*, in which he suggested that there might have been a causal link between the combined Measles, Mumps and Rubella vaccination (MMR) and childhood autism.[67] Despite repeated reassurance by medical institutions[68] that there was no evidence of a link and the eventual retraction of the paper from the *Lancet*,[69] MMR vaccines fell from over 92 per cent to under 80 per cent and the number of cases of measles rose sharply.[70]

The second of Worcester's key points is that scientists working for NGOs are more likely to be trusted than those working for the government or industry. The rationale for this is stated as being that government and industry scientists are often regarded as somehow 'shady'[71] and motivated by money, and being equally willing to present skewed data which favours their sponsors. NGO scientists, however, have a tendency of portraying themselves as the under-resources, independent champions of whichever cause the NGO relates to. The reality is somewhat different, and some research has suggested that in the environmental sphere, "NGO researchers are not generally different in terms of their environmental views"[72] to any other researchers. This has important ramifications for the discussions about climate change and energy security put forward as the rationale for the change in energy policy in 2005, as will be discussed in more depth below. Despite Worcester's points, there is strong evidence that the arguments of Gellner[73] that science is still regarded as having more influence on a debate than anything else – if it were not, then the use of science by politicians that we will see below would not be necessary.

However, the governments of Tony Blair and Gordon Brown have to some extent side-stepped this issue by appointing in 1997 as the arbiter of all things sustainable (and thus the "government scientific advisor" in all but name), the Sustainable Development Commission, under the Chairmanship first of ex-Green Party Leader and co-funder of Resources for the Future, Jonathon Porritt and then, from September 2009, Will Day.[74] By having as ex-heads of NGOs successive heads of its advisory body, the government can claim to be engaging scientists on both the industrial and NGO sides of the climate change

[64] CNAS, 2009, Lost in Translation: Closing the Gap between Climate Science and Climate Policy, College Park, MD: Center for a New American Security (CNAS), the Joint Global Change Research Institute (JGCRI).
[65] Worcester, R., Science and Democracy: Public Attitudes to Science and Scientists, Budapest: UN World Conference on Science.
[66] Ibid.
[67] Wakefield, A., et al., 1998, Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children, The Lancet, Volume 351, Issue 9103, Pages 637 – 641.
[68] Including in the UK, the Medical Research Council (1998, 2001 & 2004), the British Medical Journal (2001), St George's Hospital, London, UK, and the Institute for Child Health (2001) and the Royal Free Hospital (2002)
[69] The article was retracted in March 2004. Source: BBC, 2008a, MMR research timeline, London : BBC News, available at http://news.bbc.co.uk/1/hi/health/1808956.stm, accessed on 16/02/10
[70] Deer, B., 2009, MMR doctor Andrew Wakefield fixed data on autism, The Sunday Times, available at http://www.timesonline.co.uk/tol/life_and_style/health/article5683671.ece, accessed on 16/02/10
[71] The scientists at the Hadley Centre for Climate Change have been repeatedly referred to as 'shady' in blogs since the revelation that their data may have been not as objective as was first thought.
[72] Campion, C., & Shrum, W., 2002, Environmental Attitudes of Scientists in Ghana, Kenya, and Kerala: Evidence on NGOs and Traditional Research Sectors, Journal of Asian and African Studies, Vol. 37, No. 1, 17-42
[73] Gellner, E., 1992, Postmodernism, Reason and Religion, London: Routledge
[74] Day was previously the Funds Director for Comic Relief, CEO of CARE International, and is currently Special Advisor to the United Nations Development Programme (UNDP). Source: SDC, 2010, Who we are: Will Day, London: Sustainable Development Commission

debate.[75]

Even though the MMR vaccine and the arguments about climate change science support Worcester's premise, it does not mean, however, that scientific data surrounding the processes of nuclear fission should necessarily all be regarded as open for scientific debate or uncertainty: at all but a quantum level, the physics surrounding the reactions occurring inside the core of a nuclear reactor are certain.[76] Worcester's arguments are more about the way in which scientific arguments and information are used and abused by different bodies and for different purposes.

One of the areas in which science is used greatly by politicians and environmentalists alike is in the interpretation of the Precautionary Principle. According to the European Commission, the Precautionary Principle (enshrined into EU Law by the 1992 Maastricht Treaty, which did not trouble to define it): [77]

> "may be invoked when the potentially dangerous effects of a phenomenon, product or process have been identified by a scientific and objective evaluation, and this evaluation does not allow the risk to be determined with sufficient certainty."[78]

Whilst the phrase "scientific and objective evaluation" would suggest a level of certainty and lack of ambiguity in the results, there are many examples where the same data have been used to suggest two different courses of action.[79]

The 2001 Lowell Statement on the Precautionary Principle,[80] which supported the earlier Wingspread Statement, made wide-ranging calls for improvements in science policy, research and funding with the eventual target of:

> "creating a new interface between science and policy that stresses the continuous updating of knowledge as well as improved communication of risk, certainty and uncertainty."[81]

In their 1990 paper, Jordan and Davidson argue that there is even further conflict as "science can no longer deliver what governments expect of it"[82] but, at the same time, "politicians like consensus and encourage the political closure of scientific controversy."[83] This would suggest that the new "interface between science and policy" has been needed for some time. In some fields there have even been arguments for the legal system to be initiated to counteract decisions which have been based on political motives:

> "while the courts should not generally interfere in the affairs of science, they can be a useful mechanism to reverse irrational ideology-driven science policy and

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[75] Although the government rhetoric in unswerving in its attachment to the idea of anthropocentric climate change. See, for example, Jowit, J., 2010, Ed Miliband declares war on climate change sceptics, The Observer, 31 January 2010, p1.
[76] See Appendix VI for a summary of the nuclear chain reaction that is at the heart of a reactor.
[77] EC Treaty Article 174(2) which was inserted by Maastricht, requires only that the Community's environmental policy is based on the principle.
[78] Europa, 2005, Summaries of EU Legislation: The Precautionary Principle. Available at http://europa.eu/legislation_summaries/environment/general_provisions/l32042_en.htm, accessed on 22/03/10
[79] See, for example, Ponte, L., 1976, The Cooling: Has the Next Ice Age Already Begun, London: Prentice-Hall, which argued that man made pollution and greenhouse gases in the environment would cause a new ice age" and Rasool, S.I., & Schneider, S., 1971, Atmospheric Carbon Dioxide and Aerosols: Effects of Large Increases on Global Climate, Science, Vol. 173. no. 3992, pp. 138 – 141, which states that CO_2 could be responsible for future warming, and aerosols for future cooling.
[80] The Statement was the outcome of an interdisciplinary conference held at the Toxics Use Reduction Institute at the Lowell Campus of the University of Massachusetts. Source: Lowell, 2001, Statement from the International Summit on Science and the Precautionary Principle, 17 December 2001, Lowell Center for Sustainable Production, Lowell, MA: University of Massachusetts Lowell
[81] Ibid.
[82] Jordan, G., & Davidson, S., 2000, Science and Scepticism: Expertise and Political Decisions, Public and Policy Administration, 15 (1) 58-76:58.
[83] Jordan, G., & Davidson, S., 2000, op cit, n82, p75

decision-making"[84]

This thesis does not go quite as far as Professor Don K Price[85] in attempting to polarise politicians and scientists as representing power and truth respectively for, despite the attractions such a concept brings with it, it is sometimes science which has the power and, occasionally, politicians who represent truth. Price's ideas are closely allied to those put forward more recently by Dr Joseph Corkin, who argues that the European Court of Justice (in the cases of Pfizer[86] and Alpharma[87]) believed:

> "Scientists [to be] arbiters of fact, who conduct risk assessments to identify and characterise risks and thereby generate reliable information – the raw factual data – upon which the institutions, as the legitimate arbiters of value, make policy decisions."[88]

The thrust of the thesis becomes an investigation as to whether a particular decision was made because it was the way of dealing with matters from a practical point of view, because it was the underlying philosophy of the government at the time, or because there was a technocratic imperative to do so. What this thesis will further suggest is that politicians have always been willing and ready to use scientific rhetoric as a tool and will emphasise a false unity in scientific thinking when it suits their own political purposes, whilst simultaneously overriding scientific evidence or emphasising the discord in scientific thinking when it does not - in other words, revisiting Jordan and Davidson's idea of "political closure of scientific controversy."[89]

1.3: Technocratic Decision Making

The idea that there is some sort of technological imperative behind decision making has links to existing ideas of technocratic decision making (TDM), in which "experts are increasingly becoming a part of our decision-making structures"[90] although it does not fit exactly, since the opinions of the experts are picked up and dropped at will by the real decision makers.

Professor Kantrowitz argued, in 1975, that policy decisions could be separated into three categories:

> Technical Decisions, based solely on the application and extrapolation of scientific issues;
>
> Value Decisions, concerned with the resolution of important normative of societal issues; and
>
> Mixed Decisions, with both technical and value elements.[91]

Clearly, although Kantrowitz is clear in his categorisation, and all decisions will fit somewhere within the designations, these are more of the "ideal type" designations of the sort promoted by Weber,[92] and are not necessarily meant to exactly match all of the policy decisions. DeSario and Langton expand on Kantrowitz's ideas, arguing that:

> "Technical decisions rely on scientific techniques and extrapolations to determine

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[84] Singh, J. A., 2009, Using the courts to challenge irrational health research policies and administrative decisions, Acta Tropica, 112S (2009) S76–S79, p76
[85] Price, D. K., 1965, The Scientific Estate, Cambridge, MA: Harvard University Press
[86] Case T-13/99, Pfizer Animal Health SA v. Council of the European Union [2002] ECR II-03305
[87] Case T-70/99 Alpharma inv. v Council of the European Union [2002] ECR pt. 139 II-03495
[88] Corkin, J., Science, legitimacy and the law: regulating risk regulation judiciously in the European Community, E.L. Rev. 2008, 33(3), 359-384.
[89] Jordan, G., & Davidson, S., 2000, op cit, n82, p58
[90] DeSario, J., & Langton, S., eds., 1987, Citizen participation in public decision making, New York, NY: Greenwood Press, p7
[91] Kantrowitz, A. 1975, Controlling technology democratically, American Scientist 63:505-509:506
[92] Coser, L.A., 1977, Masters of sociological thought: Ideas in historical and social context, New York, NY: Harcourt, p223-4

> the potential of 'what is.' Value issues involve normative determinations of 'what should be.' Although scientific information can provide guidance with respect to value decisions, it is rarely the sole determinant."[93]

As will be seen below, the focus on "what is" which they say is a feature of technical decisions (and thus, by extrapolation, decisions made using TDM) has strong links to the doctrinal or black letter approach to legal analysis, which will be discussed further below.

In Professor Teichman's work on decision making in Mexico and Argentina, she argues that "small technocratic élites insulated themselves from both extra and intra state pressures."[94] Even though her work is focused on Central and Southern America, this understanding may fruitfully be applied to the early days of nuclear power in the UK, where there was certainly an élite separated from "extra and intra state pressures" although doubt remains about the extent to which those politicians involved could truly be classed as a "technocratic élite."

Professor Jasanoff argues that society may already be starting to evolve beyond TDM, into a form of decision making where:

> "dependence on scientific experts, whose judgements are necessarily influenced by their moral beliefs and social aspirations, may well replace rule by a technocratic élite for democratic process."[95]

What Jasanoff seems to be implying is that the current state is of rule by a 'technocratic élite' which, as will be shown, is at least party true in relation to the early years of the nuclear industry in the UK. However, the shift to a replacement of this by "dependence on scientific experts" does not seem to have happened and, indeed, it is argued here that we never really arrived at TDM in the first place. Using Kantrowitz's classification, which is by no means an absolutist or prescriptive one, it will be argued here that most of the decisions which have been taken in relation to nuclear power are closest to mixed decisions. This differs from the view of the ECJ in the Pfizer and Alpharma cases above, that the role of scientists is solely to provide factual evidence, as decisions made on that basis would fit the value decision category better.

An assessment of the decisions covered below will be made as to whether they fit one of Kantrowitz's categories,[96] or even Jasanoff's position of scientists as rulers,[97] and that assessment will be paired with further discussions about "everyday" political pragmatism and the use of science by politicians.

1.4: The 2001 Foot and Mouth Disease Outbreak

To illustrate the approach of this thesis, it is useful to give examples of political decisions which have been made on the grounds of political pragmatism, and for which the language and arguments of science have been used as political justification.

One of the best examples of recent years where a major policy change has come as the result of purely pragmatic considerations was the response to the outbreak of Foot & Mouth Disease (FMD) in the UK in the spring and summer of 2001. Much has been written both in the mainstream media and specialist journals concerning the pathology of FMD, and the success or otherwise of the methods employed to tackle it,[98] but it is not the

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[93] DeSario, J., & Langton, S., eds., 1987, op cit, n90, p8
[94] Teichman, J., 1997, Mexico and Argentina: Economic reform and technocratic decision making, Studies in Comparative International Development, 32 (1) 31-55.
[95] Jasanoff, S., 1994, The Fifth Branch: Science Advisers as Policymaker, Cambridge, MA: Harvard University Press
[96] Kantrowitz, A., 1975, op cit, n91
[97] Jasanoff, S., 1994, op cit, n95
[98] See, for example, Campbell, D., & Lee, R., "Carnage by Computer": the blackboard economics of the 2001 foot and mouth epidemic, Social and Legal Studies; 12 (4) Dec 2003, pp.425-459; Mepham, B., 2001, Foot and mouth disease and British agriculture: ethics in a crisis, Journal of Agricultural and Environmental Ethics 14, 3

pathological aspects of the disease or an *ex post facto* assessment of the methods which is are of interest here. One caveat which should be included, however, is that responses to a situation, which may or may not be pragmatic, are clearly reactive. Drawing up the plans for a future policy, however, which also may or may not be pragmatic, is proactive, and thus the solution for one may not be the solution for the other. This difference between proactive and reactive pragmatism will be explored further in the body of this thesis.

The first outbreak of the disease on a farm in Essex was announced by Baroness Hayman in the House of Lords on 21 February 2001.[99] When the Secretary of State for Agriculture, Fisheries and Food, Nick Brown, spoke to the Commons about the outbreak the following week he said that:

> "the United Kingdom Government and the European Commission acted swiftly to prohibit temporarily the export of live animals, meat, fresh milk and other animal products from the UK"[100] and that

> "We immediately ceased issuing export health certificates for export to third countries for any animals or products which cannot also be exported to other European Union member states."[101]

These decisions, Baroness Hayman revealed, had been taken partly on the basis of a strategy adopted after the 1967 FMD outbreak, and partly on the advice of scientific advisors from the (subsequently dismantled) Ministry of Agriculture, Fisheries and Food (MAFF).[102] As history has revealed, the pragmatic decisions made in relation to FMD were slow to take effect, and did not work effectively. The spread of the disease could have been prevented if the rules set out for controlling livestock movements had been put in place sooner,[103] although the National Audit Office pointed out that "it [was] unrealistic to expect that any contingency plan could have coped with all the problems."[104] This could make the decisions contrary to the fundamental tenet of political pragmatism – that it is "what works" which is important. It is argued that "what works" can only be assessed retrospectively and, at the point of the decision, it is "what looks most likely to work at the time" which should be the standard by which political pragmatism is measured.

Having looked at the underlying themes that will run throughout this work, and seen how they might work in an example decision, it is necessary now to turn to look at the approach taken by this thesis to the research itself.

1.5: Methodology

Various approaches were considered for this research before being rejected on the grounds of unsuitability. This section includes brief discussions of the backgrounds to, and methods used, by some of these approaches, along with the rationale for their rejection. Since "most researchers would accept that it is sensible to use a mixture of methods"[105] this section will show the combination of approaches that will be taken in the body of the thesis. The broad categorisation of methods into qualitative and quantitative and,

339-48; Guardian, 2009, Foot and Mouth: Special Report, available only at http://www.guardian.co.uk/uk/footandmouth, accessed on 05/01/10.

[99] Hayman, Baroness, 2001, Foot and Mouth disease outbreak, HL Deb 21 February 2001 vol 622 c866

[100] Brown, N., 2001, Foot and Mouth Disease, HC Deb 26 February 2001 vol 363 c598

[101] Ibid.

[102] Hayman, Baroness, 2001, op cit.,n98, c867

[103] "By the time MAFF's 5-mile exclusion zone around the first farm was put in place, the disease had already spread beyond it" Source: BBC, 2003, Beginnings of a Crisis, London: BBC News. Available at http://news.bbc.co.uk/1/hi/uk/2144168.stm, accessed on 16/03/10

[104] NAO, 2002, The 2001 Outbreak of Foot and Mouth Disease, London: National Audit Office/TSO

[105] McNeill, P., & Chapman, S., 2005, Research Methods, London: Routledge, p22

comparatively recently, the growth in interest of Q methodology[106] provided the first obstacle. This work does not make any significant use of statistical data, and thus any quantitative or numerical approach would not be suitable.

Clearly, given the six-decade time span, face-to-face interviews with the main protagonists would not have been a practicable option, this impracticability being compounded by the death of so many of the early players. McNeill and Chapman echo this reason when talking about the unsuitability of surveys, saying:

> "there are certain topics that simply cannot be studied by this methods. Many historical themes are an example, since no respondents are available."[107]

There are myriad socio-legal methodologies which could have been considered as approached to this work, and many could have been partially successful. However, as Professor Reza Banakar suggests:

> "Despite the social make-up of law and the kinship between legal theory and social theory, the former being a branch of the latter, and despite the efforts of socio-legal scholars over the past hundred years to integrate legal and sociological ideas, law and sociology remain apart."[108]

Indeed, Schmidt and Halliday argue that scholars within the socio-legal sphere referred to by Banakar not only want to change the way that law is regarded in terms of research, but further "believe that law's claim to autonomy and superiority must be laid bare."[109]

There exists, therefore, a clear tension between some of the legal approaches to research and some of the sociological approaches. There are also areas of overlap, however, and these will be where this work sits.

The approach taken here must focus on primary and secondary texts as sources of information. The basis of this work is in law; namely, the legislation which forms the backbone of the regulatory structure surrounding nuclear power. Part of what this work will do is to uncover what the legislation said at the time, subsequent amendments where applicable and how it was interpreted by the courts; the clearest mechanism by which policy makers give effect to their policies. The downside of considering legislation and case law is that, as Becher and Trowler suggest, "there is a constantly changing body of material arising from new legislation, and everything is in a state of flux."[110] However, bearing this constant flux in mind, there are several ways of discovering what the legislation means, and as Professor Cownie states:

> "Traditionally law has been analysed from a doctrinal or "black letter" perspective, which concentrates on examining statutory materials and the reports of judicial decisions as the sole means of understanding the law."[111]

This doctrinal approach, which is also referred to as positivist[112,113] and

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[106] Q Methodology was invented in the 1930s and combines statistical analysis with value statements, allowing the creation of dominant discourses on a particular topic or set of topics. Source: McKeown, B., & Thomas, D., 1988, Q Methodology: Quantitative Applications in the Social Sciences, London: Sage.
[107] McNeill, P., & Chapman, S., 2005, op cit, n105, p30
[108] Banakar, R., 2009, Law Through Sociology's Looking Glass: Conflict and Competition in Sociological Studies of Law, in Denis, A., & Kalekin-Fishman, D., eds., The New ISA Handbook in Contemporary International Sociology: Conflict, Competition, And Cooperation, London: Sage.
[109] Schmidt, P. and Halliday, S., 2009, Introduction: Beyond Methods – Law and Society in Action, in Halliday, S. and Schmidt, P., eds., Conducting Law and Society Research: Reflections on Methods and Practices, Cambridge: Cambridge University Press, p4
[110] Becher T., & Trowler, P., 2001, Academic Tribes and Territories: intellectual inquiry and the culture of disciplines, Buckingham: Open University Press & SRHE, p31
[111] Cownie, F., 2004, Legal Academics: Culture and Identities, Oxford: Hart Publishing, p35
[112] Positivism, in short, takes the view that "there is a body of knowledge that existed independently of whether people knew it or not, and that the task of the scientist was to uncover that knowledge piece by piece, building up a more complete understanding of the laws of nature." Source: McNeill, P., & Chapman, S., 2005, op cit, n105, p116

tecnocentric[114] has been criticised for being too narrow in its scope, and thus, as Adams and Brownsword argue:

> "to say black-letterism is concerned with describing the operation of the law would be to overstate its scope; for what it purports to describe is the content of the formal legal materials, not the operation of these rules in practice."[115]

Some aspects of the black letter approach will be retained as part of the "mixture of methods" and, in order to give effect to that approach, there are various other methods for interpreting the meaning of legislation which are used in case law. The three best-known approaches are the "literal", "golden" and "mischief" rules."

The literal rule was discussed in the case of Stock v Frank Jones (Tipton) Ltd [1978] where Viscount Dilhorne said that the objective of the court was to discover the intention of Parliament as expressed in the words used in the statute and nothing else.[116] This is potentially a very limited approach because, as will be seen during the course of this work, the wording of legislation is often ambiguous and, occasionally deliberately so.

The golden rule is used as a bolster to the literal rule and is used on occasions where a literal interpretation of the statute would produce a result that is patently absurd. In the case of Adler v George [1964], for example, the defendant was appealing against a conviction under section 3 of the Official Secrets Act 1920 for obstructing a member of the RAF in the vicinity of RAF Marham. The appeal was on the basis that the statutory wording was specific about the need to be "in the vicinity of" a prohibited place, and that since he was *in* the prohibited place, he was technically not covered by the statute. Lord Parker CJ felt that this would be an unacceptable result, and that:

> "I am quite satisfied that this is a case where no violence is done to the language by reading the words 'in the vicinity of' as meaning 'in or in the vicinity of.' Here is a section in an Act of Parliament designed to prevent interference with members of Her Majesty's forces, among others, who are engaged on guard, sentry, patrol or other similar duty in relation to a prohibited place such as this station. It would be extraordinary, I venture to think it would be absurd, if an indictable offence was thereby created when the obstruction took place outside the precincts of the station, albeit in the vicinity, and no offence at all was created if the obstruction occurred on the station itself."[117]

The final of the three main rules of interpretation is the mischief rule, which is sometimes referred to as the "rule in Heyden's case."[118] It allows for quite a broad interpretation of the wording of the legislation, and it bases the interpretation on the 'mischief' which previous statute allowed, but which the current law was brought in to address.

A combination of these three approaches, using a further combination of the Hansard records of Parliamentary debates, contemporary first-hand accounts and later more reflective accounts, will be used to ascertain the reasons behind the particular changes in legislation. The legislation as passed and as amended will be accessed using the major online legal databases which are available, including LexisNexis®Butterworths,[119] Westlaw,[120] the website of the Office of Public Sector Information (OPSI) and, more

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[113] "The positive study of laws is concerned with the specific content of laws." Source: Pendlebury, G., Action and ethics in Aristotle and Hegel: escaping the malign influence of Kant, Farnham: Ashgate Publishing Limited, p64

[114] Thomas, P.A., 1997, Socio-Legal Studies: The Case of Disappearing Fleas and Bustards, Thomas, P.A., ed., Socio-Legal Studies, Aldershot: Dartmouth. The link to the concerns of "what is" in technical decision making was outlined above.

[115] Adams, J., & Brownsword, R., 1999, Understanding Law, London: Sweet & Maxwell, p30

[116] Stock v Frank Jones (Tipton) Ltd [1978] 1 All ER 948, per Viscount Dilhorne at 951.

[117] Adler v George [1964] 2 QB 7, per Lord Parker CJ at 9.

[118] Heydon's case (1584) 3 Co Rep 7a.

[119] LexisNexis®Butterworths is a subscription only service available at http://www.lexisnexis.com/uk/legal

[120] Westlaw is a subscription only service run by Thompson and Sweet & Maxwell, and is available at http://login.westlaw.co.uk/wluk/

recently, the UK Statute Law Database run by the Ministry of Justice.[121] These databases are highly useful for twenty-first century legal research, as they give the researcher access not only to the elements of the legislation itself, but also to journal articles and cases which relate to the particular sections of an Act.

It is important to keep in mind when looking at the legislation, whether from a black letter, golden rule or any other perspective, that "there is a tradition that law is 'value free.'"[122] In other words, the law is concerned with what the rule in an area is, "not as it ought to be, nor why it came to be as it is."[123]

This thesis therefore will use as a start point a doctrinal, black letter, technocentric analysis of the legislation passed in relation to the nuclear-power industry in the UK. Having looked at "what the law is", it will them move on to consider, using predominantly primary data, how the law came to be the way it is. Once the underpinning evidence has been collected, the third strand of this thesis will assess *why* the law came to be shaped the way it is – in other words to bring in the ideas of pragmatism and technocratic decision making and with them the use of science for their own purposes by politicians.

1.6: Introduction to the Thesis

In this work, which focuses on the nuclear power industry in the United Kingdom, four time periods are considered to illustrate the influences on the decisions that were taken relating to nuclear power. The periods were chosen as they represent different stages in the life of nuclear power: the beginning; middle; end and rebirth. Although the later decisions about nuclear power are very easily distinguishable from those relating to nuclear weapons, in some of the earlier stages in the development of the technology the two are intrinsically linked, and will be dealt with together where necessary.

The first time period is 1944-1948, which covers the time between the run up to the end of the Second World War and the passage of the Atomic Energy Act 1946, which was the first statutory reference to the nuclear industry in the UK. The 1955 White Paper "A Programme of Nuclear Power"[124] envisaged nuclear power to be "contributing 1500 to 2000 MW of electricity to the grid and replacing five to six million tons of coal a year by a few hundred tons of uranium,"[125] and the potential benefits of nuclear power were not yet overshadowed by any real growing awareness that this new capacity carried significant risks.

The second time period covers the years 1973-1978, which is the period of the beginning of the slump in nuclear power's popularity, both in the UK and globally. The extremely long lead times between commission and completion of a nuclear power station meant that the effects of this disillusionment took up to a decade to become apparent. It is also the period of the OPEC-generated fuel crisis and resulting stock market crash. According to the IAEA:

> "From 1974 to 1975 orders dropped abruptly from 75 GW(e) to 28 GW(e). Moreover, all 41 reactors ordered after 1973 were subsequently cancelled, and, indeed, more than two-thirds of all nuclear plants ordered after January 1970 were eventually cancelled."[126]

The third time period runs from 1992-5, and covers the years between the completion of Sellafield B, the last nuclear reactor to be built in the UK, and the decision by the

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[121] The UK Statute Law Database was set up in 2007 by the Ministry of Justice. It is available at http://www.statutelaw.gov.uk/
[122] Becher T., & Trowler, P., 2001, op cit, n110, p31
[123] Adams, J., & Brownsword, R., 1999, op cit, n115, p69
[124] Lord President of the Council, 1955, A Programme of Nuclear Energy, Lord President of the Council and Minister of Fuel and Power White Paper (Cmnd 9389), London: HMSO.
[125] Jay, K., 1956, Calder Hall: The Story of Britain's first Atomic Power Station, London: Methuen & Co Ltd, p83.
[126] IAEA, 2004a, 50 years of nuclear energy: 48th IAEA General Conference, Vienna: International Atomic Energy Agency, p4

government not to fund any future development of nuclear power from the public purse.[127] In addition to apparent government policy, the comparative weapons-related calmness in the immediate post-Cold War period meant that its overshadowed sibling nuclear power slipped from the headlines as well, other than for the publicity surrounding specific actions.[128] As a result of this "quiet period" the Organization for Economic Cooperation and Development's Nuclear Energy Agency (the NEA) published a report in 2000 on the need for focused training of the next generation of nuclear scientists. In the report, entitled "Nuclear Education and Training: Cause for Concern?"[129], the NEA says that the average age of faculty members in academic institutions is almost 50 – in other words, would be rapidly approaching retirement age by the time replacements could be trained.[130] They called for a push on the teaching of nuclear disciplines at undergraduate and postgraduate level and, to that end, established the annual International School of Nuclear Law (ISNL) in France in 2001.[131] Approximately 500 doctoral level students have passed through the ISNL since its inauguration,[132] which is starting to redress the shortfall predicted by the NEA. Not only did the closing year of the twentieth century see a lack of interest in nuclear technology amongst the public, the media and politicians therefore, even academics were, to paraphrase Samuel Goldwyn, staying away from the subject in droves.

The lack of new recruits to the industry relates well to the idea that nuclear had all but disappeared from mainstream consciousness. This is reinforced by the apparent lack of interest from the media. A search of the online database of the Times newspaper reveals that between 1 January and 31 December 2000, there were just four articles published which included the term "nuclear power." By contrast, in 2006 (the year following the announcement of possible nuclear "new-build") the same newspaper published 1,104 articles including those same words.[133]

All of this could suggest that the nuclear industry in the early part of the twenty first century was, if not dead, certainly dying. This, however, is far from the truth. As the *New Internationalist* put it, in 2005:

> "Not long ago, you could have been forgiven for thinking that nuclear technology was on its way out. After major disasters such as Three Mile Island and Chernobyl, officials were sizing up the nails for the industry's coffin. But it would seem that nuclear power wasn't dead – just resting."[134]

Despite all of this apparent surface calmness, the nuclear industry was merely regrouping after a relative downturn in its fortunes. Global industry bodies such as the World Association of Nuclear Operators, the World Nuclear Association, and the World Nuclear Fuel Market linked together with regional and national bodies such as the Uranium Information Centre in Australia, the US-based Nuclear Suppliers Association, and the UK's Nuclear Industry Association to share information about the different nuclear

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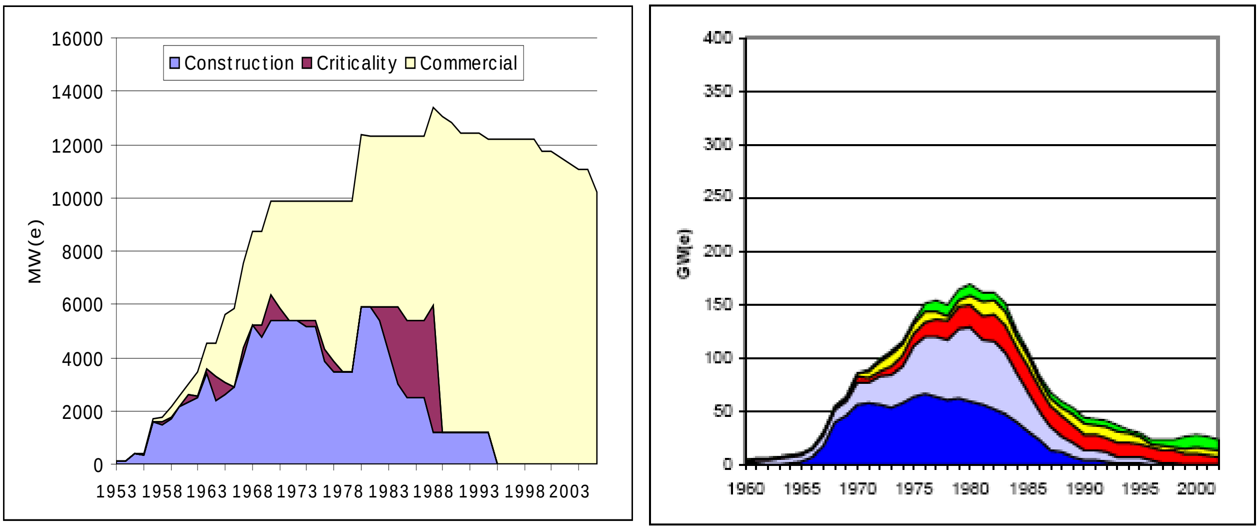
[127] DTI, 2005, The prospects for nuclear power in the UK: Conclusions of the government's nuclear review (Cmnd 2860), Department of Trade and Industry, London: HMSO
[128] The opening of Sizewell B in 1992, for example, provoked a brief resurgence in mainstream press interest.
[129] NEA, 2000, Nuclear Education and Training: Cause for Concern? A Summary Report, Issy-les-Moulineaux: Nuclear Energy Agency of the OECD.
[130] Ibid., p11.
[131] NEA, 2001, Press Communiqué: The First International School of Nuclear Law Opens in Montpellier, France, Issy-les-Moulineaux: Nuclear Energy Agency of the OECD. More discussion of the issue of shortages of trained personnel can be found in Lovins, A.B., & Sheikh, I., 2008, (The Nuclear Illusion, RMI Report E08-01, Snowmass, CO: Rocky Mountain Institute), who state that "40 per cent of those working at US plants are eligible for retirement before 2015." Gribben claims that up to 9,000 graduates and 4,500 skilled workers will be needed before 2018, and Bleasdale says that the number of people involved in nuclear Research and Development has fallen from around 9,000 in 1980 to just over 1,000. See also Catto, I., 2007, Where are the People? Nucl. Eng. Intl. 512(637), 29
[132] NEA, 2009, International School of Nuclear Law, Issy-les-Moulineaux: Nuclear Energy Agency of the OECD.
[133] The search of the Times database (http://www.timesonline.co.uk/tol/news/) was carried out on 04/07/07.
[134] Ma'anit, A., 2005, Nuclear is the new black, New Internationalist, Issue 382, pp1-9:1.

environments across the world.[135]

The final period starts in 2004 and runs until 2007. This is the period in which both the US President, George W Bush, and the British Prime Minister, Tony Blair, announced plans to return nuclear power to their countries, for reasons ostensibly linked to climate change and energy security.

Figure 1.3: Numbers of reactors (UK and Global)[136]



Underpinning all four time periods are the statistical figures relating to nuclear reactors. Figure 1.3, above, is a graphic representation of the annual figures for number of nuclear reactors ordered, under construction and operating for each year from 1953 to 2006 for the UK, and 1960 to 2006 for the rest of the world. Both graphs show a similar curve in terms of the growth, peak, and decline in reactor orders, and this could theoretically be mapped onto the idea of a product life cycle first used in relation to marketing new products 1965.[137] There are, however, many conceptual differences between introducing a new type of product into a free and open market, and the introduction of nuclear power into the national grid, not least of which is the idea of consumer choice.

The time periods are examined first in terms of the statutory and other legislative measures which are put in place relating to nuclear technology. This enables a framework to be created which can then be used to further examine the political situation at the time – in terms of foreign policy, economic policy and so on. Once this is complete, the influence of these policies on the reactions to technology will be revealed. In October 1946, for example, the then Foreign Secretary, Bevin, is reported to have said in one of the meeting of the GEN 75 cabinet committee that issues of cost were irrelevant in relation to the atomic bomb, and that it “would have a bloody Union Jack on top of it” regardless of the expense. It is important to note, however, that Bevin’s comments must be seen within the post-war context of a declining Imperial power and, as such, could not be expected to necessarily take into account the associated costs.

Any discussion of the legal development of the nuclear industry in the United Kingdom must first clarify what is meant by “the nuclear industry.” The focus of this work will be on the nuclear-power industry as categorised by commercial nuclear-power generation. It is important to reiterate that in the early years of nuclear research in the UK, the military

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[135] WANO, for example, launched a revised website in 2001, including a “searchable Good Practice database” for industry members to use. Source: Lawrence, R., 2001, WANO Website re-launch, Inside WANO, 9 (1) 13.
[136] The left hand graph shows the power generation equivalent (MW(e)) of the nuclear reactors at various stages of operation in the UK. Source: IAEA, 2006, IAEA Power Reactor Information System, Vienna: International Atomic Energy Agency. The right hand graph shows the reactor capacity under construction worldwide (in GW(e)). Source: IAEA, 2004a, op cit, n126.
[137] Levitt, T., 1965, Exploit the Product Life Cycle, Harvard Business Review, Vol. 43, pp 81-94.

and civilian programmes ran very closely with each other, to the extent that the two were often entwined. Indeed, until 1973, the UK Atomic Energy Authority had responsibility for both power and weapons research.[138] Despite this, the development of nuclear armaments will not be discussed here, except where provisions overlap with nuclear power. The rationale behind this deliberate omission is that the debates surrounding nuclear weapons involve different areas of concern – the idea of Mutually Assured Destruction, coined by Robert McNamara,[139] for example, was of grave concern to debates about nuclear weapons in the 1950s and 1960s, but has little or no direct relevance importance in discussions about energy generation.

1.7: Conclusion

This chapter has illustrated the general rationale and background to the thesis, and has set out the approach that will be taken in sourcing and assessing the relevant information. The twin rationales put forward by the Government in 2005 for reconsidering nuclear power were climate change and energy security, both of which are areas too complex to be reduced in any meaningful way to glib soundbites. Even so, the Prime Minister simplified the ideas greatly in his announcement, saying “climate change is producing a sense of urgency”[140] and “energy supply is under threat.”[141] We have seen that this decision was based on an over emphasis on some of the scientific data on climate change (variously described as “unanswerable”[142] and “overwhelming”[143]) and an excision of the caveats which accompanied that data (it is “mostly”[144] anthropogenic). This fits one of the themes running through this work, which is that politicians are willing to use what Jordan and Davidson call the “political closure of scientific certainty”[145] in order to justify their decisions. Politicians adopting this approach would be heartened by Professor Mehta’s view that in order to generate a “relatively uncritical acceptance of science on the part of the public,”[146] decision making without public participation is preferred.

The economic arguments for and against nuclear power have fluctuated over the years and, at the point at which the Prime Minister made his 2005 speech, the economic situation was looking more favourable to nuclear than it had in previous years. This was illustrated by the graph in Figure 1.2, which showed that the UK will soon be importing more crude oil than it exports, and thus become vulnerable to global price fluctuations to an extent not previously experienced.

We have seen from the example of the 2001 outbreak of Foot and Mouth Disease how decisions are taken by politicians which are certainly informed by scientific understanding, but are also based on decades-old contingency plans. Notwithstanding this basis for the decisions, they were justified by the relevant Ministers as being based on the advice of MAFF scientific advisors.[147] Since there is rarely, if ever, true consensus among the scientific community, presenting a “best case” scenario as the solution to a problem is another example of the “political closure of scientific certainty.”[148]

The consideration of the use (or abuse) by governments of science and scientific data

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[138] The weapons responsibility of the UKAEA was separated by the Atomic Energy Authority (Weapons Group) Act 1973.
[139] McNamara was US Secretary of Defense when he developed the concept of MAD in 1961. “I determined that the United States needed 400 surviving warheads to deter the Russians from a first strike” McNamara, R., 2000, Mad is not Bad, New Perspectives Quarterly, Vol. 17(3).
[140] Blair, T., 2005, op cit, n1.
[141] Ibid.
[142] Ibid.
[143] Stern, Lord, 2006, op cit, n60.
[144] Ibid.
[145] Jordan, G., & Davidson, S., 2000, op cit, n82, p58
[146] Mehta, M., 1998, Risk and Decision-Making: a theoretical approach to public participation in techno-scientific conflict situations, Technology in Society 20; 87-98
[147] Hayman, Baroness, 2001, op cit, n99, c867
[148] Jordan, G., & Davidson, S., 2000, op cit, n82, p58

in this technology-heavy area of policy-making will be based around ideas of political pragmatism, in the sense of “what works” that Diego uses, refined slightly to “what looks most likely to work at the time.” This will be coupled with an exploration of the extent to which they match concepts of Technocratic Decision Making, requiring the presence of a technocratic decision making élite and one or other of Kantrowitz’s three categories of decisions.[149]

We have also seen the temporal importance of political pragmatism. The resulting success or otherwise of particular decisions or policies should not be used as the gauge by which the pragmatic basis is measured, however easy it is to do so. Hindsight is a luxury that is available only to researchers, and it is one which decision-makers are never privy. it is cleat that the scientists involved in the (unauthorised) experimentation at Chernobyl, for example, would not have carried out their actions, yet, at the time, they appeared to be relatively risk-free.[150] The temporal aspect of pragmatism is also revealed in the ideas of proactive political pragmatism and reactive political pragmatism, which have different goals in view.

The combination of these measures will allow us to see the reasons behind key pieces of legislation decisions that have shaped the use of commercial nuclear power in the UK over the past six decades. As has been suggested already, it is the legislation which provides a framework without which policy is ineffective, and thus it is an exploration of the White Papers, Parliamentary Debates and wording of the statute, using one or more of the rules of statutory interpretation, that allows this examination to take place.

The first period that will be covered is that which begins with Britain still in the grip of the Second World War, when nuclear reactions had not yet moved beyond the laboratory, and the focus was on using the technology for weapons production.

[149] Kantrowitz, A., 1975, op cit, n91

[150] The Chernobyl accident is discussed in more detail in Chapter Three. The scientists who carried out the unauthorised experiments were later convicted of gross negligence and “sentenced to 10 years in a labor camp.” Source: NYT, 1987, Chernobyl Officials Sentenced to Labor Camp, New York Times, July 30, 1987, Page A5

Chapter 2:
1944-48: The Introduction of Nuclear Power

2.1: Introduction

This chapter focuses on the short period from 1944 to 1948, although it also considers events from outside that period which have a significant impact on decisions made during it. At the beginning of the period, scientists and politicians from the United Kingdom were working closely with their counterparts in both Canada and the United States on the development of atomic weapons. By the end of the period, however, the US had withdrawn from international cooperation and left the UK and Canada to continue this development alone. This chapter looks at some of the reasons behind that decision and, more importantly, what bearing it had on the decisions made in the UK.

The first part of the chapter lays out the general common background to nuclear research. It was never a field in which any nation claimed exclusivity and, indeed, even though American scientists led the way in the mid part of the twentieth century, the US did not claim that only it had the right to carry out the work. Since it would be neither feasible nor desirable to detail all atomic research here, only the key moments will be considered to lay the framework into which the political decisions will fit.

The second part of the chapter examines the international, regional and national legal frameworks within which the UK operated. The political decisions which are the focus of this work cannot, and do not, exist in a vacuum and, in the main, they will require passage of some form of legislation to move them from the realms of theory to practice.

The third and fourth sections examine the backgrounds to, and impacts of, the Atomic Energy Act 1946 and the Radioactive Substances Act 1948. The 1946 Act attempted to put in place a regulatory framework for an industry which not only did not exist, but was also one which many people thought would never exist. The 1948 Act, on the other hand, was considerably more prosaic in its intentions, regulating as it did an aspect of the industry which had been flourishing for some time.

The final section of the chapter assesses the success or otherwise of post-war attempts to keep atomic information secret from other governments, regardless of the diplomatic relations that might otherwise exist. The secrecy legislation is considered as is the seemingly limitless ability of atomic spies, such as Klaus Fuchs, to infiltrate the industries and pass highly sensitive information on to enemy governments.

The key decisions which were made in the UK during this period will be examined to assess extent to which they fit within the ideas of “everyday pragmatism,” and Technocratic Decision Making, outlined in the previous chapter. The role that politicians have given to science will also be examined, as it underpins much of both concepts.

The period of time covered in this chapter, therefore, begins and ends before nuclear reactions had been put to any commercial use in the field of electricity generation, running as it does up to the year in which the existence of the UK’s nuclear-weapons’ programme was finally revealed to the House of Commons, although the Secretary of Defence, the Rt Hon Albert Alexander, went on to say that he did not feel it would be in the public interest to give any more detailed information.[151] What is of particular interest here, therefore, is the background which enabled those policies to be put into place which would create an environment into which commercial nuclear power could later emerge.

2.2: Background and Development

Indirectly, the roots of nuclear theory can be traced back to the Greek philosopher

[151] Alexander, A. V., 1948, Armed Forces (Modern Weapons), Hansard, HC Deb 12 May 1948 vol 450 c2117.

Leucippus who, in the fifth century BCE,[152] started to develop the idea that matter was created from particles that were too small to see. For practical purposes, however, the theories behind nuclear power can be traced directly back to the end of the nineteenth century. In 1895, Wilhelm Röntgen had discovered x-rays. The following year, Antoine Becquerel had discovered the phenomenon of natural radioactivity in uranium salts and, in 1898, Pierre and Marie Curie discovered the main radioactive elements in uranium ore (which they named radium and polonium). This was all fundamental or "blue-sky" research, which had no particular purpose other than "improving our understanding of nature."[153] Becquerel and the Curies shared the Nobel Prize for Physics for this work in 1903[154] and both they and Röntgen have given their names to measurements in nuclear physics.[155] Other scientists, notably Ernest Rutherford, Enrico Fermi, Léo Szilárd and Albert Einstein followed up on this research in the early part of the twentieth century. Szilárd, who was convinced of the importance of keeping nuclear technology out of the hands of the Nazis,[156] convinced Einstein to read the manuscript by him and Fermi in 1939. Einstein agreed with Szilárd on the seriousness of the situation and wrote to US President Roosevelt in August of that year, encouraging him to "speed up the experimental work, which is at present being carried out within the limits of the budgets of University Laboratories."[157] Very little of this work was understood by politicians or legislators and, consequently, there was next to no regulation of the work which was being carried out, other than in terms of budgetary constraints.

Without the work of these pioneers, the development of nuclear technology would have been delayed by many years and may have followed a completely different path. These early discoveries created the foundations of scientific knowledge upon which the nuclear industry was built. To paraphrase Newton[158], if the nuclear industry has advanced, it has done so by standing on the shoulders of giants, such as the Curies.

The work on atomic research had been started by scientists working at least ostensibly independently from any government body. Pierre and Marie Curie, for example claimed to be self-funded, but were actually given materials by the Austrian government and laboratory space and support from the French Radioelements industry.[159] Enrico Fermi too was granted $6,000 of funding by the US Armed Forces in 1940 to continue his work at the University of Columbia.[160] Just as politicians use the language and information of 'science' when it suits them to do so, scientists who claim to be independent will often accept funding from industry or governments, and move beyond their field of expertise to advocate particular courses of action. At the time of the Curies and Fermi, this was not regarded as problematic although it has now led to what Professor Worcester identified as a situation where government scientists are less trusted than those working for NGOs,[161] as we saw in the previous chapter.

Despite this knowledge, the generation of electricity through the use of nuclear *fission*

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[152] Berryman, S., 2004, Leucippus, Stanford Encyclopedia of Philosophy, Stanford, MA. Available at http://plato.stanford.edu/entries/leucippus/, accessed on 22/03/10.
[153] Petit, J-C., 2004, op cit, n48.
[154] The Prize was awarded to Becquerel "in recognition of the extraordinary services he has rendered by his discovery of spontaneous radioactivity", and to the Curies "in recognition of the extraordinary services they have rendered by their joint researches on the radiation phenomena discovered by Professor Henri Becquerel." Source: Sutton, K., 2008, Nobel Laureates in Physics: 1901- present, Stanford University, CA: Stanford Linear Accelerator Center Library. Available at http://www.slac.stanford.edu/library/nobel/, accessed on 22/03/10.
[155] See Appendix I for an explanation of the terms used.
[156] Pool, R., 1999, Beyond Engineering: How Society Shapes Technology, Oxford: Oxford University Press, p32.
[157] Einstein, A., 1939, Letter to F. D. Roosevelt, President of the United States, p2. Courtesy of Argonne National Laboratory, Argonne, IL.
[158] In 1676, Isaac Newton wrote, in a letter to Robert Hooke, "If I have seen further it is by standing on the shoulders of giants." Source: Turnbull, H.W., Scott, J.F., & Hall, A.R., eds., 1959, Correspondence of Isaac Newton: Vol. 1, Cambridge: Cambridge University Press.
[159] AIP, 2009, Marie Curie and Her Legend, American Institute of Physics, College Park Maryland. Available at http://www.aip.org/history/curie/romleg.htm, accessed on 22/03/10
[160] Bernardini, C., and Bonolis, L., eds., 2004, Enrico Fermi: His Work and Legacy, Heidelberg, Germany: Springer Verlag, p357
[161] Worcester, R., 1999, op cit, n65.

(i.e., through "splitting the atom") did not become a possibility until December 1942. A team of 50 physicists and chemists, led by Fermi and Szilárd,[162] successfully completed construction of the first self-sustaining nuclear reactor (Chicago Pile-1, or CP-1) in the converted Squash Courts underneath Stagg Field, at the University of Chicago.[163] The first experimental reactor in the United Kingdom was the Graphite Low Energy Experimental Pile (GLEEP) built at Harwell in 1946, which began operating in 1947.[164] Much has been written on Fermi and Szilárd, especially the latter's growing disillusionment with the increasing use by the United States of atomic technology for weaponry,[165] but it will not be discussed further here for two reasons. Firstly, nuclear weapons are beyond the scope of this work and, despite the brief overview above, this is not intended merely to be a biography of the key players in this vast field.

It was not until 1951,[166] a further nine years after CP-1, that the experimental breeder reactor EBR-1, funded by the United States Atomic Energy Commission (US AEC), was built by Westinghouse at the Idaho National Engineering and Environmental Laboratory (INEEL) site in Arco, Idaho. In December of that year, EBR-1 achieved an historic milestone by producing usable amounts of electricity from a nuclear reaction for the first time.[167] Whereas the Fermi-Szilárd reactor was self-sustaining, meaning it required no external power source to keep it going, this reactor produced more power than it consumed. Although the power produced by the EBR-1 reactor in Idaho was usable, the first reactor to be connected to a grid was at Obninsk, near Moscow, on 26 June 1954.[168] The small (5MWe) reactor provided enough electricity for about 2,000 homes.[169]

In the early stages of the development of nuclear power, the threat as accepted by governments was that if the development of this technology was not pursued, then a division would rapidly emerge between the "haves" and the "have nots." British Prime Minister, Clement Attlee, recognised this threat and argued in 1945:

> "Scientists agree that we cannot stop the march of discovery. We can assume that any attempt to keep this as a secret in the hands of the USA and the UK is useless. Scientists in other countries are certain to hit upon the secret…. The most we may have is a few years' start."[170]

In the years covering the end of the Second World War and the immediate post-war period, this fear of being "left behind" was evident in both the penalties imposed under the McMahon Act in the US and the counter-espionage efforts made by the UK, both of which will be discussed below.

2.3: The Legal Framework

Having briefly looked at the background to the introduction of nuclear power, it is now

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[162] ANL, 2003, The Chicago Pile-1 Pioneers, Argonne, IL: Argonne National Laboratory.
[163] The CP-1 reactor went critical on 2 December 1942. It had been constructed by the Nobel prize-winning Italian physicist Professor Enrico Fermi, and the Hungarian nuclear physicist and biologist Dr (later Professor), Léo Szilárd. Source: Lanouette W., Silard, B., & Salk, J., 1994, Genius in the Shadows: A biography of Léo Szilárd, the man behind the Bomb, Chicago, IL: University of Chicago Press.
[164] UKAEA, 2004, Harwell Project Profiles: GLEEP, Harwell: United Kingdom Atomic Energy Authority.
[165] See, for example, Lanouette W., et. al, 1994, op. cit, n163.
[166] EIA, 2001, Energy in the United States: 1635-2000, Washington DC: US Department of Energy, Energy Information Administration.
[167] INEEL, 2003, INEEL's Historical Contributions, Idaho National Engineering and Environmental Laboratory, San Francisco, CA: US Atomic Energy Commission. The reactor, an experimental "breeder" type reactor known as EBR-1 first produced electricity on 20 December 1951.
[168] IAEA, 2004b, From Obninsk Beyond: Nuclear Power Conference Looks to Future, Vienna: International Atomic Energy Agency.
[169] Ibid.
[170] Hennessey, P., 2006, Having It So Good: Britain in the Fifties, London: Allen Land Publishing, p137. National Archives, nd, Transcript: Extracts from a memorandum on the Atom Bomb from Prime Minister Clement Attlee, 28th August 1945. Catalogue Ref CAB 126/257.

necessary to consider the legislation that gave rise to the structure within which the nuclear industry operated. In total, there have been over thirty Acts of Parliament and almost 130 pieces of secondary legislation concerning the nuclear power industry since 1946.[171] Scientific guidance in preparation of legislation comes from, *inter alia,* the International Atomic Energy Agency (IAEA), the European Atomic Energy Community (Euratom), the Nuclear Energy Agency (NEA) and UKAEA, the development of all of which will be discussed below. This guidance has strong persuasive powers, but it is not all binding on governmental policy-making decisions. As will be shown, this legislation will have been triggered at one of three levels:

(1) National. Generally, the UK government instigates legislation following a national consultation process.[172] This process begins with the issuing of Green Papers and consultation documents which are then followed by White Papers. A White Paper forms the basis of a Bill which is then debated at length before both houses of Parliament. Once the debating process is complete, the amended Bill may receive Royal Assent and become a full Act of Parliament.[173]

(2) European. The UK has been a member of the EEC (now EU) since 1973 and, with the passing of the European Communities Act 1972, must incorporate European Directives into national law.[174] The atomic energy aspect of the EU is covered by Euratom, which was founded as one of the three parallel communities in 1958. Euratom merged with the European Coal and Steel Community and the European Economic Community under the Merger Treaty in 1965 to become part of the new EEC.[175] This means that the UK, unlike the founding members of the EEC, has only ever belonged to the merged Community, which dealt with atomic power as an integral part of economic policy.[176]

(3) International. The UK is a signatory to a large number of international treaties (mainly, but not exclusively, through its membership of the United Nations and EU), which have had a bearing on several of the pieces of statute to be discussed below. International Law is generally separated into 'hard' law (created through the recognized procedure of law-making in international law)[177] and 'soft' law (the more informal stages in the conception of rules of international law, when these have not yet crystallized)[178] and is rarely, if ever, binding on individuals.[179]

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[171] See Appendix II for full list of primary, secondary and repealed legislation. The legislation was traced using the legal database Lexis (www.lexis-nexis.com) and the search terms "nuclear", "atomic", "radioactive" "radiological" and "radiation." Legislation which dealt with other aspects of radioactive material (e.g., hospitals, weapons, luminous watches) was omitted from the appendix. A total of 31 Acts and 126 Statutory Instruments (SIs – Regulations or Orders) have been passed, though some (5 Acts and 48 SIs) have since been revoked and repealed. Statutory Instruments taking the form of Commencement Orders have been omitted from these figures. The searches were carried out on 13/03/09.

[172] "Private members' Bills are unlikely to become law… although there have been some notable exceptions." Source: Ingman, T., 2006, The English Legal Process, Oxford: Oxford University Press, 11th Ed. p205.

[173] de Smith, S., & Brazier, R., 1999, Constitutional and Administrative Law, London: Penguin Books, 7th Ed p273.

[174] Section 2(1) European Communities Act 1972.

[175] The Merger Treaty was signed in Brussels on 8 April 1965 and came into force on 1 July 1967. It provided for a Single Commission and a Single Council of the then three European Communities.

[176] Most of the legislation emerging from the EEC on nuclear power was in the form of Directives, which set out the end result but leave the method to the Member States. There have been a number of Regulations (e.g. Council Regulation (EURATOM) No 1493/93 on Shipments of Radioactive Substances between Member States, and Council Regulation (EURATOM) No 300/2007 establishing an Instrument for Nuclear Safety Cooperation), but these have mostly concerned the transportation of radioactive waste.

[177] PADELIA, 1999, Handbook on The Implementation of Conventions Related to Biological Diversity in Africa, Nairobi: UNEP Partnership for the Development of Environmental Law and Institutions in Africa, p82.

[178] Ibid.

UK policy on nuclear power has rarely, if ever, existed outside some form of international control thus, theoretically, this section could cover the whole of the UK's policy over six decades. However, it will be limited to those international efforts which directly impacted on UK legislation or which created bodies to oversee global and regional nuclear policy.

In practice, a good example of hard law would be the 1980 Vienna Convention on the Physical Protection on Nuclear Material discussed below. The Convention is binding on the 35 signatory states and, if there is a dispute between two signatories, there is a mechanism for resolution. Non-signatory states are not affected by the terms of the treaty in any way, and can neither enforce its terms nor be subjects to sanctions for non-compliance. A specific example of soft law in the area of nuclear power is somewhat harder to find, however. The guidelines of the French-based OECD Nuclear Energy Agency would be one possibility. As a voluntary organisation, the NEA has no real binding power but, instead, it works as:

> "a forum for sharing information and experience and promoting international co-operation; a centre of excellence which helps Member countries to pool and maintain their technical expertise; a vehicle for facilitating policy analyses and developing consensus based on its technical work."[180]

Whether hard or soft, international law provides the framework within which national legislation tends to operate. This means that the events and bodies discussed below, which all either led to the creation of international measures, or were created because of them, all have a bearing on the UK's nuclear policy which is to a large extent outside the control of our own politicians.

In addition to the different levels at which legislation has been triggered, it can be shown that there are several thematic motifs running thorough the legislation. The overlying approach of government in this area has consistently followed the traditional, top-down, command and control (CAC) model of regulation, in which standards are set that have to be met by all operators in the area, with compliance with those standards being monitored regularly.[181] CAC strategies are the most straightforward to put in place, but they "will normally not be cost effective"[182] even though "cost effectiveness... depends on local circumstances."[183] This is because the initial simplicity of any CAC model has two inherent weaknesses:

(1) it presupposes the same ambient environmental standards across wide geographical areas; and

(2) it is generally based on baseline and background data which, due to the inherent scientific complexity of ecosystems, can never be relied upon completely.

Despite these weaknesses, the generalised CAC approach was revived in the UK in 2007 with the pre-approval of new reactor types which is discussed in the appendix.

Of all of the time periods covered here, this will be the most straightforward to address in terms of the domestic legislation which was passed in relation to the commercial nuclear industry. To put it simply, there were only two Acts passed in the UK. There were, however, interesting developments internationally which had an equally important bearing on the UK's policies, and these will also be discussed here.

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[179] For more discussion of the role of soft law, see Ho. D., Compliance and International Soft Law: Why do Countries Implement the Basle Accord? JIEL 2002 5 (647). For exploration of the role of hard and soft law see Guzman, A, The Design of International Agreements EJIL 2005 16 (579)

[180] NEA, 2005, The Nuclear Energy Agency: The NEA Mission, Issy-les-Moulineaux: Nuclear Energy Agency of the OECD.

[181] Tietenberg, T., 2006, Environmental Economics and Policy, Boston, MA: Addison Wesley, 5th Ed. p230.

[182] Tietenberg, T., 2006, op cit, n181, p237.

[183] Ibid.

2.3.1: Background – International

In January 1946, with the very first resolution of the General Assembly, the United Nations had formed an Atomic Energy Commission (UNAEC) to ensure that atomic energy was only used for peaceful purposes and that all atomic weapons and other weapons of mass destruction were eliminated from national arsenals.[184] Membership of the UN Atomic Energy Commission consisted of the five permanent members of the UN Security Council (USA, UK, USSR, France and China[185]), along with Canada, which was included because of its wartime role in nuclear weapons research. The members could not, however, come to an agreement on the issue of elimination and the UNAEC was dissolved by the General Assembly in 1952.[186] Four years later, a successor body, the IAEA, was finally established by the UN, albeit with a slightly different remit, having abandoned its seemingly futile quest to eliminate atomic weapons:

> "The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."[187]

In March 1946, James F. Byrnes, the United States Secretary of State, made public a Report on the International Control of Atomic Energy (the Acheson-Lilienthal Report).[188] This report made a strong link between future research into atomic energy and the dangers of atomic warfare, and proposed a series of plans to avoid the occurrence of the latter. The report also came to two further conclusions:

> "Inspections could not be relied upon to ensure that States were complying with prohibitions on developing nuclear weapons whilst simultaneously allowing them to develop atomic energy; but
>
> If a way could be found, it could not only ensure security, but also foster beneficial and humanitarian uses of atomic energy."[189]

Partly in order to address the issues raised in the Acheson-Lilienthal Report and, partly to ensure its own continued superiority in the field, the United States also passed an Atomic Energy Act in 1946.[190] Unlike its UK counterpart, which is covered below, this Act established a body to oversee the development of atomic energy, the US AEC,[191] which was authorised to establish safety and health regulations for the possession and use of fissionable and by-product materials; thus, effectively, regulating itself.[192] The US AEC took over the work of the Manhattan Project at midnight on 31 December 1946,[193] after some debate in Congress as to whether or not nuclear technology should remain exclusively under military control[194] – an argument which was diametrically opposed to

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[184] Section 5 of UN Resolution 1(I) on the Establishment of a Commission to Deal with the Problems Raised by the Discovery of Atomic Energy. The resolution is rather short, extending to only five sections.
[185] UN, 2005, United Nations Documentation: Research Guide, New York, NY: United Nations Dag Hammarskjöld Library.
[186] UN DDA, 2000, The Treaty on the non-proliferation of Nuclear Weapons (NPT), New York, NY: UN Department for Disarmament Affairs.
[187] Article II, Statute of the International Atomic Energy Authority, 1956.
[188] Barnard, C. I., et al, 1946, The Acheson-Lilienthal Report on the International Control of Atomic Energy, Washington, DC: US Secretary of State's Committee on Atomic Energy.
[189] Ibid, p9.
[190] The Act stemmed from the McMahon Bill, and is thus also sometimes referred to as the McMahon Act. Source: OEM, 2004, Timeline: July 1946, Washington DC: US Department of Energy, Office of Environmental Management.
[191] OEM, 1995, Brief History Since 1941 of Selected Applicable Statutes Pertaining to DOE Nuclear Facilities, Washington DC: US Department of Energy, Office of Environmental Management.
[192] §2 US Atomic Energy Act of 1946.
[193] OEM, 2004, op. Cit, n190.
[194] Ibid.

that put forward in the Baruch Plan.[195] Also, like the UNAEC, the US AEC no longer exists. After increasing criticism of the AEC's double role as the proponent of the use of atomic energy on the one hand, and the industry regulator on the other,[196] it was abolished in 1974 by the Energy Reorganization Act, which will be discussed further in Chapter Three. Of the three bodies set up at the start of their relevant atomic power programmes, therefore, the UKAEA (which was set up few years later) is the only one which has not had to be abolished – although its twenty-first century remit is far removed from that of 1954.

The extent of the threats posed by the wartime use of nuclear technology was not accurately predicted prior to report of the Manhattan Engineer District on the bombings of Hiroshima and Nagasaki, which had limited publication in June 1946.[197] Some side effects were noted, but it had been suggested that these could be screened,[198] making the widespread commercial and private use of nuclear power viable and turning "the Era of Atomic Energy into the Age of Plenty."[199] The potential for risk, therefore, had been acknowledged, but the scale of the impact were that risk to occur, had not, so it was not felt to be serious enough to warrant standing in the way of such a great technological leap forward. This is perhaps best illustrated in the United States' legislation, particularly the Atomic Energy Act of 1946, which states:

> "It is a field in which unknown factors are involved…. It is reasonable to anticipate, however, that tapping this new source of energy will cause profound changes in our present way of life."[200]

The US statute, illustrated the seriousness with which the science behind nuclear reactions was regarded by imposing harsh penalties on anyone who broke the law. Section 10(b) relates to the disclosure of restricted information and allows for a range of punishments – from a $20,000 fine, through maximum terms of imprisonment of 20 years or life to, in the most serious cases, the death penalty.[201]

Despite collaboration with the UK and Canada during the Manhattan Project, a combination of the McMahon Bill (which, as was shown above, had made passing nuclear-related secrets into a potentially capital offence) and "the deepening rift between the US and the USSR… the US moved closer to the McMahon concept and drew a veil of total secrecy over all nuclear matters"[202] in 1946. As an important, but relatively minor, partner in the development of nuclear technology, the UK had been heavily reliant on progress made in the US and this move would have left the UK out of the race towards nuclear power. Having been cut off from this research, however, the Government set up its own "atomic energy project… under the Ministry of Supply"[203] at the end of 1945. This project was to remain more of a theoretical idea than a practical one, as the creation of a single agency in the UK to take on this responsibility remained nine years away.[204]

It was, perhaps, too soon after the end of the war to expect countries to share the technology they had spent years developing – either through their own research or by

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[195] The Baruch Plan is discussed in more detail in Appendix I.
[196] This came to a head with the problems over the Emergency Core Cooling System (ECCS) which the AEC wanted to introduce, but which many of its own scientists felt unhappy about. Source: Joppke, C., 1993, Mobilizing against Nuclear Energy: A Comparison of Germany and the United States, Berkeley, CA: University of California Press.
[197] Groves, Maj. Gen. L.R., 1946, The Atomic Bombings of Hiroshima and Nagasaki, The Manhattan Engineer District Investigating Group, June 29th 1946. Also referred to as the Groves Report.
[198] Dietz, D., 1945, Atomic Energy in the Coming Era, New York, NY: Dodd, Mead & Company. Dietz talks about "artificial suns" made from U-235 mounted on buildings, but accepts that "the globes of such artificial suns, however, will have to screen out the lethal rays produced by the disintegration of the uranium 235" (p19).
[199] Ibid, p12.
[200] §1 US Atomic Energy Act of 1946.
[201] §10(b)(2)(A) US Atomic Energy Act of 1946.
[202] Beck, P, 1994, Prospects and Strategies for Nuclear Power: Global Boon or Dangerous Disaster? London: Earthscan / Royal Institute of International Affairs, p19.
[203] Jay, K., 1956, op cit, n125, p9. The project comprised the Atomic Energy Research Establishment at Harwell, and the Production Division at Risley.
[204] The United Kingdom Atomic Energy Authority was set up in 1954 by the Atomic Energy Authority Act 1954, and will be discussed further in the following chapter.

espionage. It is argued that this air of selfishness in research had started when the United States was so quick to ban its own collaboration with Canada and the UK in 1943. Attlee's passionate support for the Baruch plan, and the readiness of the UK and Canada to endorse it, seem to give the lie to that argument, until it is realised that the UK and Canada had more to gain than to lose by sharing atomic information – since the US had the lion's share of the data, the UK and Canada would have been net beneficiaries. This situation fits comfortably with the ideas of both Jasanoff[205] and Teichman[206] of a technocratic élite controlling policy making – some of those in the United States calling with the loudest voices against information sharing were the atomic scientists.[207]

There existed a further common point about the UNAEC, US AEC and AEA 1946. January 1946, when UN Resolution 1(I) was passed, was only five months after the use of atomic bombs on Hiroshima and Nagasaki (and five months *prior* to Major-General Groves' report into those bombings),[208] and just over three years after the successful inaugural test of the Fermi-Szilárd reactor in Chicago (see above). The United States passed its own Atomic Energy Act in August, with the UK not far behind in November – still only fifteen months after Hiroshima. All three also *pre-date* the first production of usable electricity from a nuclear reaction and illustrate the speed with which both the national and international communities were working to set up agencies when the practical science had yet to be developed. As was stated at the beginning of this section, this fits effectively within the theory that policies were being adopted with a level of precaution as to their effects. This is nothing new: there has seldom been a government policy put into place without at least some thought having been given as to its effects. What *is* new here is an appreciation of the potential scale of the effects if the policy were to be flawed, and the measures that were put into place to make sure it worked: harsh prison terms for anyone who refused to give up information; sweeping powers to acquire land; a Ministerial duty to promote the use of the new technology and further Ministerial "control of [the] development"[209] of atomic energy.

The speed of decision-making also served to emphasise the political repercussions of the use of atomic weapons by the United States. As we have seen, international reactions can be broadly categorised into two camps: on one side, those countries without an established programme for developing weapons, which supported the Baruch Plan's proposed ban on all atomic weapons and wanted the benefits of nuclear power and, on the other side, those which had already invested heavily in their own weapons-research programmes and saw the development of atomic weaponry as a matter of national pride, or security, or both. Despite Attlee's efforts, the UK fell quite definitely into the latter camp.

2.3.2: Background – Domestic

The fact that any statute on atomic energy was passed in the UK at all would not have been predictable only a few years before the Atomic Energy Act 1946. The MAUD Committee, which had been set up in 1939, was an independent scientific body which carried out research into atomic reactions.[210] The committee, chaired by the physicist Professor (later Sir) George Paget Thomson, was, in effect, a sub-committee of the Royal Society's Committee for the Scientific Study of Air Warfare, and its mandate was to carry

[205] Jasanoff, S., 1994, op cit, n95.
[206] Teichman, J., 1997, op cit, n94.
[207] Edward Teller, for example, often referred to as a "father of the hydrogen bomb" was keen to maintain American scientific and technological supremacy. Source: McMillan, P., 2005, The Ruin of J. Robert Oppenheimer and The Birth of the Arms Race, New York, NY: Viking Press
[208] Groves, Maj. Gen. L.R., 1946, op. cit, n197.
[209] Long Title, Atomic Energy Act 1946.
[210] For several years, the MAUD Committee was referred to obliquely as the "x-metal" or "tube alloy" programme. Source: Dahl, P., 1999, Heavy Water and the Wartime Race for Nuclear Energy, Bristol: Institute of Physics Publishing, p118.

out "an in-depth review of atomic energy from uranium fission for military purposes."[211] The Chairman of the contemporaneous Aeronautical Research Committee, the chemist, Sir Henry Tizard, "failed to see much of a future for nuclear power at all."[212]

During the negotiations for what was to become the Quebec Agreement of August 1943[213] Winston Churchill and the Lord President of the Council, Sir John Anderson, echoed this sentiment, telling the American Secretary of War, Henry L Stimson, that the prospects for Britain's post-war commercial exploitation of nuclear power were "remote and hardly worth considering."[214] Churchill and Anderson's statement served two purposes. Firstly, it satisfied the fears of the Americans, who had been reluctant to continue working with the British on atomic research because of the risks of Britain using the technology for its own purposes. Secondly, it meant that the British could ensure that the Americans could not "secure a monopoly in a field of enormous potential military and industrial value."[215] Even though both countries publicly stated that they felt a nuclear-power programme was something of a lame duck, neither seems to have wanted to forgo the possibility of reaping economic and spin-off benefits from pursuing such a programme.

Despite Churchill and Anderson's statement to the contrary only two years earlier, immediately after the war, decision-making in the nuclear research field was controlled by an "ad hoc committee of Cabinet ministers, called GEN.75,"[216] which was created by Attlee in October 1945. The Committee, also known as the "Cabinet Committee on Atomic Energy"[217] did not include the Minister of Fuel and Power, Emanuel Shinwell.[218] Shinwell was to oversee the post-war nationalisation of the coal industry and the creation of the National Coal Board in 1947. He was also in charge of coal stocks, which had been run dangerously low by the exceptionally cold winter of 1947, although "some of the problem with coal stock was undoubtedly Manny Shinwell's weakness as Minister for Fuel and Power."[219] This is illustrative of the fact that, in its early years, nuclear energy was little more than a by-product of the manufacture of plutonium for atomic weapons. The decision to restrict its discussions to a small portion of the Cabinet can therefore be attributed to Diego's idea of political pragmatism – as it was not yet seen as an important area itself, despite being a spin-off from nuclear weapons, and "what works" in terms of getting a decision made is reducing the number of consultees to a minimum. It would therefore have been unnecessary to have discussed it with the full Cabinet. This was emphasised within a few days of the formation of GEN.75, when Attlee was asked by the Conservative MP, Lt Col (later Sir) Martin Lindsay, during a House of Commons' debate when a full debate on atomic energy was likely. Attlee replied that he did not "think a Debate could usefully take place; but a statement will be made as soon as possible."[220]

GEN.75 only survived for about eighteen months before evolving into a further, even more exclusive committee, GEN.163, but, in its short lifespan, it did authorise the construction of the atomic pile at Windscale; which was intended to irradiate uranium in order to produce plutonium for the nuclear-weapons' programme.[221] One of the final acts of GEN.75, however, was for the Chancellor of the Exchequer, Hugh Dalton, and President of the Board of Trade, Sir Stafford Cripps, to argue strongly that the creation of a British nuclear weapon at £30-£40m[222] was becoming far too expensive,[223] an argument to which

[211] Ibid.
[212] Hall, T., 1986, Nuclear Politics: The history of nuclear power in Britain, Harmondsworth: Penguin Books, p19.
[213] See Appendix I
[214] Hall, T., 1986, op cit, n212, p21
[215] Ibid.
[216] Hall, T., 1986, op cit, n212, p26
[217] Hennessey, P., 2003, The Secret State: Whitehall and the Cold War, London: Penguin Books.
[218] Hall, T., 1986, op cit, n212, p26
[219] Helm, D., 2004, Energy, the State, and the Market: British Energy Policy since 1979, Oxford: Oxford University Press, p20.
[220] Attlee, C., 1945a, Atomic Energy (Government Policy). HC Deb 25 October 1945 vol 414 c2196
[221] Hennessey, P., 2007, Cabinets and The Bomb, British Academy Occasional Paper 11, Oxford: Oxford University Press, p8
[222] National Archives, nd, Minutes of the 15th meeting of GEN.75, 25 October 1946, Catalogue Ref: CAB 130/2

the Foreign Secretary, Ernest Bevin, responded:

> "We've got to have this thing over here whatever it costs. We've got to have the bloody Union Jack on top of it."[224]

The new GEN.163 committee consisted of the same members as GEN.75, only without the two chief doubters, Sir Stafford Cripps and Hugh Dalton.[225] It only met once, and its sole purpose appears to have been to make the decision to produce an atomic bomb[226] – once this was done, the committee was disbanded.

Both GEN.75 and GEN.163 were working on the basis that the major drive of research should be towards the development of atomic weapons and thus atomic energy production was a sideline to the plutonium-enrichment process. This was backed up by the fact that "the first Controller of Production of Atomic Energy (within the Ministry of Supply) was Marshal of the RAF Lord Portal of Hungerford."[227] Portal's chain of command for this role led directly back to Attlee and the activities in which his team were involved were "beyond question by anyone, even the Ministry of Defence."[228] Partly, it can be argued, this focus on atomic weaponry as opposed to power can be linked to the state of development of the technology itself, since no reactor had yet been constructed which actually produced a usable amount of electricity. Equally, if not more so, the focus will have been created by a combination of the cooling of relations and mutual suspicion of the Soviet Union by the Western powers[229] (which Bernard Baruch was to refer to, in 1947, as "a cold war"[230]) and the desire to see Britain in the vanguard of technological development (as evidenced by Bevin's "bloody Union Jack" comment, above[231]). This would suggest that, unlike the early discussions on the possible dead-end technology of nuclear energy, discussions on nuclear weapons brought with them a raft of other issues. Britain's place in the post-war world, for example, was seen by Cripps as being dependent on development of an independent nuclear weapon "whatever it costs."

All of the decisions made by GEN.75 and GEN.163 were kept secret until the 1970s, and this lack of accountability in relation to Britain's atomic programme was later to lead to accusations that the "British [nuclear] industry continues to exhibit little enthusiasm for freedom of information."[232] As we have seen, the decision-making body did not include the Chancellor of the Exchequer, the Minister for Fuel and Power or the President of the Board of Trade. Put very simply, this meant that there was no representation from, or oversight by, the members of the cabinet in charge of money, business or the energy industry; all of whom should have been essential elements of a nuclear industry. Returning to the ideas put forward by Jasanoff[233] and Teichman,[234] above, about rule by a technocratic decision making élite being the hallmark of TDM, this does not really ring true. The combination of Attlee, Cripps, Dalton and Bevin which made up GEN.75, and Attlee and Bevin which made up GEN.163 was certainly a decision making élite, at the very least in the sense of being "a group of people considered to be superior in an organisation,"[235] but shows little sign of being technocratic.

The rationale given for the decisions taken by the various Cabinet Committees is interesting. At home, in public, Attlee was using the rhetoric of science and arguing that

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[223] Ibid, p48
[224] Hennessey, P., 1982, How Bevin saved Britain's bomb, The Times, 30 September, p10
[225] Hennessey, P., 2003, op cit, n217, p49
[226] Hall, T., 1986, op cit, n212, p26
[227] Gray, P., 2002, Air Power: The Asymmetric Edge, Air Power Review, 5 (3) 1-12.
[228] Hall, T., 1986, op cit, n212, p27
[229] Schrafstetter, S., & Twigge, S.R., 2004, Avoiding Armageddon: Western Europe, the United States, and the Struggle for Nuclear Non-Proliferation, 1945- 1970, Santa Barbara, CA: Greenwood Press, p20
[230] Gaddis, J.L., 2007, The Cold War, London: Penguin
[231] See also Harris, K., 1982, Attlee, London: Wiedenfeld & Nicholson, p256
[232] Welsh, I., 2000, Mobilising Modernity: The nuclear moment, London: Routledge, p218.
[233] Jasanoff, S., 1994, op cit, n95
[234] Teichman, J., 1997, op cit, n94
[235] Elliott, J., ed., 2001, op cit, n20, p463

since "[s]cientists agree that we cannot stop the march of discovery"[236] it was beholden on all of the British Government, Parliament and people to support the development of nuclear technology. Within a month or two, however, he had announced not only that there would be no parliamentary debate at that time, but that it would not even be useful to have one, as the science (relating both to weapons and energy) was so complex.[237] In cabinet meetings, however, Attlee seemed to move away from this stance, claiming that:

> "the only hope for the world is that we should all lay aside our nationalistic ideas and strive without reservation to bring about an international relationship in which war is entirely ruled out."[238]

Again, this illustrates the distinction between atomic energy and atomic weapons – the former was regarded at the time as being a sideline, and so could be dealt with on a pragmatic basis, whereas the latter was subject to many different political and personal positions, including those of Cripps, who was primarily concerned with Britain's place in the world, and Attlee, who wanted to work towards an end to war itself.

Away from home, in the UN General Assembly, Attlee was again arguing passionately that the plan for the eventual global elimination of atomic weapons outlined by US representative to the UN Atomic Energy Commission, Bernard Baruch,[239] gave communities "a choice between life and death."[240] Attlee had also written the previous year to President Truman arguing that "if mankind continues to make the atomic bomb without changing the political relationships of States, sooner or later these bombs will be used for mutual annihilation."[241]

In addition to playing up the inevitability of atomic discoveries and the associated need to change the control of atomic weapons from nations to the UN (an argument which was initially supported by President Truman[242]), Attlee and Bevin were determined to press ahead with the independent development of an atomic weapon (and, as a sideline, atomic energy) because they felt they had been let down by the US Government and the terms of the McMahon Act, regarding the latter as a "breach of faith."[243] Bevin, in his determined arguments at the GEN.75 meeting in October 1946, gave a clue as to his reasons for insisting so strongly that the UK had its own nuclear programme, saying:

> "I don't mind for myself, but I don't want any other Foreign Secretary of this country to be talked at or to by a Secretary of State in the United States as I have just had [sic] in my discussions with Mr Byrnes."[244]

At about the same time as the Baruch Plan was being rejected by the United Nations, the Nobel Prize-winning physicist and MAUD Committee member, Professor PMS Blackett (later Lord Blackett of Chelsea), was arguing that this failure was inevitable as "it attempted the impossible. The attempt to find complete security was bound to fail in the field of atomic energy as in all other fields of life."[245] Blackett, who had been a member of Sir Henry Tizard's Aeronautical Research Committee, also rather scathingly pointed out that the American public "became so frightened [by publicity surrounding the dangers of atomic weapons] that nothing but the prospect of 100 per cent safety became acceptable."[246] That this fear was evident so early in the development of atomic weapons

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[236] Hennessey, P., 2006, op cit, n170
[237] Attlee, C., 1945a, op cit, n221
[238] Attlee, C., 1945b, Memorandum from the Prime Minister, 5 November 1945. National Archives Catalogue Ref CAB 130/3, GEN 75/12.
[239] See Appendix I
[240] Attlee, C., 1946a, Address to the United Nations, 19 June 1946. Audio recording available at http://www.authentichistory.com/1950s/speeches/19460619_Clement_Attlee_On_Atomic_Weapons.html accessed on 17/03/09
[241] Williams, F., 1961, A Prime Minister Remembers: The War and Post-War diaries of The Rt Hon Earl Attlee, London: Heinemann, p98
[242] Harris, K., 1982, op cit, n232, p278
[243] Williams, F., 1961, op cit, n242, p109
[244] Hennessey, P., 1982, n225, op cit
[245] Blackett, P.M.S., 1949, Military and Political Consequences of Atomic Energy, London: Turnstile Press, p144.
[246] Ibid.

is interesting, since the American public were forbidden from knowing anything about the technology. It is also likely to have provided a good rationale for keeping the information secret.

Here then we have a situation where the Prime Minister, a man described variously as "no intellectual"[247] and "singularly free of the certainty that he knew what was right for party and country,"[248] using ideas inherited from unnamed scientists to push for the country's involvement in a new form of weaponry *and* energy; albeit to develop technologies which he intended would later be passed to the United Nations. Two of his senior Cabinet Ministers (Cripps and Dalton) disapproved on economic grounds of the decision to continue with the atomic-weapon plan, but the decision was forced through by Bevin, whose opinion that President Truman and Secretary Byrnes lacked judgement[249] may have been exacerbated by his perceived poor treatment by them, outlined above.

The wider public, and even the wider membership of the Government, were being told as little as possible about the developments, even while the parliamentary debate was underway for the Atomic Energy Bill. Whilst it again sounds like an élite of sorts, it also suggests that the premise outlined in the previous chapter, that politicians will use scientific discourse to camouflage pragmatic decisions by "blinding the public with science"[250] may not be entirely accurate. In this case, there was no information revealed to the government, parliament or the public, and thus there was no need to camouflage anything. Either way, in the case of deciding to construct the UK's atomic bomb and the associated energy-producing plants, the few politicians who were aware of it flatly refused to admit that they had made a decision in the first place.

2.4: The Atomic Energy Act 1946

Out of this maelstrom of secret deals, public denials and political wrangling was born the first-ever piece of legislation in the UK concerning nuclear-power generation, the Atomic Energy Act 1946. When he introduced the second reading of the Bill in the House of Commons in the afternoon of 8 October 1946, the Prime Minister had made several key points, including:

> "The full economic significance of atomic energy is not yet known"
>
> "The programme of work already approved will cost something like £30 million"
>
> "We are anxious that research should be encouraged — not merely not impeded, but encouraged — and research is being undertaken by universities and by commercial firms under contracts placed and financed by the Government."[251]

The Act was one of 55 Acts passed by the Attlee government in its first fifteen months after taking power,[252] and formed part of the busiest parliamentary year in terms of new Acts since 1939 and the third busiest since 1925.[253] Given the finite time available for parliamentary debates, and the fact that nuclear energy was still predominantly seen as an interesting sideline, it is perhaps not surprising that the House of Commons discussions surrounding the Act lasted for only three hours on 8 October and four hours on 11

[247] Marr, A., 2008, A History of Modern Britain, London: Pan Books, p17
[248] Harris, K., 1982, op cit, n232, p566.
[249] Ibid, p293
[250] DeGarmo, D., 2004, The Blinded U.S. with Science: Scientific Underpinnings of US foreign policy, American Political Sciences Association Conference Proceeding, p36
[251] Attlee, C., 1946b, Atomic Energy Bill, HC Deb 08 October 1946 vol 427 c47
[252] King, P., 1980, Twentieth-Century British History Made Simple, London: W H Allen, p258.
[253] In 1925, there had been 91 Acts of Parliament. In 1938, that figure was 703, and in 1939, 123. This makes 1946 a busy year. It was also the second busiest year between 1940 and 1953. By way of contrast, the years 2004-7 saw 38, 24, 54 and 31 Acts passed respectively. Figures obtained from the HMSO's Public and General Acts and Measures series, published annually.

October.[254]

Described (in the Long Title to the Act) as "An Act to provide for the development of atomic energy and the control of such development, and for purposes connected therewith" it was a relatively short and general Act containing only 21 sections and two Schedules, which is to be expected since the Act was controlling an industry which did not yet exist. The Act was entered onto the statute books on 6 November 1946, slightly less than a month after it was introduced to the House. This is a far shorter time period than one would expect an important, though comparatively short, Bill to take. The imprecise nature of the long title suggests that the science had not yet been fully developed, and the discussions around it imply that it would be far better for the Minister (and hence the government) to control it than it would be to leave it to the open market. This gives the framework within which Attlee's comments (above) about research being carried out by universities but financed by the government could operate.

Section 1 gives a wide duty to the Minister of Supply "to promote and control the development of atomic energy." Section 2 of the Act supplemented the Minister's duty with further powers, relating to the "production use and disposal"[255] of atomic energy and associated research, combined with any steps that were considered necessary for storage and transport of any of the articles required to carry out these powers. The catchall section included the power to do "all such things… as appear to the Minister necessary or expedient for the exercise of the foregoing powers."[256] Section 2 is clearly a pragmatic measure, since it is broad and is the section which gives practical effectiveness to the duty given in section 1 – in other words, section 2 is what is needed to make section 1 work, when it is "what works [that] is the hallmark"[257] of political pragmatism. Section 1 on the other hand gives a strong duty to the Minister to promote the development of atomic energy, which is harder to classify directly as pragmatic, either in the "everyday" or political sense, since without the passage of the Act, the development of atomic energy in any commercial sense was not even mentioned, let alone being an inevitability. However, what was inevitable, given the thrust to create atomic weapons was that some energy would be created as a by-product. The "development" mentioned in the section is focused primarily on scientific development rather than the commercial development – this latter would not become a possibility for several years yet. Indeed, one of the suggested additions to the section while it was being debated in the House of Commons was:

> "by assisting and fostering private research and development and by a programme of Government-conducted research and development, in order to encourage maximum scientific progress."[258]

Under the powers given to the Minister in section 2 of the Act, the Atomic Energy Research Establishment (AERE) was created to "provide the basic scientific data and understanding needed to launch and underpin Britain's atomic energy projects."[259] The first AERE Director was John Cockcroft, who had previously worked with the Ministry of Supply as Assistant Director of Scientific Research, in which role he oversaw the development of radar in the early 1940s.[260] Cockcroft, who by then had been awarded the Nobel Prize for Physics,[261] would later become one of the first committee members of the

[254] Information taken from Hansard (HC Deb 08 October 1946 vol 427 cc43-98, and HC Deb 11 October 1946 vol 427 cc495-571)
[255] Section 2(1)(a) Atomic Energy Act 1946.
[256] Section 2(1)(c) Atomic Energy Act 1946.
[257] Diego, R., 2004, op cit, n31
[258] Clifton-Brown, D., 1946, CLAUSE 1.—(General duty of Minister of Supply.), HC Deb 11 October 1946 vol 427 c495
[259] Cottrell, A., 1996, History in the Making, Lecture given at Cockcroft Hall, University of Cambridge, May 1996.
[260] Elsevier, 1964, Nobel Lectures. Physics 1942-1962, Amsterdam: Elsevier Publishing Company.
[261] Cockcroft shared the 1951 Nobel Prize for Physics with Ernest Walton, "for their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles." This is generally referred to as "splitting the atom." Source: Nobel, 2003, The Nobel Prize in Physics 1951, Nobel e-Library, Sweden. Available at http://nobelprize.org/nobel_prizes/physics/laureates/1951/ accessed on 22/03/10.

UK Atomic Energy Authority in 1954,[262] making the natural transition from research itself to overseeing the research of others.

The Act further gave the Minster the ability to compel members of the public to surrender any information pertaining to atomic power[263] and imposed criminal liability upon anyone who refused to concede to such a demand. Offences under the Act were punishable by a period of imprisonment of up to three months or a fine of up to £100 (or both) on summary conviction. If the offence led to a conviction on indictment, the penalty was far stiffer – imprisonment of up to five years, a fine of up to £500, or both.[264] The prison terms remain unchanged, but the levels of the fines have subsequently been changed, so that the fine for a conviction on indictment under the amended Act can be "of any amount."[265] The potential for an unlimited fine and imprisonment purely for non-disclosure of information is considerably stiffer than others that are now imposed under other statute. [266] When the Bill was introduced, the Prime Minister admitted that some of the proposed powers might appear to be rather drastic, but justified them by arguing that:

> "[W]e are dealing with an unusual subject. I think it essential the Government must be able to inform themselves fully of unauthorised activities, not, as I said before, only in the interests of this country, but in view of the fact that we are working to try to get international control in which we must play our full part."[267]

In contrast to many subsequent Acts, it is somewhat surprising to find that there was no provision made in the Atomic Energy Act 1946 for the situation where false information pertaining to nuclear-power declaration is given to an Inspector. This led to the potential for a situation whereby, if one refused to supply relevant information to the Minister (or, more likely, those who were acting on his authority), one could end up in prison for up to five years. If, on the other hand, one provided information which was false, there was no sanction available. This can partly be explained by the fact that it would only be the atomic scientists who would have been able to correctly assess the veracity of information, and so to specifically seek to punish the public for issues they could not control would be seen as unfair. These powers are interesting for several reasons. Firstly, they can only work if there is a presumption that members of the public have "information pertaining to atomic power" at a time when, globally, there was not a great deal of such information in existence. Secondly, in light of the earlier discussion which suggested that the Minister was unlikely to have any in-depth knowledge of atomic and would, therefore, be unlikely to be able to tell who was giving false information. Finally, there is no distinction in the Act between "relevant information" which concerns the physics of a nuclear reaction, and "relevant information" which pertains solely to the whereabouts of a particular individual. Section 11 of the Act[268] generated the longest and most detailed discussion in Parliament when, as Clause 11 of the Atomic Energy Bill, it was debated for well over an hour. Labour MP for Wimbledon, Arthur Palmer, was particularly concerned that the Clause was being drafted in terms that were too wide, and proposed various scenarios illustrating his concerns.[269] His arguments were supported by Labour MPs Frederick Cobb and William Warbey, but were rejected by the Minister of Supply, John

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[262] Elsevier, 1964, op cit, n261.
[263] Section 4 Atomic Energy Act 1946.
[264] Section 14(1) Atomic Energy Act 1946.
[265] Section 14(1) Atomic Energy Act 1946, as amended by s32(1) Criminal Law Act 1977.
[266] The Proceeds of Crime Act 2002, for example, limits the penalty for failure to comply with a disclosure order (relating to a money laundering investigation) to six months' imprisonment plus a fine (s359). The powers given in the Act are intended to counter money laundering, which is seen as being the life blood both of Organised Crime and Terrorism, and this is why the sanctions imposed may seem draconian. Despite this, espionage was as much of a concern to post-war governments as terrorism is to post-9/11 governments.
[267] Attlee, 1946b, op cit, n252, c46
[268] S11 Atomic Energy Act 1946 is subtitled "Restriction on disclosure of information relating to plant"
[269] Various, 1946b, CLAUSE 11.—(Restriction on disclosure of information relating to plant.) HC Deb 11 October 1946 vol 427 cc530-52, at cc534-5

Wilmot.[270] The debate is revisited in section 2.6, below.

The rationale behind such measures were explained in terms of security, but there was also an element of reciprocity involved, since the United States had refused to share its own atomic information and the Soviet Union were no longer considered as allies. The irony of the push for secrecy is that the time of the Act is also the time when Klaus Fuchs, Guy Burgess, Donald Maclean and Anthony Blunt were beginning to become involved in passing nuclear secrets to the Soviet Union. The spying discussion is considered in more depth later in the chapter.

The final powers that were granted to the Minister were those relating to the acquisition of property. Under section 6 of the Act, the Minster could acquire any land or property (subject to various rights of objection by the owner) which was considered "necessary for the purpose of discovering whether there is present… any minerals from which in his opinion any of the prescribed substances[271] can be obtained."[272] As uranium, for example, is "is a metal approximately as common as tin or zinc, and it is a constituent of most rocks and even of the sea,"[273] this power was theoretically an enormous one. Granite rocks, for example, such as those found in Cornwall, contain uranium,[274] so the Minister had power under the Act to acquire any land in Cornwall. In practice, however, the power was tempered by the words "from which any of the prescribed substances can be obtained"[275] – the concentration of uranium in granite is only 4ppm (parts per million)[276] and is far lower than that which would be required to obtain workable quantities of uranium.

The powers and duties conferred upon the Minister by the Act were wide-ranging and, it could be said, rather sweeping and imprecise. The purpose of this, as shown by the long title to the Act, was to ensure that the Minister maintained "control of [the] development" of atomic energy. At the time, there were relatively few scientists working in atomic research in the UK. Many of those who had been involved in the field had been transferred to the United States in 1943 and joined Major-General Groves' Manhattan Project working on the development of an atomic bomb.[277] The Project which, at its peak, directly and indirectly employed 600,000 people,[278] existed in an atmosphere of excitement and creativity, and was guided "by the necessity to get the best answer in the shortest possible time rather than by questions of formal organization and prestige."[279]

Despite the surge in parliamentary activity outlined above, there is no evidence to suggest that atomic energy was not being taken sufficiently seriously by the Government. As was shown above, Attlee had addressed the UN General Assembly on 19 June 1946, urging the adoption of the "Baruch Plan", for the creation of an International Atomic Development Agency to control nuclear research across the world.[280]

The Soviet Ambassador to the UN, and future President of the Soviet Union, Andrej Gromyko, presented a rival proposal to the Baruch Plan on the same day as Atlee's

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[270] Ibid.
[271] "Prescribed Substances" are defined in s18(1) of the Atomic Energy Act 1946 as "uranium, thorium, plutonium, neptunium or any of their respective compounds as the Minister may by order prescribe, being a substance which in his opinion is or may be used for the production or use of atomic energy or research into matter connected therewith."
[272] Section 6(1) Atomic Energy Act 1946.
[273] UIC, 2006, Supply of Uranium, Nuclear Issues Briefing Paper 75, Melbourne: Uranium Information Centre.
[274] Ibid.
[275] Section 6(1) Atomic Energy Act 1946.
[276] UIC, 2006, op cit, n274.
[277] In June 1942, President Roosevelt and Winston Churchill agreed informally that it would be preferable for research into the atomic bomb to be a combined effort, but located in the United States. The agreement was formalised in Quebec in 1943. Source: Kimball Smith, A., & Weiner, C., eds., 1980, Robert Oppenheimer: Letters and Recollections, Stanford, CA: Stanford University Press, p267.
[278] Grossman, K., 1980, Cover Up: What you are not supposed to know about Nuclear Power, New York, NY: Permanent Press, p153.
[279] Kimball Smith, A., & Weiner, C., eds., 1980, op. cit, n278, p273.
[280] The Baruch Plan, named for Bernard Baruch, Economic Advisor to President Truman, is discussed in greater depth in Appendix 1

address, which would have strengthened the position of the Soviet Union.[281] Behind the scenes, the Soviet Union at that time was working on its own nuclear reactor, which was to go critical on 25 December 1946,[282] and was also developing its own nuclear-weapons' programme.[283] As a result of the Soviet plans, Stalin rejected the Baruch Plan and so the International Atomic Development Agency never came into existence. The failure of the Baruch Plan was an important point in the development of the global nuclear industry, as it would have led to much greater levels of international cooperation and collaboration in the field.

Having looked briefly at the wider international events which both preceded and surrounded the creation of the 1946 Act, it is worth reiterating that the primary effects of the Act was to give the Minister of Supply various powers and duties relating to the development of nuclear power in the UK. It was very much an inward-looking piece of legislation which could be argued to have been designed to increase Britain's sphere of influence in this new technological age, but was actually intended to put in place a series of mechanisms for controlling access to, and development of, a source of energy which was initially little more than a side benefit from the weapons programme.

2.4.1: Powers and duties

Bearing in mind the wide-ranging powers and duties given to the Minister, it is important to note at this stage the distinction between a ministerial *power* and a *duty*. As a power, the Minister would have been given the ability to act in ways which would promote the development of nuclear power, but would have had no compulsion to use this ability. This is also called a discretionary power. By imposing a duty, the Act put a much higher responsibility onto the Minister, so that not only did he have certain abilities, but also he had to use them. This meant that the Minister had no option but to promote the development of atomic energy, which is of crucial importance in tracing the reasons behind the UK's development of a nuclear industry. Even if all the scientific and economic knowledge had suggested that atomic power was not to be recommended, technically the Minister could not have given any weight to this information and would still have had to promote atomic power.

In deciding whether Ministerial powers are discretionary or not, if it is not made explicitly clear, it is necessary to consider "the whole statutory context in which the power is given."[284] In the case of the 1946 Act, most of the powers given to the Minister were discretionary, with the only duty being the "general duty… to promote and control"[285] the way that atomic energy was to be developed. Davis, writing in 1969, expands upon this and argues that when given discretionary powers, "a public officer has discretion whenever the effective limits of his power leave him free to make a choice among possible courses of action and inaction."[286]

Concerns about misuse of a discretionary power had often been expressed and in 1809, the Tavistock MP, George Ponsonby,[287] questioned the use of a Ministerial discretionary power in relation to the grant of assistance to the Austrian government

[281] Blackett, P.M.S., 1949, Military and Political Consequences of Atomic Energy, Revised edition, Turnstile Press, London, p131.
[282] The reactor, F-1, was (and still is) in the Kurchatov Institute Moscow. Source: Bukharin, O., 2002, Making fuel less tempting, Bulletin of the Atomic Scientists, 58 (4) 44-49. The name F-1 derives from the Russian Fizicheskii pervyi uranovyi kotel or "first physics uranium pile." Source: Dahl, P., 1999, Heavy Water and the Wartime Race for Nuclear Energy, Bristol: Institute of Physics Publishing, p279.
[283] The first Soviet atomic test was conducted at the Semipalatinsk Test Site in Kazakhstan, on 29 August 1949. Source: Norris, R.S., & Arkin, W.M., 1998, Nuclear Notebook – Soviet Nuclear Testing August 29, 1949 – October 24, 1990, Bulletin of the Atomic Scientists, 54 (3).
[284] Wade, H.W.R., & Forsyth, C.F., 2004, Administrative Law, Oxford: Oxford University Press, 9th Ed. p240.
[285] Section 1, Atomic Energy Act 1946
[286] Davis, K. C., 1969, Discretionary Justice: A Preliminary Inquiry, Baton Rouge, LA: Louisiana State University Press.
[287] Ponsonby had served as Lord Chancellor of Ireland until 1807, and was the Leader of the Opposition from 1808-17. Source: Foord, A. S., 1964, His Majesty's Opposition 1714-1830, Oxford: Clarendon Press.

following the invasion by Napoleon.[288]

The concerns expressed by Ponsonby and others did not die away and, in the early 1930s, the Donoughmore Committee (The "Committee on Ministers' Powers") was created, *inter alia*, to investigate these concerns. The Committee, which reported in 1932,[289] felt that there needed to be guidelines in place controlling the power of Ministers to use the so-called "Henry VIII" clauses[290] which conferred upon them the *power* to modify an Act with or without the consent of Parliament.[291] The Donoughmore Committee believed that the guidelines would prevent misuse of the powers, although seven decades later, in 2002, Lord Dahrendorf, the Chairman of the House of Lords Delegated Powers and Regulatory Reform Select Committee said that the use of Henry VIII clauses in relation to the Nationality, Immigration and Asylum Act 2002 went "right to the heart of the key constitutional question of the limits of executive power."[292] In other words, even if the Act itself had gone through the full parliamentary debate procedure, an amendment could be pushed through without recourse to Parliament.

An implicit part of the Ministerial duty to promote atomic energy was a requirement to find a location in which the necessary research could be carried out.

2.4.2: Locating the sites

When the AERE was established under section 2 of the AEA 1946, the site chosen for it was the recently disused RAF Harwell site, in Oxfordshire. In 1957, the National Institute for Research in Nuclear Science (NIRNS) was created at the Rutherford High Energy Laboratory in Culham,[293] also in Oxfordshire.

> "[The] main object of the Institute [was] to provide, for common use by universities and others, facilities and equipment which are beyond the scope of individual universities and institutions carrying out research in the nuclear field."[294]

Oxfordshire and the Thames Valley soon became an established area for nuclear research, with the Atomic Weapons Research Establishment in Aldermaston being just twenty-five miles away from Harwell. The Harwell site was later to gain the Joint European Torus (JET) nuclear fusion research project, and is still the Headquarters of the UKAEA, the National Radiological Protection Board (NRPB, absorbed into the Health Protection Agency in 2004), and the HSE Nuclear Directorate's Office for Civil Nuclear Security. Appendix VII gives a map of the key nuclear sites in the United Kingdom.

The second of the NIRNS laboratories was the Daresbury Laboratory in Cheshire, which was established in 1962. NIRNS carried on working until 1965, when the Science Research Council took over both of the NIRNS laboratories, along with the Rutherford Appleton Laboratory, and the Royal Greenwich and Edinburgh Observatories.[295] The Atomic Energy Authority Act 1971 hived off some of the businesses of UKAEA to the newly-created British Nuclear Fuels Limited (BNFL). The new company set up its

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[288] Ponsonby, G., 1809, Vote of Credit—Address respecting Austria HC Deb 31 May 1809 vol 14 cc810-30

[289] Donoughmore, Earl of, 1932, Report of the Committee on Ministers' Powers (Cmnd 4060), London: HMSO.

[290] "These clauses were so named from the Statute of Proclamations 1539, which gave King Henry VIII power to legislate by proclamation." Source: UKParl, 2009, Glossary - parliamentary language explained: Henry VIII clauses. Available at http://www.parliament.uk/site_information/glossary.cfm?ref=henryvi_6723, accessed on 16/03/10

[291] Donoughmore, Earl of, 1932, op cit, n290,p ii.

[292] Dahrendorf, Lord, 2003, Delegated Legislation, HL Deb, 14 January 2003 vol 643 c165

[293] This was renamed the Rutherford Appleton Laboratory in 2001. Source: ISIS, 2005, Living in a Materials World, ISIS, Culham: Rutherford Appleton Laboratory. Available at http://www.isis.rl.ac.uk/materialsWorld/Documents/faq1to10.doc, accessed on 22/03/10.

[294] Ibid.

[295] The Science Research Council itself was to be merged with the Particle Physics and Astronomy Council in April 2007 to form the Science and Technology Facilities Council. Source: STFC, 2009, About STFC, Swindon: Science and Technology Facilities Council. Available at http://www.scitech.ac.uk/About/Introduction.aspx, accessed on 22/03/10

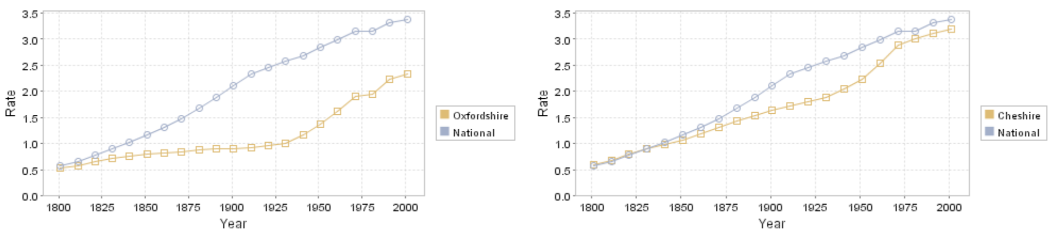
headquarters in Risley on the other side of Warrington from the NIRNS Laboratory, and remained there until 2003.[296]

This geographical clustering of so many research laboratories in Oxfordshire, at the time a comparatively sparsely populated area (see the comparison between Oxfordshire, Cheshire and the national average in Figure 2.1[297]), could been interpreted as an example of the government beginning to appreciate the potential risks associated with the work. This reiterates the point made earlier in the chapter by Bonnell that it is easier to move tens of people in the event of an accident than it is to move thousands. The more prosaic explanation is that both Culham and Harwell were old World War Two airfields and, as such, were already owned by the government, and were both within relatively easy access of London. The combination of the relative remoteness of the laboratories and a dedicated police force was useful to keep ‘prying eyes’ away from the developments of nuclear technology.

The remoteness would also be potentially useful if there was any kind of accident, In a 1965 paper, Dr John Bonnell, the Deputy Chief Nuclear Health and Safety Officer of the CEGB, would later argue that precaution had already become the watchword of the industry by the 1950s, and formed one of the three main categories of public health protection.[298] He went on to say that the construction of atomic power stations in sparsely populated areas was a deliberate decision to mitigate the potential impact of any unforeseen incident:

> “It is easier to deal with tens of people rather than hundreds or thousands. Such a policy reduces the scope of the problem but does not remove it.”[299]

Figure 2.1: Population Densities in Oxfordshire and Cheshire 1800 – 2000[300]



As the graphs show, the population density of Oxfordshire in the 1951 census was around half that of the country as a whole, with a rate of approximately 1.5 persons per hectare. Cheshire too, despite the urban centres of Chester, Warrington and Ellesmere Port was still significantly less densely populated than the country as a whole. By comparison, the 1952 census for London shows a population density of over fifty persons per hectare.

Overall, the location of the early atomic sites appears to have been deliberately linked to their remoteness. Partly this fulfilled the loose criteria of what might be termed a “proto-precautionary” approach, as scientific data concerning the potential dangers of this technology was starting to exist:

Recognition of potential risks (posed by espionage or accidents);

Growing scientific certainty (of the inherent dangers of radioactivity); and

Early action being taken to minimise the risk of both.

[296] In 2003, BNFL’s headquarters transferred to the Daresbury site itself.
[297] Cheshire was selected as a comparator for Oxfordshire because of the Daresbury NIRNS Laboratory.
[298] Bonnell, J. A., 1965, Nuclear Power and the Safeguarding of the Public, Journal of the Royal Society for the Promotion of Health, Vol.5, pp347-353
[299] Bonnell, J. A., 1965 op cit, n299, p349
[300] Source: GBH GIS, 2004, Oxfordshire and Cheshire through time, Great Britain Historical GIS Project. Available at http://www.visionofbritain.org.uk/, accessed on 22/03/10.

Equally, perhaps, the remoteness of the sites may have hampered the primary purpose of NIRNS, which was to make access to nuclear technology easier for academic institutions. There is a certain synchronicity between the enforced geographical isolation of the scientists working in the fledgling industry, and their intellectual and educational isolation, echoing the comments made five decades earlier by Peirce that scientists are moulded to an enormous extent by their isolated lives in laboratories.[301]

The duty to promote nuclear power given to the Minister gave him a considerable influence on the future development of an entire industry. Although not a scientist, the Minister was supported in his role by Sir John Cockcroft, the Nobel-prize winning physicist, in his unelected role of Director of the AERE. This seems to place both men as the members of an élite which is at the very least semi-technocratic, and fulfils part of the requirements set out by Teichman[302] and Jasanoff[303] for the presence of TDM. If TDM is present here, then the decisions taken under its guise in relation to secrecy and the location of the NIRNS sites both fit Kantrowitz's "mixed decision" category, as they contain both technical (what the situation is[304]) and value (what the situation should be[305]) elements.

2.5: The Radioactive Substances Act 1948

The Atomic Energy Act 1946 was covered in detail in the previous section, and it marked the starting point for the general powers and duties of the Minister of Supply in relation to atomic energy. The Radioactive Substances Act 1948, however, marked the first attempt at regulating the production and sale of other radioactive substances which had not been covered by the 1946 Act. It did not receive a smooth passage through Parliament and was actually introduced twice; once in April 1947 and then in revised form in April 1948. The overriding rationale behind the Act was that there had been rapid technological advances made and:

> "Though potent tools in the hands of the scientist and the doctor, these new substances and apparatus have added greatly to the need for protection."[306]

Section 1 of the 1948 Act expanded the powers given to the Minister under the 1946 Act, and added the power to "manufacture…, buy…, treat, store, transport and dispose of any radioactive substances."[307] The substances themselves were defined in rather broad terms by section 12 as "any substance which consists of or contains any radioactive chemical element, whether natural or artificial." The Minister of Supply was not the only one to be given powers by this Act, however. The role of making exceptions to the licensing requirements was given to different Ministers, based on geographical locations:[308]

England and Wales – the Minister of Health

Scotland – the Secretary of State[309]

Northern Ireland – the Minister of Health and Local Government for Northern Ireland.

The Act was not directly concerned with atomic energy and, instead, focused more on the use by professionals such as doctors, dentists, and pharmacists of radioactive

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[301] Peirce, C., 1905, op cit, n54
[302] Teichman, J., 1997, op cit, n93.
[303] Jasanoff, S., 1994, op cit, n94.
[304] DeSario, J., & Langton, S., eds., 1997, op cit, n90.
[305] Ibid.
[306] Henderson, Lord, 1948, Radioactive Substances Bill, HL Deb 29 April 1948 vol 155 c557
[307] Section 1(1) Radioactive Substances Act 1948.
[308] Sections 3(7) and 4(2) Radioactive Substances Act 1948.
[309] If the license were to be for Great Britain as a whole (i.e. England, Wales and Scotland), then the Minister of Health and the Secretary of State would act together.

materials in the course of their work. The rationale for considering its impact here is the effect it had upon the portfolio of the Minister, which had been steadily increasing since the creation of the new Ministry of Supply in April 1946.[310] By 1948, the Minister of Supply was responsible for everything which would later devolve to the War Office and Air Ministry (these would, in turn, form part of the Ministry of Defence in 1974), the Ministry of Aviation (which was to form part of the Board of Trade in 1967) and the UKAEA, which made it a post with an increasingly wide remit.

The governmental control of the use of radioactive substances was fine-tuned by section 6 of the Act, which established an Advisory Committee. The role of the Committee was to give advice to any of the Ministers given powers by the Act on the exercise of their powers. On some issues, the Ministers were required to consult the Committee and, on others, the Committee's advice did not have to be sought. The existence of an Advisory Committee to guide the decision-making of the Ministers seems, on the surface, to be a useful check on the powers of the government. There are two caveats to this, however. Firstly, there were no statutory requirements as to the weight which needed to be given to the advice issued by the Committee; thus Ministers were effectively free to ignore the Committee. Secondly:

> "the members of the Committee shall be appointed by the following Ministers jointly, that is to say the Minister of Health, the Secretary of State, the Minister of Supply and the Minister of Health and Local Government for Northern Ireland."[311]

In other words, the membership of the Committee whose role was to advise on the use of radioactive substances was decided by the same individuals who were responsible for making exceptions to licensing requirements. The Ministers also had to carry out whatever consultation they felt necessary with "scientific, professional and technical organisations and persons", but the end result was that they were able to choose their own watchdog and then, should they feel minded so to do, ignore it. This is a pattern which was repeated in the rebirth of nuclear power discussed in Chapter Five, when the government effectively "farmed out" the decision-making process to an unaccountable, unelected Quango. The Advisory Committee set up by the 1948 Act was one of the earliest occasions of a formalised structure being given to this opportunity for politicians to "pick and choose" the scientific advice which they would take or ignore.[312]

Table 2.1: Consultation requirements Committee under RSA 1948

Power of control over	**Granted in**	**Consultation with Advisory Committee required under**
Sale and supply of radioactive materials	Section 3	Section 3(11)[313]
Use of irradiating apparatus for therapeutic purposes	Section 4	Section 4(6)
Making safety regulations for occupations involving radioactive substances and irradiating apparatus	Section 5	Section 5(5)

[310] The "new" Ministry of Supply was created in April 1946 by adding the responsibilities of the wartime Ministry of Aircraft Production to those of the existing Ministry of Supply. MOD, 2009, History of the Ministry of Defence, London: Ministry of Defence / HMSO.

[311] Section 6(2) Radioactive Substances Act 1948.

[312] Other, current, examples of this including the sacking by the Home Secretary, Alan Johnson, of the UK's chief drugs advisor Professor David Nutt in October 2009, following Nutt's advice that cannabis be reclassified. Source: BBC, 2009, Cannabis drug row advisor sacked, London: BBC News. Available at http://news.bbc.co.uk/1/hi/uk/8334774.stm, accessed on 17/02/10

[313] All three of the sections in this column say the same thing, viz. "Before making any regulation under this section, the Ministers or Minister or Ministry concerned [appropriate Minister] shall consult with the Advisory Committee established under this Act" (words in square brackets are from s5(5)).

There is also no consistency within the Act as to when the Advisory Committee needed to be consulted. Any situations not mentioned by the Act fall outside its auspices and, thus, outside its power but, for those areas which were covered by the Act, Table 2.1 outlines the consultation requirements needed.

Whereas the 1946 Act was required to put in place a framework to govern an industry which did not yet exist, the role of the 1948 Act was to govern an industry which did already exist, albeit in a fledgling way. The Radiochemical Centre grew out of a luminous paint company that had been founded in 1940, and expanded its work from "from luminous paints for compasses, gunsights and aircraft instruments to medical products for cancer treatment."[314] Whilst it would be close to five decades until this "nuclear medicine" was recognised as an "independent medical speciality,"[315] by the time of the 1948 Act, the potential for such work was already being recognised.

In this area, the approach of policymakers was to adapt the existing 1946 legislation in such a way that medical work and that involving very low levels of radioactivity could be subjected to a separate regulatory regime than work which either used or produced high level radioactivity. This is despite the background scientific research on the two being inherently linked. From a policy perspective, the separation is advantageous as it means the effective separation in the minds of the public and politicians alike of "good" (medical) radiation from the fear of "bad" (military) radiation. This difference in perception is illustrated by two articles from the *Times* newspaper. The first article, from March 1948, covers the potential invention of a new type of radioactive weapon in the United States, saying:

> "The United States has developed a radioactive cloud that 'kills anyone who comes into contact with it…. it is effective over a much greater area than the atom bomb.'"[316]

The second, from July the same year discusses the medical uses of radiation and says:

> "Advances made in radiation treatment were even greater, and for some forms of cancer that form of treatment had almost superseded that of operation."[317]

Putting new measures in place to govern this industry also had a practical political and trade advantage, in that the UK already had a world-leading company which was creating products using radioactive substances, and a regulatory regime which was too restrictive might have hampered the chances of Britain becoming the vanguard of the nuclear industry.

If the first and second pieces of legislation to control nuclear material in the UK were both spawned from pragmatic concerns, the control of the information needed to develop nuclear science was not covered wholly by the "atomic" legislation. A great deal was covered by legislation designed to promote secrecy and control access to sensitive information, and it is this which must now be considered.

2.6: Secrecy and Access to Information

As we saw earlier, much of the debate surrounding the introduction of the Atomic Energy Bill in October 1946 focused on what was then Clause 11, which placed restrictions on the release of information. The rationale behind Clause 11 was given by Attlee, who stated that:

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314 Auriga, 2009, History of Auriga, Braunschweig, Germany: Auriga Medical. Available at http://www.aurigamedical.com/history.asp, accessed on 22.04/09

315 UWE, 2005, Nuclear Medicine Workbook, Bristol: University of the West of England, p1.

316 Times, 1948a, New US War Weapons: Radioactive clouds and Bacteria, The Times, Thursday, Mar 25, 1948; pg. 3; Issue 51029; col D

317 Times, 1948b, Cancer Research Progress: advances in radiation, The Times, Tuesday, Jul 20, 1948; pg. 6; Issue 51128; col D

> "the declaration made by the President of the United States, the Prime Minister of Canada and myself laid down this policy: until we can get the introduction of effective and forcible safeguards, and we all hope that international arrangements will make strict secrecy unnecessary, while we can meanwhile encourage the dissemination of basic scientific information, there must be power to prevent the dissemination of information as to what is called the 'know-how.'"[318]

The drafting of Clause 11 came in to some criticism from both sides of the house. Conservative MP, Richard Law, said that the clause "seems to be not unduly restrictive but to have an entirely negative atmosphere about it"[319] although he tempered the criticism by adding "it is easier to make a list of the things the Minister must prohibit than to make a list of the things he must encourage."[320]

Capt Albert Blackburn, the MP for Birmingham Green's Norton, argued that the clause was far too restrictive and would prevent dissemination of information between academics – the very thing for which the government was pressing. Blackburn argued that:

> "Professor Oliphant would be unable to talk to Professor Peierls, the theoretical physicist, advising him upon any of the matters on which the Government have allocated him £141,000. He would first have to submit to the Minister a request for permission to do so…. Atomic energy is defined [in such a way] that would cover a cyclotron, a betatron, a Cockcroft-Walton apparatus and other instruments for fundamental research."[321]

Despite the criticisms, Clause 11 of the Bill duly became Section 11 of the Act without any fundamental relaxation of its terms and atomic energy research became one of the most closely regulated industries in peacetime Britain.

As was shown earlier, the 1946 Act specified that the development of all technology relating to atomic energy was to be controlled by the Minister of Supply[322] and the Act also imposed a duty on the public to surrender any atomic information the Minister required.[323] Despite these provisions and despite the clearly stricter controls on access to information, there had been no extra enactments relating to espionage. Indeed, the most recent Official Secrets' Act at the time dated from 1920 and the area of law was not seriously revised until 1989.[324] This seems a surprising oversight in terms of government control of the area – all the technology was controlled, as was the access to information. People could be jailed for not providing information to the appointees of the Minister and, in 1958, the security service, MI5, had a team of "thirty people at AWRE [Atomic Weapons Research Establishment] and for two years AWRE carried the entire cost."[325] As though having an MI5 team at the AWRE was not a strong enough deterrent to potential Soviet spies, the team was involved in the British part of Operation Venona, which was specifically using the AWRE computer power to try and break Soviet spy codes.[326]

This reliance on pre-war, anti-espionage measures in a Cold War context meant that it was almost inevitable that, during the 1950s, the UK would suffer from a number of espionage-related scandals, and suffer it did. An agent, given the CIA codename REST (who was actually Klaus Fuchs – otherwise known as Emil Julius Klaus Fuchs, or Karl

[318] Attlee, C., 1946b, op cit, n252
[319] Law, R., 1946, Atomic Energy Bill, HC Deb 08 October 1946 vol 427 c52
[320] Ibid.
[321] Blackburn A., 1946, , Atomic Energy Bill, HC Deb 08 October 1946 vol 427 c80
[322] Section 1 Atomic Energy Act 1946.
[323] Section 4 Atomic Energy Act 1946.
[324] The first Official Secrets Act was in 1911. This was supplemented, and repealed in part by the Official Secrets Act 1920. During the Second World War, a new Official Secrets Act (1939 replaced s6 of the 1920 Act, which concerned the duty of individuals to so-operate with the Police. The current Official Secrets Act dates from 1989, and is used in conjunction with the earlier Acts. Source: Search of Lexis (http://www.lexis-nexis.com) on 17/03/09.
[325] Wright, P., 1987, Spycatcher: The Candid Autobiography of a Senior Intelligence Officer, New York, NY: Viking Penguin Inc., p118.
[326] Haynes, J. E., & Klehr, H., 2000, Venona: Decoding Soviet Espionage in America, New Haven, CT: Yale University Press

Fuchs), was employed "by the British Atomic Energy Commission [sic]"[327] in the mid-1940s, before transferring to the Manhattan Project and returning at the AEA in Harwell in the late 1940s.[328] Fuchs was caught by Operation Venona (above), but the CIA did not reveal this information until 1995.[329] In 1950, convicted of leaking atomic secrets to the KGB (and thereby advancing the Soviet Union's atomic bomb project by "at least a year"[330]) Fuchs was given a fourteen-year prison sentence.[331]

Slightly over a year later, in May 1951, Donald Maclean and Guy Burgess publicly defected to the Soviet Union, having been warned by fellow Cambridge spy, Kim Philby, that they were being investigated by MI5.[332] Maclean and Burgess were assisted in their defection by the fourth of the Cambridge spies, Sir Anthony Blunt.[333] Philby himself did not defect for another twelve years, disappearing from Beirut in January 1963. Blunt, a cousin of the Queen, never defected, although he was stripped of his knighthood in 1979 after being publicly named by Margaret Thatcher. He was also granted immunity from prosecution in 1979 in exchange for a full confession.[334] The information leaked to the Soviet Union by Burgess and Maclean focused on non-scientific "atomic bomb secrets and strategy"[335] partly relating to the UK but mainly "assessments of the American atomic arsenal, production capabilities, and nuclear resources," [336] whereas those leaked by Philby were more strategy-related.

Despite its attempts to keep a firm rein on everything that was being carried out under the broad umbrella of nuclear research, therefore, and the impact that those measures were having on the public, the UK government had singularly failed to ensure the security of information from Soviet spies, the one group which had the potential to cause the most damage. This failure, coupled with similar lapses in the United States, was responsible for the Soviet Union's dramatic progress in nuclear research, both civil and military, despite the point being made at the time that the wording of Clause 11 was:

> "founded upon suspicion of the intentions of other nations and the possibility of espionage by other nations."[337]

The desire by governments to keep the science behind nuclear reactions secret was never going to be easy and was, actually, rather naïve – as has been shown, the research which led to the development of a self-sustaining reactor in 1942 by Enrico Fermi and his team was based on decades of existing work, the background to which was in the public domain. As the Nobel-Prize winning physicist and MAUD committee member, Professor James Chadwick, later wrote "[by December 1940] I realised that a nuclear bomb was not only possible, it was inevitable."[338] In addition to this, the Cold War was rife with espionage and counter-espionage: keeping technology secret only seems to have increased the desire of the "other side" to possess it. Indeed, "espionage played a key role in the atomic Soviet project"[339] and, without the efforts of men like Fuchs, the Soviet

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[327] Lamphere, R. J., 1949, Letter to Meredith Knox Gardner: Emil Julius Klaus Fuchs, aka; Karl Fuchs, Republished by the Central Intelligence Agency on https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/books-and-monographs/venona-soviet-espionage-and-the-american-response-1939-1957/part1.htm, accessed on 17/03/09.
[328] Ibid.
[329] Haynes, J. E., & Klehr, H., 2000, op cit, n327
[330] Holloway, D., 1984, Stalin and the Bomb: The Soviet Union and Atomic Energy, New Haven CT: Yale University Press, p222.
[331] Pincher, C., 1950, Fuchs game bomb to Russia, Daily Express, 2 March 1950.
[332] BBC, 2008b, Historic Figures: The Cambridge Spies, London: BBC. Available at http://www.bbc.co.uk/history/historic_figures/spies_cambridge.shtml, accessed on 17/03/09.
[333] Ibid.
[334] CWG, 2002, Blunt Anthony Frederick, Cold War Guide. Available at http://www.cold-war.info/people/blunt-anthony-frederick.html, accessed on 17/03/09.
[335] TCH, 1983, End of an infamous 'adventure' Tri-City Herald, Friday March 18 1983, pA4
[336] Lerner, A., 2004, Encyclopedia of Espionage, Intelligence and Security, Farmington Hills, MI: Gale Publications
[337] Ranger, J., 1946, Atomic Energy Bill, HC Deb 08 October 1946 vol 427 c68
[338] Brown, A., 1997, The Neutron and the Bomb: A Biography of Sir James Chadwick, Oxford: Oxford University Press, p202.
[339] Holloway, D., 1984, op cit, n331.

atomic programme would have been delayed by many years. The impact that the drive for secrecy had within the UK cannot be underestimated either. By 1940, for example, Dr Otto Frisch and Professor Rudolph Peierls were working at the University of Birmingham[340] and their conversations, which had crystallised into the Frisch-Peierls Memorandum,[341] would subsequently have been forbidden by s11 of the 1946 Act. Other notable scientists were working at the Cavendish Laboratory, including Dr Egon Bretscher and Dr Norman Feather[342] and indeed, as Professor JD Bernal, the Irish X-ray crystallographer wrote in 1939:

> "Science policy in England depends on the fact that a handful of the more important scientists in the country know one another, and between them know practically everybody else."[343]

In other words, the worries of some politicians that the 1946 Act had a potential to stop legitimate collaboration appear to have been wholly justified, whilst at the same time, scientists working for the Soviet Union were able to spirit away highly sensitive documents seemingly at will. This suggests that the intellectual and geographical separation of those working in the nuclear industry, wherever the policy might be attributed, may occasionally have been counter-productive.

2.7: Conclusion

The two main decisions taken during the time period covered by this chapter were, essentially, to create a nuclear energy industry from the by-product of the nuclear weapons industry, and to create a regulatory framework around the existing radioactive material industry.

As has been shown above, the legislative and policy steps which were taken by the UK Government and the international community during this period were all working to a greater or lesser extent without knowing what they were trying to do. As such, governments were being forced to a greater extent to react to events, rather than make any overarching strategic plans. As was shown in the previous chapter, the hallmark of political pragmatism as it is being used here is "what works," but what can be seen to work in relation to reactive pragmatism is not necessarily the same as what would be seen to work relation to proactive pragmatism. Due to this, the extent to which decisions in this period were pragmatic must be measured against what seemed most likely to work at the time.

At the beginning of the chapter, we are faced with a national government which has just emerged from an expensive period of conflict, and which sees almost no practical future in atomic energy at all. By the time the chapter ends, however, statute required the Minister of Supply to promote its development, and further to provide an environment in which the relevant research could flourish without security being compromised.

The outline a fledgling international system of legislation was also beginning to show, with the abortive introduction of the Baruch Plan to control the spread of nuclear technology, and swingeing US legislation to punish those who assisted with any dissemination. Indeed, one of the themes which runs through this period is the desire to restrict the flow of nuclear information as much as possible, both on a national and international scale. On both scales this was seen as a priority, and on both scales it failed.

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[340] Brown, A., 2007, Moonshine, MAUD, Manhattan, Monte Bello: British Scientists and Nuclear Weapons Policy, 1940 – 1952, Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Cambridge, MA: Harvard University Press.

[341] The Frisch-Peierls "Memorandum on the properties of a radioactive 'super bomb'" led to the creation of the MAUD Committee in April 1940, and from there can be traced the entire atomic industry. Source: Hennessey, P., 2007, op cit, n222.

[342] Bretscher and Feather were the first to realise that plutonium-239 would be produced in large quantities by a slow neutron bombardment of uranium-239. Source: Hennessey, P., 2007, op cit, n222.

[343] Bernal, J. D., 1967, The social function of science, Cambridge, MA: MIT Press.

Partly through espionage, despite the wrangling over Section 11 of the 1946 Act, and partly through the beginnings of cold-war posturing by the US and USSR, both of whom presented and vetoed alternate control plans. Britain's role in these plans was as a supporter of the US Baruch Plan, as was befitting (not to mention politically pragmatic) for a fellow NATO member, and a recipient of Marshall Aid.

The chapter has also covered the detail of the first two pieces of nuclear-related legislation passed in the UK, and drawn parallels between the approach taken in the UK and elsewhere. At this point in the development of nuclear power, the policy outlined in the 1946 Act can be argued to be at its core a proactively pragmatic attempt to deal with a source of energy which no-one really expected to become commercially viable at the time. The selection of the Ministry of Supply to control the area illustrates this – if it had been truly intended to develop atomic energy as a useful, nationwide energy source, then control of the technology would doubtless have come under the remit of the Minister of Fuel and Power.

As we have seen, giving the duty to promote nuclear power given to the Minister of Supply, assisted by Sir John Cockcroft and other scientific advisors, gave them considerable influence on the way the nuclear industry might develop. We have seen that the move placed those in control in a 'semi-technocratic' élite, and enabled them to make "mixed decisions." This, it is argued was a pragmatic move of the proactive type, as it was only the scientists who understood the potential of nuclear energy and, more importantly, the mechanisms through which the weapons technology could develop into "beneficial and humanitarian uses."[344] The ideas put forward by Teichman and Jasanoff, that there exists a technocratic decision making élite hidden from view do not work in the context of the 1946 Act. There is, without doubt, a decision making élite, as all the decisions as to the direction of nuclear power policy were taken by the Minister of Supply. Equally, there was a technocratic élite, as the number of people with knowledge of this area of science was small, and many of them became influential members of industry bodies. What was lacking, however was any sign of a single élite fulfilling both roles.

The 1948 Act, on the other hand did not have any overt links to the weapons industry, yet as we have seen was still a pragmatic course of action, this time more of the reactive type. Unlike the as-yet-nonexistent nuclear power industry, radioactive material industry had been in operation for many years. The term "radioactive material industry" is something of a misnomer, as it was in fact several industries, linked only by their use of various radioactive materials. The immediate focus of the legislation was on creating guidelines on what materials should be used, how widely these materials should be distributed, and the level of safety requirements that should be in place. The 1948 Act did not try to put any of these guidelines in place on a statutory basis, but delegated responsibility to an Advisory Committee, predominantly composed of scientists. This situation, however, does not give rise to a technocratic élite, since it is not the Advisory Committee that would be making the policy decisions, and the Act only required Ministers to "consult"[345] the committee, not necessarily follow their advice. What the Advisory Committee did do, however, was provide a scientific basis which politicians could then choose to use to justify their decisions.

We have also seen that the decisions taken during this period were highly driven by scientific discovery, much of which had originated as "blue sky" research; the feasibility of a self-sustaining controlled atomic chain reaction, or the luminescence of certain elements used in products ranging from paints to cancer treatment, and so on. The language used by politicians in the introduction and promotion of the statute echoed this, despite the politicians themselves having little scientific background. There was seemingly no real attempt made by politicians in this period to simplify the scientific data, or to use only those elements of it which supported their intended decisions, and that separates this period from the other three. The innocence, or naïveté of the politicians, and indeed

[344] Barnard, C. I., et al, 1946, op cit, n188.
[345] Sections 3(11), 4(6), and 5(5) Radioactive Substances Act 1948

scientists, involved in the early days of nuclear energy was partly fuelled by their wish, and the wish of many, for a “brighter, cleaner world”[346] in contrast to a dark and dirty war.

This chapter ends with the passage of the Radioactive Substances Act 1948, and a period in which nuclear power and the science associated with it seemed to be without many publicly-acknowledged flaws. Chapter Three, however, begins with an investigation of a series of accidents which were to help shape attitudes to nuclear power for several decades.

[346] Yarsley, E., & Couzens, E., 1945, Plastics, Harmondsworth: Penguin, p152

Chapter 3:
1973-78: Mortal Wounding of Nuclear Power?

3.1: Introduction

As with the previous chapter, the focus of this chapter will be on a relatively short time period. However, there will also be a secondary focus on the inter-period, that is to say the time which passed between the four-year focus of the last chapter and the five-year focus of this.

As the end of the previous chapter, there had been two Acts of Parliament relating to nuclear technology – the Atomic Energy Act 1946 and the Radioactive Substances Act 1948 – but there was still nothing resembling a coherent industry to regulate. The period covered by this chapter has a similar lack of quantity of legislation, but the few Acts which were passed were of great significance to the continued development of nuclear energy.

The first part of the chapter covers the main nuclear-related occurrences in the 1950s and 1960s and their impact on the UK's nuclear industry. This will include accidents at nuclear plants, the development of the industry and the creation of national, regional and international bodies to regulate the industry. Since the industry in the UK has been regulated primarily by the United Kingdom Atomic Energy Authority (UKAEA), a significant part of this section will deal with the creation and running of that Authority.

The second part of the chapter assesses the background to and rationale for, the Atomic Energy Authority (Weapons Group) Act 1973. This Act is important insofar as it strips the UKAEA of its responsibility for nuclear weapons and refocuses the regulator on the energy aspects of nuclear technology. As was outlined in Chapter One, this section will make use of the Hansard parliamentary record and the various rules of statutory interpretation to uncover any points of contention relating to the separation of weapons and energy.

The third section stays with a statutory focus and traces the background and development of the Nuclear Industry (Finance) Act 1977 and the Nuclear Safeguards and Electricity (Finance) Act 1978; a pair of small yet significant measures introduced to give increased financial support to nuclear plant operation. This section also looks specifically at one of the stand-alone companies which emerged from the early years of the UK nuclear industry, British Nuclear Fuels Limited (BNFL). BNFL was created by statute and the reasons and decisions behind its creation will be analysed in order to discover the extent to which that decision-making process matches the underlying argument of this thesis, that politicians use the language of science to lend weight and credibility to their politically pragmatic decisions.

The final part of the chapter focuses on the 1978 report of the inquiry into the Thermal Oxygen Reprocessing Plant (THORP) which was proposed for the Windscale site. This, it is argued, was one of the last decisions taken in the UK which led to the construction of a nuclear-related facility and thus it is vital to understand how the environment was changing by the end of the 1970s. In addition, throughout all of the sections, assessment of other non-nuclear international and regional events which might have had a direct or indirect impact on policy-making will be included.

This period of time covered in this chapter therefore begins on the day of the UK's accession to the combined European Economic Community, European Coal and Steel Community and European Atomic Energy Community (Euratom) and ends the month that Austria, a future EEC (and thus Euratom) Member State, passed an act specifically banning the development or use of nuclear energy.[347] We have already encountered the argument put forward by Professor Nowotny that even if there had once been a single scientific community, which she doubted, it had been long-separated into many different

[347] Act of 1978 forbidding the use of nuclear fission for the purposes of providing energy in Austria.

sections, each claiming to be the most authoritative.[348]

The title of this chapter suggests that nuclear power fell out of favour in this period and, while subsequent events have shown that this was not a terminal decline, this was not entirely evident at the time. However, any decisions made in this period must be assessed in the context of the slow-down (at best) of global nuclear expansion. Also in the period, Professor Steve Cohn speaks of a collapse of orders of new nuclear plants in the United States. He says that:

> "all forty-one reactors ordered after 1973 were subsequently cancelled. In fact more than two-thirds of all nuclear plants ordered after January 1970 were subsequently cancelled."[349]

As was discussed earlier, what this chapter does is to examine the decisions behind the creation and passage of the three main pieces of legislation, and assess the extent to which they were triggered by everyday or political pragmatism, and the extent to which that was as a result of a TDM process. It also reveals that, whatever the trigger, politicians are willing to hold aloft the "brilliant light of science"[350] when the scientific data supports their decisions, and equally willing to "extinguish the light of science"[351] when it does not.

3.2: Developments between 1948 and 1972

This section will cover the main nuclear-related developments which occurred between the passage of the Radioactive Substances Act 1948 and the entry into force of the European Communities Act 1973, through which the UK's membership of the EEC was formalised. Some of the developments will have had a direct impact of the way in which the nuclear-energy industry was managed and regulated (for example, the creation of specific, semi-autonomous regulatory agencies), and other developments will have been equally important but a less direct in their impact (for example, the way in which the number of companies involved in the consortia to build power stations was steadily reduced).

Attlee's comments mentioned in the previous chapter were echoed in 1951, both by Lord Cherwell who pointed out that if the UK had to "rely on the United States… we shall sink to the rank of a second class nation"[352] and future French Prime Minister, Félix Gaillard, who said:

> "those nations which [do] not follow a clear path of atomic development [will] be, 25 years hence, as backward relative to the nuclear nations of that time as the primitive peoples of Africa [are] to the industrialised nations of today."[353]

However, although it was not until 1956 that a nuclear reactor was connected to a national grid, experimental reactors had been operating since the late 1940s and, by the late 1950s, there had been a number of accidents at nuclear-power stations at home and abroad and most of these would have had an impact on policy making. There existed a general idea that it was better to try to control the technology early, rather than to develop it first and then try to get it under control. These connotations were echoed in a statement in the early 1960s by the Project Plowshare team, who planned to use nuclear explosions for engineering purposes (and who will be discussed further in Appendix VIII):

> "In order to tame the nuclear giant and harness him to our national strategies,

[348] Nowotny, H., 1980, op cit, n55
[349] Cohn, S.M., 1997, Too Cheap to Meter: An Economic and Philosophical Analysis of the Nuclear Dream, Albany, NY: State University of New York Press, p127
[350] Blair, T., 2006, op cit, n57
[351] Lingard, J., 1810, The Antiquities of the Anglo-Saxon Church, London: Booker & Keating, p315
[352] Cawte, A., 1992, Atomic Australia 1944-1990, Kensington, NSW: New South Wales University Press, p41.
[353] Hecht, G., 2003, Globalization meets Frankenstein? Reflections on Terrorism, Nuclearity, and Global Technopolitical Discourse, History and Technology, Vol. 19(1), pp1-8. p3.

we must set the guidelines of policy today – before and not after he has realized his full potential."[354]

The first part of this section will assess the effect on attitudes to nuclear power that was triggered by a series of accidents across the world from the 1950s onwards. Far from being the "safe, clean" energy that had been promised by the early proponents of nuclear power, these accidents revealed a more dangerous aspect to the technology. The fact that those nuclear energy programmes which were up and running by this stage were not mothballed or abandoned as soon as questions about their safety and cleanliness were raised, suggests both that politicians and scientists alike opted for the more pragmatic "wait and see" approach, and that the contribution made by nuclear to the UK's energy production had become too significant to replace.[355] This was in fact the very antithesis of the "precautionary" approach which would come into force by the end of this period.

3.2.1: Accidents

In December 1952, there was an explosion in the National Research Experimental Reactor at Chalk River in Canada, contaminating the site.[356] There was a second fire at the Chalk River site in November 1958,[357] which was referred to the following month by Minister without Portfolio, Lord Mills, in the House of Lords' debate on the Nuclear Installations (Licensing and Insurance) Bill, who reminded the House that "accident do happen" but:

> "is clearly our duty to make sure that in legislating for such a disaster, which we all hope will not happen, we are fully realistic and do not funk the possible consequences of something which we all agree to be inherently desirable—namely, the successful and fruitful use of atomic energy"[358]

Just under three years after the first Chalk River accident, and three years before the second, EBR-1, the Experimental Breeder Reactor in Idaho, was partly destroyed by a partial core meltdown and released low-level contamination in November 1955.[359] As we saw in Chapter One, EBR-1 was the first reactor in the world to generate more electricity than it consumed, which it did in December 1951.[360] The EBR-1 accident was caused by operator error, but the sequence of events which led to the partial core meltdown not properly explained as the investigation by "MIT scientist TJ Thompson… did not reach firm conclusions about what had happened."[361]

In September 1957, there was a chemical explosion[362] at the nuclear plant[363] at Chelyabinsk, in the Urals, in which about two megacuries of radiation were released and more than 100,000 hectares (approx. 250,000 acres) of land were contaminated.[364]

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[354] Sanders, R., 1962, Project Plowshare: The Development of the Peaceful Use of Nuclear Explosions, Washington, DC: Public Affairs Press,p140.
[355] By 1972, nuclear reactors were contributing 4,500MWe to the national grid, and reactors with a production capacity of a further 5300Mwe were under construction. Source: IAEA, 2006, op cit, n137.
[356] AECL, 2004, AECL Triumphs over NRX Accident, Mississauga, Ontario: Atomic Energy of Canada Ltd.
[357] NAPF, 2004, Nuclear Accidents, Santa Barbara, CA: Nuclear Age Peace Foundation.
[358] Mills, P., 1958, Nuclear Installations (Licensing and Insurance) Bill, HL Deb 02 December 1958 vol 212 c1032
[359] Weaver, 1995, A Brief Chronology of Radiation and Protection, Pocatello, ID: Idaho State University.
[360] Michal, R., 2001, Historic Milestone: Fifty years ago in December: Atomic reactor EBR-I produced first electricity, American Nuclear Society News, November 2001, p28
[361] Newtan, S. U., 2007, Nuclear War I and Other Major Nuclear Disasters of the 20th Century. Bloomington, IN: AuthorHouse Publishing, p175
[362] Kabakchi, S. A., Putilov, A. V., and Nazin, Ye. R., 1995, Data Analysis and Physicochemical Modeling of the Radiation Accident in the Southern Urals in 1957, Atomnaya Energiya, Jan 95 No 1, pp 46-50.
[363] Variously referred to as Chelyabinsk-40 and Chelyabinsk-65. The numbers refer to the distance in kilometres of the site from the town but, due to the extreme secrecy surrounding the Soviet nuclear programme, these distances were often changed. Source: Bunn, M., et al., 1998, Retooling Russia's Nuclear Cities, Bulletin of the Atomic Scientists, 54 (5) 1.
[364] Nikipelov, B. V., et al, 1989, Report on a Radiological Accident in the Southern Urals on 29 September 1957, INFCIRC/368, Vienna: International Atomic Energy Agency Circular

Whilst the accident was not publicly acknowledged (either by the USSR or anyone else) until 1989,[365] exiled Russian biochemist, Zhores Medvedev, wrote about it in the *New Scientist* in 1977,[366] and Robin Cook MP brought Medvedev's article into a Commons' debate on Nuclear Energy in December 1977 saying that:

> "it is perfectly clear that the nuclear community in the West had known about this for many years and had concealed it from the public with as much care as the Russians, for reasons that we can only speculate upon."[367]

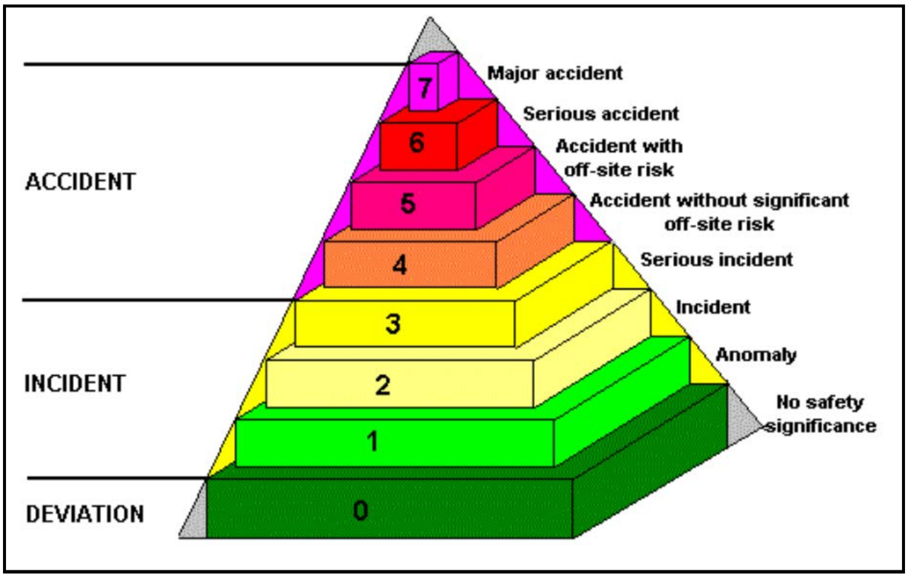
The most influential accident, in terms of its direct impact on UK nuclear policy, however, was the accident at Windscale Pile No. 1 in October 1957.[368] A fire in the graphite reactor core led to a release of radioactive material and to the pile being mothballed[369] until its decommissioning in the 1990s. The Fleck Report[370] into the fire, published in 1958, found the cause to be a series of minor errors, combined with poor checks and balances, cumulating in the contamination of a large part of Cumbria with radioactive fallout. The Fleck Report found that there were improvements and modifications which should be made to the design of Windscale Pile No 2 and believed that it might be possible to restart Pile No 1 as early as 1959.[371] In fact, Pile No 1 was never restarted and has now been decommissioned.

The 1957 accident at Windscale signalled to the government that there were, indeed, risks associated with running a nuclear-power station. Although the technology involved in a nuclear reactor itself is inherently safe and there cannot possibly be a Nagasaki-style explosion, the accident further gave notice that, if these risks were to manifest themselves into an incident, it would be expensive to rectify. In addition to being the trigger for the Atomic Energy Act 1959, the journalist Tony Hall attributes the 1957 accident at Windscale as being the incident which led to what he calls the "a long, slow fall from grace"[372] by the nuclear-power industry in the UK.

The Windscale fire was retrospectively classified as a Level 5 incident on the International Nuclear Event Scale (INES), which was developed jointly by the IAEA and the NEA (see Figure 3.1) and came into operation in May 1990.[373] Only two other events have ever been classified this high; the 1979 Three Mile Island accident in the United States (a Level 5 incident) and the 1986 Chernobyl-4 accident (or *severe reactivity excursion*[374]) in the Soviet Union (a Level 7 incident).[375]

Figure 3.1: International Nuclear Event Scale

[365] Smith, J., 1989, Soviets describe Accident at Secret Nuclear Center, The Washington Post, 10 July 1989.
[366] Medvedev, Z., 1977, Nuclear disaster in the Soviet Union, New Scientist
[367] Cook, R., 1977, Nuclear Energy, HC Deb 02 December 1977 vol 940 c934. The debate was held in the light of the Flowers Report (RCEP, 1976, Royal Commission on Environmental Pollution: Sixth Report: Nuclear Power and the Environment, London: RCEP/HMSO,), which had been published the previous September.
[368] For an in-depth discussion of the accident at Windscale see: Arnold, L., 2007, Windscale 1957: anatomy of a Nuclear Accident, London: Palgrave Macmillan, 3rd Ed.
[369] NRPB, 1997, Radiological Consequences of the 1957 Windscale Fire, Chilton: National Radiological Protection Board.
[370] Fleck, A., Cockcroft, J., Penney, W., Spence, R., Diamond, J., Kay, J., and Skinner, H., 1958, Final Report of the Committee Appointed by the Prime Minister to Make a Technical Evaluation of Information Relating to the Design and Operation of Windscale Piles and to Review the Factors Involved in the Controlled Release of Wigner Energy, (Cmnd 471), London: HMSO.
[371] Ibid, p17.
[372] Hall, T., 1986, op cit, n213.
[373] IAEA, 1997, IAEA Turns 40: Supplement to IAEA Bulletin September 1997, Vienna: International Atomic Energy Authority, p24.
[374] WANO, 2007, Key events in WANO's History, World Association of Nuclear Operators. Only available at http://www.wano.org.uk/WANO_Documents/WANO_Chronology/wano_chronology.asp, accessed on 22/03/10.
[375] IAEA, 2004c, International Nuclear Event Scale Information Service, Vienna: International Atomic Energy Authority.



The 'science' behind the Windscale accident was not widely published at the time of the radioactive leak and, indeed, has still not been much circulated beyond the specialist media. There were, however, eighteen stories published in the Times in the two weeks after the accident, using phrases like "radio iodine content six times permissible levels"[376], and "official readings of radioactivity in London… have shown an increase of 20 times."[377] This was followed by an editorial in the *New Scientist* at the time, which claimed that:

> "Public confidence has been severely shaken by what appeared to be attempts to minimise the gravity of what had taken place at Windscale, and even more by the extremely late hour at which any precautions to safeguard public health were put into effect."[378]

The possibility that the scale of the accident was down played could be regarded as nothing more than an unfortunate oversight. What cannot be and has not been denied, however, is that the official report issued in 1957[379] was not the unexpurgated version – this was released in 1988 under the '30-year rule.'[380]

In September 1973, a further accident at Windscale released radioactive ruthenium gas into the plant, although none of the gas escaped into the surrounding countryside. The report into the incident[381] concluded that the accident increased the risk of developing cancer for the 35 workers who had been exposed to the gas by approximately one per cent.

The accidents discussed here are merely a selection of what is a very large total number of nuclear-related accidents in the twenty-four year period between the two chapters. According to Dr T.J. Thompson, the scientist who led the investigation of the EBR-1 fire in 1955, there had already been dozens of "criticality accidents which have

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376 Times, 1957a, Milk from farms near Windscale stopped: Radio iodine content six times permissible levels, The Times, Monday Oct 14, 1957; pg. 10; Issue 53971; col E

377 Times, 1957b, Second Pile At Windscale Closed Down: Step Taken To Help Inquiry, The Times, Friday, Oct 18, 1957; pg. 10; Issue 53975; col E

378 New Scientist, 1957, Windscale Fire, New Scientist, 17 October 1957.

379 Atomic Energy Office, 1957, Accident at Windscale No. 1 Pile on 10th October 1957 (Cmnd. 302), London: HMSO.

380 The revised version was released in January 1988. In April 1989 a revised transcript was published by the UKAEA: UKAEA, 1989, A Revised Transcript of the Proceedings of the Board of Enquiry into the Fire at Windscale Pile No. 1 October 1957, Harwell: United Kingdom Atomic Energy Authority. The 30 year rule was introduced by the Public Records Act 1958, amended by the Public Records Act 1967, and sets the statutory closure period after which records must be made available for public inspection as 30 years, except for certain defined reasons. Under the Freedom of Information Act 2001, which came into force fully on 1 January 2005, the 30-year rule was abolished in relation to access to documents, which can now be requested much earlier.

381 NII, 1974, Report by the Chief Inspector of Nuclear Installations into the incident in Building B204 at the Windscale Works of British Nuclear Fuels Limited, (Cmnd 5703), London: Nuclear Installations Inspectorate

occurred outside of nuclear reactors through 1963, and a further five in 1964."[382] Despite these accidents:

> "at the time, nuclear power programmes were thought to be safe and economical methods of generating electricity that appealed to countries seeking to promote the rapid development of their electric power systems."[383]

This optimism among the non-nuclear countries can partly be explained by the fact that the accidents were, at least, underplayed and, at most, flatly denied, by the relevant government bodies. The effect of these accidents on attitudes to nuclear power, which might have been expected to have been significant, were actually comparatively minor, as general awareness of them outside the nuclear sphere was very low. The cover up of accidents by the Soviet government was comparatively easy to achieve, given the lack of press freedom which existed in the Soviet Union at the time. In the UK, this was not so easy, and so the government and the nuclear industry, both of which had a vested interest at that time of ensuring the continuation of nuclear power generation, relied on official scientists to downplay the dangers. A Times report from October 1957, for example, reports that:

> "The Ministry of Agriculture, on the advice of the Medical Research Council, last night issued an assurance that milk from cows removed from the Windscale area… could be used with no risks to the health of adults or children."[384]

This was only twelve days after the accident had occurred, and reveals the extent to which the Ministry was able to claim to be relying on unified scientific opinion about the safety of milk. The Prime Minister, Harold MacMillan spoke of the Medical Research Council's report a few days later in the House of Commons, saying that the report was "very technical, and not very easy for a layman to follow,"[385] but that a simplified summary would be released. This was despite his assurance that the advice given to him was clear. As we have seen in previous chapters, the desire of politicians for "political closure of scientific controversy"[386] is an ever-present one in policy making areas such as this.

The two types of organisation which would have been aware of both the risks and likelihood of accidents at nuclear reactors however, would be the newly-formed regulators and the insurance industry and it is the creation of the former to which we will now turn.

3.2.2: The creation of the Atomic Energy Agencies

This section focuses primarily on the creation of the regulatory authority for the UK but, since nuclear-power generation is a discipline involving multiple regulators, it also will outline the development of the International Atomic Energy Agency and the two European Nuclear Agencies.

The United Kingdom Atomic Energy Authority (UKAEA)

As we have already seen, at the end of the 1940s, the as-yet non-existent nuclear industry in the UK was under the nominal control of the Minister of Supply, who had been given the duty to promote its development under section 1 of the 1946 Act.

In 1953, Prime Minister, Winston Churchill, set up a Committee of Atomic Energy Organisation under the chairmanship of Lord Waverley, the ex-Chancellor of the

[382] Thompson, T.J., & Beckerley, J.G., eds, 1964, The Technology of Nuclear Reactor Safety: Volume 1: Reactor Physics and Control, Cambridge, MA: MIT Press, p609
[383] Rogers, P., 2005, International Security Monthly Briefing: The Bush Administration, Insurgencies and Iran, Oxford: Oxford Research Group, p4.
[384] Times, 1957c, Windscale area "cleaner": Experts may report next week, The Times, Thursday, Oct 24, 1957; pg. 6; Issue 53980; col F
[385] MacMillan, H., 1957, Atomic Energy Establishment, Windscale (Accident) HC Deb 29 October 1957 vol 575, c34
[386] Jordan, G., & Davidson, S., 2000, op cit, n82, p58

Exchequer. The Committee, also known as the Waverley Committee, was given a very specific aim:

> "to devise a plan for transferring responsibility for atomic energy from the Ministry of Supply to a non-departmental organisation and to work out the most suitable form for the new organisation, due regard being paid to any constitutional and financial implications."[387]

One harsh critic of the previous policy where the Ministry of Supply ran all nuclear technology was Oxford Physics Professor, Frederick Lindemann, who would later sit on the initial board of the UKAEA as Lord Cherwell. Lindemann's biographer, the Earl of Birkenhead, felt that he believed that this was "the worst possible choice"[388] as it put nuclear energy into the same category as "the collection of customs."[389]

Although the Waverley Committee's Report itself was never published (for reasons relating to national security), a summary of the chief recommendations was published as Appendix 1.[390] These recommendations were that there should be:

> A Statutory Atomic Energy Corporation with an executive Board;
>
> A designated Minister with no departmental responsibilities encroaching on the field, e.g., the Lord President of the Council;
>
> A Ministerial Committee and
>
> An Official Committee representative of the Departments concerned.[391]

Some of these recommendations were adopted in the government's White Paper on Atomic Energy, also issued in 1953 and, following the standard statutory procedures, the Atomic Energy Authority Act came into force on 4 June 1954.

One recommendation which was not followed, however, was that of creating a dedicated ministerial post for Atomic Energy. Given that work had already commenced on Calder Hall, this cannot be because there was perceived to be no need for such a post. In order to better understand this decision, it is necessary to look briefly at the background to the Ministries of Supply and Fuel and Power.

The Ministry of Supply had been created at the beginning of the Second World War to coordinate the equipping of the armed forces. In so doing, it took on parts of the roles of the Air Ministry, War Office and Admiralty. On 1 January 1946, a new Ministry of Supply had been created, which was an amalgamation of the existing one and the Ministry of Aircraft Production. As has been shown above, it was this new Ministry that took on the role of coordinating the work of the atomic-energy research. Interestingly, despite this control over nuclear power, the rest of the country's power production was controlled by the Ministry of Fuel and Power, which had been created in 1942.[392] This left the country in the situation where one Ministry controlled the production of electricity from nuclear power and another controlled coal-based production. This split can be traced back to the GEN.75 and GEN.163 Cabinet committees of eight years earlier. The situation continued with separate boards existing for Coal, Gas and Electricity until those industries were privatised, and it is only today that there are suppliers offering both electricity and gas to consumers. This structure was never really the most efficient way of governing the power industry, as it inevitably meant that the different industries were forced to compete with each other, rather than spending money on improving technology or services. The

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[387] Churchill, W., 1953, Atomic Energy Project (Reorganisation Committee), HC Deb 28 April 1953 vol 514, c1959

[388] Birkenhead, Earl of, 1961, The Prof in Two Worlds: The official life of Professor F.A. Lindemann, Viscount Cherwell, London: Collins, p308.

[389] Ibid.

[390] Waverley, 1953, Report of the Committee on the Future Organisation of the United Kingdom Atomic Energy Project: Appendix I, (Cmnd 8986) London: Prime Minister's Office / HMSO.

[391] Ibid.

[392] AMH, 2005, Coal and the government, Access to Mineral Heritage Project. Available at http://mininghistory.thehumanjourney.net/edu/Govt.shtml, accessed on 22/03/10

decision, therefore, not to create a single Atomic Energy ministerial post could be justified on the 'conflict of interests' argument. In 1959, Lindemann got his way and the Ministry of Supply was abolished completely.

The main purpose of the Atomic Energy Authority Act 1954 was to create "an Authority, to be called the United Kingdom Atomic Energy Authority"[393] (the UKAEA). The members of this Authority were to be appointed by the Lord President of the Council,[394] rather than the Minister of Supply.[395] However, the UKAEA was not just intended to replace the Minister; it also took on a role which had not existed before; namely, that it was empowered to "make arrangements with universities and other institutions… for the conduct of research into matters connected with atomic energy."[396] This broadened the scope for involvement considerably from the AEA 1946, and meant that, as was the situation prior to the AEA 1946, independent (or at least quasi-independent, as approval needed to come from UKAEA and the Lord President), research into atomic power was allowed to flourish. The rationale behind this was that the control elements of the 1946 Act, which had been intended to keep nuclear research as tightly controlled as possible had, to a certain extent backfired. Many of those who would otherwise have been tempted into researching this area of experimental physics did not do so, for they had no desire to see their work classified and restricted by the government, and this led to a shortage of scientists. As the Labour MP for Watford, Maj. John Freeman, put it:

> "Over the whole field, this enterprise is working in very straightened circumstances. It is using scientists, and we have not enough scientists. It is using Government research establishments, and we have not enough Government research establishments."[397]

Against this background, the 1954 Act was a purely pragmatic response, and it created a system in which research could once again occur.

The UKAEA was not given wide operational freedom by the 1954 Act. Instead, it was to operate under the direct control of the Lord President of the Council, the approval of whom was necessary before most ventures were undertaken. The reason for the split was outlined by the Minister of Works, Sir David Eccles MP in the second reading of the Bill as being a way of ensuring that:

> "Policy remains firmly in the hands of the Government while the Authority is given sufficient freedom to operate that policy with efficiency and in a far-seeing manner."[398]

This reveals that deliberate attempts were being made to ensure that the UKAEA did not mutate into a technocratic élite in control of policy making – the organisation certainly fits all the criteria of a technocratic élite, comprised as the Committee was of high ranking scientists and bureaucrats, but the decisions were still made by the politicians.

The development of weapons was expressly forbidden to the Authority "save in accordance with arrangements made with the Minister of Supply"[399] but research and experimentation in areas which may have led to more efficient and advanced atomic weapons was not.[400] The "arrangements made with the Minster" led to the creation of four groups within the UKAEA: Production, Reactor, Research and Weapons.[401] This led to a

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[393] Section 1(1) Atomic Energy Authority Act 1954. Discussions of the current role of the UKAEA can be found below, in later sections of this piece.
[394] Section 1(3) Atomic Energy Authority Act 1954. The Lord President of the Council is the member of the cabinet in charge of the Office of the Privy Council; it is a non-departmental post, and therefore as removed from inter-departmental strife as possible. In 1954, the Lord President was Lord Salisbury.
[395] The Minister also lost powers which had been granted under section 2(1) of the Atomic Energy Act 1946, and section 1(1) of the Radioactive Substances Act 1948.
[396] Section 2(2)(e) Atomic Energy Authority Act 1954.
[397] Freeman, J., 1954, Atomic Energy Authority Bill, HC Deb 01 March 1954 vol 524 c897
[398] Eccles, D., 1954, Atomic Energy Authority Bill, HC Deb 01 March 1954 vol 524 c845
[399] Section 2(2)(i) Atomic Energy Authority Act 1954.
[400] Ibid.
[401] MOD, 2001, Plutonium and Aldermaston – An Historical Account, London: Ministry of Defence / HMSO.

slightly perverse situation where the UKAEA could not develop weapons itself unless the Minister gave specific permission, but could develop, entirely of its own volition, the technology to be used in weapons. Despite the presence of the Weapons Group, which took advantage of its ability to develop weapons-improvement technology, the main thrust of the Authority's work was focused on atomic energy[402] and the Authority was separated into four operational groups:

> Production:
> This group, which was born out of the AERE,[403] was responsible for uranium enrichment and ran the nuclear fuel cycle programme.[404] The group's fuel cycle work was transferred by the Atomic Energy Act 1971 (below) to British Nuclear Fuels Ltd[405] and its enrichment work to Urenco, also in 1971.[406]
>
> Reactor:
> This group had the "prime responsibility for the development and introduction of nuclear-power reactor systems."[407]
>
> Research:
> Run by Sir John Cockcroft.[408] The little information available on the Research Group suggests that it was heavily involved in UKAEA's research computer systems, and was jointly based at Harwell and Culham, both in Oxfordshire.[409] It should not be confused with the UKAEA Research Establishment, which was also based at the Harwell site, but dealt with reactor research.
>
> Weapons:
> This was to remain part of the UKAEA until 1973 (below). It took over the work of the Atomic Weapons Research Establishment (AWRE), based at Aldermaston in Berkshire and a trials' range at Foulness in Essex. By this time, the UK had successfully tested its first atomic bomb, at one minute past midnight on 3 October 1952. The bomb, which had been designed by a team led by Sir William Penney, was detonated aboard HMS Plym, anchored off the island of Trimouille in the Pacific, in Operation Hurricane.[410]

The initial UKAEA Committee was to consist of a chairman and between seven and ten other members,[411] three of which would have capacity in dealing with problems associated with atomic energy and two with experience in administration and labour relations.[412] Sitting MPs were specifically disqualified from becoming committee members shortly after the Authority came into existence, and vice versa. This was not a restriction which was specific to members of the UKAEA, but encompassed:

> "… certain offices [which] are incompatible with membership of the House of Commons, some as involving physical impossibilities of simultaneous attendance in two places, some because of possible patronage, and others because of a

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[402] Ibid.
[403] Jay, K., 1956, op cit,n125, p9.
[404] UKAEA, 2001, UKAEA's Decommissioning Strategy. Volume 1: The Management of Nuclear Liabilities in UKAEA, Harwell: United Kingdom Atomic Energy Authority. This document formed part of UKAEA's submission to the NII's Quinquennial Review.
[405] SCTI, 2000, Proposed Public Private Partnership for BNFL: The Ninth Report of the House of Commons Select Committee on Trade and Industry, London: HMSO, Chapter II, Section 6.
[406] Under the terms of the 1970 Treaty of Almelo, the German, Dutch and British governments agreed to pool resources on uranium enrichment. Urenco, 2003, Welcome to Urenco, Available at http://www.urenco.com/htm/corporate/urenco_group.htm, accessed on 01/02/08.
[407] LHCMA, 2005, Nuclear History Database, Liddell Hart Centre for Military Archives, King's College London. Available at http://www.kcl.ac.uk/lhcma/pro/p-ab37.htm, accessed on 01/02/08.
[408] Munn, A., 2004, UKAEA's first 50 years, Nuclear Engineering International Magazine, 5 November 2004.
[409] No information on the Research Group was available from UKAEA despite repeated requests. However, a reference from the UKAEA Research Group is used in Betts, J. T., 1980, A compact algorithm for Computing the Stationary Point of a Quadratic Function Subject to Linear Constraints, ACM Transactions on Mathematical Software, 6 (3) 391-397.
[410] AWE 2008a, First UK Nuclear Device Successfully Detonated, Aldermaston: Atomic Weapons Establishment
[411] Section 1(2) Atomic Energy Authority Act 1954.
[412] Section 1(3) Atomic Energy Authority Act 1954.

conflict of duties"[413]

The 1956 Report of the Spens Committee[414] helped lead to the enactment of the House of Commons Disqualification Act 1957, section 1 of which stated "a person is disqualified for membership of the House of Commons who for the time being … (f) holds any office described in Part II or Part III of the said First Schedule", and then goes on to list the UKAEA in Schedule I, Part II.

Members of the House of Commons, therefore, were barred from sitting on the UKAEA Committee on the grounds of the potential for conflicts of interest and yet, as will be shown, all of the men who were appointed to the committee had much greater potential for a conflict of interest themselves. As was argued earlier in relation to the creation of the Advisory Committee under the Radioactive Substances Act 1948, this could be seen as a deliberate move to take nuclear oversight away from the political realm and leave it under the (unelected, unaccountable) control of a Quango. Now, as then, the rationale can be seen to be a pragmatic (if inevitably doomed) attempt to in some way place the nuclear industry above and apart from issues of party politics. What it actually achieved was, to all intents and purposes, to leave the industry as a self-regulating one. It did not go unchallenged, however and in the debate on the Bill, the Labour MP for Watford, John Freeman argued that:

> "The danger is that… a new private empire, ruled by the atomic knights, will be set up."[415]

A similarity between Freeman's feared "private empire" and the idea of a technocratic decision making élite put forward by Jasanoff and Teichman can clearly be seen here, and this point marks the closest to which TDM has come to having an impact on nuclear power.

The requirements under Section 1(3) of the Act, relating to the experience of a proportion of the committee members, were abolished by Section 11(3) of the Atomic Energy Authority Act 1995 (see below). The maximum membership level of the committee was increased to fifteen, by section 1 of the Atomic Energy Authority Act 1959, and the minimum level from four to seven, by section 11(2) of the Atomic Energy Authority Act 1995. It is worth bearing in mind that the UKAEA of the 1950s was running an industry which was intended to grow for several more decades, whereas the UKAEA of the 1990s was in charge of an industry where no new plants had been ordered for many years and the existing ones were beginning to be decommissioned. It does, seemingly, take more people to orchestrate the dismantling an industry than its creation.

The first Chairman of the UKAEA was the economist Sir Edwin (later Lord) Plowden, formerly Chief Planning Officer for HM Treasury. Plowden was a highly regarded economic planner who had previously been a director of British Aluminium. He had also been one of the "three wise men" charged with organising the planning and financing of NATO in 1951.[416] He was to remain Chairman until 1959, when he was replaced by Sir Roger Makins (later Lord Sherfield), who had previously been Chairman of the Marshall Commission in the United States.[417]

Both the Committee members and ordinary members of UKAEA were, as was to be

[413] Spens, 1956, Special Report from the Select Committee on the House of Commons Disqualification Bill, London: HMSO, Para 2.
[414] Along with the earlier reports and guidance of the Herbert Committee which had been set up in 1941 to try and address "confusion about the actual and intended scope and effect of existing disqualifying provisions." Source: Gay, O., 2004, Disqualification for Membership of the House of Commons, House of Commons Library Standard Note SN/PC.3221, London: House of Commons.
[415] Freeman, J., 1954, op cit, n399.
[416] Ismay, Lord, 1955, NATO: The first five years, Paris: NATO.
[417] The Marshall Aid Commemoration Commission was set up in 1953 to administer the Marshall Scholarships, named after the post-war European Recovery Programme (the Marshall Plan). There are also two fellowships awarded annually (since 1998) by the Marshall Sherfield Fellowship Foundation. Source: Marshall, 2008, The Marshall Sherfield Fellowship – History, Marshall Scholarships Website at http://www.marshallscholarship.org/, accessed on 22/03/10.

expected, to be remunerated by the Authority.[418] This could be in the form of fees, expenses, or allowances[419] and also included pension provisions. The level of remuneration was to be agreed by the Lord President of the Council, who would have to present a statement of remuneration before Parliament.[420] It is worth noting that, by the time Calder Hall went on-line in 1956, the UKAEA had grown to a total workforce of roughly 24,000[421] compared to the 600,000 who worked on the Manhattan Project in the US.[422]

The 1954 Act specifically convened the UKAEA Committee to be an expert group of scientists, industrialists and civil servants. The eight initial UKAEA committee members back up this assertion: a senior civil servant with directorial experience (Plowden), four physicists (Cockcroft, Penney, Hinton and Cherwell), two industrialists (Perrott and Stedeford), and a trade-unionist knight (Fawcett). Of the full-time members, Cockcroft, Penney, and Lords Plowden and Hinton had all either been senior civil servants or involved with the early development of atomic policy in the UK, and the same can be said of the part-time members. That these men were leaders, and often giants, in their specialised fields cannot be denied, however,[423] and so the scientific elements of their work are beyond any real reproach.

The rather cosy relationship between the industry and its regulator was to continue with the creation of the Central Electricity Generating Board (CEGB) in 1957, as the sole customer for atomic power.[424] The new Chairman of the CEGB was to be none other than Sir Christopher Hinton who had moved across from the UKAEA.[425]

Also within the makeup of the UKAEA, was the creation of the UKAEA Constabulary (UKAEAC). Section 3 of the Special Constables Act 1923 was used to give the UKAEA power to swear in its own constables – “the powers of nomination conferred by those provisions shall be exercisable also by the Authority.”[426] The amendment of the UKAEAC is discussed further in section 3.4, below.

The UKAEA was not given any specific *duties* relating to atomic energy; instead its authority arose solely from the granting of *powers*. This marks something of a sea change from the 1946 Act. In that Act, as has been illustrated above, the Minister had a duty to promote the use of atomic energy[427] by whomsoever he felt was able so to do. Under the new Act, however, that role was split into two parts. The UKAEA now had the sole power to “produce, use or dispose of atomic energy”,[428] but no duty of promotion. That was given to the Lord President of the Council, along with a further duty to “secure that… the proper degrees of importance are attached to the various applications of atomic energy.”[429] Again, this illustrates the level of low-key influence which politicians were able to maintain in the nuclear arena.

Responsibilities allocated under the 1954 Act were not restricted to the Authority, the Lord President and the Minister of Supply, however. Both the Ministers of Housing and Local Government and Agriculture and Fisheries were required to authorise the disposal of any radioactive waste generated by the work of the UKAEA.[430] This was a new provision, as no mention of radioactive waste disposal had been made in the 1946 Act. As there had only been very low-scale, atomic-energy projects by that time, the omission of radioactive

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[418] Section 1(6) Atomic Energy Authority Act 1954.
[419] Section 1(6)(a) Atomic Energy Authority Act 1954.
[420] Section 1(8) Atomic Energy Authority Act 1954.
[421] Plowden, E., 1956, Foreword, in Jay, K., 1956, op cit, n125.
[422] Grossman, K., 1980, op cit, n279.
[423] Further details of the members of the Committee can be found in Appendix V.
[424] Helm, D., 2004, op cit, n220, p92.
[425] Hinton’s role as CEGB Chairman, and particularly his falling out with the Authority over the choice of generator types, is discussed briefly below.
[426] Schedule 3 Atomic Energy Authority Act 1954.
[427] Section 1(1) Atomic Energy Act 1946.
[428] Section 2(2) Atomic Energy Authority Act 1954.
[429] Section 3(1) Atomic Energy Authority Act 1954.
[430] Section 5(4)(a) Atomic Energy Authority Act 1954.

waste in the 1946 Act was not a serious oversight, but it does reveal that neither the risks associated with waste storage nor the eventual scale of the waste generated were fully appreciated at that time. Since the nuclear industry in the UK did not exist in a vacuum, having examined how the UK regulatory body came into existence it is now useful to compare this with its international and European counterparts, which would create much of the overarching legislation governing all nuclear industries.

The International Atomic Energy Authority

In December 1953, US President Eisenhower made his famous "Atoms for Peace" address before the UN General Assembly.[431] Eisenhower, who had the support of the UK and French governments,[432] was arguing along much the same lines as had been tried by the Baruch Plan, seven years earlier,[433] namely that:

> "The Governments principally involved, to the extent permitted by elementary prudence, to begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international Atomic Energy Agency. We would expect that such an agency would be set up under the aegis of the United Nations."[434]

Unfortunately, by the time the Agency was set up in 1957, it was no longer practicable for it to become a bank of fissionable material. The growth of military stockpiles made this particularly tricky, as the number of warheads, which had stood at just over 2,000 in 1954, had grown to over 7,000 by 1957.[435]

The statute of the International Atomic Energy Authority, which was signed in 1956, set out the functions and objectives of the IAEA. In Article III of the Statute, the Authority is given the authorization to:

> "Make provision… for materials, services, equipment, and facilities to meet the needs of research on, and development and practical application of, atomic energy for peaceful purposes, including the production of electric power, with due consideration for the needs of the under-developed areas of the world."[436]

This suggests that, under the terms of its creation, the IAEA has the power, if not the duty, to assist all under-developed areas of the world with the development of a peaceful nuclear-power programme. However, there is a caveat in the statute, which says that the Agency has the right and responsibility to:

> "Examine the design of specialized equipment and facilities, including nuclear reactors, and to approve it only from the view-point assuring that it will not further any military purpose."[437]

As with UKAEA, therefore, developing the military aspects of nuclear technology had been removed from the remit of the IAEA, although the latter did still maintain the right and responsibility for inspecting IAEA member states to ensure that military developments were not surreptitiously being carried out. Within a year of the statute being signed, the IAEA was being cited by Francis Noel-Baker MP, in a Commons' debate on the wider issue of disarmament, as having:

> "a very great deal of practical experience, now applied over a limited field, in the

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[431] UN, 1953, Address by Mr. Dwight D. Eisenhower, President of the United States of America, 8 December 1953, New York. Available at http://www.iaea.org/About/history_speech.html, accessed on 01/02/08.
[432] Holl, J.M., and Anders, R.M., 2005, Atoms for Peace: A NARA Milestone Document, College Park, MD: National Archives and Records Administration.
[433] See above and Appendix I.
[434] UN, 1953, op. cit, n433.
[435] PPU, 2003, Global Nuclear Stockpile 1945-2002, Peace Pledge Union, available at http://www.ppu.org.uk/learn/info/atom2.htwml, accessed on 22/03/10. This figure was to peak at over 65,000 in 1986.
[436] Article III(A)(3) Statute of the International Atomic Energy Authority, 1956.
[437] Article XII(A)(1) Statute of the International Atomic Energy Authority, 1956.

technique of inspection and control of fissile material which could be used for atomic weapons."[438]

The position of ultimate authority in relation to the UK's nuclear power industry filled by the UKAEA in 1954 had only lasted for two years until elements of it were already being overreached by the new IAEA. Further erosion to the power of the UKAEA was to come with the creation of the European Atomic Energy Community which only directly affected the UK after 1973.

European Atomic Energy Community[439]

In March 1957, the Treaty establishing the European Atomic Energy Community (Euratom) had been signed in Rome. Historian Alexander Rudhart, writing in the mid 1970s, suggests that the creation of Euratom had been triggered by "the threat of an Arab oil boycott in the wake of the 1956 Suez crisis"[440] which provides an interesting thematic link to the 2005 decision discussed later to reintroduce nuclear power partly because of issues around "energy security."

Although only six countries signed the treaty at this time,[441] the UK would eventually join Euratom along with the other European Communities in 1973. This meant that, for the first time since the war, there was a wider atomic research community; admittedly, one of which the UK was not to become a part for a further 16 years. The historian Martin Dedman points out that Britain had initially been a part of the negotiations which would later lead to the Treaty of Rome, but had pulled out in 1955.[442] Disagreement between the President of the Board of Trade, the Chancellor of the Exchequer and the Prime Minister about the wisdom of Britain joining a European Coal and Steel Community are also cited by Dedman as being important factors in the decision to pull out of the talks.[443]

The UK's attempts to become a member state had been blocked on two occasions before they were successful in 1972. The French President, Charles de Gaulle, had vetoed the UK's application to join in January 1963, on the basis that "enlarging the Market would produce a colossal Atlantic grouping under American dependence and control."[444] Again, in May 1967 the UK made a second formal application to join the EEC and, despite the other five members supporting the bid, de Gaulle was able to exercise the French veto. This was partly to do with the UK's membership of, and staunch support for, NATO at a time when de Gaulle was feuding with it. Historian Peter King argues, however, that "the position of sterling and the Common Agricultural Policy... were the main attacking points."[445] This is perhaps an example of a decision by the French President which was made for pragmatic reasons – resisting the strength of sterling and the power which the UK would bring into the CAP – but which was justified on the basis of an ideological standpoint – that Europe should remain free of American influence.

The entry of the UK into the Common Market was important step in relation to nuclear power. Many aspects of the UK's nuclear research had been governed by the IAEA since 1956, which sought "to accelerate and enlarge the contribution of atomic energy to peace,

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[438] Noel-Baker, F., 1957, Disarmament, HC Deb 10 June 1958 vol 589 c105
[439] For a discussion about the non-energy role of Euratom in regard to nuclear testing, see Deimann, S., & Betlam, G., 1995, Nuclear testing and Europe 145 NLJ 1236.
[440] Rudhart, A., 1975, Twentieth Century Europe, Englewood Cliffs, NJ: Prentice Hall, p432
[441] The six signatories were "His Majesty The King Of The Belgians, The President Of The Federal Republic Of Germany, The President Of The French Republic, The President Of The Italian Republic, Her Royal Highness The Grand Duchess Of Luxembourg, Her Majesty The Queen Of The Netherlands" – Preamble to the 1957 Treaty Establishing the European Atomic Energy Authority.
[442] Dedman, M., 1996, The Origins and Development of the European Union 1945-95, London: Routledge Publications.
[443] Peter Thorneycroft, President of the Board of Trade, "was willing to consider UK entry into a common market for steel", but Rab Butler, the Chancellor was "extremely hostile to the idea of closer links with the ECSC", and Anthony Eden "also did not want to do anything to encourage European integration." Source: Dedman, M., 1996, op cit, n444, pp66-67.
[444] King, P., 1980, op cit, n253, p353.
[445] Ibid, p359.

health and prosperity throughout the world."[446] The aims of Euratom, by comparison, were focused primarily on the member states within Europe, although there was provision for it to "establish with other countries and international organizations such relations as will foster progress in the peaceful uses of nuclear energy."[447] Although, in practice, there has never been a recorded conflict between the aims of the IAEA and Euratom, we can see the potential for conflict between them. The IAEA was geared towards enhancing the global role played by nuclear power, whereas Euratom was geared towards the stability of the Common Market, and only then to enhance global relations.

Even though it would be a further sixteen years before the UK became a formal member of Euratom, in February 1959, a cooperation agreement was signed between the UK and Euratom, providing:

> "the framework for development of close co-operation between institutions and private industry in the United Kingdom and in the European Atomic Energy Community."[448]

Although the UK was not a member of Euratom until the 1970s, as discussed above, it did become a member of yet another international nuclear regulator in the late 1950s.

<u>European Nuclear Energy Agency</u>

In December 1957, the Council of the Organisation for European Economic Co-operation (OEEC) adopted the creation of the European Nuclear Energy Agency (NEA).[449] The UK was one of the signatory states to the NEA, the role of which was:

> "... the development of the production and uses of nuclear energy, including applications of ionizing radiations, for peaceful purposes by the participating countries, through co-operation between those countries and a harmonization of measures taken at the national level."[450]

It is interesting to note that, of all the regulatory and overseeing bodies discussed here, the NEA is the only one to use the word "nuclear" in its title as opposed to "atomic." Professor Sir John Cockcroft, writing in 1947 whilst Director of the AERE, had argued that "atomic energy should really be called nuclear energy because it comes from a joining together or splitting up of nuclei of atoms"[451] and yet it took until the passage of the Atomic Energy Act 1959 for the term 'nuclear' to make it onto the statute book in the UK – and until the Nuclear installations (Amendment) Act 1965 for an attempt to be made to define the term. For all that politicians have a tendency to use scientific language when it suits them, as we have seen, this suggests that there was not a great deal of understanding of the scientific information being used.

The agency, which still exists, is now called the Nuclear Energy Agency, or *Agence pour l'energie nucléaire*, and is run by the Organisation for Economic Co-operation and Development (OECD), which took on the role of the OEEC in 1961.[452] The relationship between the NEA and Euratom was described in rather loose terms by the then Home Secretary, Rab Butler, as:

> "The Agency Statute provides that it shall be established in close collaboration with Euratom whose members are also members of the Agency."[453]

This is rather meaningless, since the seventeen-state original membership of the NEA

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[446] Article II, Statute of the International Atomic Energy Authority, 1956.
[447] Article 2(h) Treaty Establishing the European Atomic Energy Community, 25 March 1957.
[448] Macmillan, H., 1959, Euratom (Agreement), HC Deb 22 January 1959 vol 598 c56W
[449] OECD, 2004, The Organisation for European Economic Co-operation, Paris: Organisation for Economic Co-operation and Development.
[450] Article 1(b) of the Statute of the Nuclear Energy Agency 1957.
[451] Cockcroft, J. D., 1947, Discovery and Development: Early Experiments, <u>The Listener</u>, Vol. XXXVII, No. 946, p356.
[452] OECD, 2004, op cit, n451
[453] Butler, R. A., 1958, European Nuclear energy agency, HC Deb 04 February 1958 vol 581 c974

included all six original members of Euratom, but the "close collaboration" of which Butler spoke was to come to fruition with the construction of the Dragon High Temperature Reactor at Winfrith in 1959, initially under the joint auspices of the NEA and UKAEA, but also with the involvement of Euratom from 1973-6.[454]

In the space of five years therefore, the UK had shifted from a position whereby all nuclear activity was regulated solely by the Minister of Supply, to one where the wishes and proposals of the UKAEA, IAEA and NEA all had to be entertained, and those of Euratom were already being given due regard in political debates. The role of Ministry of Supply was changed in December 1953, and atomic energy was moved into:

> "an independent Department of State under the Lord President. The arguments for doing that and no more are variations on the theme that atomic energy is in its prodigious infancy, still very dangerous, very costly to the taxpayers, and still unready to leave the nursery of the Civil Service."[455]

As we have seen the rationale behind the 1954 Act was a pragmatic response to the lack of scientists working in the field, to the growth in possibilities of atomic research, and to the very real probability that there would be an atomic industry in need of regulation before very long.

3.2.3: The 1955 White Paper "A Programme of Nuclear Energy"

With the creation of the UKAEA, the government's confidence in atomic energy appeared to be getting stronger and, on 15 February 1955, the Churchill Government published a White Paper "A Programme of Nuclear Energy."[456] The White Paper spoke of a new dawn for the British public and of cheap, clean power, and the press reacted with a lack of interest – the *Times* only mentioned the White Paper only once, and in the whole of the year published only twenty pieces on atomic energy, many of which concerned the establishment of the UKAEA. Indeed, the political news story of the early part of 1955 was the resignation of Churchill as Prime Minister in April[457] and the election of Anthony Eden in May.[458]

In the White Paper, "the Government was sufficiently confident of progress to announce a £300m programme of civil nuclear power based on the [PIPPA] reactor, aiming for 1500-2000 MW of electricity by 1965."[459] The provisional, three-stage programme foresaw that the power stations "will be built in the normal way by private industry for the Electricity Authorities, who will own and operate them."[460] The capital cost of building these stations was estimated at £300m in 1955 prices (approximately £6bn in April 2009 prices[461]), which was offset against

> "the investment by the Electricity Association… in the absence of nuclear power… of the order of about £1.2bn."[462]

The White Paper hoped to replace "five to six million tons of coal per year"[463] through the nuclear programme, which would have amounted to between 50 and 60 millions tons (mt) over the subsequent decade. In fact, between 1955 and 1965, coal production had

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[454] Goldschmidt, B., 1978, International Co-operation in the Nuclear Field – Past, Present and Prospects, IAEA Bulletin, Vol 20, No 2.
[455] Eccles, D., 1954, op cit, , n400, c846
[456] Lord President of the Council, 1955, op cit, n124
[457] Times, 1955a, Sir Winston Churchill, The Times, Monday, Apr 04, 1955; pg. 4; Issue 53200H; col A
[458] Times 1955b, The General Election: Last Night's results, The Times, Friday, May 27, 1955; pg. 4; Issue 53231; col A
[459] Fishlock, D., 2003, An appreciation: Richard Valentine Moore GC CBE, Atomic Energy, 43 (3) 136-138:137.
[460] Lord President of the Council, 1955, op. cit, n124, p5, para 23.
[461] ONS, 2010, RP02: Retail Prices Index (RPI) all items, Office for National Statistics, London.
[462] Lord President of the Council, 1955, op. cit, n124, p5, para 30.
[463] Ibid.

fallen fell by only 33.5mt, from 211.3mt to 177.8mt. [464] Of that fall, 1.2mt can be attributed to "shifts not actually worked owing to industrial disputes"[465] in 1954, so the actual figure is closer to 32mt, which means the claims made by the White Paper were rather wide of the mark

An average drop of over three million tons a year still represents a marked fall in coal use, however, even if not all of it was due to the few nuclear plants which came on stream during that period. These new plants contributed only about a tenth of the electricity requirements of the time – this is especially true since "demand for electricity rose during the 1950s and 1960s at a rate of around 7 per cent per year."[466] In 1965, the Minister for Fuel and Power, Frederick Lee, was asked by Nicholas Ridley MP whether the government felt that coal production would be reduced as a result of "atomic energy becoming competitive with coal-fired power stations."[467] The minister replied that, on the contrary:

> "it is clear that the use of coal by power stations will increase substantially over the next few years."[468]

The £300m cost of providing up to 2000MW of power appeared to be rather sizeable at the time of the White Paper,[469] but started to look more reasonable when Egyptian President Nasser nationalised and closed the Suez Canal in 1956; thus cutting off the shorter route for oil into Britain. At the time, the Prime Minister, Sir Anthony Eden, was advised that closure of the canal would lead Britain dangerously short of oil and, in November 1956, introduced petrol rationing.[470] Before rationing had been introduced, the price of petrol had already risen by 35 per cent.[471] Shortage of oil also meant that the case for increased use of nuclear fuel for which the country would not be dependent on foreign nations was strengthened: the Suez crisis had already revealed how fragile the illusion of a secure energy supply was, and the extent to which "keeping the lights on"[472] at home was dependent upon a stable global situation. It also underlined, not that any underlining was necessary, the strong link between energy policy and foreign policy. The end of the Suez crisis and the re-opening of the canal in April 1957 meant, however, that:

> "all the assumptions that underlay the nuclear programme were in tatters. By then it was clear that the Suez crisis had not provided a lasting threat to Britain's oil supplies... In fact, oil prices were falling to such an extent that it actually became cheaper for power stations... to burn oil rather than coal."[473]

It is the economic benefits of oil-fired, rather than coal-fired power stations, which therefore must shoulder much of the responsibility for the fall in domestic coal production in the late 1950s and early 1960s. This leads to the inevitable conclusion that the 1955 White Paper was even more inaccurate in its estimates than first appeared to be the case. The scientific basis for the estimates was never revealed in the White Paper, and strengthens the argument that the policy makers portrayed their decision as being based on unified and accurate science, when hindsight and experience tell us that it was not.

As we have seen, the cost of the nuclear programme would involve investment of around £300m, and this enormous figure would be allocated by the technocrats in the UKAEA (although the decisions would still have to be passed through the Lord President),

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[464] Figures from: CA, 2006, Summary of Coal Production and Manpower from 1947, Mansfield: The Coal Authority, pp1-2.
[465] The industrial disputes referred to included the Dock workers' strike and the electricians' strike. Source: Joynson-Hicks, L., 1955, Industrial Disputes (Losses), HC Deb 21 February 1955 vol 537 c110W
[466] Helm, D., 2004, op cit, n220, p27.
[467] Ridley, N., 1965, Power Stations (Fuel Requirements), HC Deb 13 July 1965 vol 716 c263
[468] Lee, F, 1965, Power Stations (Fuel Requirements), HC Deb 13 July 1965 vol 716 c263
[469] As a rough guide this equated to about £150 per Kilowatt in 1955 (including capital and generating costs),
[470] Hennessey, P., 2006, op cit, n170
[471] DETR, 1997, National Road Traffic Forecasts (Great Britain) 1997: Working Paper No 2, Car Use: Modelling and Forecasting, London: Department of the Environment Transport and the Regions, p7.
[472] The quote actually relates to the CEGB's reliance on nuclear power during the Miners' Strike on 1984-5. Source: NIA, 2010a, Nuclear energy past, present and future, London: Nuclear Industry Association.
[473] Hennessey, P., 2006, op cit, n170, p67.

to whichever companies were lucky enough to be involved in the capital building programme. No single company felt that it had the experience or expertise to bid for these projects along and so the companies created a series of nuclear consortia.

3.2.4: The Nuclear Consortia

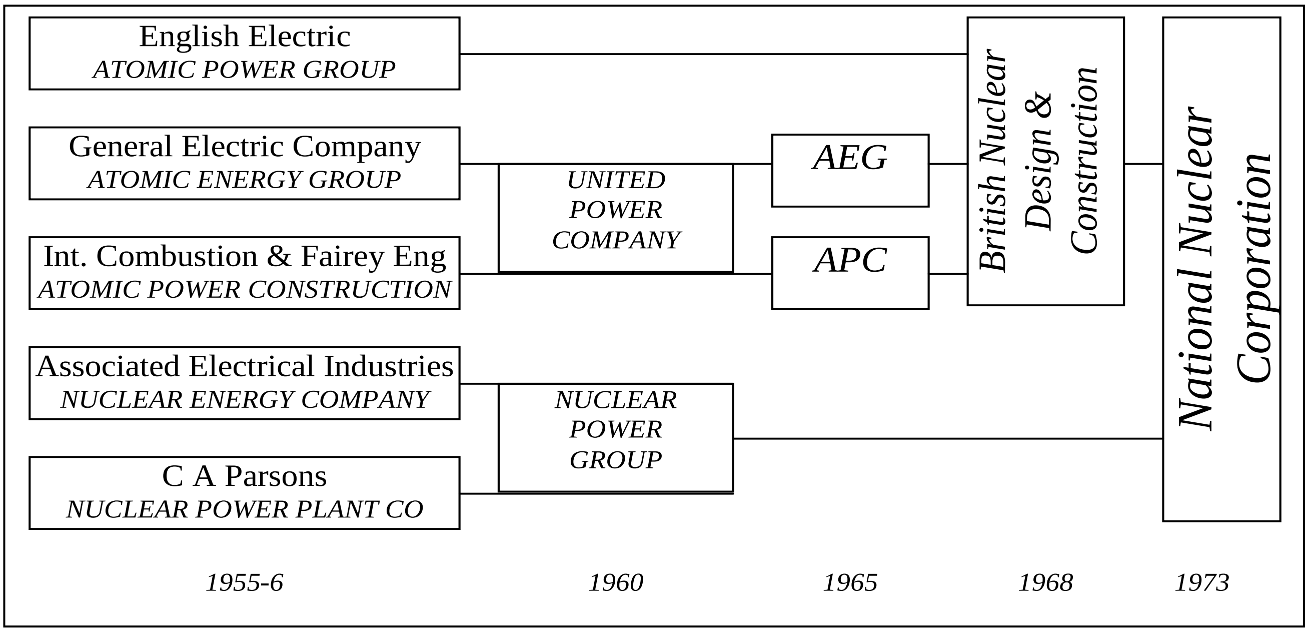
At this point, it is worth looking both at how the 1955 White Paper envisaged the future of nuclear power in the UK and how those plans translated into reality. The proposed plants were to be built by a number of consortia, which would be formed by the leading engineering companies of the time, all of which were in private hands. Originally, there were four consortia set up, led by Associated Electrical Industries (as the Nuclear Energy Company, NEC), the General Electric Company (as the Atomic Energy Group, AEG), English Electric (as the Atomic Power Group, APG) and CA Parsons (as the Nuclear Power Plant Company, NPPC).[474] A fifth consortium, led by Internal Combustion and Fairey Engineering (called Atomic Power Constructions, APC) had been added in 1956.[475]

By the end of 1960, there would have been two mergers of the consortia. The NEC joined with the NPPC to form The Nuclear Power Group (NPG) and the AEG joined with the newcomer, APC, to become the United Power Company (UPC).[476] This left three consortia, although they were not to remain unchanged for long. GEC pulled out of the UPC Consortium in 1965, leaving APC on its own. GEC also merged with English Electric in 1968, leading to the emergence of a new consortium, British Nuclear Design and Construction (BNDC). This new organisation not only took over from the old APG (which had been led by English Electric), but also took on the work of the APC, which was running into difficulties.[477] The two remaining consortia continued until 1973 when a new company, the National Nuclear Corporation (NNC) was set up by the government "to build all of Britain's power reactors."[478]

NNC was to be owned partly by the UKAEA (15 per cent), GEC (50 per cent), and the remaining consortia companies (35 per cent).[479] The post-1970s' developments of the NNC will be discussed in more detail later in this thesis and this complicated series of developments is summarised in Figure 3.2, below. Although this makes the development of NNC appear complex, there are other nuances which need to be taken into account in terms of the ownership of these companies. The companies named in the first five consortia are only the major members and, in all cases, there were other companies involved. Indeed, in the first five consortia, there were 23 companies involved and, over the several iterations of consortia, a total of more than 30 companies were members.[480]

Figure 3.2: Development of the Nuclear Power Consortia[481]

[474] Patterson, W. C., 1985, Going Critical: An Unofficial History of British Nuclear Power, London: Paladin Grafton Books, pp5-6.
[475] Ibid., p7.
[476] Ibid., p8.
[477] Ibid., p21.
[478] NNC, 2004, History, Knutsford: NNC Holdings Limited. In 2005, NNC was bought by AMEC Construction.
[479] Patterson, W. C., 1985, op cit, n476, p25. The shareholding rose by a further 20 per cent to 35 per cent in 1976. Source: Benn, T., 1976, National Nuclear Corporation, HC Deb 14 July 1976 vol 915 c169W. By this stage, there were no issues about conflicts of interest arising from the UKAEA's part ownership of NNC, as there was only a single consortium left.
[480] The details of the companies involved in the various iterations of the consortia can be found in Appendix IV
[481] Figure based on information from Patterson, W. C., 1985, op cit, n476; NNC, 2004, op cit, n480; and MMC, 1981, Central Electricity Generating Board: A report on the operation by the Board of its system for the generation and supply of electricity in bulk, HC315, London: Monopolies and Mergers Commission / HMSO, p359-61.



Some of the companies themselves merged over the years as well, reducing the number of consortia members in the process:

> GEC (Atomic Energy Group) purchased Associated Electrical Industries (Nuclear Energy Company) in 1967 and English Electric (Atomic Power Group) in 1968, becoming one of the world's largest electrical manufacturing companies.[482]
>
> C A Parsons & Co Ltd and A. Reyrolle & Co Ltd (Nuclear Power Group) merged in 1968 to form Reyrolle Parsons. Clarke Chapman & Co (Nuclear Power Group) acquired International Combustion Ltd (Atomic Power Construction) and then merged with John Thompson Ltd (Nuclear Power Group) in 1970 to form Clarke Chapman John Thompson Ltd. Reyrolle Parsons merged with Clarke Chapman John Thompson Ltd to form Northern Engineering Industries in 1977. NEI is now owned by Siemens.

All of the larger companies were in public ownership at the time of the consortia and so the shareholders could, in theory, access company information. In practice, however, two things must be borne in mind. Firstly, many chose not to access the detailed company data available in annual reports and, secondly, if there was any information which the companies felt it would be undesirable to release, there were far fewer mechanisms in existence for forcing them to do so than there are today.[483]

One area where the consortia wanted protection from the government was in terms of nuclear liability, and this was a significant part of the pressure which led to the passage of the Nuclear Installations (Licensing and Insurance) Act 1959.

3.2.5: Nuclear Installations (Licensing and Insurance) Act 1959

The Fleck Report into the Windscale accident, which had been published in 1958, found that there were improvements and modifications which should be made to the design of Windscale Pile No 2. The Fleck Report also suggested that it might be possible to restart Pile No 1 as early as 1959,[484] although in practice this was never done. The potential costs associated with such an accident in the future were felt likely to deter potential investors and, since the 1955 White Paper envisaged the five private nuclear

[482] MMC, 1979, The General Electric Company Limited and Averys Limited: a report on the proposed merger (Cmnd 7653), London: Monopolies and Mergers Committee / HMSO, p9.
[483] The full provisions of the Freedom of Information Act 2000, for example did not come into effect until 2005, and even this does not give an absolute right to access information, since it only requires public authorities to comply.
[484] Fleck, A., et at., op cit., n370, p17

consortia (and at this point there still were five consortia, but only just) playing a major role in future plant construction and operation, the creation of some form of state indemnity or insurance became a priority. This had been done in the United States the year prior to the Fleck Report by the Price Anderson Act (discussed below), which had limited the liability of plant operators to $60m, with the State underwriting the first $500m of any claim.[485]

The 1959 Act dealt in detail with the granting of "nuclear site licences"[486] to corporations (and, specifically, not individuals[487]) by the Minister. These licences would enable the licensee to construct and operate plant concerned with most aspects of the atomic energy process – "the production of atomic energy by a fission process…"[488] "any process which is preparatory or ancillary…"[489] and "the storage, processing or disposal of nuclear fuel."[490] Despite these seemingly blanket allowances, there were areas of activity in which only the UKAEA was allowed to work and licences could not be granted to third parties. This exception to the general rule covered "any treatment of irradiated matter which involves the extraction therefrom of plutonium or uranium; or for any treatment of uranium such as to increase the proportion of the isotope 235 contained therein."[491]

There are several different isotopes of uranium, some of which are of more use in the atomic energy process than others. Naturally occurring uranium is about 99% uranium-238 and contains about 0.7% uranium-235 by weight.[492] The fuel used in nuclear reactors must have "a higher concentration of uranium-235, as it is the key ingredient that starts a nuclear reactor and keeps it going"[493] and the process of increasing this concentration is called "enrichment." This means that, although the Act made it possible for bodies other than the Authority to carry out research or other work connected to the atomic-energy process, the production of fuel could not be delegated. One reason for this non-delegation clause is that the enrichment process used to increase the usefulness of Uranium as a fuel source is the same process as is used to create Highly Enriched Uranium (HEU), which is used in atomic weapons. While the Government would be content to allow third parties to become involved in some of the research linked to the atomic-energy process, it was bound by the terms of the IAEA Statute (dealt with in Chapter 3.2.2) not to allow weapons' technology out of its control.

The Act imposed a basic restriction on licensees, who were required to ensure that there were no escapes of ionising radiation (Section 4). This was not a blanket restriction, as it exempted two categories of escape: those which did not "cause any hurt to any person or any damage to any property, whether that person or property is on that site or elsewhere,"[494] or those were attributable to "hostile actions in the course of any armed conflict."[495] The logic behind these exemptions is entirely sound – making licensees liable for escapes of radioactive material caused by a war (which, by assumption was not the fault of the licensee, since the licensees were all companies) would contravene the common law maxim that "*actus legis nemini facit injuriam*" ("the act of the law injures no-one").[496] Legal maxims, whilst not having the same level of power and authority as statute law, still have a level of importance which has been recognised for centuries. They have also been rehearsed and revisited by generations of law students old and new. Lord Edward Coke, Chief Justice of the King's Bench in the seventeenth century, had fairly

[485] Price Anderson Act 1957
[486] Section 1(1) Nuclear Installations (Licensing and Insurance) Act 1959
[487] Section 1(4) Nuclear Installations (Licensing and Insurance) Act 1959
[488] Section 1(1)(a) Nuclear Installations (Licensing and Insurance) Act 1959
[489] Section 1(1)(b) Nuclear Installations (Licensing and Insurance) Act 1959
[490] Section 1(1)(c) Nuclear Installations (Licensing and Insurance) Act 1959
[491] Sections 1(2)(a) and (b) Nuclear Installations (Licensing and Insurance) Act 1959
[492] BNFL, 2003, Enrichment, British Nuclear Fuels Ltd, http://www.bnfl.com/index.aspx?page=160, accessed on 25/01/04
[493] US NRC, 2003, Uranium Enrichment, United States Nuclear Regulatory Commission, Washington, DC: US DoE / US EPA
[494] Section 4(1) Nuclear Installations (Licensing and Insurance) Act 1959
[495] Section 4(2) Nuclear Installations (Licensing and Insurance) Act 1959
[496] See Volume 5, Coke's King's Bench Reports [1572-1616] @ 116

strong views on the level of power exerted by statute and whether or not it could be bypassed by common sense:

> "It appears in our books that in many cases the common law will control acts of parliament and sometimes adjudge them to be utterly void; for when an act of parliament is against common right and reason, or repugnant, or impossible to be performed, the common law will control it and adjudge such act to be void."[497]

Coke's words are well known amongst lawyers and politicians alike and indeed, have been cited in parliamentary debates.[498] Insurance policies, however, have traditionally excluded any liability for "losses… proceeding from the act of God, or the King's enemies"[499] – in other words, losses attributable to natural disasters or acts of war (and, more recently, terrorism). This meant that the provision of cover under section 5 was the exact opposite of mainstream insurance policies. This approach suggests both that the government already considered that its atomic plants were more of a target than other industries, and that the consequences of an attack on such a plant would be far graver than they would for an attack on a coal mine, for example.

Licensees were also required to take out insurance against any possible escape of radioactive material, up to a value of £5m[500] (£90m). Several different claim periods were set out in the Act, ranging from ten years with respect to single incidences of pollution (Section 4(4) and Section 5(1)), up to thirty years in situations where the "occurrence was a continuing one, or was one of a succession of occurrences…."[501]

Equally importantly, section 7 of the Act gave the Minister the power to appoint Inspectors, who were given powers of entry onto licensed sites in order to assess whether the terms of a license were being complied with. The Inspectors, and their parent body the Nuclear Installations Inspectorate (NII), were protected from interference and obstruction in the course of their duties. The provisions of the Act which prevented Inspectors from disclosing any information that was discovered on inspection were much stricter, however.[502] As with the unusual exemption clauses to insurance discussed earlier, these draconian measures for interfering with inspectors suggest that, as the Cold War was at its height, concerns about espionage were still at an acute level.

The general rule on a person's liability for the escape of something on their land is a well-established one, having been set out towards the end of the 19th Century by Blackburn J, in the case of Rylands v Fletcher.[503] The rule states that:

> "… the person who for his own purposes brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril and if he does not do so, if prima facie liable for all the damage which is the natural consequence of its escape."[504]

The Rule in Rylands and Fletcher was soon refined and now covers only a *non-natural* use of the land.[505] This, in turn, was refined further in the early twentieth century to the extent that:

> "non-natural use… must not merely be the ordinary use of the land or such a use

[497] Dr Bonham's Case (1610) 8 Co Rep 114
[498] See for example, Ferrand, W., 1847, Poor Law Administration Bill, HC Deb 17 May 1847 vol 92 c983, and Mar and Kelly, Earl, 1999, House of Lords Bill, HL Deb 11 May 1999 vol 600 c1153
[499] Butler v Wildman [1814] 23 All ER 748, per Best J @ 52
[500] Section 5(1) Nuclear Installations (Licensing and Insurance) Act 1959
[501] Section 4(4) Nuclear Installations (Licensing and Insurance) Act 1959
[502] Section 7(1) gives the power to appoint. Section 7(3) protects the Inspectors from obstruction by the imposition of a criminal penalty of up to £50 and three months' imprisonment. Section 7(4) imposes a criminal penalty of up to £100 and two years' imprisonment on "any person who… discloses any information obtained in the exercise of powers under this Act"
[503] Rylands v Fletcher (1868) LR 3 HL 330
[504] Rylands v Fletcher (1868) LR 3 HL 330, per Blackburn J at 333. this is generally referred to as "the Rule in Rylands and Fletcher"
[505] This was added by Cairns LJ when the case was appealed to the House of Lords.

as is proper for the general benefit of the community"[506]

The use of statutory powers as a basis for construction of a site also has an effect on potential liability under Rylands v Fletcher. Although writing about a reservoir rather than a nuclear-power station, Professor Simpson states that, for such cases, "in the absence of negligence, the occupiers whose lands had been [damaged] would have had no remedy."[507]

Similarly, actions for nuisance against installations which have been granted planning permission has become more difficult since the case of Gillingham BC v Medway (Chatham) Dock Co Ltd.[508] In this case, the court held that the character of the residential area had been changed by the grant of planning permission for a commercial port and that what may have constituted a nuisance prior to the grant of planning permission would not necessarily do so afterwards.[509]

The law regarding the level of compensation payable is almost as well established, having been set out later by the same Judge (who, by now, was a Lord Justice):

> "... where any injury is to be compensated by damages, in settling the sum of money to be given for reparation of damages you should as nearly as possible get at that sum of money which will put the party who has been injured, or who has suffered, in the same position as he would have been in if he had not sustained the wrong for which he is now getting his compensation or reparation"[510]

The 1959 Act thus appears to envisage situations where damage of more that £5m could be caused by an escape of "iodising radiations"[511] from a licensed site. If it did not, then there would have been no need for a cap on the required insurance. As ever, this could be argued to be a sensible, pragmatic, "belt and braces" approach –parliament believed nuclear power to be safe, and to demonstrate this they would cover claims for any damages resulting from an accident. However, just in case it turned out not to be as safe as they had hoped, a cap would prevent too great a level of exposure to the government (and thus taxpayers and voters).

Although the UK opted to introduce a liability regime on the operators of nuclear sites with a comparatively low cap, the United States followed a different path via the Price Anderson Act of 1957.[512] This imposed a total cap on a single claim of $560m ($4.5bn at 2007 rates[513]), and set out that the first $500m of any claim would be covered by the Federal government, leaving the licensee with a $60m maximum exposure.[514] Without this limit, it was argued, insurance costs would run at $23.5 m per plant per year[515] – meaning that no company would be interested in operating a nuclear facility. With a cap on the exposure to liability, companies would look upon the development of nuclear-power stations more favourably – Westinghouse Electric Corporation had already built reactors[516] and was now joined in the field by Consolidated Edison Company[517] and Commonwealth Edison Company,[518] who started construction work respectively on the Indian Point

[506] Rickards v Lothian [1913] AC 263, per Moulton LJ at 280
[507] Simpson, B., 1984, Legal Liability for Bursting Reservoirs: The Historical Context of Rylands v Fletcher, Journal of Legal Studies, Vol. 13, p209 @ 225
[508] Gillingham BC v Medway (Chatham) Dock Co Ltd (1993) QB 343
[509] Moore, V., 2002, A Practical Approach to Planning Law, Oxford: Oxford University Press, 8th Ed.
[510] Livingstone v Raywards Coal Co [1880] 5 App Cas 25, per Blackburn LJ at 39
[511] Section 4(1) Nuclear Installations (Licensing and Insurance) Act 1959
[512] This Act was incorporated as Part e of the (US) Atomic Energy Act of 1957.
[513] All US inflation data sources from: BLS, 2007, Overview of BLS Statistics on Inflation and Consumer Spending, US Bureau of Labor Statistics, Washington, DC. Available at http://www.bls.gov/ accessed on 22/03/10
[514] Section 1(e) Atomic Energy Act of 1957
[515] Grossman, K., 1980, op cit, n279, p137
[516] The reactor, EBR-1 was built at the US AEC's laboratory in Idaho in 1952. Source INEEL, 2003, op cit, n137
[517] SUP, 2005, The Encyclopedia of New York State: Consolidated Edison, Syracuse, NY: Syracuse University Press.
[518] US NRC, 2005, Dresden Unit 1, United States Nuclear Regulatory Commission, Washington, DC: US DoE / US EPA

reactor at Buchanan, New York, and the Dresden plant in Grundy County, Illinois, in 1957.

The UK and the US had two things in common in the 1950s and 1960s; governments which were decidedly pro-nuclear power and privately-owned nuclear construction and operation industries. Added to this heady mixture was the increasingly apparent suggestion that accidents at nuclear power stations, even though they could not be as destructive as the bombs dropped on Hiroshima and Nagasaki, could cause considerable, and expensive, damage. The costs of this were presumed to be high enough to deter private companies from wanting to become involved in the industry, and so the UK and the US therefore had already started imposing limits on liability for nuclear-related accidents, as a mechanism for encouraging investment. It was not long before both the United Nations and the OEEC joined them.

3.2.6: The Paris, Vienna and Brussels Conventions 1960-3[519]

The Paris Convention 1960[520] and Brussels Convention 1963,[521] both of which were introduced under the auspices of the OEEC/OECD, and the Vienna Convention of 1963,[522] which was a United Nations instrument, were all concerned with the imposition of liability for nuclear incidents and accidents. They were given effect in the UK by the Nuclear Installations Act 1969.[523]

The 1960 Paris Convention established the absolute liability of plant operators for personal injury and damage to property as a result of a nuclear incident.[524] In relation to a nuclear installation, the operator was defined as "the person designated or recognised by the competent public authority as the operator of that installation."[525] In the UK, therefore, this would mean anyone who had been granted an operating licence by the Nuclear Installations Act 1965. The financial limit of liability was set out in Article 7 as 15 million "Special Drawing Rights"[526] (SDRs), although it could be amended by the signatory States depending on various insurance criteria.[527]

The Brussels Convention then extended that liability to the signatory States themselves for "damage caused by nuclear incidents"[528] by their national operators. The limit was set at 300 million SDRs,[529] much higher than that set by the Paris Convention only three years earlier. The 300 million SDRs would consist of a combination of insurance, national public finds and funds made available by all the Contracting Parties.[530]

The Vienna Convention did much the same as the Paris and Brussels Conventions but, as a UN instrument, it was open to a greater number of signatories. Another difference is that lack of any specified financial cap on claims. Claimants were specifically barred from claiming under both the Vienna Convention and the Paris/Brussels Conventions by Article

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[519] For further discussion of the role that these conventions have in the area of liability for nuclear incidents, see: Temple, R., Penney, C, & Sullivan M., Liability for Nuclear Incidents: Should the UK Now Follow the US approach? (2006) 18 JEL (443).
[520] Paris Convention on Third Party Liability in the Field of Nuclear Energy, 1960.
[521] Brussels Convention of 31 January 1963 Supplementary to the Paris Convention 1960.
[522] Vienna Convention on Civil Liability for Nuclear Damage, 1963.
[523] The 1969 Act had, in its Long Title the role of bringing the 1965 Act into conformity with international agreements – in other words, the Vienna, Paris and Brussels Conventions.
[524] Woolley, J., 2000, Report on the Legal Liabilities for Civil Plutonium Incidents, Oxford: Oxford Research Group
[525] Article 1 (a)(vi), Paris Convention 1960.
[526] IMF, 2006, Factsheet: Special Drawing Rights (SDRs), Washington, DC: International Monetary Fund. Available at: http://www.imf.org/external/np/exr/facts/sdr.htm, accessed on 22/03/10.
[527] Article 7(b) Paris Convention 1960. Defined by the International Monetary Fund, the SDR was originally calculated as the equivalent of US$1 in fine gold. After the collapse of the Bretton Woods fixed exchange rate system in 1973, the SDR became calculated on the basis of a basket of currencies. Source: IMF, 2010, SDRs per Currency unit and Currency units per SDR last five days, Washington, DC: International Monetary Fund. Available at http://www.imf.org/external/np/fin/data/rms_five.aspx, accessed on 22/03/10.
[528] Article 2(a) Brussels Convention 1963.
[529] Article 3(a) Brussels Convention 1963.
[530] Article 3(b) Brussels Convention 1963.

XVI. As a result of this provision there are no countries which have ratified both the Paris and Vienna Conventions. Spain and the UK are the only countries to have signed both, but both have only ratified the Paris Convention.[531]

The amendments in the Nuclear Installations Act 1969 covered two specific areas. Section 1 inserted a new subsection (3A) into the 1965 Act, which extended the restrictions on liability for certain types of damage. Section 2 amended the thresholds and maximum amounts that would be made available by Parliament to meet compensation claims. In the case of compensation awarded by a foreign court, the threshold amount was raised from £1.75m to £2.1m.[532] The maximum limit on the compensation fund to be made available by Parliament was raised from £43m to £50m.[533] This rise of 16.3 per cent over four years is more or less in line with inflation over the same period.[534]

A considerable amount of the 1965 Amendment Act was devoted to assessing the apportionment of risks associated with transportation of nuclear matter and the involvement of "relevant foreign operators."[535] The transportation covered was wholly within the United Kingdom (Section 3) and, therefore, would not later fall under the auspices of the United Nations' Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.[536] Moreover, under section 5 of the Act, any damage or injury that occurred outside the UK and which, had it happened within the UK, would normally have invoked the compensation regime under section 4, was expressly excluded from compensation.

The rationale behind this exception was quite simple: licences could only be granted under the provisions of the linked 1959 and 1965 Acts in relation to sites within the UK and, thus, having Crown liability for an accident occurring outside the UK was unnecessary. As is often the case in statute, there was a caveat to this rule, meaning that compensation would have been payable if it could have been shown that the damage or injury occurred on a ship or aircraft registered in the UK.[537] The effective extension of the UK's responsibility onto its ships and aircraft is nothing new. In 1901, a government report[538] decided that there was no effective difference between the general extent of the British Empire and British ships. The report concluded:

> "the simplest rule would be that a person born on a British ship in foreign waters should be a British subject, but that a person born on board a foreign ship should not be deemed to be a British subject merely because the ship was at the time of his birth in British waters"[539]

Although this report concerned naturalisation laws rather than civil or criminal liability, what it did was to extend what was already an accepted idea that British sovereign territory extended to its ships (and, by logical extension, aircraft).

The existing Nuclear Installations (Licensing and Insurance) Act 1959 and Nuclear

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[531] Spain signed the Paris Convention on 31 October 1961 and the Vienna Convention on 6 September 1963. The UK signed the Paris Convention on 23 February 1966 and the Vienna Convention on 11 November 1964. Sources: NEA, 2006, 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy: Status of ratifications or accessions, Issy-les-Moulineaux: Nuclear Energy Agency of the OECD; IAEA, 2005, Vienna Convention on Civil Liability for Nuclear Damage, Vienna: International Atomic Energy Authority.
[532] The first amount was stated in Section 17(3)(b)(ii) Nuclear Installations Act 1965, and was substituted for the second amount by virtue of Section 2(1) Nuclear Installations Act 1969.
[533] The first amount was stated in Section 18(1) and (4) Nuclear Installations Act 1965, and was substituted for the second amount by virtue of Section 2(2) Nuclear Installations Act 1969.
[534] The Retail Prices Index (RPI all items) rose by 17.5% from January 1965 to January 1969. Source: ONS, 2010, op cit, n463
[535] Section 2 Nuclear Installations (Amendment) Act 1965.
[536] The UN Basel Convention on the Control of Transboundary movements of Hazardous Wastes and their Disposal 1989. Although the Nuclear Installations (Amendment) Act 1965 predates the Basel Convention by some 24 years, the provisions relating to movement of nuclear waste within the UK have not been amended (other than by the Nuclear Installations Act 1965, which did not change the text), and so still apply today.
[537] Section 5(2) Nuclear Installations (Licensing and Insurance) Act 1959.
[538] Digby, K., E., 1901, Report of the Inter-Departmental Naturalization Acts Committee of Inquiry, London: HMSO
[539] Ibid, p8.

Installations (Amendment) Act 1965 were repealed in their entirety by section 29(1) of the Nuclear Installations Act 1965. This Act was entered onto the statute books on 5 August 1965, but did not come into force until a further four months later, however.[540] Whilst not a point of great significance, this is a longer time period than for most pieces of statute, particularly consolidation Acts which say nothing new or controversial. Although those four months were a busy time for the Wilson Government, which had to contend with the increasing US involvement in Vietnam, the outbreak of war between India and Pakistan[541] and the oil embargo against Ian Smith's Rhodesia, the delay appears to have been simply an administrative measure designed to smooth the transition between the old Acts and the new Act.

This is a good example of what was mentioned in the introductory chapter; a situation where national legislation was initially informed and directed by international law, but subsequently developed along a more independent pathway. One advantage of this is that international treaties and conventions, such as the Paris Convention, have no direct legal effect on real or legal persons – that is to say on people or companies.[542] International law needs to be put into a national framework before it becomes anything more than a statement of intent by the signatory states, so the states which have signed but not ratified any of above Conventions are not bound by their provisions. This means that although the Nuclear Installations Act 1969 stated that its purpose was to bring the Nuclear Installations Act 1965 into "conformity with international agreements" the provisions of the Vienna Convention are still not binding in the UK, only those of the Paris and Brussels Conventions. The differences in levels of liability under the Paris/Brussels Conventions, the Vienna Convention, the 1959/1965 Acts and the 1957 Price Anderson Act (which was the US equivalent) are summarised in Table 3.1.

Table 3.1: Liability under UK and other Law[543]

Statute	Liability for Escape or Damage		Time Period
	Operator	State	
Price Anderson Act 1957	$60m (£223m)	$500m (£1.9bn)	
Nuclear Industry (Licensing and Insurance) Act 1959	£5m (£84m)	£43m (£722m)	10-30 yrs
Paris Convention 1960	15mSDR (£53m)	300mSDR (£1bn)	
Vienna Convention 1963	UNSPECIFIED		
Nuclear Industry (Amendment) Act 1965	£5m (£70m)	£43m (£600m)	10, 20, 30 yrs
Nuclear Industry Act 1965	£5m (£70m)	£43m (£600m)	10, 20, 30 yrs

Although the figures used in the table are all just rough approximations, it is clear to see that liability for both state and licensee under UK law is considerably lower than under either US law or International Law. Given the way in which the nuclear consortia (who were the licensees) managed to exert influence on the legislative process in the UK, this is not a great surprise.

The inherent internal contradiction between governments which, on the one hand

[540] Nuclear Installations Act 1965 (Commencement No 1) Order 1965 (SI 1965/1880).
[541] Sked, A., & Cook, C., 1993, Post-War Britain: A Political History 1945-1992, London: Penguin Books, p213.
[542] A corporation has had legal personality, or the right to enter into contracts in its own name, since the sixteenth century. The more formalised Doctrine of Separate Legal Personality evolved at the end of the nineteenth century (see especially Salomon v A Salomon & Co Ltd [1897] AC 22), but that is beyond the focus of this work.
[543] Figures in brackets represent rough 2007 Sterling equivalents. Sources: ONS, 2009, op cit, n463; BLS, 2007, op cit, n515; and IMF, 2010, op cit, n529. Paris Convention figures are calculated as if the Bretton Woods system were still in place.

were convinced that nuclear energy was the future of commercial energy production and, on the other knew that they could not encourage private enterprise to play any significant role in this future without sweetening the deal considerably, was first marked in the eight year period between the 1956 Price Anderson Act and the 1963 Vienna Convention. Prior to Price Anderson, no company had any indemnity from the state. After Vienna, no company operated *without* indemnity from the state.

Having considered the general developments which occurred in the interim time period between the end of chapter two and the beginning of this chapter, it can be seen that the Acts which were passed between 1973 and 1977 were forged in a completely different environment to those which had been created in the late 1940s. In the early Acts, the environment was what Professor Steve Cohn refers to as a "politico-economic consensus in favour of nuclear power development."[544]

Nineteen sixty-four saw the election of Harold Wilson and the Labour Party, following the increasing unpopularity of the Conservative government, which had been in power since 1951. Partly because of the tiny Labour majority (of four), Wilson was unable to introduce any significant legislative changes to the previous government's nuclear policy – the 1965 Nuclear Installations Act, for example, built on existing policy decisions. This put Wilson somewhat at odds with a significant proportion of the party membership, which had by that time established close links with the Campaign for Nuclear Disarmament (CND). According to the CND, "Labour Party members and trade unionists were overwhelmingly sympathetic"[545] to their causes, but this should not be taken at face value, since the organisation proffers no concrete evidence to back up their assertion. Additionally, the Trade Unions with their block votes were generally unsympathetic to the nuclear industry, particularly since the passing of a party conference motion in 1960 in support of unilateral nuclear disarmament, which had gone against the advice of the leadership.[546] In the UK, nuclear power related decisions were taken, as has already been shown, by the Minister of Power (although this post was incorporated into the Ministry of Technology in the late autumn of 1969[547]) and UKAEA. Clearly, as a political appointee, the Minister of Power is bound to a large extent by government policy which in the 1964-70 period was broadly pro-nuclear and pro-British buying. Indeed, Harold Wilson launched the "I'm backing Britain" campaign in 1968[548] (shortly after the devaluation of Sterling by around 15 per cent in November 1967[549]) in which the public was urged to purchase only home-produced goods rather than imported goods. Clearly it was far from being his intention, but by making foreign goods and services more expensive almost overnight, Wilson's actions made the choice of a British reactor slightly more economically viable.

Professor Cohn, who looked at the development of the nuclear industry primarily from the perspective of the United States, makes some points which translate equally well to the UK, arguing that there had been several elements which spawned the political-economic consensus he claimed to have been in place in the 1950s and 1960s, including "widespread public trust in business and government leaders" and "popular faith in 'Science.'"[550] By 1973, as we have seen to some extent above, and will be shown in more detail in the following sections, many of these elements had either begun to be eroded or had been eroded completely, and thus the use of scientific language and rhetoric by politicians could be expected to change.

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[544] Cohn, S.M., 1997, op cit, n350, p17
[545] CND, nd, Briefings and Information: A brief history of CND, London: Campaign for Nuclear Disarmament.
[546] Harris, T., Kincaid, J., Pritchard, R., & Tracey, N., 1962, Labour and the Bomb, International Socialism, No.10, pp21-31:23.
[547] DTI, 2006a, About us: History – Outlines – Department of Energy 1974-1992, London: Department of Trade and Industry.
[548] Arnot, C., 2005, A collection that speaks volumes, The Guardian, 15 February 2005.
[549] Burk, K., 2003, Anglo-American Relations: Where we are and how we got here, text of a speech given at Barnard's Inn Hall, Gresham College, London, October 2003. Available at http://gresham.ac.uk/event.asp?PageId=45&EventId=201, accessed on 22/03/10.
[550] Cohn, S.M., 1997, op cit, n350, p17.

3.3: The Atomic Energy Agency (Weapons Group) Act 1973

As has been shown in earlier chapters, the early days of nuclear research were focused on the weapons-related potential of the technology, with Sir Henry Tizard, Chair of the Aeronautical Research Committee "fail[ing] to see much of a future for nuclear power at all"[551] and Winston Churchill and Sir John Anderson claiming in 1943 that the prospects for Britain's post-war commercial exploitation of nuclear power were "remote and hardly worth considering."[552]

However, an industry dedicated to nuclear power did develop, as we have also seen, and the separation of this industry from the parallel nuclear-weapons' industry is marked in the UK by the separation of the Weapons Group (one of the four specialist groups within the UKAEA) from the rest of the Authority by the Atomic Energy Authority (Weapons Group) Act 1973. This Act, while not privatising any aspect of the industry, transferred the Weapons Group to the direct control of the Secretary of State for Defence.[553] Along with the personnel (who were given guarantees of continuation of employment under Section 2(1) of the Act), any land that had been used by the Weapons Group prior to 1 November 1972 was also transferred away from UKAEA.[554]

Perhaps unnecessarily, given the complete removal of its Weapons Group, the Act goes on to specifically forbid the UKAEA from engaging "in any work, whether by way of research, experiment, development, production or otherwise, on any explosive nuclear device, whether for war-like application or otherwise"[555] without the authority of the Secretary of State. This inclusion of "war-like application or otherwise" has links back to the US Plowshare programme of the 1960s which will be discussed below. There is no evidence to suggest that the UKAEA had ever entertained any plans for such a project prior to this date, but the Act made sure than no plan was ever subsequently devised.

Although the Weapons Group was transferred directly to the control of the Secretary of State, in practice it remained at the same site at Aldermaston, in Berkshire, where its management was taken over by the newly created Ministry of Defence (MOD).[556] [557] Sir Derek Rayner, as part of his role as Chief Executive of the MOD Procurement Executive,[558] had been given the task of looking:

> "at defence procurement as a whole, and will aim to reach lasting conclusions to end the constant reorganisation in this field which has plagued us ever since the war."[559]

When his review was complete, Rayner had proposed that in order to rationalise overall research and development in defence:

> "procurement activities embracing all stages of all defence procurement from research through to production should be brought together into a single organisation within the Ministry of Defence."[560]

There was very little disagreement with the fundamental issues of the Bill when it was debated in Parliament – in fact, the main bones of contention were relating to the pension rights and wage levels of those employees who would be transferred from the UKAEA to

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551 Hall, T., 1986, op cit, n213, p19.
552 Ibid, p21
553 Section 1(1) Atomic Energy Authority (Weapons Group) Act 1973.
554 Section 1(2)(a) Atomic Energy Authority (Weapons Group) Act 1973.
555 Section 6(1) Atomic Energy Authority (Weapons Group) Act 1973.
556 UKAEA, 1998, Parliamentary question linking Dounreay and Aldermaston, Harwell: United Kingdom Atomic Energy Authority
557 The AWRE became the Atomic Weapons Establishment (AWE) in 1987, and became privately operated (but still government controlled) in 1993. Source: AWE, 2008b, History, Aldermaston: Atomic Weapons Establishment.
558 MOD, 2009, op cit, n311
559 Jellicoe, Earl, 1970, Reorganisation of Central Government, HL Deb 10 November 1970 vol 312 c620
560 Gilmour, I., 1973, Atomic Energy Authority (Weapons Group) Bill [Lords], HC Deb 30 January 1973 vol 849 c1167

the MOD.

Although the separation of weapons- and energy-related work in the UK was formalised by the Act, elsewhere the ideas of using nuclear explosions for non-warlike reasons was still a matter of potential development. The best known of these examples was Project Plowshare, which Foreign and Commonwealth Office Minister Lord Chalfont described as "an important branch of civil nuclear technology and engineering"[561] in a House of Lords' debate on Disarmament in 1967. The wider debate around Project Plowshare,[562] and similar programmes is not directly relevant to this discussion, and will be dealt with in Appendix VIII.

The separation of the UKAEA into separate weapons and energy groups was made, as we have seen, on the back of a recommendation that it would be more economical and efficient. Nuclear weapons, by the early 1970s were felt by many to be eternally tarnished by their role in the Cold War in general, as well as in specific flash points such as the Cuban Missile crisis of the previous decade. The UK government's overarching attitude to nuclear weapons was, as the title of Professor (and ex-UKAEA historian and archivist) Margaret Gowing's history of nuclear policymaking in the 1940s suggests, "Independence and Deterrence."[563] Nuclear power, on the other hand, although inherently linked in the minds of many to nuclear weapons, was being portrayed as the clean power of the future and, by separating out the oversight and management of the two types of technology, the government was attempting to distance nuclear power in the minds of the public from the weapons debate.

One reason for separating the two sibling technologies is a continuation of the separation that had started with the Radioactive Substances Act 1948 between "bad" radiation and "good" radiation. In the earlier case, the good radiation was that used for medical and commercial purposes, and it was separated from the bomb-related technology. By the time of the 1973 Act, however, the "good" side of the nuclear industry was probably at best the "not so bad" side, and still needed to be distanced from the weapons-related technology.

A second reason for the separation was that the nuclear energy industry in the UK was in need of financial stimulation; not only were the funding and accounts of nuclear power a matter of public record, but the technology also had to compete (albeit at this time not in a truly competitive marketplace) with other forms of electricity generation. Nuclear weaponry, on the other hand, and the UK's nuclear deterrent in particular, could be financed without full public disclosure (under the umbrella of "national security") and without competition. The financial stimulation for nuclear energy came in the form of two pieces of legislation, the Nuclear Industry (Finance) Act 1977 and the Nuclear Safeguards and Electricity (Finance) Act 1978.

3.4: The Nuclear Industry (Finance) Act 1977 and the Nuclear Safeguards and Electricity (Finance) Act 1978

These two pieces of statute will be dealt with together, since neither is particularly lengthy and yet both had an impact which was larger than might at first seem to be the case. The 1977 Act concerned extension of monies available to the National Nuclear Corporation, which was discussed above, and British Nuclear Fuels Ltd (BNFL) and the Radiochemical Centre Ltd (TRC), both of which were set up under the Atomic Energy Act 1971, and will be discussed shortly.

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[561] Chalfont, Lord, 1967, Disarmament, HL Deb 08 March 1967 vol 280 c1525

[562] Project Plowshare was ardently supported by leading US atomic scientist Professor Edward Teller, the "father of the hydrogen bomb."

[563] Gowing, M., 1974a, Independence and Deterrence: Britain and Atomic Energy, 1945-52: Volume 1: Policy Making, London: Palgrave Macmillan; and Gowing, M., 1974b, Independence and Deterrence: Britain and Atomic Energy, 1945-52: Volume 2: Policy Execution, London: Palgrave Macmillan.

The influence of the OPEC region was to become more important once these states formed the Organization of the Petroleum Exporting Countries (OPEC) in 1960,[564] but was offset to a certain extent in the UK by the commencement of commercial North Sea Oil production in the early 1970s.[565] The OPEC-triggered fuel shortages of the mid-1970s led to another rise in the drive for nuclear power; again, the rationale being national energy security.

In October 1973, the Egyptian and Syrian armies advanced on Israel, in what is now referred to as the Yom Kippur war.[566] The details of the conflict are not important for this discussion, but the reverberations are. In the same month, OPEC announced that it was reducing oil production (and increasing prices), by 17 per cent in retaliation for the support of the United States and the West for Israel during the brief war.[567] Retail prices for fuel also rose sharply, both in the United States[568] and in the UK, where "car use fell on average 1.81 per cent per annum"[569]

In this environment of high fossil-fuel prices, the Energy Secretary, Eric Varley, announced UK's third nuclear-power programme in July 1974.[570] The announcement was that there would be just six new reactors built, but that they would all be larger than any previously constructed (at 660MW each), and of the Steam-Generating Heavy Water (SGHWR) type. Other than a small experimental prototype at Winfrith, however, the SGHWR was an untested design.[571] The CEGB, as eventual customer for the electricity these reactors would produce, had preferred the established and much-tested (but American-designed and built) Pressurised Water Reactor (PWR), and wanted 18 PWR type reactors to be built. In this case, however, the wishes of the customer, both in design and scale of construction, were overridden by the political desires of the time which, in the midst of a recession, were resolutely pro-British industry.[572] As with the decisions above taken at the height of the Suez crisis, this was a clear example of a piece of decision making based on a pragmatic stance in response to the problems of higher fuel prices and over-reliance on imported energy sources. This is not the only occasion where "the trouble for Britain was that in many ways the least satisfactory runner had won"[573] and later, similar, outcomes were to arise in relation to the decisions over Nimrod Airborne Early Warning System[574] and Westland Helicopters[575] in the 1980s. In all three of these decisions, time (and hindsight) showed that the decision made was not the right one, and eventually the bids which had initially lost were adopted (*viz*. the PWR, Hawkeye and Black Hawk). However, as has already been suggested, political pragmatism must be judged against the situation as it appeared then, rather than the situation as it appears now. Given that proviso, and despite much of the advice given at the time being against such a move, the decision to adopt the SGHWR was still at its heart a pragmatic attempt

[564] Palmer, A., 1983, The Penguin Dictionary of Twentieth-Century History: 1900-1982, Harmondsworth: Penguin Books, p297.
[565] Helm, D., 2004, op cit, n220, p40.
[566] For some of the background to the Yom Kippur war, see Foster, C., 1991, Israel: the Temple Mount and the crisis of the courts, 141 NLJ 34.
[567] EIA, 1998, 25th Anniversary of the 1973 Oil Embargo, Washington, DC: US Department of Energy, Energy Information Administration.
[568] In the US, the retail price for petrol rose by 43 per cent between May 1973 and June 1974. Source: Foner, E., & Garraty, J., eds., 1991, The Reader's Companion to American History, Boston, MA: Houghton Mifflin Company.
[569] DETR, 1997, op cit, n473, p6
[570] Varley, E., 1974, Nuclear Reactor Policy, HC Deb 10 July 1974 vol 876 c1357
[571] Ham, A., & Hall, R., 2006, A way forward for nuclear power: A 2006 Energy Review Submission, London: Department of Trade and Industry, p45.
[572] Ibid.
[573] Dungeness A was commissioned in 1966, but did not open until almost twenty years later. Source: ibid, p43.
[574] With the decision to develop the Nimrod Airborne Early Warning System instead of buying the US E-2 Hawkeye AWACS system, the Conservative government of Margaret (now Baroness) Thatcher spent £660m on a project which was eventually scrapped in December 1986. Source: Thatcher, M., 1993, Margaret Thatcher: The Downing Street Years, London: HarperCollins, p424.
[575] Here, the Prime Minister and Trade and Industry Secretary clashed with the Defence Secretary over how to ensure the survival of Westland, the UK's only helicopter company

to alleviate some of the impact of the recession. In 1976, the Chairman of the CEGB, Arthur Hawkins, again suggested the cancellation of the SGHWR programme which had been announced two years earlier (and which the CEGB had never fully supported anyway) on the basis that the PWR had by then passed a stringent safety review by the Department of Energy and was operating successfully in France and the United States.[576]

At the time, there was no reaction from the government of the opposition, but the Liberal Party did pass a motion at their Annual Conference in October 1977 to oppose all nuclear power in the UK.[577] In January 1978, the Energy Secretary, Tony Benn, announced that more power stations would be built, but that the SGHWR design (which he had initially favoured very strongly) would be abandoned, saying:

> "It is the unanimous advice of all concerned that in the changed circumstances of today the SGHWR should not be adopted for the next power station orders. The Government have accordingly decided that it would be right to discontinue work on the SGHWR."[578]

What Tony Benn is effectively saying is that the moves he felt to be pragmatic at the time (but which many disagreed with) were no longer pragmatic since the global situation had changed. Ironically, if the government had given sufficient weight to the opinions of the CEGB, which was, after all, the sole UK customer for nuclear power, then the programme would not have been delayed for so long and a great deal of money (estimated at the time as £145m[579]) could have been saved. However, despite abandoning the SGHWR design, Benn still avoided opting wholly for the tried and tested PWR design that was being used in the United States and elsewhere. Instead, the new plants would be built using a combination of the British AGR and PWR designs and the US PWR design. The decision was given a somewhat mixed reception:

> "The government's decision on the next generation of nuclear power stations sets the nuclear industry back 10 years. Or, to put it another way, it represents a major milestone in the successful development of nuclear power. Take your choice; as Mr Tony Benn, the energy secretary puts it, Britain is in 'a valid option situation.'"[580]

The rationale given by the government for what an editorial piece in the *Economist* berated as a lack of a proper decision, was that it was better not to be "dependent upon an exclusive commitment to any one reactor system"[581] as that could potentially lead to problems with competitiveness in the future. In other words, Tony Benn was "hedging his bets" in an attempt to avoid the situation that he had created with regard to the SGHWR programme. The Secretary of State also argued that, much as it would be unwise to rely wholly on the tried and tested AGR, it would not be a pragmatic choice to opt exclusively for the unfamiliar PWR system, not least because:

> "In general, it is quicker to build what one knows best. It takes longer to build what one has not built before and longest to build what has never been built before."[582]

The justification of the SGHWR decision did not involve much reliance of scientific data – much of which would have shown the design to be too expensive and uncompetitive – and this is another example of politicians being prepared to drop all scientific rhetoric to justify a policy if it does not support their decision.

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[576] Ibid.
[577] National Archives, 2007, Significant Events of 1977, Kew: The National Archives.
[578] Benn, T., 1978, Thermal Reactor Policy, HC Deb 25 January 1978 vol 942 c1392
[579] Benn, T., 1978, op cit, n579, c1403. The equivalent cost in 2009 is £1.2bn – Source: ONS, 2010, op cit, n463.
[580] Economist, 1978a, Nuclear Choice; Confusion Still, The Economist, January 28,1978, p85
[581] Benn, T., 1978, op cit, n579, c1392
[582] Benn, T., 1978, op cit, n579, c1406

3.4.1: British Nuclear Fuels Limited

Section 1 of the Atomic Energy Authority Act 1971 had gone to great lengths to specify which parts of the UKAEA were to be transferred to BNFL (effectively, everything which was part of the UKAEA trading fund and was not specifically excluded in sub-section 2[583]). Everything in the trading fund which did not go to BNFL went to TRC under section 1(2). Excepted from transfer to either BNFL or TRC was any interest which the UKAEA may have had relating to a "patent, registered design or registered trade mark";[584] whether existing, applied for, or pending. Intellectual property rights in any product, design or idea arising after the transfer from UKAEA, however, were to be owned by whichever of BNFL or TRC was responsible for their creation. The trading fund had been set up some six years previously and used primarily to cover the production of nuclear fuels. Between 1965 and 1970:

> "the "value of sales of nuclear fuel services has grown from £19½ million to £30 million and the value of sales of radioisotopes from £2.3 million to £4 million."[585]

Much of the Act was concerned with the minutiae of every step involved with the transformation of a state-owned company into a quasi-independent body corporate. This meant that the company could own its assets and deal with them in much the same way as an independent company floated on the Stock Exchange; the difference being that the Government maintained ownership of all the shares. The Secretary of State was empowered to make loans to the two companies from the National Loans Fund,[586] up to a maximum of £75m for BNFL and £7m for TRC.[587] The whole of this section was repealed only six years later, however, by the Nuclear Industry (Finance) Act 1977, which is discussed below.

Whilst BNFL ended up being a wholly government-owned entity, there was support for the idea that ownership of BNFL would also be offered to private shareholders. During the second reading of the Bill in the House of Commons, the Minister for Industry, Sir John Eden, said that there were "strong grounds for ensuring that in the foreseeable future there shall be a majority public shareholding."[588] The "strong grounds" that were being discussed included the fact that, due to the nature of its work, BNFL would inevitably "be handling, and in fact generating, information of a particularly sensitive nature"[589] and that it would be in the interests of security to keep this information secure.

The financial limits on the two companies which the 1971 Act had set at £50m for BNFL[590] and £5m for TRC[591] were also addressed by the 1977 Act. These limits represented the maximum amount of public money that could be injected into the two companies. The limits for BNFL were increased to £300m (with a capacity for further extending it to £500m).[592] For TRC, the limit remained at £5m, but the extension limit was raised to £15m.[593] This reflects the fact that BNFL had expanded quite significantly over the intervening time period, but TRC had done so only marginally. Although the limits for TRC remained the same, those for BNFL were increased again to £1bn)[594] by the Nuclear Industry (Finance) Act 1981 (which had no other function) and to £2bn, with no capacity for extension[595] by the Atomic Energy Act 1989 (below). These rises are

583 Section 1(1)(a) Atomic Energy Authority Act 1971
584 Section 3(1) Atomic Energy Authority Act 1971
585 Eden, J., 1970, Atomic Energy Authority Bill HC Deb 17 December 1970 vol 808 c1591
586 Set up under the National Loans Act 1968 and administered by the Comptroller and Auditor-General. Source: HM Treasury, 2000, Governmental Accounting 2000: Amendment 3/03, London: HM Treasury / HMSO
587 Sections 13(2)(a) and (b) Atomic Energy Authority Act 1971. The approximate 2009 equivalent values are £800m for BNFL and £80m for TRC.
588 Eden, J., 1970, op cit, n586, c1593
589 Eden, J., 1970, op cit, n586, c1594
590 Section 13(2)(a) Atomic Energy Authority Act 1971 – BNFL's limit could be raised to £75m.
591 Section 13(2)(b) Atomic Energy Authority Act 1971 – TRC's limit could be raised to £7m.
592 Section 2(1)(a) Nuclear Industry (Finance) Act 1977
593 Section 2(1)(b) Nuclear Industry (Finance) Act 1977
594 Section 1 Nuclear Industry (Finance) Act 1981. The limit could be raised to £1.5bn.
595 Section 1 Atomic Energy Act 1989

represented in a Table 3.2 below, and it is clear to see that BNFL's financial limits were increased by roughly ten times the underlying rate of inflation (from £50m to £2bn), which can be argued to be a sign that either the company was outperforming the market consistently (since a larger company requires larger capital flows to operate) or the reverse – that the company was struggling to stay afloat in the unprotected market in which it had been launched. The truth lies between the two extremes – the company had grown dramatically, but with that growth had come increased exposure to changes in the market.

Table 3.2: Financial Limits on Nuclear Companies

	1971	1977	1981	1989	OVERALL RISE
BNFL	£50m (£75m)	£300m (£500m)	£1bn (£1.5bn)	£2bn --	£1.95bn (£1.425bn)
Rise	N/A	600% (666%)	333% (333%)	100% --	3,900% (2,000%)
TRC	£5m (£7m)	£5m (£15m)	£5m (£15m)	£5m (£15m)	0 (£8m)
Rise	N/A	0% (114%)	0% (0%)	0% (0%)	0% (114%)
Inflation[596]	N/A	127.6%	62%	54%	393.3%

The Act also made provision for the government to buy more shares in the National Nuclear Corporation Ltd (NCC). NCC had been formed in 1973, when the consortia which had been formed to build the UK's nuclear power stations amalgamated.[597] The government maintained their one-third shareholding until 1988, when the company was sold to General Electric.[598] The creation of, and amendments to, the consortia were discussed more fully above.

The Nuclear Industry (Finance) Act 1977 ran to only four sections. Section 1 concerned the extension of guarantees given by the Secretary of State for the repayments of loans made to BNFL or TRC, which had been set up six years previously. The mechanics of the guarantee process did not change, however, and will not be discussed in any further detail. The idea of setting up two new companies which could potentially be privatised also ties in with the creation in January 1975 of the National Enterprise Board by the Industry Act 1974, the purpose of which was to extend public ownership of industry.

3.4.2: Nuclear Safeguards and Electricity (Finance) Act 1978

The 1978 Act has a dual role. The first part of the Act was concerned with giving effect to an agreement made in the autumn of 1976[599] between "the United Kingdom, The European Atomic Energy Community and the International Atomic Energy Agency."[600] This agreement was made to allow inspectors from the IAEA to enter the UK and inspect sites under the terms of the 1968 UN Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which came into force in 1970. Although this Treaty concerns nuclear weapons, and so is not strictly within the areas of discussion here, it does have a bearing on the role of the UKAEA. The Treaty (and Safeguards Agreement) gave the IAEA Inspectors the right to inspect all nuclear facilities, whether involved in the production of weapons-grade fissile material or power production. The UK was not the only country to put in place a Safeguards Agreement following the NPT. Although none were required to do so by the

596 ONS, 20019 op cit, n463
597 NNC, 2004, op cit, n480.
598 ibid.
599 UK Safeguards Agreement, Cmnd 6730
600 Section 1(1) Nuclear Safeguards and Electricity (Finance) Act 1978

Treaty itself, "all five declared nuclear weapon States (France... China, the Soviet Union, the UK and the United States) subsequently concluded voluntary safeguards agreements with the IAEA."[601] The rationale behind the UK's decision to sign the Safeguard agreement is set out in the 13-part preamble to the Treaty. Some of the sections of the preamble are purely procedural, but others are more substantive, particularly the fourth, which states:

> "WHEREAS the United Kingdom, as a nuclear-weapon State within the meaning of the Treaty, has throughout desired to encourage widespread adherence to the Treaty by demonstrating to non-nuclear-weapon States that they would not be placed at a commercial disadvantage by reason of the application of safeguards pursuant to the Treaty."[602]

In other words, if the UK and the other states which had signed their own Safeguard Agreements could demonstrate to those countries which had not yet developed this type of technology that they would not suffer as a result of abandoning attempts to develop it, then the Treaty would stand a greater chance of working. Since the 1968 Treaty and the 1976 Safeguards Agreement India, Pakistan and South Africa all admit to having developed nuclear weapons (though the latter has since relinquished them) and, since the revelations of Mordechai Vanunu, Israel is widely regarded to have done so, although it has never admitted to it.[603]

Inspectors appointed by the IAEA under the terms of the Safeguards Agreement[604] were given the power to enter "any facility of part thereof and there make any inspection or do any other thing which may reasonably be required."[605] If the IAEA Inspectors were obstructed in their duties or if their reasonable requests for information were refused, the penalty on summary conviction could have amounted to a fine of up to £1000.[606] Moreover, the provision of false information to the IAEA Inspectors was punishable on indictment by imprisonment of up to two years.[607]

These sanctions can be compared with those under section 7(3) of the Nuclear Installations (Licensing and Insurance) Act 1959 which impose a maximum fine of £50 and maximum imprisonment of three months. Whilst it is true that nearly two decades have passed between the Acts, this alone does not explain a rise of 2,000% in the level fines available, or 800% in potential prison sentence.

One possible explanation for this sharp rise in sanctions is, as was mentioned earlier, that the timing of this Act coincided with a growth in dissatisfaction with nuclear power among the public, both in continental Europe and in the UK. In 1976, the Danish government was forced to abandon its plans to build six nuclear-power stations in the face of massive public opposition.[608] Stocketon and Janke also attribute the fall of the Swedish Social-Democrat government in 1976 and the "collapse of the Conservative Coalition in October 1978" to similar factors.[609] In Austria, as we have already seen, a referendum led to atomic energy being banned from the entire country. Although the effective abandonment of nuclear energy by the governments of Denmark, Sweden and Austria does not, of course have any direct impact on decisions made in the UK, it can be seen to

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[601] Youngs, T., & Danby, G., 2000, The Nuclear Safeguards Bill, House of Commons Research Paper 00/40, London: HMSO, , p8

[602] 4th point of the Preamble to the UK Safeguards Agreement, Cmnd 6730

[603] Sunday Times, 1986, Revealed - the secrets of Israel's nuclear arsenal: Atomic technician Mordechai Vanunu reveals secret weapons production, Sunday Times, 5th October 1986

[604] A laborious process set out in Article 85 of the Agreement. This requires the IAEA to give all the details of anyone it wishes to appoint as an Inspector to the UK and EURATOM, both of whom have to accept the appointment before it becomes valid.

[605] Section 2(1) Nuclear Safeguards and Electricity (Finance) Act 1978

[606] Section 2(4) Nuclear Safeguards and Electricity (Finance) Act 1978. £1000 in 1978 is equivalent to approximately £4000 in 2009.

[607] Section 2(5) Nuclear Safeguards and Electricity (Finance) Act 1978. The punishment on summary conviction for this offence was a fine of up to £1000.

[608] Stockton, B., & Janke, P., 1978, Nuclear Power: Protest and Violence, Conflict Studies, No 102, December 1978, p2

[609] Ibid.

be symptomatic of a growing disillusionment with nuclear energy, which will have been picked up on by politicians in the UK[610] and, as such, the increased penalties can be seen as a pragmatic response to the perceived increase in risk of non-compliance with inspectors.

The “Electricity (Finance)” section of the 1978 Act concerned the making available of extra government funds to construct the second-stage of the coal-fired Drax power station in Yorkshire,[611] and was repealed by the Electricity Act 1989 (below) so will not be discussed further here. It does, however, illustrate that the labour government had not completely abandoned fossil fuels in pursuance of nuclear power.

The remaining sections of the Act, further pertaining to the IAEA Inspectors, have remained substantially the same since their inception, other than for minor amendments; e.g., changing the Section 2 fines discussed above to “level 5 on the standard scale.”[612]

The 1978 decision to abandon the SGHRW-type reactor was based, in the words of the Energy Secretary, on the “unanimous advice of all concerned”[613] as the existing AGR technology was more easily accessible and cheaper. By the late 1970s, cost had become an important issue in the UK, since inflation was running at over 15 per cent for almost the whole of the period focused on in this chapter[614] and, as a direct result of the OPEC price hikes of 1972-3,[615] the “sterling crisis” of 1976 led to the UK being forced to ask the International Monetary Fund for a loan of £45.3bn in September 1976.[616]

These two Acts refined the framework which had already been put into place in order to support the companies involved in the nuclear industry. As policy measures, the financial support given under the 1977 Act was entirely pragmatic, as it was realised that without extra funding being made available, neither BNFL nor TRC would be able to continue operating and the government would be saddled with the entire cost of the operation. One area where debates were still continuing was in the drawn-out discussions about whether a large plant should be built in rural Cumbria to reprocess spent nuclear fuel rods.

3.5: The Parker Inquiry

In early 1978, the Report of the Windscale Inquiry (the Parker Report) was published.[617] The report recommended that the construction of the Windscale reprocessing plant should continue without delay, even though in practical terms it was unlikely to “start for 2-3 years [and] the first ounce of plutonium will not be recycled for 10 years.”[618]

On its publication, the Parker Report was given a mixed reaction by politicians. Sir Peter Emery, the Conservative MP for East Devon, argued that:

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[610] See, for example, Hinton, Lord, 1973, Energy Policy and World Supplies, HL Deb 28 February 1973 vol 339 c689 (“in a realistic energy plan there must he some things which are unpopular with some people”), and Sherfield, Lord, 1976, EEC: Thirty-Second Report on the Technological Problems of Nuclear Safety, HL Deb 29 January 1976 vol 367 c1188.

[611] Section 5 Nuclear Safeguards and Electricity (Finance) Act 1978

[612] Amended by sections 37 & 46 of the Criminal Justice Act 1982. The purpose of the Standard Scale for fines was administrative ease. It allowed future amendments by Statutory Instrument rather than having to amend each Act separately and this, as discussed in earlier chapters, keeps the time and cost of legislative changes to a minimum. Level 5 currently stands at £5,000 (Section 37(2) Criminal Justice Act 1982, as amended by s17(1) Criminal Justice Act 1991)

[613] Benn, T., 1978, op cit, n579.

[614] ONS, 2010,op cit, n463.

[615] Hickson, K., 2005, The IMF Crisis of 1976 and British Politics: Keynesian Social Democracy, Monetarism and Economic Liberalism: the 1970s Struggle in British Politics, London: Taurus Academic Studies, , p1

[616] National Archives, 2009, Sterling Devalued and the IMF Loan: Devaluation of the Pound, Kew: The National Archives.

[617] Parker, J., 1978, Report of the Windscale Inquiry, London: HMSO.

[618] Economist, 1978b, Windscale, four million words later; Mr Justice Parker’s report on Britain’s plans for nuclear reprocessing clears away many myths. President Carter will be unconvinced, The Economist, March 11, 1978, p72

> "the whole House must be grateful to Mr. Justice Parker for the extensive nature of the report. In view of the considerable emotional feelings and fears about nuclear energy… over the past 15 years there has been not one fatality or serious accident due to radiation in the whole of the nuclear power industry That is surely of significance in allaying people's fears."[619]

The East Devon constituency, based around the town of Honiton is, it should be noted, approximately 350 miles from the THORP site at Windscale. The reaction appears not to have been consistent along party political lines, however, as Emery's fellow Conservative MP, Michael Noble,[620] (later Lord Glenkinglas), argued, "the original planning inquiry [was] unsatisfactory in view of the nature of the decision"[621] and went on to say that "we find the proposal for a further debate to be unsatisfactory"[622] as it would not take into account the apparent objections of the United States to the development of the plan. These objections, which were raised in a letter from Joseph Nye, a State Department official,[623] were based on the "misunderstanding [of US policy] which arose at the at the Windscale hearing."[624] The misunderstanding arose when the US granted a licence to a Japanese consignment of fuel elements sent for storage at Winsdcale with a view to reprocessing.[625] The licence was not meant to signal "an endorsement of reprocessing",[626] and the US "moratorium on the development of nuclear reprocessing"[627] was still in force. Despite the efforts of the US State Department, the recommendations of the Parker Report for the construction of the reprocessing plant at Windscale were approved by MPs on 23 March 1978 by a 130 majority.[628]

The authors of the Parker Report also sought to dispel many of the common misconceptions about plutonium as a substance:

> "It is not highly radioactive; and it is not the most toxic substance known to man. You could sit on it wearing nothing stouter than a pair of jeans. The escape of plutonium would be less damaging than an accident to a tanker of chlorine."[629]

This compares to the information given by opponents of nuclear power; the Australian physicist, Dr. Alan Roberts, in his 1977 book, *The Hazards of Nuclear Power*,[630] gives a theoretical scenario based on a predicted 2,000 reactors operating:

> "If the leak is as small as one hundredth of one per cent of the total, this still constitutes a maximum permissible dose [of plutonium] for every person in the world, ten times over."[631]

With this type of rhetoric entering the public domain, if not necessarily the public consciousness, it is unsurprising that the public in the UK was becoming concerned about nuclear power. The *Times* reports in February 1977 on "A coordinated campaign, called 'energy 2000' against the development of nuclear power"[632] which was going to be launched the following month. the campaign would involve representatives of local campaign groups (e.g. South Yorkshire nuclear action group) and national organisations

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[619] Emery, P., 1978, Windscale Inquiry (Report), HC Deb 06 March 1978 vol 945 c987
[620] Noble was MP for the Argyll constituency in Scotland, parts of which are only just over 100 miles from Windscale, and both are adjacent to the Irish Sea.
[621] Noble, M., 1978, Windscale Inquiry (Report), HC Deb 06 March 1978 vol 945 c988
[622] Ibid.
[623] Wright, P., 1978, US letter hints that Britain should drop Windscale plan, The Times, 9 February 1978, pg. 1; Issue 60232; col D.
[624] Cook, R., 1978 Windscale Inquiry Report, HC Deb 22 March 1978 vol 946 c1595
[625] Wright, P., 1978, op cit, n624
[626] Ibid.
[627] Ibid.
[628] Noyes, H., 1978, MPs back Windscale by 130-vote majority, The Times, 23 March 1978, p1
[629] Economist, 1978b, op cit, n619.
[630] Roberts, A., & Medvedev, Z., 1977, Hazards of Nuclear Power, Nottingham: Spokesman.
[631] Ibid, p10
[632] Kerhsaw, R., 1977, Drive against nuclear power development, The Times, Friday, Feb 18, 1977; pg. 14; Issue 59937; col C

(e.g. Friends of the Earth).[633]

Equally, the rhetoric employed by the anti-nuclear scientists helps to explain why the experts may have been having trouble in getting their message across to the public. Part of the problem was access to information: the sober and reflective Parker Report was published by HMSO, ran to three volumes of often complex language, and was nearly 700 pages long; whereas the Roberts' book, which was neither sober nor reflective, was cheaper, shorter and more accessible. These two texts illustrate the fracturing of scientific opinion on nuclear power, and the increasing extent to which the presentation of a unified scientific discourse was a fallacy. To revisit Kuhn's three stages outlined briefly in Chapter One, this period of scientific debate around the safety of nuclear power was beginning to move beyond the "normal" phase into a more turbulent pre-revolutionary phase.

If the Parker Report can be criticised somewhat for its inaccessibility to the "man on the Clapham omnibus"[634] and the inevitable consequence that it did not provoke much of a reaction, the British approach to nuclear power was still more measured than that used in France. In July 1977, for example, when rioting broke out near the Superphénix fast-breeder reactor in Creys-Malville, the *compagnies républicaines de sécurité* (CRS – elite French riot police) were deployed and the resulting conflict left one person dead and over 100 injured.[635] Interestingly, the French approach to nuclear energy was later recalled by Dr Jack Cunningham MP (now Lord Cunningham of Felling), who said, in an Environment and Industry debate in the House of Commons that:

> "The French Minister of the time [Michel d'Ornano, French *Ministre de la Culture et de l'Environnement*] said to [Tony Benn, then Energy Secretary] and me when we queried public reaction to their policy, 'When you are draining the swamp you do not consult the frogs.' It was hardly environmental concerns that drove the French; it was because they recognised that they had no oil or gas and very little coal of their own."[636]

This would appear to be an even more pragmatic basis for decision-making in the nuclear-energy arena than that which has been adopted in the UK, but suggests that outside the UK, the debate about nuclear power was far more volatile. In addressing this point in mid-1979, RJS Baker, a Reader at Sheffield City Polytechnic wrote:

> "If the nuclear debate ceases to be a rational debate, the wider political consequences could be very serious indeed. Already we have seen the horrific confrontations between large crowds and riot police which seem to constitute some of our European partners' chosen methods of decision-making in nuclear policy matters."[637]

This is illustrative of the increasing levels of concern which were starting to be felt in many circles of society. Baron Taverne, ex-government minister, director of the Institute for Fiscal Studies, and co-founder of the Sense about Science charity,[638] argues that in the 1950s and 1960s, as the wider public started to appreciate the dangers which could be associated with nuclear technologies, that appreciation in turn led to "a widespread public feeling that [the dangers] had been deliberately concealed."[639] Taverne goes on to argue that there are three reasons why the public has lost faith in nuclear science particularly:

The politicisation of scientists;

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633 Ibid.
634 In other words, an ordinary member of the public. McQuire v Western Morning News [1903] 2 KB 100 (CA) at 109 per Collins MR
635 WISE, 1978, News Communiqué 1: Malville: Hard Times, Amsterdam: WISE-Amsterdam.
636 Cunningham, J., Environment and Industry, HC Deb 28 November 1988 vol 142 cc445-6.
637 Baker, R.J.S., 1979, Nuclear Power: The Widening Debate, The Political Quarterly, 50 (1) 71-85: 83.
638 "A an independent charitable trust promoting good science and evidence in public debates" Source: SAS, 2009, About us, Sense About Science, London. Available online at http://www.senseaboutscience.org.uk/index.php/site/about/6/, accessed on 22/03/10
639 Taverne, D., 2005, The March of Unreason: Science, Democracy, and the New Fundamentalism, Oxford: Oxford University Press, p27

Increasing suspicion of a conspiracy between government, scientists and industry "to pursue technological progress regardless of social consequences and risks" [640]; and

The fact that scientists appeared for both the pro- and anti- nuclear sides of the argument, suggesting that even they weren't sure of the impact of their work.

Taverne's point about the perceived politicisation of scientists is far from being new. In 1969, Professor Michael D Reagan of the University of California, wrote that participation in the political decision-making process by scientists had grown to such an extent that it could now be regarded as "an integral, routine part of the process."[641] What did appear to develop over the course of this chapter was the increasing use of scientific language by those opposed to nuclear power,[642] and much of this can be attributed to the simple fact that more research was being undertaken, and awareness of the nuclear industry was increasing. It also links with one of the points made in Chapter One by Professor Worcester, that scientists working for NGOs are more likely to be trusted than those working for the government or industry,[643] especially given that the latter are, rightly or wrongly, perceived to be involved in the pursuit of technological progress regardless of the risks.[644] In terms of public awareness, two early key developments are argued to be the publications of Rachel Carson's *Silent Spring*,[645] and Ralph Nader's *Unsafe at Any Speed*[646] in the US in 1962 and 1965. Carson, a biologist, argued that the use of pesticides, especially DDT, was causing irreparable damage to wildlife, was part of the beginnings of widespread public concern over environmental issues. By 1965, this book had led to the beginnings of a revision of US pesticide policy, although the use of DDT was not to be banned in the US until 1972.[647] Nader, an attorney, attacked the safety record of General Motors' Chevrolet Corvair, and his work led to the passage of the National Traffic and Motor Vehicle Safety Act 1966,[648] which established the National Highway Traffic Safety Administration. Both books pointed to a lack of accountability on the part of big business (chemical and motoring) and government, and the opaque nature of decision-making, and both ultimately led to fundamental changes in US Government' policy.

Nader went further than Carson in relation to the nuclear industry and, in 1973, launched a joint court case (with Friends of the Earth) against the Chair of the US Atomic Energy Commission (USAEC), Dixie Lee Ray, in an attempt to force the USAEC to revoke twenty nuclear site licenses.[649] The case was dismissed by the Civil Division of the US District Court for the District of Columbia in 1977, on the basis that "absolute certainty [about plant safety] is not required by the [US] Atomic Energy Act, nor does nuclear safety technology admit of such a technology."[650] As with the point made above concerning the indirect impact of some European countries halting the use of nuclear power, the frank admission that no plant is required to be absolutely safe, helped create a situation where the Director-General of the IAEA announced a "worldwide concern about the safety of nuclear power plants."[651]

This perception of an increasing lack of faith is not helped by the language used by

[640] Ibid
[641] Reagan, M. R., 1969, Science and the Federal Patron, New York, NY: Oxford University Press,
[642] See, for example, the rise of Friends of the Earth and Greenpeace during this period.
[643] Worcester, R., 1999, op cit, n65.
[644] Taverne, D., 2005, op cit, n640.
[645] Carson, R., 1962, Silent Spring, Boston, MA: Houghton Mifflin Co. The British publication of the book was not until 1963.
[646] Nader, R., 1965, Unsafe at any Speed: The Designed-in Dangers of the American Automobile, New York, NY: Grossman Publishers.
[647] EPA, 2006, DDT Ban Takes Effect: EPA Press Release – December 31, 1972, Washington, DC: US Environmental Protection Agency.
[648] The National Traffic and Motor Vehicle Safety Act of 1966 (P.L. 89-563, 80 Stat. 718)
[649] NADER, Ralph v. Dixie Lee Ray, (USDC DC, No. 74-670)
[650] NADER, Ralph v. Dixie Lee Ray, (USDC DC, No. 74-670)
[651] Watson, W., 1977, Nuclear Energy Only Choice – Energy Chief, Pittsburgh Post-Gazette, 23 March 1977, pA-2

the politicians who are arguing for or against particular policies. As we have seen, the majority of MPs are not, and have never been, qualified nuclear scientists, and neither could we (or should we) reasonably expect them to be. The rhetoric employed in this subject by politicians has consistently leaned towards the scientific, for, as Cohn suggested earlier, the public were initially more inclined to trust 'science'. In a speech to the British Institute of Management in December 1977, Kingman Brewster Jr., the US Ambassador to Britain, is attributed with saying that "incomprehensible jargon is the hallmark of a profession"[652] and this can definitely be said of the nuclear industry.

In addition to an inevitable level of incomprehensibility, Bernard (now Sir Bernard) Ingham strongly criticised the levels of secrecy which surrounded the industry as being counter-productive. Ingham, a staunch supporter of nuclear power,[653] who had spend much of the 1970s as Director of Information at the Department of Energy, criticised the "nuclear industry, made up of a Civil Service scientific elite brought up in a tradition of defence secrecy [as] worse than useless in combating this threat to its existence [from Friends of the Earth]."[654] Ingham was making the point that the levels of secrecy inherent in the nuclear industry were playing into the hands of anyone opposed to it and that, if secrecy levels were to be reduced, the public would be less inclined to believe that there was a threat which was being concealed from them and, therefore, groups like Friends of the Earth would be weakened. The fact that high levels of secrecy continued relates back to the discussions of Clause 11 of the 1946 Act covered in the previous chapter – those involved in the nuclear industry were governed by some of the most stringent security regulations in the country, which dated back to the end of World War 2 and fears relating to espionage.

Brewster is accurate in his summation of professional use (or perhaps misuse) of language and, given that the development of the legislative framework surrounding the nuclear power industry was effectively a joint process between the three professions – scientific (as providers of information), political (as decision makers) and legal (as drafters, enforcers and arbiters), it is an argument which has had great resonance. Early on in the process of decision-making:

> "Outside scrutiny of the decisions made about nuclear power was inordinately weak. In part this was because of the real difficulty Parliament, and for that matter Government, had in dealing with scientific issues of greater and greater complexity. One MP commented that in a world where even the scientists found it difficult work in areas other than their own 'it is hardly surprising that non-scientific politicians and MPs struggle helplessly to deal with their responsibilities for deciding policy and appropriate funds.'"[655]

What this suggests is that senior politicians who, as we have already seen, are not reticent about trying to confuse and misdirect opponents with illusions of scientific certainty, are equally prepared to do it when it comes to their colleagues on the Parliamentary sub-committees.

Despite this supposed ease of access to materials and information, the seriousness of an uncontrolled proliferation of nuclear technology is still taken very seriously – perhaps, as Franks argues,[656] since atomic energy can be considered as a matter of state:

> "[it] is handled by the executive alone, is treated with extreme secrecy, and the

[652] Bourek, A., 2005, System of Quality Management in the Healthcare Environment, Växjö, Sweden: Växjö University.
[653] Ingham's PR company, the Norman Phillips Organisation, lists his consultancy appointments with BNFL and the British Nuclear Forum. Source: PS, 2009, After Dinner Speakers – Sir Bernard Ingham, Personally Speaking, Guisborough: Norman Phillips Organisation. He is also the Secretary of the Supporters of Nuclear Energy, and has given talks to the World Nuclear Association.
[654] Ingham, B, 2004, And why shouldn't we go nuclear? Presentation given at the Gaia and Global Change Conference, Dartington, Devon.
[655] Hall, T., 1986, op cit, n213, p74.
[656] Franks, C.E.S., 1978, The development of peaceful nuclear energy: three configurations of knowledge and power, International Journal, Vol. 34, pp 187-208: 187

> argument which justifies it is that of reason of state, a doctrine which in its extreme limits subordinates constitutional principles and the rule of law to the safety of the state."[657]

Taverne's final point is that at its heart, the scientific debate on nuclear safety is just that, a scientific one. The point at which enriched uranium reaches a self-sustaining chain reaction is not one which is affected by any political, social, or moral standpoint. Where the debate becomes fractured, however, is partly in what Professor Nowotny referred to as the "pluralistic"[658] nature of scientific communities, and partly in the manner that politicians then use that scientific information, whilst playing down (or ignoring) any element of pluralism. The Parker Report on Windscale, which the Secretary of State for the Environment called "exceptionally wide-ranging"[659] and the most "open and thorough examination of a major nuclear proposal"[660] received and considered evidence from scientists on all sides of the debate, "listing 13 points made by BNFL in support of their application, and 17 points put forward by objectors."[661] Having considered the evidence, the Parker Inquiry found in favour of the construction of the THORP plant, accepting all of BNFL's points, and rejecting all those of the objectors,[662] and prompting the Labour MP for Northampton North, Maureen Colquhoun, to assert that:

> "These predictable findings of such people as Mr. Justice Parker are the result of allowing the power of science and technology to fall into the hands of over-large institutions, Government and industry."[663]

What Colquhoun is suggesting is that THORP was decided by a group of people who were insulated from various other pressures and were either making technical decisions, or allowing them to be made. This runs contrary to both Teichman's ideas of TDM[664] and Jasanoff's "rule by a technocratic élite"[665]since, although there is a decision making élite and a technocratic élite, there is no technocratic decision making élite

3.6: Conclusion

This chapter has shown that in the period between 1973 and 1978, the nuclear industry in the UK had faced a seismic shift in fortunes. Just before the period began, it was still expanding and had the broad, though not unqualified, support of politicians from across the political spectrum, industry, scientists and the public. By the end of the period, the science was becoming even more fractured, politicians at home and abroad were more disillusioned, and the public (in the form of pressure groups) were calling for mass protests.[666] The nuclear industry, though reduced to a single consortium, was still "on side", however.

We have seen in previous chapter that decisions made in this area are often reacting to external circumstances, rather than creating them, and the same is true in this period. The accidents at Chalk River, Chelyabinsk and Windscale in the 1950s caused governments and industry to re-evaluate the costs associated with nuclear power. In the UK, the government enacted the Nuclear Installations (Licensing and Insurance) Act 1959, which limited financial exposure to operators of nuclear facilities. As pragmatic as these decisions were, given that the government could not have afforded to construct the power plants without the involvement of private industry, the Act came too late to prevent the five original consortia from merging unhappily into three.

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[657] Ibid.
[658] Nowotny, H., 1980, op cit, n55.
[659] Shore, P., 1978, Windscale Inquiry Report, HC Deb 22 March 1978 vol 946 c1540
[660] Ibid.
[661] Rotblatt, I., 1978, Windscale Inquiry Findings, the Times, 9 March, 1978; pg. 17; Issue 60252; col D
[662] Ibid.
[663] Colquhoun, M., 1978, Windscale Inquiry Report, HC Deb 22 March 1978 vol 946 c1631
[664] Teichman, J., 1997, op cit.
[665] Jasanoff, S., 1994, op cit.
[666] Young, J., 1978, Fears of violence over Windscale plan, The Times, 8 March 1978, pg. 4; Issue 60251; col C

Controlling the industry was the UK Atomic Energy Authority, the unelected, all-powerful group of scientists and industrialists who were appointed initially by the government, and then by the UKAEA itself. Although some MPs were concerned that "a new private empire, ruled by the atomic knights, will be set up,"[667] the Authority was deliberately created in such a manner as to prevent it from making policy. This means that, although the UKAEA was clearly an élite, given that all eight of the original Board members were either knights of the realm or had been ennobled, and it was clearly technocratic, again as half the Board were Professors of Physics, it was not making decisions. This means that while the criteria set out Teichman[668] or Jasanoff[669] for the creation of a Technocratic Decision Making organisation may work well in other fields, they do not fit the structure, power or role of the UKAEA.

Another theme which runs through this section is that of secrecy. The 1940s saw the era of paranoia about espionage from the Soviet Union, as was explored in the previous chapter, but in this period there was a shift in the nature of that secrecy. At the beginning of the chapter, there was still no functioning nuclear industry, and the technology that was going to power it was new, experimental, and subject to strict secrecy rules. By the same token, the various accidents of the 1950s were either covered up, or played down by the relevant governments, so as to maintain public faith in the new technology. By the end of the period, the UK is purchasing technology from the United States, and the PWR technology has been exported across the world, and Bernard Ingham, among others is calling for all information to be given to the newly-formed environmental groups to weaken their case that there had been a cover-up.

During this period, Politicians were beginning to use the rhetoric of science to justify their decisions more in this period than they had in previous periods and, equally to ignore the scientific evidence if it disagreed with what they wanted to do. Tony Benn, in pushing for the British-built but untested SGHRW ignored all of the scientific data that proved the US-built and widely tested PWR would be the best option for the new generation of nuclear plants in the UK, and was later forced to overturn his own decision when the evidence against the SGHWR became insurmountable. The 1955 White Paper, on the other hand, gave the justification for nuclear power that it would be clean, safe and cheap – indeed, as the future Chairman of both the UKAEA and CEGB, Dr Walter Marshall, announced in 1955, the electricity produced would be "too cheap to meter."[670] The irony of these two examples is, of course, that the accurate science was ignored, and the inaccurate science was triumphed.

Further international incidents that required responses from UK policy included the Suez Crisis of 1956 and the Yom Kippur war of 1974. Both of these, and particularly the latter, caused sharp rises in crude oil prices, and economic hardship; by the end of December 1974, the global price for crude oil was £12 per barrel, a rise of 400 per cent on December 1972, rising a further ten per cent in January 1975. This should have proven to be manna from heaven for the nuclear industry, as it revealed the inherent instability of oil supplies and made oil-fired power stations much less competitive. However, as Cohn points out, orders for all new nuclear reactors after 1973 were cancelled in the US[671] and, according to junior minister for Energy, Alexander Eadie MP, the same was true in the UK:

> "In the United Kingdom in the years concerned [1973 – 1977], no new orders were placed for civil nuclear power stations and none was cancelled."[672]

As has been shown, what Tony Hall calls the "long, slow fall from grace"[673] by the nuclear-power industry in the UK was just that. Not an immediate reversal of policy, but a series of pragmatic decisions based on immediate problems and short-term gains.

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[667] Freeman, J., 1954, op cit, n399.
[668] Teichman, J., 1997, op cit, n93.
[669] Jasanoff, S., 1994, op cit, n94.
[670] Marshall later became Baron Marshall of Goring
[671] Cohn, S. M., 1997, op cit, n350.
[672] Eadie, E., 1978, Nuclear Reactor Orders, HC Deb 11 May 1978 vol 949 c574W
[673] Hall, T., 1986, op cit, n213, p59.

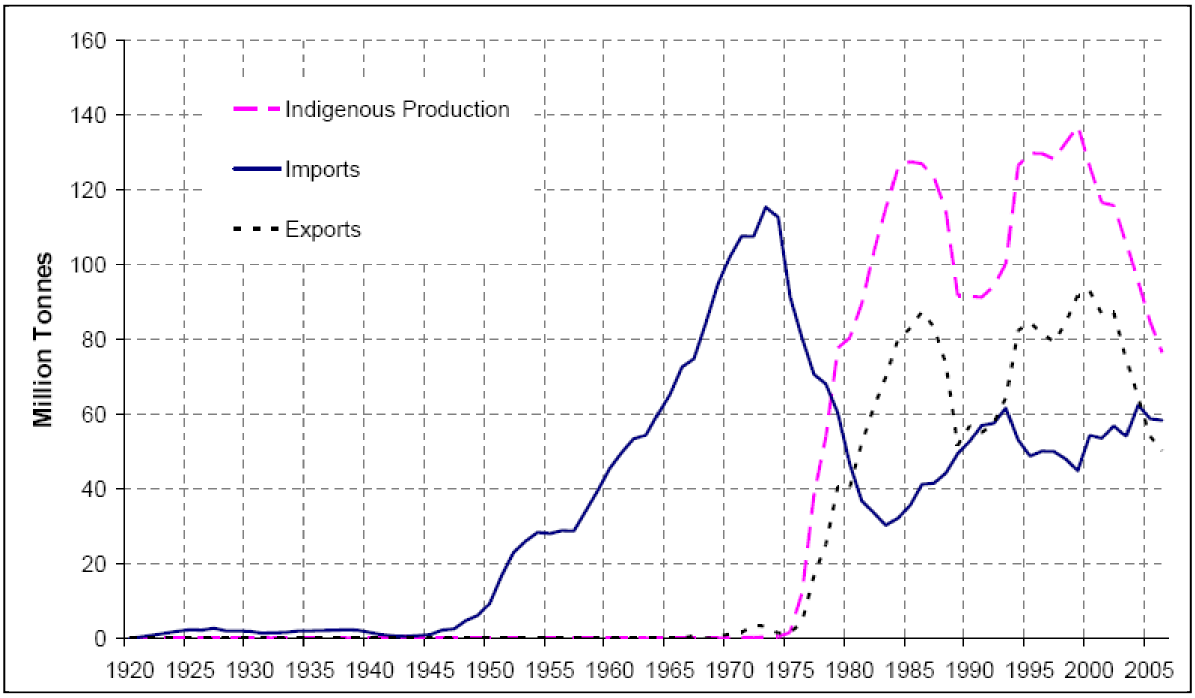
Chapter 4:
1992-95: The Decline of Public Funding

4.1: Introduction

At the end of the previous chapter, the Labour Government had less than a year left of its five year term in office, MORI polls put 'nuclear' as a general topic very low on the list of public concerns[674] and the UK nuclear-power industry appeared as though it was beginning a "long, slow fall from grace" with the May 1978 cancellation of the entire Steam-Generating Heavy Water Reactor programme.

As this chapter will show, that fall from grace was accelerated by the squeeze of public finance and subsequent attempts to shift the industry into the private sector. The second half of the 1970s saw the beginnings of a global recession, which hit the UK faster than most other economies. The whole of 1980 was marked by negative growth, and this was combined with a 20 per cent peak in interest rates in June of that year. On the brighter side, the UK did achieve self-sufficiency in oil in 1980 as well, partly because the recession was lowering demand, but also because of the increasing contribution made by North Sea Oil. This can be seen in Figure 4.1, which illustrates the quantity of oil imported into the UK between 1920 and 2005 – a sharp drop in oil imports combined with a rise in indigenous production can be seen in the 1975-1980 period, and this corresponds with the growth in North Sea Oil production.

Figure 4.1: UK crude oil imports, exports and production, 1920 – 2006[675]



Well-publicised accidents at Three Mile Island in 1979 and, seven years later, Chernobyl in 1986 did little to warm national or international feeling towards nuclear energy, despite the findings of inquiries into both accidents revealing that they were caused by human error, rather than any inherent flaw in plant or reactor design.

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[674] The August 1978, February 1979 and April 1979 MORI polls asked people to name the most important thing affecting the UK. In all three polls, no one said that 'nuclear' (a generic term which included nuclear power and nuclear weapons) was the most important thing. the top three issues in each survey were:
August 1978: Inflation (63%); Unemployment (55%); and Race Relations (27%)
February 1979: Trade Unions (73%); Inflation (66%); and Unemployment (31%)
April 1979: Inflation (68%); Trade Unions (56%); and Unemployment (53%)
Source: Ipsos MORI, 2009, The Most Important Issues Facing Britain Today, 1974-2009, London: Ipsos MORI.
[675] DBERR, 2007, op cit, n12

The 1980s are remembered chiefly as the decade of what Norwegian sociologist and economist, Thorstein Veblen, had 90 years earlier termed conspicuous consumerism,[676] combined with the liberalisation of economic markets across the world and the associated economic impact of both.

Improvements in information technology over the decade led to the shift from ENQUIRE (a rudimentary forerunner to the Internet created by Tim Berners-Lee in 1980) to the proposals for the World Wide Web as we know it in 1989.[677] Berners-Lee's work on the World Wide Web is interesting for the purposes of the current discussion, as it was carried out under the funding of CERN, the European Organization for Nuclear Research, with the intended goal of:

> "[meeting] the demand for automatic information sharing between scientists working in different universities and institutes all over the world."[678]

The logarithmic growth in internet capacity over the period is also interesting as it marked the beginning of the ability to access and share information globally in seconds, rather than days or weeks and this, in turn, led to the explosion in Internet usage which occurred during the 1990s.

Towards the end of the period between the two chapters, not only were new nuclear-power stations no longer being planned or built in the UK (with the exception of Sizewell B, which was completed in 1992), some of the existing ones were beginning the long process of decommissioning and, for the first time since 1956, the amount of nuclear energy being produced in the UK was falling. This change in fortune for nuclear power meant that the decisions which were made on the basis of what was pragmatic *at the time*, and were explored in previous chapters, would no longer necessarily be pragmatic if they had been made in this period. Diego has suggested that the hallmark of a pragmatic decision is "what works."[679] In this area of policy making, if not necessarily in all, "what works" will rarely be a constant – what worked in 1974 when oil prices were high (over $40 a barrel)[680] and the economy was beginning to recover from the stock market crash, would not necessarily work in 1994, when oil prices were lower (at around $20 a barrel),[681] and the global economy was well-recovered from the recession of the early 1990s, for example.

As intimated above, in addition to the general social, economic and political situation in the period, there were some specific incidents which can be assessed to discover their impact on nuclear policy in the UK.

4.2: Developments between 1978 and 1992

4.2.1: Three Mile Island.

The Three Mile Island nuclear power plant, located in Harrisburg, Pennsylvania, had two Pressurised Water Reactors (PWR) operating within in, TMI-1 and TMI-2. At the end of March 1979:

> "a blast of superheated steam, 500 degrees hot and under pressure of a

[676] Veblen, T., 1899, Theory of the Leisure Class: An Economic Study in the Evolution of Institutions, New York, NY: Macmillan.
[677] Tim Berners-Lee launched the idea of the WWW in 1989, in collaboration with CERN in Switzerland, but the tools were not completed until December 1990. Source: CERN, 2008a, Tim Berners-Lee's original World Wide Web browser, European Organization for Nuclear Research, Geneva. Available at http://info.cern.ch/NextBrowser.html, accessed on 22/03/10
[678] CERN, 2008b, Where the web was born, European Organization for Nuclear Research, Geneva. Available at http://public.web.cern.ch/public/en/About/Web-en.html, accessed on 05/06/09.
[679] Diego, R., 2004, op cit, n31
[680] WTRG, 2009, Crude Oil Prices 1947 - August, 2009 (2008 Dollars), London, AR: WTRG Economics.
[681] Ibid.

thousand pounds per square inch, shot from a safety valve at the top of Three Mile Island's Unit 2 reactor building."[682]

The accident at the Three Mile Island (TMI), which was owned and operated by the Metropolitan Edison Company (MEC),[683] was later classified as a Level 5 incident on the International Nuclear Event Scale (INES) discussed earlier.[684] As with the other Level 5 incidents, assessment of the number of deaths or injuries directly or indirectly attributable to TMI has been difficult and the figures are still contested. Some sources argue that "there was no significant off-site radiological consequence from TMI",[685] whereas others point to a death rate in those living near to TMI of almost 40 per cent higher than in neighbouring counties.[686] The TMI accident has always been surrounded by a perceived lack of transparency[687] and this has helped to fuel to rumours, and counter-rumours[688] and contribute to an overall lack of trust on the part of some members of the public. The direct political fall-out of the TMI accident was not felt very strongly in the UK, as there were no Pressurised Water Reactors operating at the time, although the cancellation of the SGHWR programme ten months earlier had led to plans for PWR construction being considered. TMI remains one of the defining moments in any debate about nuclear safety: after the accident, for example, the US government did not commission a single new reactor and would not consider doing so again until 2005. [689]

The months immediately following the TMI accident, had also seen a change in government in the UK and the new Energy Secretary, David Howell MP, announced that:

> "The Nuclear Installations Inspectorate, the Nuclear Power Company and the UKAEA will be providing considered assessments of the accident at [TMI] as soon as they are in a position to do so, and the Central Electricity Generating Board is considering the implications for its safety procedures. The lessons to be learnt from the incident will need to be studied carefully in the light of these reports."[690]

This was a standard, non-committal statement – and could not have been much else given that the accident had happened just a matter of weeks earlier and the investigations were not yet complete. In a slightly later House of Lords debate on energy in June 1979, Lord Sherfield identified that the TMI accident was going to have an impact on nuclear programmes outside the United States, although he argued that this was not for sound scientific reasons:

> "The emotional repercussions of this serious accident, which caused great anxiety and inconvenience to a great number of people, but which, in fact, led, so far as I know, to no serious injuries or loss of life, will retard the already lagging rate of nuclear building in Europe"[691]

Lord Sherfield was well-placed to comment on the nuclear programme for even

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682 Stephens, M., 1980, Three Mile Island: The hour-by-hour account of what really happened, London: Junction Books, p7.
683 Boudreau, J., 1981, Editorial: Three Mile Island: Aftermath and Impact, Los Alamos Science, 2 (2) 92-97:93.
684 IAEA, 2004c, op cit, n376.
685 Whitlock, J., 2006, What kind of third-party liability regime exists in Canada? Canadian Nuclear FAQ. Available at http://www.nuclearfaq.ca/cnf_sectionD.htm, accessed on 22/03/10
686 Mangano, J., 2004, Three Mile Island: Health study meltdown, Bulletin of the Atomic Scientists, 60 (5) 30-35:34.
687 See, for example: Staley, J., 1979, Three Mile Island: A time of Fear, Harrisburg, PA: RFJ Publishing Inc; Stephens, M., 1980, op cit, n684; Sternglass, E., 1981, Secret Fallout: Low Level Radiation for Hiroshima to Three Mile Island, Maidenhead: McGraw-Hill.
688 See, for example Miller, R., & Pencak, W., 2002, Pennsylvania: A History of the Commonwealth, University Park, PA: Pennsylvania State University Press, in which the authors argue that it was "rumors that contributed to the natural panic [and] spread rapidly" (p328)
689 Meek, J., 2005, Back to the Future, The Guardian, 4 October 2005.
690 Howell, D., 1979, Nuclear Reactors, HC Deb 21 May 1979 vol 967 c17W
691 Sherfield, Lord, 1979, op cit, n611

though he was "not a scientist himself",[692] he had been involved in the nuclear industry since the 1950s and, as Sir Roger Makins, had been the Chair of the UKAEA from 1960-1964.[693] His comments echo the point outlined at the end of the previous chapter that orders for new nuclear reactors in the UK had already been non-existent for six years by the time of the TMI accident[694] and were unlikely to restart in the aftermath. It also illustrates the argument that, although there was little direct evidence to show that the British public was actually concerned about TMI, the politicians were worried that they might become so and were already preparing themselves for having to make decisions based, at least in part, on that supposed fear.

TMI was a PWR and the accident threw into sharp relief the safety systems which surrounded the US nuclear industry and, by extension, that of the rest of the world. As discussed in the introductory chapter, PWR-type plants are by far the most commonly used across the globe, accounting for more than 85 per cent of all power generation.[695] Indeed, the UK had only recently decided to use the PWR design as one of the options for its future nuclear plans. In the short-term aftermath of TMI, several books were published or revised which gave, or purported to give, an assessment of "what went wrong."[696] In the US, the Institute of Nuclear Power Operators (INPO) was formed by the nuclear electric utility industry in 1979 as a result of TMI and, together with the National Academy for Nuclear Training (NAAT), has since been "effective in promoting excellence in the operation of nuclear plants and accrediting their training programs."[697] Every company in the US which operates a nuclear power plant is a member if INPO[698] and, some argue:

> "As a result of realizing certain facts about TMI, the principle of transparency triumphed decisively over the principle of trade secrecy."[699]

In the UK, there was no equivalent body to either INPO or NAAT set up either at the time of the TMI accident, or in the thirty years that followed, despite the indication from the Energy Secretary (above) that "the lessons from the incident will need to be studied carefully."[700]

The lawsuits surrounding the deaths and personal injuries which may or may not have been attributable to the TMI accident carried on for more than two decades. Within a very short time after TMI, a class action relating to the alleged heath effects caused by the accident was brought against the MEC. The TMI case did the rounds of the various courts until 1996, when it was dismissed by Judge Sylvia Rambo of the Pennsylvania District Court, who said:

> "The parties… [to this] action have had nearly two decades to muster evidence in support of their respective cases.... The paucity of proof alleged in support of Plaintiffs' case is manifest. The court has searched the record for any and all evidence which construed in a light most favourable to Plaintiffs creates a genuine issue of material fact warranting submission of

[692] Edwards, J., & Dalyell, T., 1996, Obituary: Lord Sherfield, The Independent, 11 November 1996.
[693] Arnold, L., 2000, A Letter from Oxford: The History of Nuclear History in Britain, Minerva, 38(2) 201-219:205.
[694] Eadie, E., 1978, op cit, n674
[695] Barré, B., 2004, The Nuclear Reactors from a "Natural History" Perspective, European Nuclear Society e-news, Issue 6, European Nuclear Society, Brussels, p9.
[696] See, for example, Stephens, M., 1980, op cit, n684; Burleson, C. W., 1980, The Day the Bomb Fell: True stories of the nuclear age, London: Sphere Books.
[697] UIC, 2001, Three Mile Island 1979, Nuclear Issues Briefing Paper 48, Melbourne: Uranium Information Centre, pp6-7.
[698] DoE, 2007, Institute of Nuclear Power Operations (INPO) Liaison, Washington, DC: US Department of Energy, Office of Health Safety and Security.
[699] Braithwaite, J., & Brahos, P., 2008, Global Business Regulation, Cambridge: Cambridge University Press, p306
[700] Howell, D., 1979, op cit, n692

their claims to a jury. This effort has been in vain."[701]

The class action was dismissed and the plaintiffs appealed to the US Third Circuit Court of Appeals, where the decision to reject their case was reaffirmed.[702] This is not to say that no compensation was ever paid out as a result of TMI, however. According to the pressure group Three Mile Island Alert, a $20m find had been set up by MEC and a further $5m was set aside to set up the TMI Public Health Fund.[703] On top of these figures, almost $14m had been paid in out-of-court settlements by 1985.[704] As is common in such settlements, the recipients are forbidden from revealing the terms of the agreement. As the lack of public accountability forms part of these discussions, it is also worth noting that, as a result of the provisions of the Price-Anderson Act of 1957, explained in the previous chapter, the Federal government covered the first $500m of any claim[705] and, indeed, there are unsubstantiated claims that the General Public Utility Company (the parent company of MEC) subsequently made a successful insurance claim of $560m.[706]

The impact of TMI on the general public, identified by Lord Sherfield, might not have been great, and it would probably have been even less significant had it not followed just days after the release of the Columbia Pictures movie "The China Syndrome" which was based on very similar, but fictitious, circumstances. According to the Office for National Statistics, there were 112 million cinema tickets sold in 1979[707] and, as such, it is inevitable that the number of people who saw the film was many times that which read the case reports.

The accident at TMI added to a growing body of accident data[708] that served to provide the world greater scientific understanding of what accidents could happen with the use of a nuclear reactor. The report into the aftermath of Hiroshima and Nagasaki[709] had already shown the effects of radioactive fallout caused by atomic weapons, but these civil accidents were something of a new phenomenon. They would also show that the cost of decontaminating land affected by such accidents could be potentially huge, and it was not long before these potentially enormous costs started to affect the attitude of industry and government alike.

4.2.2: Atomic Energy (Misc. Provisions) & Nuclear Industry (Finance) Acts 1981

The Atomic Energy (Miscellaneous Provisions) Act 1981 concerned granting the Secretary of State the power to dispose of the government's shares held in BNFL and the Radiochemical Centre Ltd (TRC), the two bodies that had been set up as pseudo-independent companies after being hived off from the main body of the UKAEA ten years earlier by the Atomic Energy Authority Act 1971. Norman Lamont MP, the Parliamentary Undersecretary of State for Energy, introduced the second reading of the Bill in February 1981, revealing the intention of the government:

"The present proposal to sell shares in TRC is in accordance with the

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[701] In re TMI (D.C. Civ. Nos. 88-cv-01452, 88-cv-01551, 88-cv-01558), per Judge Rambo.
[702] In re Three Mile Island Litigation, 193 F.3d 613 (3d Cir. 1999).
[703] ANS, 2005, The Price-Anderson Act: Background Information, La Grange Park, IL: The American Nuclear Society. p3.
[704] Ibid.
[705] Section 1(e) Atomic Energy Act of 1957.
[706] TMIA, 2009, Legal History of Three Mile Island, Three Mile Island Alert, Harrisburg, PA. Available on-line at http://www.tmia.com/tmilegalhistory, accessed on 05/01/10.
[707] ONS, 2009, Cinema admissions, 1951-1998: Social Trends 30, London: Office for National Statistics.
[708] See, for example, Wakstein, C., 1977, The Myth of Nuclear Safety, The Ecologist, Vol 7 No 6 pp 210-15, which discusses, inter alia, radioactive leaks at Windscale in 1973, 1974, 1975 and 1976, and several accidents in England and Scotland throughout the 1970s. Whilst the circulation of the Ecologist was not high in 1977, it had risen considerably in the seven years since its inception. Source: Ecologist, 2010, Archive 1970-2009, available at http://www.theecologist.org/ accessed on 05/01/10.
[709] Groves, Maj. Gen. L.R., 1946, op cit, n197

Government's policy of introducing private capital into public sector companies… and at present the Government have no plans to dispose of shares in BNFL. The Bill would allow the Government to do so up to 49 per cent."[710]

The Conservative "Government's policy of introducing private capital into public sector companies"[711] was already well underway by this time. The Industry Act 1980 had given the National Enterprise Board (NEB, and its regional equivalents) a duty to "to promote the private ownership of interests in industrial undertakings"[712] by selling off assets that it controlled. The NEB had been established just five years earlier by the Industry Act 1975 with a remit of extending public ownership of industry and, although it would exist in some form in the public sector until 1991, the 1980 Act marked the beginning of the end for the NEB. The erosion of the NEB's portfolio can be seen to be as much an expression of Margaret Thatcher's desire to "extend the ownership of property to the largest possible majority"[713] and "create a bulwark of new shareholders"[714] as it was of her desire to hold down the Public Sector Borrowing Requirement (PSBR).[715] This combination of a wish for privatisation can be interpreted as a political standpoint[716] and indeed, it is often cited as being one of the underpinning concepts of, and crucial to, the Thatcher Government.[717] However, Marr's description of the new shareholding class as a "bulwark" (or "defensive wall"[718]) combined with Sked and Cook's argument that the rationale was to keep the PSBR low, suggests that there was a strong pragmatic edge to the Prime Minister's decisions.

The first part of the Miscellaneous Provisions Act makes some minor amendments to the powers of the UKAEA and the Secretary of State. In the case of the former, UKAEA could now dispose of shares held in any company,[719] giving them the freedom to dispose of their holding in TRC, which was a necessary step as it allowed for the sale of TRC. In the case of the latter, the Secretary of State could dispose of shares held in "any company whose activities include the development of atomic energy or research into matters connected therewith."[720] Another important issue was that the Secretary of State's power to dispose of shares in these companies was acceptable "whether or not the disposal is consistent with promoting or controlling the development of atomic energy."[721] We have already seen that the Atomic Energy Authority Act 1954 supplemented the Minster's existing duty to promote atomic energy with the UKAEA's powers and duties. This Act, therefore, marks a further explicit diminution of the duty imposed on the Secretary by the 1946 Act which was, after all, to "promote and control the development of atomic energy."[722] As discussed in Chapter One, a statutory duty is not something which is imposed lightly, and the decision to effectively remove it was criticised in some quarters as being "too wide a clause to include in a Bill of this kind dealing with atomic energy."[723]

Under the Atomic Energy Authority Act 1971, the government had been required to maintain shares carrying more than half the voting rights in both BNFL and RCL, but the

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710 Lamont, N., 1981, Atomic Energy (Miscellaneous Provisions) Act 1981, HC Deb 10 February 1981 vol 998 cc747 & 749
711 Ibid.
712 Section 1(1) Industry Act 1980. The regional equivalents referred to were the Scottish Development agency, the Welsh Development Agency.
713 Lawson, N., 1993, The View from No 11: Memoirs of a Tory Radical, London: Corgi, p208.
714 Marr, A., 2008, op cit, n248, p429
715 Sked, A., & Cook, C., 1993, op cit, n543, p338
716 In the Commons debate on the Atomic Energy Bill in 1989, Kevin Barron, the Labour MP for Rother Valley referred to privatisation as "the present ideology." Source: Barron, K., 1989, Atomic Energy Bill [Lords] HC Deb 13 April 1989 vol 150 c1108
717 Seldon, A. & Collings, D., 2000, Britain under Thatcher, London: Longman, p. 27
718 Elliott, J., ed., 2001, op cit, n20, p184
719 Section 1(1) Atomic Energy (Miscellaneous Provisions) Act 1981
720 Section 1(1) Atomic Energy (Miscellaneous Provisions) Act 1981
721 Section 1(3)(a) Atomic Energy (Miscellaneous Provisions) Act 1981
722 Section 1(1) Atomic Energy Act 1946
723 Lloyd of Kilgerran, Lord, 1981, Atomic Energy (Miscellaneous Provisions) Bill, HL Deb 23 June 1981 vol 421 cc972

Miscellaneous Provisions Act removes that requirement in relation to TRC.[724] This means that, for the first time, private interests could control TRC, and it would be able to take full advantage of the market. In February 1982, shortly after the July 1981 entry into force of the Act, TRC was fully privatised and became Amersham International plc. [725] The privatisation was 25-times oversubscribed,[726] which is partly a measure of the interest the market had for the company but, mainly, because, as Andrew Marr argues, the sale was "grossly undervalued."[727]

The sale of TRC was important as it marked the first full-scale privatisation of an industry linked to nuclear power, albeit one on the low-risk, low-radiation end of the scale. It is also regarded as the first flotation of a state-owned firm[728] and raised £71 million; of which £64 million went to the Exchequer.[729] As will be shown below, subsequent ideas about privatising the main part of the nuclear-power industry were not too successful.

One of the other areas of the nuclear industry for which privatisation remained a possibility was BNFL. In the previous chapter, the issue of the level of guarantee which the Exchequer provided for BNFL and TRC was discussed and, in 1981, the Nuclear Industry (Finance) Act 1981 amended the Nuclear Industry (Finance) Act 1977 to raise the level of guarantee in relation to BNFL. Since TRC was about to be sold, no changes were made to the guarantees available for that company. David Mellor MP who, by October 1981, had replaced Norman Lamont MP as Parliamentary Undersecretary of State for Energy, introduced the second reading of the Bill and said that:

> "The Bill proposes to set a new limit of £1,000 million, with power to raise that by statutory instrument to £1,500 million"[730]

This was more than a threefold rise in terms of both the immediate and maximum loan guarantees from the 1977 Act, over a period when the UK economy had already suffered quite badly (and was still suffering) as a result of the recession. The rationale behind the enormous increase in funding available to BNFL was explained by Mr Mellor as being the company's £3.5bn investment plan between 1981 and 1991 (at 1981 prices, or equivalent to £6bn), which could only be 70 per cent met by the company itself.[731] Part of the expansion programme related to BNFL's work within the UK, but some also related to the 40 per cent of work which BNFL undertook outside the UK, and for which all the waste imported into the UK for reprocessing was returned to its country of origin once the process was completed.[732] This state guarantee which, as was shown on Table 3.2 in the previous chapter, would be raised again to £2bn in 1989, was never called upon and, indeed, BNFL was in fact paying the Government (as sole shareholder an annual dividend, which amounted to £36m by 1987-8.[733]

In the entire nuclear-fuel cycle (enrichment, use as fuel, storage as waste, or reprocessing), the point at which nuclear material becomes most vulnerable to loss, theft or mishap is, naturally, during transit. Fears about the threat of theft of nuclear material "from terrorists, from fanatics and from – may I say it? – nut cases"[734] had been expressed in Parliament since the late 1960s, when £8,000 worth of nuclear fuel cores had been stolen from Bradwell power station in Essex.[735] BNFL was in the business of

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[724] Section 1(6) Atomic Energy (Miscellaneous Provisions) Act 1981
[725] Since 2004, Amersham has been part of GE Healthcare. Source: Amersham UK, 2004, Our Heritage: 1874-2003. Little Chalfont: Amersham plc.
[726] Moore, J., 1982, Amersham International, HC Deb 24 February 1982 vol 18 c397W
[727] Marr, A., 2008, op cit, n248, p430
[728] Economist, 1992, Hot at Last: Amersham, 13 June 1992
[729] Moore, J., 1982, op cit, n728. The current equivalent values are £191 million raised and £172 million to the Exchequer. Source: ONS, 2010, op cit, n463.
[730] Mellor, D., 1981a, Nuclear Industry (Finance) Bill, HC Deb 16 November 1981, vol 13 c89
[731] Mellor, D., 1981a, op cit, n732, c89 et seq.
[732] Mellor, D., 1981b, Business of the House HC Deb, 16 November 1981, vol 13 c106
[733] Spicer, M., 1989, Atomic Energy Bill [Lords], HC Deb 13 April 1989 vol 150 c1103
[734] Griffiths, E., 1976, Atomic Energy Authority (Special Constables) Bill, HC Deb 26 February 1976 vol 906 cc745
[735] Allaun, F., 1967, Nuclear Material (Security) HC Deb 17 January 1967 vol 739 c1W

transporting both used and reprocessed fuel rods across the world, and that business meant that there was a higher inherent risk associated with BNFL than if it had focused on the operation of power stations. As such, BNFL was spending higher sums on logistics than similar companies in different industries,[736] and so such guarantees of extra funding could be justified.

4.2.3: Nuclear Material (Offences) Act 1983

Although nuclear material was at a higher risk of misappropriation whilst in transit, it had been clear to the UN since the early 1970s that nuclear material was becoming more sought after by terrorist and rebel groups. In December 1976, the United Nations' General Assembly passed Resolution 31/102, in the preamble to which it declared that it would invite the *ad hoc* Committee on International Terrorism (set up under Resolution 3034 (XXVII) in 1972) to recommence its work, since it had become:

> "Deeply perturbed over acts of international terrorism which are occurring with increasing frequency and which take a toll of innocent human lives"[737]

It is important to note that Resolution 31/102 (and the subsequent Resolution 31/103 on the drafting of the International Hostages Convention) were not specifically related to any terrorist threats specifically against nuclear facilities, but to terrorism in its wider context.

The Nuclear Material (Offences) Act 1983 was added to the statute books in order to give effect to the UK signing of the UN Convention on the Physical Protection of Nuclear Material in Vienna in 1980.[738] The UK had signed jointly as a Euratom Member State, rather than individually.[739] The Convention was the sixth in a series of UN anti-terrorism conventions which had started with the 1963 Tokyo Convention ("on Offences and Certain other Acts Committed Onboard Aircraft") and currently numbers thirteen major multinational conventions in force.[740] It built on the fears expressed in the UN General Assembly Resolution 31/102 discussed above. The *ad hoc* Committee on International Terrorism resurrected by the resolution had reported regularly to the UN General Assembly and its recommendations had been adopted several times, including in the drafting of the Vienna Convention.

Article 7 of the Convention[741] made it a requirement that the signatory states create a number of new offences, although as Home Office Minister, David Waddington MP, pointed out on the introduction of the Bill:

> "The acts which we are required to make punishable may be divided into two groups: first, those which parallel offences that already exist in our domestic law; and, secondly, those for which our law has no direct equivalents. Most of the acts covered by the convention fall into the first group and correspond broadly with existing offences."[742]

Parliamentary discussions during the first reading of the Bill rapidly moved from the scope of the legislation to a wider discussion of the desirability of nuclear power in the UK

[736] Mellor, D., 1981a, op cit, n732, c93
[737] UN Resolution 31/102 – A Resolution on Measures to Prevent International Terrorism which Endangers or Takes Innocent Human Lives or Jeopardizes Fundamental Freedoms, and Study of the Underlying Causes of those Forms of Terrorism and Acts of Violence which lie in Misery, Frustration, Grievance and Despair and which cause some people to Sacrifice Human Lives, including their own, in an Attempt to Effect Radical Changes, Resolution of the General Assembly of the United Nations A/RES/31/102.
[738] For a discussion of the role that this Convention might play in countering twenty-first century terrorism, see: Joyner, C., Countering Nuclear Terrorism: A Conventional Response EJIL 2007 18 (225)
[739] IAEA, 1995, Information Circular: Convention on Physical Protection of Nuclear Material, INFCIRC/274/Rev.1/Add.5, Vienna: International Atomic Energy Agency.
[740] UNODC, 2009, United Nations Counter-Terrorism Conventions, Vienna: UN Office on Drugs and Crime.
[741] "The intentional commission of [a list of actions] shall be made a punishable offence by each State Party under its national law" Article 7(1) UN Convention on the Physical Protection of Nuclear Material
[742] Waddington, D., 1983, Nuclear Materials (Offences) Bill, HC Deb 08 February 1983 vol 36 cc944-5

and, on the part of Tam Dalyell MP, of the Falklands War.[743] The committee stage of the Bill passed without amendment, and it was only two weeks after the Bill was introduced that it had its third reading in the Commons, where it was passed.

Although the passage of the Bill through Parliament was rather rapid and the Act entered on the statute book in May 1983, the date at which it was to come into force was left open.[744] Despite the fact that the Vienna Convention itself came into force in February 1987,[745] the UK did not ratify it until 6 September 1991[746] (again, through Euratom, rather than individually)[747] and thus the Act did not come into force until October 1991[748] (see table 4.2). On the point of ratification, the Opposition Home Affairs spokeswoman, Dr Shirley Summerskill MP, said that:

> "Under successive Governments it has been the commendable practice of this country, unlike many other countries, not to ratify United Nations conventions until we are able to put into effect and into law the requirements of that convention. This has meant that although we are often slow to ratify, and have been subjected to criticism because we have not ratified, when we do it means something and is a significant step forward."[749]

The ratification by Euratom and the UK was less than a year before the first Review Conference was convened by the IAEA and there was still a reservation by Euratom in relation to Articles 7-13 (which are all related and concern the punishment of various offences by the State Parties to the Convention). This should not be regarded as an illustration of any reluctance on the part of Euratom to fully commit to the Convention more that, as a non-state party to the Convention, it could not have been bound by those Articles even if it had so wanted. The 1983 Act, which implemented the whole of the Vienna Convention, meant that the Articles for which Euratom had entered a reservation would still have effect in the UK. Table 4.1 illustrates that Euratom took an inordinately long time (even for international law) to ratify the Convention. The reason behind this is that, as a representative of the Member States, Euratom had to get agreement from each one before it was empowered to ratify the Convention.

Table 4.1: Vienna Convention on Physical Protection of Nuclear Material

Date	Progress of Convention
03-03-1980	Vienna Convention opens for signature.
13-06-1980	Euratom becomes a signatory to the Convention (and therefore so does the UK). Euratom declares itself not to be bound by Articles 7 to 13 of the Convention.
09-05-1983	Nuclear Material (Offences) Act 1983 passed in UK, and extends the effects of Articles 7-13.
08-02-1987	Vienna Convention comes into force under Article 19, paragraph 1 (on the 30th day following the deposit of the 21st instrument of ratification)
06-09-1991	Euratom ratifies the Convention (as does UK), but maintains its reservation relating to Articles 7-13.
02-10-1991	Nuclear Material (Offences) Act 1983 comes into force[750]

[743] Dalyell, T., 1983, Nuclear Materials (Offences) Bill, HC Deb 08 February 1983 vol 36 c958 et seq.
[744] Section 8(2) Nuclear Materials (Offences) Act 1983.
[745] US DoS, 2004, Convention on the Physical Protection of Nuclear Material, Washington, DC: US Department of State Bureau of Public Affairs
[746] IAEA, 2004d, Convention on the Physical Protection of Nuclear Material: Latest Status, Vienna: International Atomic Energy Authority.
[747] Commission Regulation 3956/92 of 21.12.1992 on the accession of EURATOM to the International Convention on the Physical Protection of Nuclear Materials (O.J. L409/10)
[748] Article 2, Nuclear Materials (Offences) Act 1983 (Commencement) Order 1991 (SI 1991/1716).
[749] Summerskill, S., 1983, Nuclear Material (Offences) Bill, HC Deb 08 February 1983 vol 36 c947
[750] Article 2, Nuclear Materials (Offences) Act 1983 (Commencement) Order 1991 (SI 1991/1716).

When the Bill was being discussed in the House of Lords, Lord Flowers who, as Sir Brian Flowers, had chaired the 1976 RCEP Report into Nuclear Power and the Environment,[751] argued that it was essential for such a Convention and, thus, the Act to have effect, if only to counteract the attitude of the nuclear industry at that time which:

> "when it meets with a problem which lies outside its competence, sometimes behaves as if the problem does not exist. For many years it behaved as if the dangers from the illicit diversion of fissile materials were negligible, even to the extent of relaxing physical controls over their storage and movement."[752]

The primary effect of the Convention (and, therefore, the Act) was to extend liability for many offences, from murder to fraud, to any person, regardless of their nationality, to areas outside the United Kingdom.[753] The liability imposed is the same as would have arisen if the offence had taken place within the UK, but there is a prerequisite that the offence must be "in relation to or by means of nuclear material."[754] The definition of "nuclear material" is taken directly from the Convention and included as the Schedule to the Act.

The Vienna Convention and the Act that implements it in the UK illustrate that, although the UK had not knowingly been exposed to crimes involving nuclear material, the potential threat was seen by politicians, if not by the industry itself, as real enough to warrant international legislative provision. Interestingly, a search of the Westlaw database reveals that since the Vienna Convention was ratified into law in the UK, only one case[755] even mentioned the Nuclear Material (Offences) Act 1983, and that was only in passing.

If the 1983 Act was a pragmatic response to International and European pressure to tackle the perceived threat of terrorism (even if it has never actually been used), then the intentions of the next piece of legislation to be considered here were far more humble.

4.2.4: Atomic Energy Authority Act 1986

The main purpose of this Act was to convert UKAEA from an integral part of government to a semi-autonomous corporation, with the ability to borrow money from the Secretary of State or, with his permission, from anyone else.[756] This borrowing capacity was not limitless – the aggregate limit for money borrowed by UKAEA, its subsidiaries, and any sums for which they were acting as guarantors was set at £150 million, with the possibility of extending the limit to £200m.[757] The majority of the rest of the Act is concerned with specific points on guarantees by the Treasury[758] and other supervisory powers of the Secretary of State.[759] When the Bill was introduced into the House of Lords in November 1985, Lord Gray of Contin, the Minister of State for the Scottish Office (but former Minister of Energy with responsibility for North Sea Oil[760]), explained that the Authority was to have its finances put onto a trading fund basis, and went on:

> "Your Lordships may find it helpful at this point to be reminded of the key features of Government trading funds. These are:

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[751] RCEP, 1976, op cit, n348
[752] Flowers, Lord, 1983, Nuclear Material (Offences) Bill, HL Deb 21 March 1983 vol 440 cc987
[753] Section 1(1)(a)-(d) Nuclear Material (Offences) Act 1983.
[754] Section 1(1) Nuclear Material (Offences) Act 1983.
[755] R (Al-Fawwaz) v Governor of Brixton Prison [2001] UKHL 69
[756] Section 2(1) Atomic Energy Authority Act 1986
[757] Section 3(1) Atomic Energy Authority Act 1986. As with the examples of BNFL and TRC discussed above and in the previous chapter, the Secretary of State also had the power to extend the amount to £200 million by using a Statutory Instrument. This was done in 1991 with The United Kingdom Atomic Energy Authority (Limit on Borrowing) Order SI 1991/1973. The limit was not raised again, and indeed The United Kingdom Atomic Energy Authority (Extinguishment of Liabilities) Order SI 1996/2511 any debts incurred under the 1986 Act were extinguished as UKAEA was prepared for sale.
[758] Section 5 Atomic Energy Authority Act 1986
[759] Section 6 Atomic Energy Authority Act 1986
[760] Dalyell, T., 2006, Obituary: Lord Gray Of Contin: Popular Conservative minister, The Independent, 18 March 2006

- a capital structure including a commencing debt;
- a profit and loss account and ability to carry surpluses or deficits forward from one year to the next;
- powers to borrow, subject to a limit on total indebtedness; and
- a duty to achieve, to the extent possible, financial objectives set by the responsible Minister, with the agreement of the Treasury."[761]

The Act put into place some of the recommendations of the 1984 Manley Report,[762] which had come out of a working group set up by the Department of Energy.[763] The primary recommendation of the report was followed was that the funding of nuclear research be moved from government to industry.[764] The Parliamentary Undersecretary of State for Energy, Alisdair Goodlad MP, was very clear to point out, however, "that the Government have no intention of privatising the authority."[765]

UKAEA was given the power to draw up new terms of appointment for committee members, provided that they were first approved by HM Treasury. For the first time in its 32-year history, this enabled the inclusion of provisions for payment of compensation for UKAEA Committee Members if their contracts were ended in particular circumstances.[766] This is a small, but important, step as it brought UKAEA contracts into line with other government contracts. As was discussed in earlier chapters, When the original atomic energy industry had been set up in the 1940s and 1950s, very little of it had conformed to standard practice – amongst other things, the initial financing was even kept from the Chancellor of the Exchequer and there was little accountability surrounding any of the early decisions. This new measure, combined with others in the Act meant that the UKAEA was becoming more like an ordinary company than a semi-autonomous organ of government. Despite the assurances of Alisdair Goodlad MP (above) and Lord Gray that privatisation was not the aim:

> "Lord Stoddart of Swindon, Opposition spokesman on Energy, said despite the assurances there was suspicion th; Bill was a paving measure towards eventual full-scale privatisation."[767]

If the measures of the 1986 Act were intended to make the UKAEA operate more like an ordinary company, the decisions as to which type of reactor would be used were taken in a different way to those in other electricity industries. There was heavy influence from the opposing, not to say warring, factions within the sole surviving Consortia, the National Nuclear Corporation and its operational subsidiary, the Nuclear Power Company (see Figure 3.2 above). The NPC "a merged company only in name, [was] split between diehard supporters of the PWR (men from GEC), and bitter opponents of it."[768] This is partly as a result of the different technologies which were available (not a real issue for the construction of coal- or gas-fired power stations), and partly as a result of the historical preferences adopted by the original consortia. When the five consortia existed in 1955, they were all working towards the design and manufacture of Magnox-type reactors (although each had a different design),[769] but by 1964, when there were only three

[761] Gray, Lord, 1985, Atomic Energy Authority Bill [H.L.] HL Deb 19 November 1985 vol 468 c527
[762] It is only the summary contained in the press notice which was published as "the report itself is a classified internal departmental document, and it is not normal practice to publish confidential advice to Ministers" Goodlad, A., 1986a, Manley Report, HC Deb 17 January 1986 vol 89 c717W
[763] MMC, 1992, United Kingdom Atomic Energy Authority: A report on the service provided by the Authority (Cmnd 1947), London: Monopolies and Mergers Committee / HMSO, p21
[764] Goodlad, A., 1986b, Atomic Energy Authority Bill, HC Deb 21 January 1986 vol 90, c216
[765] Ibid.
[766] Section 7(3) Atomic Energy Authority Act 1986, which inserted Section 1(8A) and (8B) into the Atomic Energy Authority Act 1954.
[767] Times, 1985, Privatization of Atomic Energy not practicable, The Times, 20 Nov 1985, p4
[768] Economist, 1977, Nuclear Power; AGR's Turn?, The Economist, May 28, 1977, p115
[769] Paterson, W.C., 1985, op cit, n476, p6.

consortia remaining; one (The Nuclear Power Group) favoured a Boiling Water Reactor, one (The Atomic Power Group) favoured a Pressurised Water Reactor designed by Westinghouse and the third (The United Power Company) favouring the Advanced Gas-Cooled Reactor.[770] By the time of the NNC/NPC, parts of all of the consortia had been amalgamated and the differences of engineering opinion had been covered over.

Slowly but surely, UKAEA was losing its unique status in the energy market. The two models outlined in Figure 4.2 were designed by Dr Wolfgang Rüdig to explain the development of a nuclear industry in a free-market economy. The star structure (left) puts the nuclear energy agency as the lynch-pin of a functioning nuclear sector – all the decisions go through the agency and it assumes the lead role. Political systems, the construction industry and the supply industries do not work with each other in this model and the public are excluded from any meaningful role. The 'triangle' structure (right), on the other hand, which he argues is a development of the star, removes the nuclear-energy agency from the process completely. This could make the industry more efficient and commercially viable, as decisions would not all have to pass through the central agency, but it could also mean that there would be less monitoring and oversight than previously. Reduced regulation, or even deregulation, is seen by many as one of the hallmarks of 'neoliberalism', a label which has often been applied to the Thatcher government.[771] Martinez and Garcia define neoliberalism as being based around five points:

The rule of the Market;

Cutting Public Expenditure for Social Services;

Deregulation;

Privatization; and

Replacing the concept of "public good" with "individual responsibility"[772]

Bearing those five points in mind, the links to the policies adopted by the Thatcher government are clear to see. It is also possible, therefore, to see a link between Rüdig's Triangle-shaped model and the policies of the Conservative government of the mid-1980s towards an increasingly open electricity market. As we will see below, the nuclear element of the industry was eventually removed from the privatisation, but that had not yet happened.

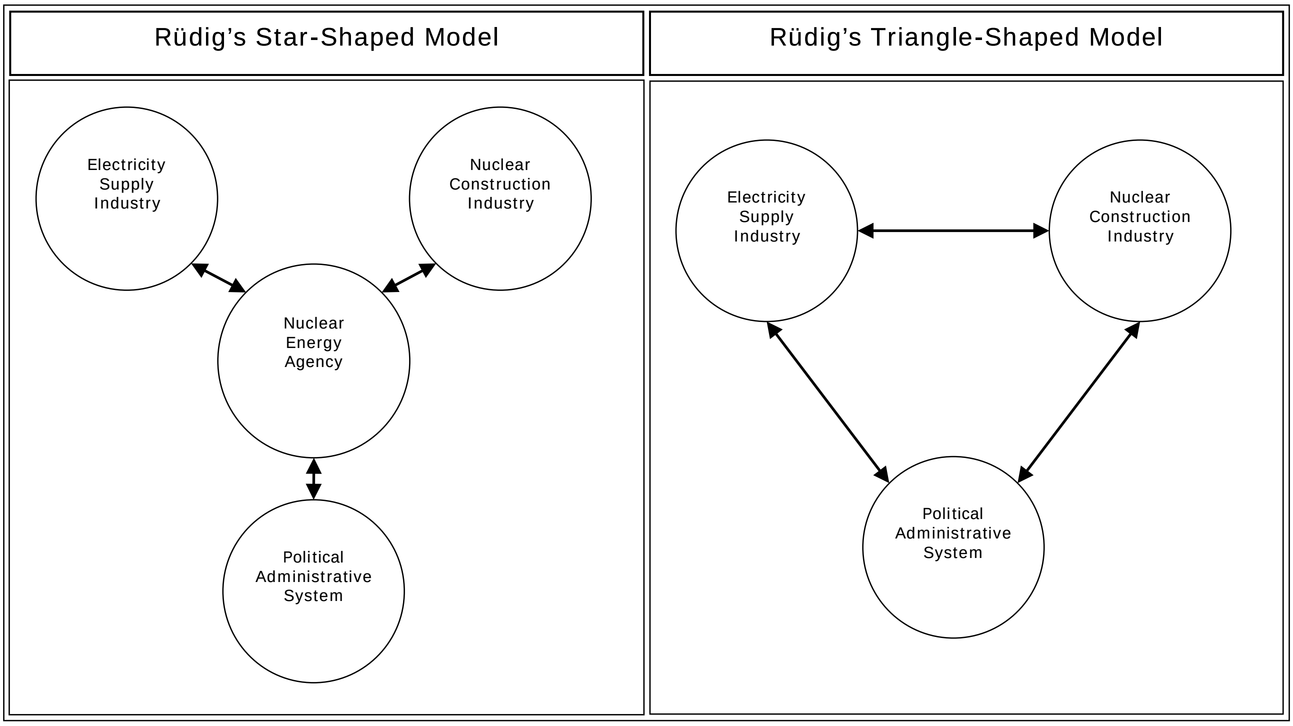
The changing status of UKAEA matches the shift towards decentralisation in those models. A further power granted to UKAEA, which moved it further along the road to full independence was that of commercial exploitation of the intellectual property resulting from both its own research and development programmes and, through any mutual agreements, for exchange of information.[773] This fitted in well with the overriding purpose of the Act, which had been to make UKAEA as independent as was practicable at the time. Alongside this independence came a reduction in the power which the Authority was able to exert on the government since, despite the guarantees discussed above, the Authority was meant to succeed on its own.

By the time the Act was passed, the major public inquiry into the construction of Sizewell B power station is Essex had been completed. The inquiry lasted for more than two years and cost an estimated £25m to hold, with the report not being released for a further 18 months, in December 1986. Between the completion of the report and its publication, there had been a catastrophic accident at the Chernobyl-4 reactor in the Soviet Union, discussed below, which changed the atmosphere into which the report was

[770] Paterson, W.C., 1985, op cit, n476, p16.
[771] See, for example, McChesney, R., 1999, Noam Chomsky and the struggle against neoliberalism, Monthly Review, who says "Associated initially with Reagan and Thatcher, neoliberalism has for the past two decades been the dominant global political economic trend adopted by political parties of the center, much of the traditional left, and the right." (p1)
[772] Martinez, E., & Garcia, A., 2000, What is neo-liberalism? GlobalExchange. Available at http://www.globalexchange.org/campaigns/econ101/neoliberalDefined.html, accessed on 17/03/10
[773] Section 8 Atomic Energy Authority Act 1986

released. The accident served to crystallise a great deal of existing opposition to *all* types of nuclear power, despite the fundamental difference in design between the RBMK design used at Chernobyl (and the fact that even with these flaws it took human error to cause the accident), and the PWR design which was to be used at Sizewell.

Figure 4.2: Decentralisation of Nuclear Industries[774]



Friends of the Earth International (FOEI) and Greenpeace International, for example, both used the Chernobyl accident to muster support for their pre-existing campaigns against all types of nuclear power, with FOEI claiming that the accident "increased the number of FoE groups strenuously opposing nuclear energy"[775] and Greenpeace even being cited in the House of Commons:

> "Shortly after Chernobyl, Greenpeace published a full-page advertisement in several national newspapers listing all power stations, those in the first category that it thought should be closed immediately, and those in the latter category that should be phased out."[776]

The government did not respond officially to the Greenpeace advert however, as shown below, it did respond to the Chernobyl accident by admitting that the accident would have "a profound impact on public opinion"[777] and by reassuring the House that the nuclear industry in the UK "is the most regulated industry in the country"[778] thus making it considerably less likely that such an accident could ever occur here. 1986 also saw the adoption of a new organisational strategy for the coal industry; the Wheeler Plan. The Plan, which built on the earlier, but classified, Miron Report:

> "anticipated the creation of a downsized 'core' workforce engaged in coal getting, supported by a 'peripheral' workforce comprised of subcontractors."[779]

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[774] Rüdig, W., 1987, Outcomes of nuclear technology policy: do varying political styles make a difference? Journal of Public Policy, 7/4, pp.389-430.
[775] See, for example, FOEI, 2010, The First 25 Years: A Short History, Friends of the Earth International, available at http://www.foei.org/en/who-we-are/about/25years.html/, accessed on 18/01/10.
[776] Best, K., 1986, Nuclear Power, HC Deb 11 May 1987 vol 116 c88
[777] Baker, K., 1986, Nuclear Energy, HC Deb 13 May 1986 vol 97 c569
[778] Baker, K., 1986, op cit, n779, c571
[779] Wallis, E., Winterton, J., & Winterton, A., 2000, Notes and Issues: Subcontracting in the Privatised Coal Industry, Work, Employment & Society, Vol. 14,No. 4,pp. 727–742: 729

The Wheeler Plan, which was released in the aftermath of the contentious and long-lasting strikes by the NUM from 1984-5, should have been popular with the nuclear industry in the UK, since any diminution in reliance on fossil fuels would be likely to necessitate more reliance on nuclear as a generating source. However, the Shadow Energy spokesman, and well-known opponent of nuclear power, Stanley Orme MP (later Baron Orme of Salford), argued during the second reading of what would become the Coal Industry Act 1987, that:

> "The Government have no coherent energy policy; they have merely used the energy industries as a political tool, motivated only by the ballot sheet and short-term gain."[780]

For Margaret Thatcher, it has been argued that there was also a strong element of "essential revenge" on the miners after the humiliation that had been meted out on Ted Heath in the miners' strike of 1974.[781] Norman Lamont MP, when Minister of State for Industry, said that the:

> "policy of returning whole or parts of nationalized industries to the private sector wherever this is practicable will assist the operation of market forces; it is the best spur to efficiency and the optimal allocation of resources."[782]

Table 4.2: Pre-and post-Privatisation profits for three companies

COMPANY	PRE-PRIVATISATION PROFIT (LOSS)	POST-PRIVATISATION PROFIT (LOSS)	PERCENTAGE RISE
Cable and Wireless	£62m[783] (1980/1)	£157m (1982/3)[784]	155% (76% p.a.)
British Aerospace	£52.8m[785] (1980)	£95m (1982)[786]	80% (40% p.a.)
National Freight Co	£1m (1980/1)[787]	£37m (1985/6)[788]	3600% (74% p.a.)

As explored above, therefore, the drive for privatisation can be interpreted as a pragmatic way of ensuring that governments were able to transfer ownership of low-profit-making companies (see Table 4.2) to the public, reduce the PSBR and, in theory, improve the economic position of the country. The downside of privatisation if, of course, that the increased profits remain in the hands of investors and the private sector, instead of becoming available to government. In the case of the National Freight Company however, the corporate tax paid on the post-privatisation profits exceeded the whole sum of the pre-privatisation profits.[789]

It should be noted that the rise in profits for the three companies in Table 4.2 cannot be wholly attributed to their privatisation – in the case of Cable & Wireless, for example,

780 Orme, S., 1986, Coal Industry Bill, HC Deb 25 November 1986 vol 106 cc156
781 Marr, A., 2008, n248, p410. Also Greenaway, J., Smith, S., Street, J., 1992, Deciding Factors in British Politics: A Case Study Approach, London: Routledge.
782 Townsend, E., 1982a, Lamont affirms privatization plan, The Times, 14 May 1982, p15
783 Tebbit, N., 1984a, Cable and Wireless, HC Deb 01 August 1984 vol 65 c300W
784 Lintott, W., 1983, Cable and Wireless beats all City forecasts with a 76% climb in profits, The Times, 14 July 1983, p19
785 Tebbit, N., 1984b, British Aerospace, HC Deb 01 August 1984 vol 65 cc299-300W
786 Townsend, E., 1982b, British Aerospace profits hit by Laker Airways collapse, The Times, 31 March 1982, p13
787 ASI, 2002, Around the World in 80 ideas: Privatization by employee buyout, Adam Smith Institute. Available at http://www.adamsmith.org/80ideas/idea/35.htm, accessed on 19/01/10
788 Ibid.
789 In 1985, the rate of Corporate Tax in the UK was at 40 per cent, thus generating a potential tax income of £14.8m, far outstripping the £1m pre-privatisation profits. Source: Devereux, M., Griffith, R., & Klemm, A., 2004, Why has the UK Corporation Tax raised so much Revenue? Report WP04/04, London: Institute of Fiscal Studies, p3

changes in the telecommunications industry in the late 1980s and 1990s led to a huge boom in profits in the sector worldwide.

4.2.5: Atomic Energy Act 1989 and Electricity Act 1989

The early years of the nuclear industry can be painted as an occasionally haphazard series of lurches from potential crisis to potential crisis. The truly international aspect of this technology was first properly revealed with the accident at Chernobyl in 1986.

The Chernobyl Accident, April 1986

The RBMK-1000 design of the reactor which was at the heart of the accident at Chernobyl was unique to the Soviet nuclear programme. The specifics of the design are covered in greater detail in Appendix III, but the immediate cause of the accident was the unauthorised experimentation of the reactor crew, who began:

> "preparing for a test to determine how long turbines would spin and supply power following a loss of main electrical power supply. Similar tests had already been carried out at Chernobyl and other plants, despite the fact that these reactors were known to be very unstable at low power settings."[790]

The experiment was a resounding failure, and a series of explosions caused a huge quantity of radioactive dust to escape into the surrounding atmosphere. The prevailing wind currents caused the cloud to drift over much of Western Europe before the radioactivity finally dissipated to an undetectable level. [791] The size and nature of the escape caused the accident to be classified at Level 7 on the INES scale reproduced in the previous chapter. The economic costs of the Chernobyl accident were estimated at roughly $100bn,[792] and this was in addition to the number of deaths which are directly attributable.[793]

Taken as a solo incident, the Chernobyl explosion would more than likely have had a significant effect on European attitudes to the safety of nuclear power but, coming as it did a few years after the Three Mile Island accident, the combined impact would be much greater.

Impact of the TMI and Chernobyl Accidents

The combination of the accidents and "low energy prices and abundant supplies of oil and gas… made nuclear power even less attractive as a policy option"[794] and it is unsurprising that when this situation was superimposed on the planning enquiry for the Sizewell B power station in Essex, it was to be the last nuclear-power station built in the UK. It may also have had an impact on the decision not to include nuclear-power stations in the privatisation of the electricity industry in the 1990s. However, it is as treacherous to try and attribute actions of governments to that single cause as it is to try and attribute the number of deaths.

In terms of the impact that these accidents had on nuclear policy in the UK, one of the potentially most important was the passage of the Atomic Energy Act 1989, part of

[790] WNA, 2007, Chernobyl Accident, London: World Nuclear Association, p2.
[791] For initial reaction of the Chernobyl accident from a legal perspective, see Harris, B., 1987, EEC Laws on Environmental Protection 137 NLJ 1058.
[792] Jaworowski, Z., 2004, Lessons of Chernobyl – with particular reference to thyroid cancer, Australasian Radiation Protection Society Newsletter, No.30.
[793] As with other accidents of the era, for example the leak of Methyl Isocyanate from the Union Carbide factory in Bhopal in 1984, the estimates of how many people died as a result vary dramatically. The IAEA and WHO say that only 50 deaths can be directly attributable, but the National Commission for Radiation Protection in the Ukraine argues that nearly 500,000 may have already died. Sources: Chernobyl Forum, 2005, Chernobyl's Legacy: Health, Environmental and Socio-economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine, Vienna: International Atomic Energy Authority; Vidal, J., 2006, UN accused of ignoring 500,000 Chernobyl deaths, Guardian, 25 March 2006.
[794] Cameron, P., The Revival of Nuclear Power: An Analysis of the Legal Implications (2007) 19 JEL (71)

which gives effect to the UK's ratification of the IAEA Vienna Convention 1986.[795] Since no similar incident has occurred since Chernobyl, the actual impact of this statute has been minimal but, nevertheless, the potential impact was dramatic. Chernobyl did not just have an impact on statute; it was also considered in the decision on whether or not to allow the construction of Britain's newest nuclear power station, at Sizewell, in Suffolk.

Sizewell B

The construction of the Sizewell B in Pressurised Water Reactor in Suffolk had been initially mooted in the early 1980s and was "called in"[796] for a planning inquiry in 1983. The Sizewell B Inquiry was to be headed by Sir Frank Layfield QC, an experienced planning barrister, and would last for more that two years, at an estimated cost of £25m.

In the report of the Sizewell B Inquiry, which was not released until December 1986, a full 18 months after the Inquiry had ended,[797] Layfield found in favour of the construction of the Sizewell B PWR plant. He did not, however, give unconditional support to the idea, arguing that that building the plant was not an ideal solution and that the plant would be "a totally inappropriate intrusion into the Suffolk countryside"[798] but that it was, nevertheless, justified on the basis of national interest.

The Labour MP and Shadow Environment Spokesman, Dr David Clark, summed up the report with a mixture of praise and implied criticism, saying:

> "The report might be long, but it is lucid, as hon. Members on both sides have said. Sir Frank Layfield has the facility to translate complicated and technical issues into words which the layman can follow.
>
> The report has about 3,000 pages. I fear that it will have a similar fate to 'Das Kapital' – many people will quote from it, but few will read it. That is a pity, because the report is in depth, thorough and well written."[799]

In March 1987, the Energy Secretary, Peter Walker, announced that he was giving the go-ahead for the project, having "in particular, considered the relevance of Chernobyl to the safety of the proposed station."[800] Walker also commented that

> "Sizewell B was sufficiently safe to be tolerable, and that the national need for the station overrides the local interest in favour of conservation."[801]

Playing the "national interests" card was a way for the government to ensure that its policy went ahead. Given the plethora of scientific reports what had been published on the safety (or otherwise) of Chernobyl[802] and the fact that the scientific opinion contained in these reports differed widely, the fact that Walker presented his conclusion as though it was backed up by a unified scientific community supports one of the themes of this work, that politicians will feign unity of science when it suits their purposes.

It was to be one of the last major acts that Walker made in the post before he was replaced by Cecil Parkinson in the post-election cabinet reshuffle a few weeks later. The

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[795] The Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency.
[796] "Most planning applications are decided locally by the district or other council. But the Secretary of State has reserve powers to direct the council to refer an application to him for decision. This is what is meant by a 'called-in' application" and is done in cases where, for example development may conflict with national planning policy, or have wide effects beyond its immediate locality. Source: PI, 2009, A Guide to Called In Planning Applications, London: Planning Inspectorate / HMSO.
[797] Milne, R., 1989, Missing the Hinkley Point, New Scientist, No 1684.
[798] Baker, R., 1988, The Politics of Energy: The Layfield Report on "Sizewell B", The Political Quarterly, 59 (1) 91-96: 93.
[799] Clark, D., 1997, Sizewell Nuclear Power Station, HC Deb 23 February 1987 vol 111 c105
[800] Walker, P., 1987, Sizewell B Nuclear Power Station, HC Deb 12 March 1987 vol 112 cc475-90
[801] Ibid.
[802] See, for example, Reisch, F., 1987, The Chernobyl Accident – its impact on Sweden, Nuclear Safety, 28 pp. 29–36; US NRC, 1987, Report on the Accident at the Chernobyl Nuclear Power Station, US Nuclear Regulatory Committee Report NUREG-1250, Washington, DC: US DoE / US EPA; Buesseler, K.O., 1987, Chernobyl: Oceanographic studies in the Black Sea. Oceanus. pp23-30; and Joshi, S.R., 1987, Early Canadian results on the long-range transport of Chernobyl radioactivity, The Science of the Total Environment, 63:125-137.

construction of Sizewell B lasted much longer than the remaining Commons careers of either Walker or Parkinson though,[803] and it would not be completed until 1995, having proved to be:

> "every bit as expensive as its critics suggested, and to run into many of the problems its predecessors had done."[804]

Greenpeace cite the initial construction estimate as £1.9bn, and the final estimate as £2.6bn, which is a rise in cost of over 40 per cent.[805] This increase in costs associated with the nuclear industry was a pattern which had been established with the first round of stations to be built, in the 1950s and 1960s, and would be continued with the financial support offered to British Nuclear Fuels Ltd.

Atomic Energy Act 1989

This Act was a rather fragmentary one and dealt with four main themes in six sections. The first move was to increase the limits of the government's financial support to BNFL yet again, this time to £2bn.[806] As was discussed in section 4.2.1, above, this limit had originally been set by the Atomic Energy Authority Act 1971 at £50m[807] and had been increased several times. The rationale for the trebling of funding in 1981 had been the ambitious expansion project planned by BNFL between then and 1991, and this was repeated by the Parliamentary Undersecretary of State for Energy, Baroness Hooper, when she introduced the second reading of the Bill in the House of Lords, saying:

> "BNFL is supporting a massive investment programme of more than £5 billion until the turn of the century, mainly in support of its waste management and reprocessing operations at Sellafield."[808]

Most of the money that BNFL needed for its expansion (75 per cent) would come from internal sources or overseas customers, and the guarantees were identified as being "copper-bottomed"[809] (or, as the OED puts it "thoroughly reliable")[810] and exempted from the privatisation programme. Removing the potentially costly guarantees from the offer was a pragmatic and ingenious way of making the company that was being sold to the public far more attractive, and thus likely to command a higher price.

The second purpose of the Act was to allow the Health and Safety Executive (HSE, which had gained licensing powers in the Nuclear Installations Act 1965 under the Health and Safety at Work Etc Act 1974) to recover costs for the work carried out by its enforcement body, the Health and Safety Commission (HSC). The Act made it clear that the ability to recoup costs only applies to actions started after the Act had been passed (25 May 1989) and was not in any way retrospective.[811] The HSE was not just given the responsibility for inspecting nuclear installations, but was:

> "charged with ensuring that adequate safety research programmes continue to be carried out, that the contribution research can make to higher standards of nuclear safety is fully exploited and that the results are disseminated."[812]

This would mean that the HSE would take a leading role in the safety-related research on specific reactor types as well as the industry as a whole. Putting the work, which had

[803] Both men were elevated to the peerage in 1992 - Peter Walker as Baron Walker of Worcester, and Cecil Parkinson as Baron Parkinson.
[804] Helm, D., 2004, op cit, n220, p104.
[805] Greenpeace UK, 2002, Sizewell B: the facts, Greenpeace UK. Available at http://www.greenpeace.org.uk/nuclear/sizewell-b-the-facts, accessed on 05/01/10.
[806] Section 1 Atomic Energy Act 1989
[807] Section 13(2)(a) Atomic Energy Authority Act 1971
[808] Hooper, Baroness, 1988, Atomic Energy Bill, HL Deb 13 December 1988 vol 502 c829
[809] Williams of Elvel, Lord, 1989, Atomic Energy Bill, HL Deb 26 January 1989 vol 503 c835. The phrase "copper-bottomed" in relation to various guarantees appears 316 in Hansard between the start of 1950 and the end of 1999. Source http://hansard.millbanksystems.com/, search carried out on 05/01/10.
[810] Elliott, J., ed., 2001, op cit, n20, p314
[811] Sections 2(2) and (3) Atomic Energy Act 1989
[812] Hooper, Baroness, 1988, op cit, n810

previously been carried out by the Nuclear Installations Inspectorate (NII), under the overall umbrella of the HSE was a logical step in streamlining the number of safety-related inspectorates which existed.

Part three of the Act made changes to the Nuclear Installations Act 1965. Section 19 of the 1965 Act, which had provided a £5m insurance fund by the government for licensees of nuclear sites, had been amended previously by the Energy Act 1983, which had also increased the limits for single claims under section 16 of the 1965 Act to £280m per incident.[813] That 1983 amendment had meant that the cover period would end whenever the government amended the maximum limit for single claims.[814] The amendment by the 1989 Act made what looks, at first glance, like a minor change, insofar as the grant of a new nuclear site licence to the licensee did not mark the end of the period of cover, as it had previously.[815] This had a potentially dramatic effect, however.

Before the amendment, the period of cover would finish every time the site licence was renewed. All of the periods of liability that had initially been set out in the Nuclear Installations (Licensing and Insurance) Act 1959 (above) and then amended variously, were set up so that they would continue to run with *residual liability* for a limited time after the end of the cover periods. That is so say, if the cover period ended on 1 January 1969, the liability would be extinguished either ten or thirty years from that date (depending on the subject matter to which the claim related),[816] *regardless* of whether or not the license had been renewed to the same person. Under the amended version of the system, if the license was renewed continuously from 1969 onwards, the cover period would not have come to an end and so the clock would not have started to run. The effect that this has is only felt on sites where ownership changed hands. Under the new regime, the current owner and occupier of the site (or rather their insurance provider) takes on the liability for the site, since it is the same insurance cover which rolls over.[817]

The final part of the Act gave effect to the UK's ratification of the IAEA Vienna Convention 1986, which set out a framework for international co-operation on the occurrence of a Chernobyl-type accident. The Convention entered into force on 26 February 1987,[818] but did not do so in the UK until 12 March 1990 under the Atomic Energy (Mutual Assistance Convention) Order 1990.[819] This delay between signature and ratification of an international convention is fairly standard in international law, and is considerably shorter than the equivalent time lag in relation to the 1980 Vienna Convention discussed above.

The Electricity Act 1989

Returning to the privatisation of the industry, "nuclear power was removed from the government's privatisation plans."[820] This was for several reasons. Firstly, in 1988, the Department of Energy revised (upwards) its estimate of the costs associated with decommissioning of some of the older Magnox reactors which had, until then "been consistently underestimated, or perhaps even concealed"[821] by the operators. Later in the

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813 DTI, 2000, The Government's Expenditure Plans: Trade and Industry 2000 (Cmnd 4611), London: Department of Trade and Industry, Annex B2, p219

814 Section 27 Energy Act 1983

815 Section 4(1) Atomic Energy Act 1989. Section 4(2) further stated that "the amendments made… shall be deemed always to have had effect"

816 If a company wishes to indemnify itself against losses which might arise if the previous owner has polluted the site, then this becomes a matter for contract law, and brings this type of land transaction in line withal other commercial land deals. See, for example, sections 4(4) and 5(1) Nuclear Industry (Licensing and Insurance) Act 1959 (as amended)

817 See, for example, Reece, R., Garancher, T., & Cousin, A., Nuclear Projects in the 21st Century, I.B.L.J. 2009, 4, 437-454

818 IAEA, 2004e, Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency, Vienna: International Atomic Energy Authority.

819 Atomic Energy (Mutual Assistance Convention) Order 1990 (SI 1990/235)

820 DTI, 2003, White Paper: Our energy future – creating a low carbon economy (Cmnd 5761), Department of Trade and Industry, London: HMSO.

821 Thatcher, M., 1993, op cit, n576, p685

year, the costs associated with the remaining nuclear-power stations, particularly the planned construction of more Pressurised-Water Reactors similar to the Sizewell B reactor (which was under construction at the time), led to all nuclear-power stations being retained under state control. It was only the cost that was an issue: "it was never a matter of safety, which could perfectly well have been ensured in the private sector"[822] The Prime Minister's words were in some ways echoed by those of Conservative MP for Rochford (and future NRPB member), Dr Michael Clarke, who said during the debate on the Electricity Bill:

> "The Secretary of State [has] said that all costs will be borne by the private sector unless there is exceptional or retrospective legislation, in which case the Government will consider whether to help with the cost of decommissioning."[823]

The Opposition argued that the escalating cost of nuclear power was, indeed, the rationale behind keeping the nuclear side of the electricity industry out of private hands. Stanley Orme MP, who had spent seven years as the Opposition Spokesman on Industry and Energy, pointed out during the debate that:

> "The prices of oil and coal, nuclear's fossil fuel competitors, have fallen to their lowest level in real terms for many years, and are likely to languish there for some time.
>
> In these conditions, even the PWR, the American-designed pressurised water reactor on which so many of the British industry's hopes now rest, cannot expect to compete with coal.
>
> No private sector utility would dream of building one in the present climate."[824]

The Central Electricity Generating Board (CEGB) which, particularly under the chairmanship of Arthur Hawkins, had disagreed with the government on questions relating to nuclear power, was split into fourteen smaller pieces. The twelve regional electricity companies were floated in December 1990 with the generating companies, PowerGen and National Power, being floated[825] later in two tranches in March 1991 and March 1995.[826] The National Grid Group was not floated until December 1995, five and a half years after it was vested.[827] An industry which had effectively been controlled by a single unit since the creation of the CEGB in 1958 was thus broken up into 15 different pieces, all of which were disposed of separately. The interesting similarity between the structure of the electricity industry at the beginning and end of the life of the CEGB was that the nuclear-power sector was not included at either point. The privatisation of the electricity supply companies was over subscribed several times over, the "bulwark" of share-owning public was extended and approximately £11.1bn was raised from the sale of the shares.[828] This is equivalent to forty seven per cent of the government's £23bn spending on defence in the same year. As a pragmatic measure for raising short term financial gain, a phrase used as a criticism by Stanley Orme in 1986,[829] the sale of the non-nuclear elements of the electricity industry can be judged to have "worked"[830] and thus fulfil the criteria of political pragmatism.

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[822] Ibid.
[823] Clarke, M., 1988, Electricity Bill, HC Deb 12 December 1988 vol 143 c726.
[824] Orme, S., 1988, Electricity Bill, HC Deb 13 December 1988 vol 143 c809. Orme's words were prophetic and, at the time of writing, no private sector utility company has built a nuclear power station in the UK
[825] At its simplest, vesting refers to the point of the privatisation process at which the assets of the new company are transferred across from the original, state-owned company. The new company, which will have been registered at Companies House, will then control its own assets, although its share capital will be held wholly by the Government. Similarly, at the point of floating, some or all of the shares in the new company will be offered for sale to the public and the company will then be quoted on the Stock Exchange
[826] EA, 2003, Electricity Companies in the United Kingdom – a brief chronology, London: Electricity Association.
[827] Ibid.
[828] The sale was achieved at a total cost of about £270m. Source Wakeham, J., 1992, Electricity Privatisation, HC Deb 31 January 1992 vol 202 cc723-4W.
[829] Orme, S., 1986, op cit, n782.
[830] Diego, R., 2004, op cit, n31

For all of the successes of privatisation, however, it should not be thought that either the government or the nuclear industry were getting things all their own way. In 1985, for example, a Mr & Mrs Merlin, who lived close to the Sellafield site in Cumbria, issued a writ against British Nuclear Fuels Limited for damages caused by the loss of value of their house. This case was to become critical to the continued future of the nuclear industry in the UK.

The "Merlin Case"[831]

This case concerns the Merlin family, who claimed for damages pursuant to s12 Nuclear Installations Act 1965, which gives a right to compensation if "injury or damage has been caused in breach of a duty."[832] Their allegation was that BNFL had breached a statutory duty imposed by s7(1) Nuclear Installations Act 1965 by disposing of radioactive waste from the Sellafield site through a pipe into the Irish Sea between 1973 and 1984, and further that the action of the current had caused this waste to emit non-iodising nuclear radiation.

The Merlins also issued a parallel claim, in case the first one was unsuccessful, which alleged that there was a duty under the rule in Rylands v Fletcher.[833] The non-iodising radiation would constitute a "non-natural use" of the land and following the rule the onus was on BNFL not to let a the "thing" escape from their land and to be *prima facie* liable for any damage caused by that escape.

BNFL did not deny that the radio nuclides found in the property would have come from Sellafield but, instead, argued that the claim was invalid as, even if there was a link to sections 7 or 12 of the 1965 Act, or a link to the rule in Rylands and Fletcher, the crux of the case was on the nature of the loss. Rather than being a foreseeable and quantifiable loss, as the Merlins had argued, BNFL argued that the claim was:

> "a claim for financial loss arising out of a fear of the risk of sustaining personal injury; such loss not generally being recoverable."[834]

In summing up the case, Gatehouse J went to some length to point out that plaintiffs did not believe there was any negligence involved, but that this was an "absolute liability" case, where fault is not an issue. There was some consideration of the wording of the Vienna Convention 1963 (which, it will be recalled was the trigger for the Nuclear Installations Act 1965), and the case hinged on whether there had actually been any loss. The court found in favour of BNFL and dismissed the case, because:

> "For there to be a breach of statutory duty, carrying with it a right to compensation, the plaintiff must establish that he has suffered injury or damage to his property caused by nuclear matter, section 7(1)(a) , or an emission of ionising radiations on or from the site: section 7(1)(b)…. in either case there must be cause and effect. The mere presence of ionising radiations within the plaintiffs' property emitted from waste discharged from the site, is not enough to constitute a breach of statutory duty. There must be consequential damage. The radionuclides with which this case is concerned… are alpha emitters. These cannot do any significant damage to persons or property externally, but when inhaled, ingested or otherwise enabled to enter the body they may induce cancers, but, of course, will not necessarily do so."[835]

What this case meant for the nuclear industry is that unless there could be actual evidence of damage suffered by a plaintiff, as opposed to damage avoided, there would be no case to answer. Indeed:

> "it was a well-established principle in law that where there was no physical injury,

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[831] Merlin and Another v British Nuclear Fuels PLC [1990] 2 QB 557
[832] Section 12(1) Nuclear Installations Act 1965.
[833] (1868) L.R. 3 H.L. 330. See also Chapter three for a more detailed discussion of this rule.
[834] Merlin and Another v British Nuclear Fuels PLC [1990] 2 QB 557 @ 559
[835] Merlin and Another v British Nuclear Fuels PLC [1990] 2 QB 557 per Gatehouse J at 572 et seq.

damages were awarded only where there was an identifiable psychiatric or psychological illness or condition caused by the wrongful act."[836]

The Merlin case then marked something of a temporary watershed for the liability of nuclear companies and the government which indemnified them. Before the case, there was always the possibility that a claim would be successful and that a large compensation order would be made but, after the case, the likelihood of this dropped dramatically. The case was to remain the precedent in this area for over a decade, and it was not until the Magnohard case,[837] in 2004, that the area of law was relaxed slightly.

A second case which might have weakened the position of the nuclear industry came before the courts a few years later. Unlike the Merlin case, this was not a claim for damages, but a claim for judicial review of a decision by Her Majesty's Inspectorate of Pollution and the Ministry of Agriculture Fisheries and Food.

The 1994 Greenpeace Case[838]

In 1992, the decade or so of construction work of the Thermal Oxygen Reprocessing Plant or THORP plant at the renamed Sellafield had been completed.[839] In 1994, two years after completion of the plant, the pressure group Greenpeace was able to seek a judicial review of the decisions behind the agreement for the development of the THORP site, which was being run by British Nuclear Fuels Ltd. In 1994 Greenpeace Case the court recognised that, although Greenpeace would not be directly affected by the decision,[840] it "was a responsible and respected body with a genuine concern in the environment"[841] and also was the only organisation with the sufficient resources and expertise necessary to fund such an action.[842]

The implications of this decision had the potential to be dramatic and far-reaching. On the plus side, the courts had at last recognised that nationwide environmental pressure groups now had the *locus standi* or legal standing, to bring judicial review actions. This meant that the untouchable nature of decision-making in relation to nuclear power had been, at least theoretically, reversed.

The downside of the court's decision in the case was that part of their rationale for allowing Greenpeace leave to apply for judicial review was that they had sufficient funds to launch such an action. This narrow scope of who could bring an action brought with it an attendant difficulty – the small, local, directly affected groups would find it extraordinarily difficult to raise sufficient finances to launch such a challenge, since there was no form of legal aid for any type of judicial review. On a point of practicality, this is wholly logical – judicial reviews are immensely expensive, and can be drawn out affairs. However, this effectively rules out all smaller protest groups, such as those which appeared at Tony Benn's 'great debate' in 1976.

The 1994 Greenpeace case, therefore, marked a theoretical widening of accountability, but any fears that the floodgates would open was limited by the fact that the court had only granted *locus standi* because Greenpeace was such a large group. The

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836 Tromans, S., Environmental Law Developments, J.P.L. 2005, Aug, 984-996:989

837 Magnohard v United Kingdom Atomic Energy Authority [2004] Env. L.R. 19. The case found that the Merlin case was distinguishable on its facts and so the precedent did not need to be followed in this instance. The case awarded damages for the damage caused to a beach by radioactive waste from the Dounreay nuclear plant in Scotland.

838 R v H M Inspectorate of Pollution and Ministry of Agriculture Fisheries and Food, ex p Greenpeace Ltd. (No 2) [1994] Env. L.R. 76

839 Aubrey, C., 1993, THORP: The Whitehall Nightmare, Oxford: Jon Carpenter, p9.

840 This direct link gives rise to locus standi, or the right to stand. The rule for standing in making an application for judicial review originates in s31(3) of the Supreme Court Act 1981, and is that the applicant should have sufficient interest in the matter to which the application relates. For further discussion on this point, see for example Soriano, L.M., Environmental 'Wrongs' And Environmental Rights: Challenging The Legal Reasoning Of English Judges (2001) 13 JEL (297)

841 R v H M Inspectorate of Pollution and Ministry of Agriculture Fisheries and Food, ex p Greenpeace (No 2) [1994] Env. L.R. 76 @78

842 Hughes, D., et al., 2002, Environmental Law, London: Butterworths LexisNexis, 4th Ed., pp168-9

small groups therefore still missed out on judicial review on financial grounds, and the medium-sized groups who could potentially afford it, missed out on the grounds of insufficient *locus standi*. In truth, it was a precedent with far less impact than many had hoped or predicted.

Where the Merlin case marked a genuine strengthening of the position of the nuclear industry (and the government) in relation to pollution incidents, the 1994 Greenpeace case was a weakening of the decision-making process. This difference in impact was shadowed by a difference in applicability – for 14 years, everyone had to follow the precedent set by the decision in the Merlin case but, in practical terms, no-one was able to follow the precedent of the 1994 Greenpeace case.

4.3: The Radioactive Materials (Road Transport) Act 1991 and the Radioactive Substances Act 1993

4.3.1: The Radioactive Materials (Road Transport) Act 1991

This Act made new provisions for the transportation of radioactive material by road. Prior to the enactment of the Act, the only restrictions on such transportation had been put in place under the auspices of s5(2) Radioactive Substances Act 1948 (above) which simply said that:

> "The appropriate Minister may, as respects the transport of any radioactive substances, make such regulations as appear to him to be necessary to prevent injury being caused by such transport to the health of persons engaged therein and other persons."

The power granted to the Minister had been used several times to make regulations, but all of the Orders made were revoked with the passage of the 1991 Act. The power to grant new Regulations was maintained by Section 2 of the Act and extended the remit of the Secretary of State from just the protection of human health to the prevention of:

> "any injury to health, or any damage to property or to the environment, being caused by, or any incident arising out of, the transport of radioactive material"[843]

Radioactive material was defined in s1(1)(b) of the Act as "any material having a specific activity in excess of 70 kilobecquerels per kilogram", which would include the obvious targets of spent fuel and other Intermediate- and High-Level Waste.[844] Whilst this limit is quite high (granite, for example is rated at around 70Bq/kg, or 1,000 times less-radioactive)[845] and the new Act was partly triggered by the International Atomic Energy Authority's revision of their Regulations for the Safe Transport of Radioactive Material in 1990.[846]

The necessity for a new Act was purely pragmatic – the existing Act had been in place for almost half a century and the scale of the operation had grown dramatically. By the time the Bill was being debated, in June 1991, the number of road shipments of radioactive waste was roughly "half a million a year"[847] whereas:

> "the last time the House considered these matters, which was in 1947—a time when the nuclear industry was in its infancy and when there were probably no more than 100 shipments a year by road."[848]

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843 Section 2(1)(a) Radioactive Material (Road Transport) Act 1991
844 The limit remained unchanged until 2002, when it was dramatically reduced to 0.1 kilobecquerels per kilogram (or 100Bq/g) by the Radioactive Material (Road Transport) (Definition of Radioactive Material) Order 2002, SI 2002/1092
845 WNA, 2009, Naturally-Occurring Radioactive Materials (NORM), London: World Nuclear Association.
846 IAEA, 1990, Regulations for the Safe Transport of Radioactive Material, 1985 Edition (as Amended), Safety Series No. 6, Vienna: International Atomic Energy Agency
847 Fishburn, D., 1991, Radioactive Material (Road Transport) Bill, HC Deb 26 April 1991 vol 189 c1323
848 Ibid.

The Radioactive Substances Act 1948 was further amended with respect to the powers of Inspectors to investigate possible offences relating to carriage of radioactive materials by road. Under the 1948 Act, the powers extended to any "premises, vehicle, vessel or aircraft"[849] but this was then amended just to premises.[850] This did not mean, however, that vehicles were exempt from inspection, as Section 3 of the 1991 Act created a new type of Inspector who could work in conjunction with examiners appointed under section 68(1) of the Road Traffic Act 1988.[851] These officers had powers limited to the inspection of vehicles[852] and the imposition of prohibition or enforcement notices[853] on operators.

Failure to comply with any of the provisions of the Act, whether those provisions were imposed by Regulations created by the Secretary of State, or enforcement notices served by the Inspectors, was made an offence. The maximum punishment for such an offence was, on indictment, an unspecified fine and two-years' imprisonment.[854] As the vast majority of those transporting radioactive material were companies, rather than individuals, the Act makes specific provision for liability to attach both to the company and to:

> "any director, manager, secretary or similar officer… or any person who was purporting to act in such a capacity."[855]

In order to trigger this section, it was first necessary to prove that the offence had been committed with the "consent or connivance"[856] of such people, or through their neglect. This is an interesting provision as it was not technically necessary. As early as 1957, Lord Justice Denning had developed the "controlling officer test", where he said:

> "A company may in many ways be likened to a human body. It has a brain and nerve centre which controls what it does. It also has hands which hold the tools and act in accordance with directions from the centre… (the) directors and managers represent the directing mind and will of the company and control what it does. The state of mind of these managers is the state of mind of the company and is treated by the law as such."[857]

This meant that under this test, the "director, manager, secretary or similar officer" outlined in Section 6(1) would already be liable. However, the Act was passed in June 1991, which is not long after the collapse of the prosecution of P&O Ferries[858] in connection with the sinking of the passenger ferry *Herald of Free Enterprise* outside Zeebrugge harbour in March 1987. The prosecution failed because there was no Director within P&O (which had purchased Townsend Thorensen and thus taken on all its liabilities), who had responsibility for safety and, thus, no liability could attach to the company.

Evidently, the sinking of a passenger ferry does not have any direct link to nuclear-power policy, but the principle involved in the case is of potential interest. We have already seen that radioactive material in the form of spent fuel has an incredibly long half-life, during which period it poses a considerable risk to the public. If a train carrying such material had become derailed or otherwise involved in an accident and the material had entered the surrounding environment, it would have had the potential for serious embarrassment, not to mention cost, for the government should a prosecution have

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[849] Section 7(1) Radioactive Substances Act 1948
[850] Section 7(1) Radioactive Substances Act 1948 as amended by Section 9(2) and Schedule 1 Radioactive Material (Road Transport) Act 1991
[851] Section 1(2) Radioactive Material (Road Transport) Act 1991
[852] Section 3(1) Radioactive Material (Road Transport) Act 1991
[853] Section 4 Radioactive Material (Road Transport) Act 1991
[854] Section 6(3) Radioactive Material (Road Transport) Act 1991. Under Section 6(4), any costs associated with the destruction of radioactive material would also become the liability of the offender.
[855] Section 6(1) Radioactive Material (Road Transport) Act 1991
[856] Section 6(1) Radioactive Material (Road Transport) Act 1991
[857] per Denning LJ in H. L. Bolton & Co v T.J. Graham & Sons Ltd [1956] 3 All ER 634
[858] R v P&O European Ferries (Dover) Ltd (1991) 93 Cr App R 72

collapsed in the same was as the *Herald of Free Enterprise* case. This potential, however unlikely in practice, would help to explain the "belt and braces" approach adopted by the Act. At this stage, of course, the government was still pressing on with its nuclear-power programme.

Less than two years after road transport of high and intermediate level radioactive material had been tidied up, the untidy regulations surrounding the use of lower level radioactive substances came under scrutiny.

4.3.2: The Radioactive Substances Act 1993

The Radioactive Substances Act 1993 was a consolidation Act, the theory and rules of which were discussed in earlier chapters but which, to recap, cannot introduce any major new provisions. Section 50 and Schedule 3 of the 1993 Act[859] repealed the remnants of the Radioactive Substances Act 1948[860] and the entirety of the Radioactive Substances Act 1960. There were also smaller repeals to eleven other Acts and five pieces of secondary legislation, but these tended to amount to one paragraph in each.[861]

The small changes that were made by the 1993 Act were partly to do with the structure of the Act: in the 1960 Act, the definitions of the key terms "radioactive substance", "radioactive waste" and "mobile radioactive apparatus" had been put towards the end of the Act[862] but now, in accordance with modern drafting standards, they had been moved to sections 1, 2, and 3 respectively. This is the type of change that a consolidation Act is intended to make.

Although it had no effect on the substance of the previous Acts, the 1993 Act did change the unit of measurement for radioactive substances. As we saw above, the lower limit at which something was classified as radioactive material under the 1991 Act was 70kBq/kg. Under the 1948 and 1960 Acts, the classification of "radioactive substance" [863] had been expressed as "Microcuries per gramme (μc/g)"[864] but this was changed by the 1993 Act to "Becquerels per gram (Bq/g)."[865] even though the measurement in which radioactivity was expressed was changed, the level of radioactivity was not. Bequerels per kilogram as a measurement has two advantages, both of which are pragmatic. Firstly, it brings the Radioactive Substances Acts into line with other statute, which was already expressing radiation in these units. Secondly, it allowed for more precise measurement of radiation levels, since 1μc/g is the same as 37,000Bq/g.

The 1993 Act also changed some of the provisions around inspectors, in order to bring the regulations in line with other, non-nuclear statute. Two types of inspectors could be appointed under the Act. With respect to "premises in England which are situated on a nuclear site"[866], the Minister of Agriculture, Fisheries and Food was given the power to appoint inspectors. These inspectors did not have the power to inspect mobile radioactive apparatus. That power, along with a wider geographical jurisdiction, was limited to those inspectors appointed by the Secretary of State, who could also:

> "be appointed both as an inspector or as chief inspector under this section and as an inspector or as chief inspector under section 16 of the Environmental

[859] Section 50 and Schedule 6 Part 1 Radioactive Substances Act 1993

[860] The Radioactive Substances Act 1948 had a fragmented life, as do many statutes: the first part of it to be changed was Section 1, which was repealed by s2 Atomic Energy Authority Act 1954; Section 14 was repealed by s30 Northern Ireland Act 1962; Sections 3, 4 and 12 were repealed by s135 Medicines Act 1968; Sections 5 and 6 by s7 Radiological Protection Act 1970; and the remainder by the Radioactive Substances Act 1993.

[861] Schedule 6 Part 1 of the Radioactive Substances Act 1993 lists all thirteen Acts and all of the secondary legislation repealed or revoked by the 1993 Act.

[862] Section 18, Radioactive Substances Act 1960

[863] Actinium, lead, polonium, protoactinium, radium, radon, thorium, and uranium (Schedule 3 Radioactive Substances Act 1960, and Schedule 1 Radioactive Substances Act 1993).

[864] Schedule 1 Radioactive Substances Act 1960.

[865] Schedule 3 Radioactive Substances Act 1993.

[866] Section 5(1) Radioactive Substances Act 1993

Protection Act 1990."[867]

The inspectors appointed under the Environmental Protection Act 1990 (EPA) had been given wide-ranging powers of entry, inspection and confiscation[868] and this inequality left the situation where one industry, albeit a very disparate one, could be controlled by different sets of inspectors, appointed under different Acts, with different powers. This far from ideal situation was not rectified until five years later with the passage of the Environment Act, which will be discussed below.

The penalties for committing offences under the Act were also amended slightly to bring them up to date. The most serious offences under the Act were still those relating to registration or authorisation. Under the 1960 Act, the maximum penalty was a fine of £100 and/or imprisonment of up to three months on summary conviction, or an unspecified fine and/or up to five years imprisonment for conviction on indictment.[869] Under the 1993 Act, the penalties for conviction on indictment remained the same, but the maximum fine for a summary conviction was increased to a £20,000.[870] This was a higher rate of increase than was warranted simply by inflation. The inflation rate between January 1960 and January 1993 was 1,029%[871] which, if it were applied to the maximum penalty, would have only led to an increase to £1129. There is no evidence to suggest that this increase is due to the offence being taken more seriously, however, the increase in fine was to have that effect.

Obstruction of Inspectors (of either type), which was punishable by a £50 fine and up to three-months' imprisonment in 1960,[872] was changed to a purely financial penalty in 1993.[873] There are no provisions under the Act regarding sanctions for giving false information to the inspectors[874]. The logic behind this is that providing false information to an inspector could be classed as obstruction, and so the separate provision would not be needed.

However, since inspections were, and are, the best way to discover if the operator of a nuclear site is breaching the terms of their licence, or the absolute liability discussed in the Merlin case, giving more powers to inspectors and increasing the penalties for interfering with them was a logical and pragmatic step.

The final piece of legislation to be passed in this period was the Atomic Energy Authority Act 1995, which entered the statute books in the November of that year.

4.4: The Atomic Energy Authority Act 1995

In the spring of 1995, at around the same time as the final checks were being carried out on the new Sizewell B power station, the government published a report which reviewed the future for nuclear power.[875] The review found that there was no case, at that time, for the construction of new nuclear plant by the private sector and that:

> "because of the high cost of capital… only with government support would new reactors be built."[876]

This marks rather a change in direction from the 1988 position which, as we have

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[867] Section 4(3) Radioactive Substances Act 1993
[868] Section 17 Environmental Protection Act 1990.
[869] Section 13(2) Radioactive Substances Act 1960
[870] Section 32(2) Radioactive Substances Act 1993
[871] Figure calculated by the author, based on: ONS, 2019, op cit, n463
[872] Section 13(5) Radioactive Substances Act 1960
[873] Section 35(2) Radioactive Substances Act 1993
[874] This is at odds with provisions under Section 2(5) of the Nuclear Safeguards and Electricity (Finance) Act 1978 which imposes a prison term of up to two years for giving false information to IAEA Inspectors.
[875] DTI, 2005, op cit, n127
[876] Thomas, S., 2005, The economics of nuclear power: analysis of recent studies, Greenwich: Public Services International Research Unit p22

seen, was that "all costs will be borne by the private sector"[877] and shows the extent to which private sector involvement was only a pragmatic response to a particular set of circumstances, rather than a firm political belief. Later in 2005, the Atomic Energy Authority Act 1995 was passed, in order make provision for the transfer ownership of parts of the UKAEA into the private sector. The Act did not privatise the whole UKAEA, but simply put into place the necessary provisions for later privatisation "if so directed by the Secretary of State"[878] and with the approval of the Treasury.[879] Any nuclear-site licences held by the Authority (i.e., those granted under the Nuclear Installations Act 1965) were excluded from any possible transfer by virtue of Section 1(3) of the Act, as were any areas of land to which such a site license applied. This was a commonsense exclusion for, without it, any new body would have been able to take on the site license without having to go through the stringent vetting process set out in sections 2 and 3 of the 1965 Act.

The Act itself was short, running only to six pages and fourteen sections, but the Schedules to the Act were much larger. These dealt with the provisions for the full details of, *inter alia*, the taxation and pension provisions of such a transfer into private ownership.[880] The intention was that the Act would allow for the transfer of:

> "the activities of what now constitutes AEA Technology to a single successor company owned by the Secretary of State"[881] so that

> "AEA Technology may well be able to offer a wider range of competitively priced services once it is freed from the shackles of public-sector control."[882]

This successor company could then carry on as a separate entity from the remainder of the UKAEA until such time as it was floated on the Stock Exchange. As has been discussed in earlier sections, privatising the industries which had been nationalised by Attlee fifty years earlier (coal, gas, railways, electricity), was a major step and was popular with the Treasury, as it raised large amounts of money. It was also, at least initially, popular with those sections of the voting public who were able to buy shares in the new industries (and, more often than not, sell them shortly afterwards at an increased price). This can be shown by the levels of oversubscription for the share offers in the regional electric companies in 1990 and the electricity generating companies in 1991; which between them were oversubscribed to the value of £5.4bn.[883] As was shown in table 4.2, above, the benefits of privatisation for the government are short-term income and reduced cost. For the consumer, the benefits are argued to be more competition and, thus, lower prices. In a US study, economist Dr Clifford Winston and a team from the Brookings Institution[884] calculated that deregulation of the US airline industry had saved the public over $8bn, and that the equivalent figure for the railway freight industry was $18bn.[885]

Of course, there was a perceived downside to the mass privatisation. The Opposition

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[877] Clarke, M., 1988, op cit, n825
[878] Section 1(1) Atomic Energy Authority Act 1995.
[879] Section 2(1) Atomic Energy Authority Act 1995.
[880] The body of the Act runs to 124 sections and six pages, whereas the four appendices to the Act run to a total of 26 pages and 57 sections. Although, clearly, not all sections of an Act are the same length, this gives a rough idea of the difference in length between the main body of the Act and its appendices.
[881] Carmyllie, Lord, 1995, Atomic Energy Authority Bill, HL Deb 23 October 1995 vol 566 c896
[882] Carmyllie, Lord, 1995, op cit, n883, c899
[883] The Scottish Electricity Board share offer was oversubscribed by £1.2bn, and that for the 12 regional electricity boards in England and Wales was oversubscribed by £4.2bn. Source: BoE, 2006, Diary of Events Relevant to the Interpretation of the Monetary Statistics: 1960 – August 2006, London: Bank of England.
[884] The Brookings Institution is A Washington, DC-based "think tank" that describes itself as "non-artisan" but has also been described as "conservative" and "centrist" by some newspapers. Source: WP, 2009, Mr Obama's Job Plan: How much bang would he get for borrowed bucks? The Washington Post, Wednesday, December 9, 2009
[885] Winston, C., Corsi, T.C., Grimm, C.M., & Evans, C., 1990, The Economic Effects of Surface Freight Deregulation, Washington DC: Brookings Institution

repeatedly accused the government of "selling off the family silver"[886] and, although the later sales raised £42bn between 1990 and 2000,[887] disillusionment with the policy was growing by the turn of the decade. Although the revenue generated by a sale was potentially colossal, the long-term revenue stream that nationalised industries provided would then be destroyed.

As well as witnessing the creation of an environment in which the UKAEA could leave the public sector, 1995 saw the enactment of the Environment Act. This was a huge piece of legislation, mainly geared around creating a single Agency[888] to which the powers of the National Rivers' Authority, Her Majesty's Inspectorate of Pollution and various other organisations would be transferred.[889] It is relevant here insofar as the new agency takes on the functions "conferred or imposed" on the "Chief Inspector for England and Wales appointed [by] the Radioactive Substances Act 1993."[890] Once again, the regulatory regime surrounding the use of radioactive material had been changed – the second time in two years, and a different system was put into place.

The EA 1995 also further amended the Nuclear Installations Act 1965, and inserted the requirement that the Health and Safety Executive (which had been given licensing powers relating to nuclear sites in 1974) consult with the "appropriate Agency" (i.e., the Environment Agency in England and Wales or SEPA in Scotland) before granting or varying the terms of any site licence.

Just over a month after the Atomic Energy Authority was passed, and less than a year after the Review paper was published, Dr Robert Hawley, the Chief Executive of British Energy, announced that the company was abandoning its plans for building the Sizewell C and Hinkley C PWR stations.[891] The travails of British Energy, which had been set up earlier in the year to run the UK's eight newest nuclear power stations,[892] will be discussed in the following chapter.

The 1995 Act can be regarded as a 'fixer' – it did little dramatic itself, but it did put into place provisions which would allow for the privatisation of AEA Technology the following year. As has been argued above, the push towards privatisation is best classed as a pragmatic move, as it was intended to raise short-term finance and removed long-term costs and, as far as things appeared at the end of 1995, this is exactly what it did.

4.5: Conclusion

This chapter considered the impact of the accidents at Three Mile Island in 1979 and Chernobyl in 1986, both of which were identified in parliamentary debates as having a "profound effect on public opinion"[893] and thus policy, outside their immediate region. Despite this assertion, the TMI accident was not reacted to by policy makers in any significant way, and it was left to the CEGB to "consider the implications"[894] of the report by the Nuclear Installations Inspectorate. For nuclear power policy in the UK to be

[886] The Phrase was first used by the Labour Minister Lord Diamond in January 1985 when he asked in Parliament "When will the government cease… selling off the family silver to pay for the groceries?" Source: Childs, D., 2001, Britain Since 1945: A Political History, London: Routledge, p243.
[887] Obinger, H., & Zohlnhöfer, R., 2004, Selling off the "Family Silver": The Politics of Privatization in the OECD 1990-2000, Working Paper No 121, The Minda de Gunzburg Centre for European Studies, University of Harvard, MA.
[888] The desire for a "single agency" was tempered somewhat by the creation of the Environment Agency in England (known as Asiantaeth yr Amgylchedd in Wales although it was the same organisation), and the separate Scottish Environmental Protection Agency in Scotland.
[889] Sections 1-10, Environment Act 1995
[890] Section 2(e) Environment Act 1995
[891] Highfield, R., 1995, Nuclear future in doubt as £5bn plants are scrapped, The Daily Telegraph, 12 December 1995, p3.
[892] The AGR at Dungeness, Hartlepool, Heysham 1, Heysham 2, Hinkley Point B, Hunterston B and Torness B, along with the PWR at Sizewell B.
[893] Baker, K., 1986, op cit, n779.
[894] Howell, D., 1979, op cit, n692.

influenced even slightly by overseas accidents was a sign that the use of the technology had become widespread and, equally, that public concern over that technology was increasing. This is evidenced in the Merlin case, the transcript of which makes repeated reference to television documentary programmes and suggests that it was these, rather than the scientific evidence, which induced the Merlin family to move. The 1994 Greenpeace case too, illustrated the increasing access to scientific information by non-scientists, and what Baron Taverne called the increasing lack of trust in government scientists.[895] In addition to the lack of trust in government scientists, we have seen an increasingly uncritical acceptance of the evidence produced by NGO scientists, which matches the suggestions made by Professor Mehta[896].

The chapter also included an assessment of nine Acts of Parliament, ranging in scope from the specific methods of transporting radioactive waste by road, to more general (though no less important) attempts to redesign the Atomic Energy Authority. Some of the statute was lengthy, some was far shorter but, as we have seen, all relied to an extent on the political debate being couched in scientific language. We have seen examples in the Hansard records of parliamentary debates of politicians struggling (and, for the main part, admitting their struggle) with the scientific background to some of the policies. If we are to adopt the classification put forward by Kantrowitz thirty-five years ago,[897] these policies would all fall into the “mixed decisions” category, as they contained both technical elements, informed by the underlying science, and value elements. This weakens any argument that TDM is operating during this period even though, as with both of the previous periods considered, the criterion of having a technocratic élite[898] is partly, if not wholly satisfied. The UKAEA, which always had the ability to inform and influence policy, but which never had policy-making powers, was being moved away from the public sector during this period and towards the private sector.

The UKAEA was not the only body to be moved to a greater or lesser extent towards the private sector. We have also considered here the successful sales of the Radiochemical Centre Ltd and the non-nuclear portion of the electricity industry, and the increased financial support given to British Nuclear fuels Ltd as part of the overarching policy of privatisation adopted by the Thatcher government in the 1980s. On the basis of an assessment of the pre- and post-privatisation profits of three of the first companies to be sold; Cable & Wireless, British Aerospace and National Freight, that this move could correctly be classified as a reactive pragmatic response to the financial situation with which the UK was faced in 1980. In other words, the intention was to raise short-term capital, and this it achieved very well indeed. As we have seen in previous chapters, reactive pragmatism by its nature often focuses on “what works” in the shorter-term, and is shaped by external events.

Equally pragmatic, but more proactive, was the approach taken to reduce the perceived risk from international terrorism by the passage of the Nuclear Material (Offences) Act in 1983 and the ratification of the Vienna Convention on Physical Protection of Nuclear Material in 1991. Terrorism had not yet occurred in relation to nuclear sites, and the Act and Convention put in place measures to prevent it. The pragmatism displayed here was partly that the UK was bound by its membership of Euratom to ratify the Convention, and really had no choice but to do so, but also partly that the threat of terrorism in relation to nuclear facilities and materials was being assessed by various expert bodies as increasing.

Part of the rationale given by Tony Blair for the consideration of a nuclear rebirth in 2005 was that of energy security, and the access to North Sea Oil that began in this period marked, as Figure 4.1 clearly showed, the beginning of a ten-year drop in the UK’s reliance on imported oil. Just as the hike in oil prices following the Suez Crisis and Yom

[895] Taverne, D., 2005, op cit, n640.
[896] Mehta, M., 1998, op cit, n145.
[897] Kantrowitz, A., 1975, op cit, n91.
[898] Teichman, J., 1997, op cit, n93; Jasanoff, S., 1994, op cit, n94.

Kippur was ought to have been a boon time for the nuclear industry, this period should have marked a period of decline, and indeed it did. Linked to this was a shift in government approach to the construction of nuclear plants, from a position that “all costs would be borne by the private sector”[899] to one where “only with government support would new reactors be built”[900], prompting accusations that the government had “no coherent energy policy.”[901] This was meant as a criticism of a particular government, however it is clear that no post-war government has truly had a coherent energy policy, and all have had their moves shaped to a greater or lesser extent by external events and internal aims with a resulting piecemeal, reactively politically pragmatic, approach.

As was the case in previous sections, there is a combination here of planned political pragmatism – the development of measures to prevent an as-yet-unrealised terrorist threat – and more reactive political pragmatism – responses to international crises, the need to ratify international legislation, or things as prosaic as the increased level of traffic. Just as the scientists carrying out unauthorised experiments at Chernobyl in 1986 would not have done so with the benefit of hindsight (and, with a 10 year sentence in a labour camp, they would have had plenty of time for reflection) the “what works” criteria have to be judged upon the situation at the time.

The final section which will be focused on by this thesis begins with the announcement by the Prime Minister that nuclear power is no longer anathema, but is back on the agenda.

[899] Clarke, M., 1988, op cit, n825.
[900] Thomas, S., 2000, op cit, n878.
[901] Orme, S., 1986, op cit, n782.

Chapter 5: November 2005 – May 2008: The Rebirth of Nuclear Power?

5.1: Introduction

This chapter focuses on the period from the end of November 2005 until the late spring of 2008. At less than thirty months, it is the shortest period on which this work has focused, and it begins starting just over a decade after the previous chapter finished. Nevertheless, despite being only a brief period, it was a time of great importance to the nuclear industry and to nuclear policy-makers alike.

The chapter begins by looking at the developments in the wider area of energy policy between 1995 and the end of 2005. During this period, increased global focus on the dangers of the enhanced greenhouse effect and the anthropogenic contribution to carbon emissions led to the adoption of the Kyoto Protocol[902] in 1997 which came into force in February 2005.[903] The period also saw major terrorist attacks in the United States, Bali, Madrid and London, and the invasions of Iraq and Afghanistan, bringing with them heightened global tensions and a raft of publications concerning the security of nuclear installations against terrorism.[904] In 1997, eighteen years of Conservative governments in the UK were brought to an end with the election of Tony Blair and New Labour. The impact that this change of government had on the nuclear industry is assessed in this part of the chapter.

The second section of this chapter covers the Prime Minister's speech to the Confederation of British Industries in November 2005 ("the CBI Speech"), the resulting publication of the Energy Review in 2006[905] and the subsequent enactment of the Climate Change and Sustainable Energy Act 2006. This is the final period to be discussed in this research and, had the work been completed even as late as October 2005, there would have been little forewarning that the occurrences covered here would have happened. As covered in Chapter One, the situation of the apparent "long slow fall from grace" of nuclear power was dramatically slowed, if not reversed, after the CBI speech, which covered six "key areas": public service reform, increasing age of the population, transport, skills, energy and bank deregulation.[906] It was not until towards the end that the announcement was made that energy policy was "the issue back on the agenda with a vengeance"[907] and further that the UK would look in the summer of 2006 at:

> "the issue of whether we facilitate the development of a new generation of nuclear power stations."[908]

The impact of this statement cannot be underestimated and will be discussed in more depth later in the chapter, but it is important to note that there had been some anticipation of the announcement both in the press and in Parliament. Less than a month earlier, the Secretary of State for Trade and Industry, Alan Johnson, had said, during a parliamentary debate, that the reintroduction of nuclear was:

> "A very big if, because factors such as waste and cost have to be taken into account.... A very healthy public debate is going on, but it is very different from

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902 Technically the "Kyoto Protocol to the UN Framework Convention on Climate Change", but generally referred to in its abbreviated form.

903 Per Article 25(1) of the Protocol "This Protocol shall enter into force on the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted in total for at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance, approval or accession."

904 See, for example POST, 2004, Postnote 222: Assessing the risk of terrorist attacks on nuclear facilities, London: Parliamentary Office of Science and Technology/ HMSO; and Badey, T.J., 2001, Nuclear Terrorism: Actor-Based threat Assessment, Intelligence and National Security, Vol 16 No 2 p39-54.

905 DTI, 2006b, The Energy Challenge. Energy Review (Cmnd 6887), London: Department of Trade and Industry / HMSO

906 Blair, T., 2005, op cit, n1

907 Ibid.

908 Ibid.

> that which took place even as recently as 2003 in terms of climate change and the need for security of supply. I hope that we can ensure a proper, comprehensive debate that examines the issues, instead of people taking stances based on, perhaps, an ideological viewpoint. Taking such stances will not help us."[909]

What the Secretary of State is suggesting is that the facts underpinning the announcement in the 2003 White Paper, considered later in this chapter, that a renewed development of nuclear power was considered "an unattractive option"[910] had changed to such an extent that "what worked"[911] in 2003 might not be suitable for the end of 2005. His use of the "ideological viewpoint" as a term of disapproval suggests that he is using it as a contrast to a rational debate. What the Secretary of State's comments seem to be leading to is the fact that he considers the reappraisal of nuclear power as an option to be pragmatic (inasmuch as it might be the most practicable choice) and that there is no room in the discussion for any other viewpoints.

The chapter concludes with a discussion of the high court challenge to the energy consultation and the two similarly named White Papers which were published in 2007 and 2008.[912]

Throughout the chapter, the decisions which were made in relation to nuclear power policy will be assessed in order to ascertain, as far as is practicable, the reasons for making them. As with previous chapters, the ideas of political pragmatism and Technocratic Decision Making will be used as the models against which the decisions will be measured. In addition to this, and of particular importance in a chapter where global climate change plays such a major role, the extent to which politicians have made use of 'science' as a tool to justify their decision will be assessed.

5.2: Developments between 1995 and 2005

This section will consider the impact of several key events that happened in the decade between the end of the previous chapter and the beginning of this one. Some, but not all, of the events are directly linked to nuclear power, and some are linked to much wider issues such as climate change and energy security.

5.2.1: Home Energy Conservation Act and Environment Act 1995

The first element to consider is statutory and is the passage into law of two Acts: the Home Energy Conservation Act 1995 (HECA) and the Environment Act 1995 (EA). The scale of the two Acts could not be more different – the HECA 1995 is only nine sections long, whereas the EA 1995 runs to 125 sections and 24 Schedules. Their relevance is also different. HECA is mentioned as it speaks to the wider issue of energy conservation, which would affect demand for electricity and thus impact on the potential requirement for nuclear power. The Act made every local housing authority in England and Wales[913] into an "Energy Conservation Authority" and then gave them a duty to prepare a report setting out:

> "energy conservation measures that the authority considers practicable, cost-effective and likely to result in significant improvement in the energy efficiency of

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909 Johnson, A., 2005, Energy Policy, HC Deb 3 Nov 2005 vol 438 c954
910 DTI, 2003, op cit, n822, p12 para 1.24
911 Diego, R., 2004, op cit, n31
912 DTI, 2007a, Meeting the Energy Challenge (Cmnd 7124), Department of Trade and Industry, London: HMSO; and DBERR, 2008a, Meeting the Energy Challenge: A White Paper on Nuclear Power, London: DBERR
913 (or Scottish local authorities or the Northern Ireland Housing Executive) Source: Section 1(1) Housing Energy Conservation Ac t 1995.

residential accommodation[914] in its area."[915]

The measures put into place under HECA were modest, in terms of the total use of energy across the country, and included local authority schemes such as grants for improved insulation, subsidised (or free) low-energy light bulbs and draught proofing. The target was to improve energy efficiency levels (from a 1996 baseline) by 30 per cent by the end of 2010.[916] The performance of the Energy Conservation Authorities was revealed in July 2005 when, in a House of Lords debate, Baroness Maddock inquired as to the cumulative amount of energy saved as a result of the Act. In response, Lord Bach stated that, up to the end of March 2004, 93.4 TWh had been saved;[917] which equates to about 12 TWh a year, on average. Since the total UK energy production for 2005 was estimated by the investment analysts Bloomberg as 398 TWh,[918] this suggests that HECA managed to reduce the UK's energy demand by about 3 per cent a year. Since each of the fourteen nuclear-power stations still operating in 2005 contributed about 1.8 per cent of the total UK energy demand, the energy efficiency requirements of HECA have obviated the need for one and a half nuclear-power stations. In the light of this apparent success, the need for politicians to make concrete decisions about the reintroduction of nuclear power, as opposed to vague policy ideas, has been greatly reduced.

Whereas HECA was concerned with the wider issue of energy conservation, the EA 1995, spoke to the linked but separate key strand of this period, that of environmental concerns. It was an almost all-encompassing piece of legislation which covered areas as diverse as:

The establishment of an Environment Agency (EA) and Scottish Environmental Protection Agency (SEPA) (ss1-56);

Dealing with abandoned mines (ss57-60);

Restating the purpose and organisation of National Parks (ss61-79);

Setting up a National Air Quality Strategy (ss80-91); and

Sundry areas (waste, mineral rights, hedgerows, drainage and fisheries).

In such a large piece of legislation, one might have thought that the impact of the nuclear-power industry would have come under more attention. However, the amendments to existing legislation are limited to a small procedural change to the Nuclear Installations Act 1965[919] and another to the Radioactive Substances Act 1993.[920] What is important about the EA 1995 is that it illustrates the growing importance of "the environment" as a political influence. According to the ex-Prime Minister, Margaret Thatcher, writing several years after the event, the "environmental lobby… used the concern about global warming to attack capitalism, growth and industry."[921] However, as Robert Garner of the University of Leicester points out:

"Documenting the objective reality of environmental problems is much more straightforward… than explaining why the environment has emerged as a political

[914] The definition of residential accommodation was set out in section 191) of the Home Energy Conservation Act 1995, and was amended by section 1(2) of the Energy Conservation Act 1996 which added houses in multiple occupation and house-boats to the definition.

[915] Section 2(2) Housing Energy Conservation Act 1995.

[916] Gore, D., 2000, The Warm Homes and Energy Conservation Bill (Revised edition), house of Commons Research Paper 00/26, London: HMSO, p12

[917] Bach, Lord, 2005, Home Energy Conservation Act 1995, HL Deb 21 Jul 2005 vol 673 cWA282

[918] Paulsson L., & Dobson, P., 2006, British Energy Ousts Its Nuclear Chief; Output Cut, Bloomberg. Available online at http://www.bloomberg.com/apps/news?pid=20601102&refer=uk&sid=aCxTPyjq2eiM, accessed on 06/07/09

[919] Section 7 of Schedule 22 (Minor and Consequential Amendments) to the Environment Act 1995 adds the requirement for the Health and Safety Executive to consult with the new EA and SEPA before nuclear site licences are granted.

[920] Section 205 (5) of Schedule 22 (Minor and Consequential Amendments) to the Environment Act 1995 adds a requirement for the EA or SEPA to consult with the "relevant Minister and Health and Safety Executive" when deciding whether or not to issue a consent for the disposal of radioactive waste.

[921] Thatcher, M., 1993, op cit, n576

issue. In particular we cannot just assume that the former accounts for the latter."[922]

Although it is true that some in the environmental lobby welcomed the move towards total decommissioning,[923] other leading figures have clamed that it is a short-sighted step. The announcement late in 1995 by Dr Robert Hawley, the Chief Executive of British Energy, that the company was abandoning its plans for building the Sizewell C and Hinkley C PWR stations[924] had a mixed reaction – The Amalgamated Engineering and Electrical Union was angry that abandoning the plans meant that roughly 10,000 jobs would no longer be created, but Greenpeace and Friends of the Earth both welcomed the decision[925] as it was aligned with their long-standing campaigns to phase out nuclear power altogether.

Even though Greenpeace, Friends of the Earth and other environmental groups take a position on the safety, economics and desirability of, not to mention the need for, nuclear power that is fundamentally contrary to the nuclear industry itself, both sides in the debate are ready and willing to use scientific data to back up their arguments. There is a fracturing over the acceptance or otherwise of science, however. In some circles there appears to be an assumption that "the involvement of experts in policy-making is obviously desirable."[926] Others, for example Hannigan, argue that involving experts in areas where there is a lack of either information or consensus "opens the door to manipulation by vested interests."[927] Professor Jasanoff[928] appears to support this second view suggesting that, in addition to the 'scientific community' and science itself fracturing, there is an erosion of public consensus to the extent that the public too are splintered into smaller and smaller groups. She also identifies a second set of issues which started to have an impact on policy-making; *viz*:

> "two larger sets of *fin de siècle* concerns: the reinvention of the Labour Party in the post-Thatcher years, and Britain's ongoing struggle to modernize and democratize institutions seen to be out of touch with the economic and social realities of the twenty-first century."[929]

She goes on to say that questions over:

> "How to regain a technological edge, what social compromises to make or not to make in that process, figured as sub-texts in virtually every major structural reform initiative."[930]

Whatever standpoint one adopts, it must be conceded that there is no absolutely accurate model for the role played by science in the legislative process.[931] Some areas of policy are clearly going to be highly reliant on detailed scientific data, whereas others may be more closely linked to sociological or economic data. Science and scientific research, which were the *raison d'être* of many academic institutions across the globe are now, as Professor Worcester suggested in the previous chapter, often regarded as tools to be used by politicians and in the furtherance of their own political goals. This is not a sudden shift

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922 Garner, R., 2000, Environmental Politics: Britain, Europe and the Global Environment, Basingstoke: MacMillan Press Ltd, p14.

923 For example, "Nuclear power should have no role in Scotland's sustainable energy future beyond the life of the current stations" FOES, 2001, Friends of the Earth Scotland Briefing: Nuclear Power, Edinburgh: Friends of the Earth Scotland, p1.

924 Highfield, R., 1995, op cit, n893, p3

925 Ibid.

926 Jordan, G., & Davidson, S., 2000, op cit., n82, p75.

927 Hannigan, J. A, 1999, Environmental Sociology: A Social Constructionist Perspective, London: Routledge, p82.

928 Jasanoff, S., 2000, The Science wars and American Politics, in Dierkes, M., & von Grote C., eds., Between understanding and trust: The Public Science and Technology, Amsterdam: Harwood Academic Press.

929 Jasanoff, S., 2003,Designs on Nature: Science and Democracy in Europe and the United States, Princeton, NJ: Princeton University Press, p7

930 Ibid.

931 For more discussion of the role played by science in American lawmaking, see, Carden, K., 2006, Bridging the Divide: The Role of Science in Species Conservation Law, 30 Harvard Environmental Law Review 165.

– as we saw in earlier chapters, Clement Attlee was prepared to use the argument that his decision to adopt nuclear technology was driven by scientific inevitability. Due to the inherently scientific underpinnings of discussions about the environment, climate change and nuclear power, the use of scientific language by policy makers is brought into stark relief. Worcester further reports that:

> "There is considerable scepticism among the public about scientists' competence as experts. In the field of the environment, this perception has been fairly steady for a number of years, with the public generally fairly evenly divided on the proposition that 'even the scientists don't really know what they're talking about when it comes to the environment'."[932]

The "considerable scepticism" that Worcester talks about will not have been helped by occurrences such as the salmonella in eggs debacle of the 1980s and the outbreak of bovine spongiform encephalitis (BSE), with its links to new variant Creuzfeld-Jacob Disease in the 1990s.[933] As was discussed in Chapter Three, Taverne takes the argument a stage further, suggesting that:

> "Suspicion has increased [following TMI and Chernobyl] that there was a conspiracy between government, scientists and industry to pursue technological progress regardless of social consequences and risks."[934]

However pragmatic the decisions made by politicians prove to be in this final chapter, the direct and indirect influence of environmentalists was at a greater level than it had been in any of the previous chapters, as will be demonstrated below. The extent to which it was more influential than other factors will be investigated with respect to each piece of relevant legislation passed during the period.

5.2.2: Labour's Election Victory, May 1997

On 2 May 1997, eighteen years of Conservative government ended when the Labour Party, under the leadership of Tony Blair, swept to victory in the General Election with 419 parliamentary seats – a majority over the Conservative Party of 254. The rhetoric of "old" Labour had consistently been opposed to nuclear weapons[935] although its viewpoint on nuclear power fluctuated somewhat over the years.[936] "New" Labour, as the Labour Party started to refer to itself in 1996,[937] had also made a break with the old party's commitment to nationalisation.[938]

Nuclear power remained a low priority for the government in the first years of its term in office, as it had during the election. In the wider manifesto, nuclear energy warrants only a single sentence:

> "We see no economic case for building any new nuclear power stations."[939]

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[932] Worcester, R., 1999, op cit, n65. Worcester is also founder of the MORI Polling Organisation.
[933] The growing disillusionment with science has continued in the twenty-first century with the handling of GMOs, foot-and-mouth disease, bluetongue and avian influenza (H5N1), and Swine Flu (H1N1) in the twenty-first century.
[934] Taverne, D., 2005, op cit, n640, p27.
[935] The Labour party adopted a policy of unilateral nuclear disarmament at the party conference in 1960, reversed its decision at the following party conference, and then adopted it again between 1982 and 1989. Source: Hinton, J., 1989, Protests and Visions. Peace Politics in Twentieth Century Britain, Santa Fe, CA: Radius Books
[936] As we have seen in earlier chapters, in was Clement Attlee's government which introduced nuclear power in the first instance, and Tony Benn
[937] Labour, 1996, New Labour, New Life For Britain, Labour Party draft Manifesto, London: Labour Party.
[938] Clause IV of the Labour Party Constitution had been amended at a Special Party Conference in the spring of 1995. For a more detailed discussion on the impacts of the reforms of Clause IV see: Kenny, M., & Smith, M. J., Discourses of modernization: Gaitskell, Blair and the reform of Clause iv, pp110-168 in Denver, D., Fisher, J., Ludlam, S., & Pattie, C., (Eds.), 1997, British Elections and Parties Review: v. 7, London: Routledge, and Dolowitz, D. P., New Labour: the phoenix has risen, Contemporary politics 2007 (6)13 (2). 139-146
[939] Labour, 1997, New Labour, New Life for Britain, Labour Party Manifesto, London: Labour Party

Instead, the priorities of the new government were set out on a card as part of the 1997 manifesto. [940] They were "centred on five pledges: education; crime; health; jobs and economic stability."[941] Indeed, in parliamentary debates between 1997 and the end of 2004, Tony Blair never used the words "nuclear energy" and used "nuclear power" only nine times, and on several of these occasions he was referring to the former Soviet Union or Iran.[942] It is suggested that, in the first few years of his premiership, therefore, Tony Blair did not express a strong opinion on nuclear energy and the subject remained a low priority. The quote (above) from the manifesto suggests that it was a reactive, pragmatic, economics-based decision which led the Labour government to shift its attention away from nuclear power.

What the new government did achieve in its first full year of office was to pass two pieces of statute which could have had a dramatic impact on the different aspects of the nuclear industry; the Nuclear Explosions (Prohibitions and Inspections) Act and the Human Rights Act. As we will see, in practice, one of them has had considerably more effect than the other.

5.2.3: Nuclear Safeguards Act 2000

The relevant background to the Nuclear Safeguards Act 2000 is quite complex. The 1968 UN Treaty on the Non-Proliferation of Nuclear Weapons (NPT) came into force in March 1970, and was given effect in the UK by the UK Safeguards Agreement 1976 and the Nuclear Safeguards and Electricity (Finance) Act 1978. The 2000 Act relates to a Protocol to the 1976 Safeguards Agreement which had been signed in Vienna in September 1998. The Protocol bolstered the inspection regime of the NPT as it was felt that the existing regime was insufficient to meet new demands, following the 1991 Gulf War, and the:

> "discovery… of the full extent of the secret Iraqi nuclear programme, combined with revelations about the North Korean programme"[943]

On the face of it, this Act would seem to impact the civil nuclear industry to the same extent as the previous two which have been discussed; i.e., not greatly. However, because the technology involved in enriching uranium to weapons-grade is essentially the same as that used to enrich uranium sufficiently for use in a reactor, there is a much larger impact on the nuclear industry as a whole, and also in the UK. Despite some initial concern by the industry that these extra disclosure requirements[944] would result in excessive costs, the Government announced that:

> "that the estimated total cost for businesses likely to be affected by the new safeguards measures would be of the order of £150,000 in the first year."[945]

As it transpires, the Act did not come into force until the middle of 2004, so any business which could be affected by it had plenty of lead time in which to make necessary changes to their disclosure and secure record-keeping procedures.

The Act also served to add another tier of inspection onto the nuclear industry, which was already covered under several different inspection regimes. Unauthorised disclosure

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[940] Ibid.
[941] Labour, 2010, History of the Labour Party: New Labour, available at http://www.labour.org.uk/historyofthelabourparty3, accessed on 21/01/10
[942] Blair, T., 1999a, Chernobyl, HC Deb 15 March 1999 vol 327 c440W and Blair, T., 1999b, Former Soviet Union (Nuclear Reactors), HC Deb 10 February 1999 vol 325 c284W
[943] Youngs, T., & Danby, G., 2000, op cot, n602, p9
[944] This included keeping enhanced records so that any information required by the Secretary of State can be supplied. (Section 2, Nuclear Safeguards Act 2000)
[945] McIntosh, Lord, 1999, Nuclear Safeguards Bill, HL Deb 30 November 1999 vol 607 c777

of information obtained by the Inspectors can be punished by an unspecified fine and a prison term of up to two years.[946] The same is true for "knowingly or recklessly mak[ing] a statement that is false or misleading."[947]

Unlike the Nuclear Explosions (Prohibitions and Inspections) Act 1998, where inspections are limited to sites that are suspected of conducting nuclear testing, inspectors under the 2000 Act can carry out inspections on any site, provided the Secretary of State issues the correct notice.[948] Although the Act is not specific on the issue, during the debate stage in the House of Lords, Lord McIntosh of Haringey, the Government's Spokesman, said that:

> "the obligations in the Additional Protocol [and thus the Act] do not extend to defence-related activities. As is the case with our existing safeguards agreement, this will remain outside the scope of [International Atomic Energy Authority] oversight. This is, of course essential for reasons of national security."[949]

It is ironic that the rationale for increasing the powers of the IAEA Inspectors was, as was discussed briefly above, the secret development of nuclear technology by Iraq and North Korea; exactly the type of programme which would be covered by the phrase "reasons of national security." The UK had, therefore, albeit with the full knowledge and co-operation of the IAEA, exempted itself from having its military sites inspected, when these were exactly the sites that it argued ought to be subjected to inspection abroad. This makes the Protocol less universal than it was intended to be and although this was not an ideal situation for the IAEA, it was better, perhaps, than the UK deciding to invoke its rights under Article X of the NPT to withdraw from the treaty:

> "if it decides that extraordinary events… have jeopardized the supreme interests of its country."[950]

As has been shown at the beginning of the discussions of the 2000 Act, its *raison d'être* was to give force to the 1998 Protocol to the 1976 Safeguards Agreement, one of the requirements of which was that:

> "all of the then 15 member states and the European Commission… notify the IAEA that their statutory and/or constitutional requirements for implementation were in place."[951]

As with several of the Acts considered here, the purpose of the Act was to ratify an instrument of international law which had already been signed and, with the caveat from section 5.2.3 above, it can be framed as a pragmatic piece of policy-making, rather than something triggered by any political ideology.

The final notification from the member states went to the IAEA in April 2004, which is why there was such a delay between the Act being passed and coming into force.[952] This Act then was in place but was dependent upon the subsequent occurrence of external events to give it effect. By sharp contrast, the Anti Terrorism, Crime and Security Act 2001, however, was an immediate *ex post facto* reaction to external events.

5.2.4: Anti Terrorism Crime and Security Act 2001

The Anti Terrorism Crime and Security Act 2001 (ATCSA) entered the statute books on 14 December 2001, slightly more than three months after the terrorist attacks on the

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[946] Section 9(2) Nuclear Safeguards Act 2000
[947] Section 7 Nuclear Safeguards Act 2000sets out the offence, and section 9(2) NSA 2000 sets out the maximum punishment for those convicted on indictment.
[948] Section 2 Nuclear Safeguards Act 2000
[949] McIntosh, Lord, 1999, op cit, n971.
[950] Article X, 1968 UN Treaty on the Non-Proliferation of Nuclear Weapons
[951] Sainsbury of Turville, Lord, 2004, Nuclear Safeguards Act 2000, HL Deb 07 June 2004 vol 662 c23WA
[952] "…the Act shall come into force on 1st May 2004" Reg 2, The Nuclear Safeguards Act Commencement (No. 1) Order 2004 (SI 2004/1252)

United States on 11 September 2001. This Act has attracted criticism from several groups who question whether many of the measures it put into place comply with the provisions of the Human Rights Act above[953] and has sweeping powers in many areas. Only one small part of the Act relates to the nuclear industry, however, Part 8 ("Security of Nuclear Industry") of the Act amounts to only half a dozen sections (ss76-81), and Part 5 of Schedule 8 relates to Civil Nuclear Security. Nevertheless, there are some important changes made to the nuclear-security regime.

Section 76 of the Act repealed section 3 and parts of section 4 of the Atomic Energy Authority (Special Constables) Act 1976 and also restated the limits of the powers of the UKAEA constables from their previous limits to the situation where:

> "An AEA constable shall have the powers and privileges (and be liable to the duties and responsibilities) of a constable at any place at which he reasonably believes a particular consignment of nuclear material will be trans-shipped or stored incidentally to its carriage, in order to ensure the security of the nuclear material on its arrival at that place."[954]

The UKAEA Constabulary was reviewed in 2002 by HM Inspectorate of Constabulary which, in its report, made several recommendations relating to training and some aspects of restructuring.[955] Many of these recommendations were incorporated in a new body, the Civil Nuclear Police Authority (CNPA), created by the Energy Act 2004 which will be dealt with in due course.

Section 79 imposed criminal liability onto anyone who deliberately or recklessly "discloses any information or thing the disclosure of which might prejudice the security of any nuclear site or any nuclear material."[956] This liability attracts a maximum prison sentence of seven years and an unlimited fine,[957] which is higher than any other sentence relating to disclosure of information. The Act specified that the person making the disclosure must either do so with the intention of prejudicing security, or recklessly as to whether or not security will be prejudiced.[958] The old definition of recklessness stemmed from the case of Metropolitan Police Commissioner v Caldwell,[959] which gave it:

> "a so-called objective interpretation in relation to offences of criminal damage so as to include those who had failed to consider an obvious risk."[960]

This "objective recklessness" test was used as the yardstick in criminal cases for over two decades, before it was been overruled by the case of R v G[961] which:

> "re-asserted a subjective test requiring actual awareness of risks in cases of criminal damage."[962]

For the purposes of this part of ATCSA, a subjective test would be applied, which means that, in order for an offence to have been carried out, the person carrying out the disclosure must have been aware themselves that such a disclosure "might prejudice the security of any nuclear site or any nuclear material."[963]

Section 80 concerned the possible future introduction (through delegated legislation)

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953 See, for example, JCHR, 2004, Eighteenth Report of the Parliamentary Joint Committee on Human Rights, London: HMSO; Crossman, G., 2005, Liberty's Response to the Constitutional Affairs Committee call for evidence on the Special Immigration Appeals Commission, London: Liberty
954 Section 76(5) Anti Terrorism Crime and Security Act 2001
955 HMIC, 2003, 2002/2003 Inspection: UK Atomic Energy Authority Constabulary, London: Her Majesty's Inspectorate of Constabulary
956 Section 79(1) Anti Terrorism Crime and Security Act 2001
957 Section 79(3) Anti Terrorism Crime and Security Act 2001
958 Section 79(1) Anti Terrorism Crime and Security Act 2001
959 Metropolitan Police Commissioner v Caldwell [1982] AC 341
960 Murphy, P & Stockdale, E., 2005, Blackstone's Criminal Practice 2005, Oxford: Oxford University Press, p20
961 R v G [2004] 1 AC 1034
962 Murphy, P & Stockdale, E., 2005, op cit., n974, p21
963 Section 79(1) Anti Terrorism Crime and Security Act 2001

of an offence of disclosing information about, or relating to, the enrichment of uranium.[964] The Act provided that the regulations would impose the same level of punishment as was created under section 79. No Regulations were passed for almost three years, until the passage of the Uranium Enrichment Technology (Prohibition on Disclosure) Regulations 2004.[965] These Regulations gave power to the offence created under Section 80(3) of the Act which, as with the offence under Section 79, carried a maximum prison term of seven years.

The rationale behind the introduction of the 2004 Regulations was that the enrichment of uranium is essential for both nuclear power and nuclear weapons. Naturally occurring uranium contains only about 0.7% by mass of U^{235}, the fissile isotope needed to generate a reaction and so needs to be *enriched* before it is of use.[966] Uranium used in power stations is generally enriched to between three and five per cent U-235[967] but, as the same processes can be used to enrich uranium sufficiently for use in weapons,[968] it is important to keep the technology under control. This is the same rationale that used above, in relation to the Nuclear Safeguards Act 2000.

Maintaining security of "sensitive nuclear information"[969] was not simply a question of preventing its disclosure by Inspectors or others who came across the knowledge, however. Anyone with sensitive nuclear information were required to:

> "maintain such security standards, procedures and arrangements as are necessary for the purpose of minimising the risk of loss, theft or unauthorised disclosure"[970]

There was no criminal sanction imposed for failure to comply with these regulations, however, which potentially weakens their impact. This means that the security regime surrounding this highly sensitive information is in two layers.

In terms of external security threats, the UK Government revisited the issue of possible terrorist attacks on nuclear facilities shortly after ATCSA had been passed. In July 2002, in conjunction with its report into UK security,[971] the House of Commons Defence Select Committee invited the Parliamentary Office for Science and Technology (POST) to investigate:

> "the physical robustness of nuclear installations against such [terrorist] attacks as well as the potential consequences in terms of the amounts of radioactive material liable to be released and its effects."[972]

In the early 1970s, Professor Hunt, Dean of the Faculty of Science at Aston University, had written, somewhat prophetically:

> "the crashing of an aircraft on a reactor building, simultaneously with two other only slightly less unlikely fault conditions, were combined to constitute a "maximum credible accident" against which a reactor had to be safe."[973]

He carried on to say that the entire range of reactor buildings tested passed

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964 Section 81(1)(a) and (b) Anti Terrorism Crime and Security Act 2001
965 The Uranium Enrichment Technology (Prohibition on Disclosure) Regulations 2004 (SI 2004/1818)
966 Settle, F., 2003, Nuclear Chemistry: Uranium Enrichment, Kennesaw State University, Kennesaw, GA. Available at http://www.chemcases.com/2003version/nuclear/nc-07.htm, accessed on 22/03/10
967 Ramsay, C., & Modarres, M., 1998, Commercial Nuclear Power: Assuring Safety for the Future, London: John Wiley, p25
968 Settle, F., 2003, op. cit, n992. Weapons-quality, or Highly Enriched Uranium (HEU) is enriched to around 90 per cent U-235. There are several methods which can be employed for uranium enrichment, and all can be used equally well for reactor- and weapons-grade uranium. Source: WNA, 2010, Uranium Enrichment Factsheet, London: World Nuclear Association.
969 Regulation 22, The Nuclear Industries Security Regulations 2003 (SI 2003/403)
970 Regulation 22(3)(a) The Nuclear Industries Security Regulations 2003
971 DSC, 2002, Defence and Security in the UK, 6th Report of the House of Commons Defence Select Committee, July 2002, London: HMSO
972 POST, 2004, op cit, n906, p1
973 Hunt, S. E., 1974, Fission, Fusion and the Energy Crisis, Oxford: Pergamom Press,. p58.

satisfactorily and that there was no major risk. The 148-page POST report, published in July 2004, was a comprehensive analysis of both the actual and perceived safety of all nuclear activities (power stations, research reactors, military sites and waste transportation) in the UK. There are several key points that the report makes, including:

> Ways terrorists might bring about a release of radioactive material from a nuclear facility are known, but not the likelihood of success attack, or the size and nature of any release.
>
> 9/11 led to increased security and strengthened emergency planning at and around nuclear facilities.
>
> Nuclear power plants were not designed to withstand some forms of terrorist attack, such as large aircraft impact, but existing safety and security regimes provide some defence. A worst-case scenario would release radioactive material (i.e., *not* cause meltdown).
>
> Large numbers of instant fatalities are unlikely, but long-term deaths along with social and economic repercussions are likely.[974]

This is rather inconclusive and repeats, mantra-like, the caveat that more research still needed to be undertaken. What the POST report does do, however, is contradict the earlier report by Professor Hunt, even though the reactors being used in 2004 were little changed from those being used in the mid-1970s.[975]

At time the Act was introduced, the regular poll into "the most important issue facing Britain today" by IPSOS MORI showed that the proportion of people who believed that the answer was the broad category of "nuclear" rose tenfold from less than 0.5 per cent in August 2001 to four per cent in September 2001.[976] Whilst these levels were still very low, compared to the numbers ranking "defence" as the most important issue,[977] non-committal reports such as the POST Report would do little to allay any concerns. In a House of Lords debate on International Terrorism which followed two days after the 9/11 attacks, Lord Brennan spoke of the possibility of "an aircraft hitting a nuclear reactor",[978] and continued that "This form of terrorism will happen again unless we fight to stop it."[979] As important as a Lords' debate might be, the readership of Hansard is quite limited. Of more dramatic impact was the fact that the media too had picked up on the "appalling"[980] possibility of an attack against a nuclear facility.[981] This illustrates that the scientific data, some of which suggested there was a slightly increased risk, and others of which suggested there was not, was inconclusive. Despite this, politicians and the media alike presented the negative data as if it were incontrovertible proof.

The ATCSA was rushed through Parliament in a matter of weeks after the 9/11 attacks in the United States, although it is safe to say that many of the provisions of the Act had already been contemplated by the government.[982] Liberal Democrat peer Lord Phillips of Sudbury, said, during the debate on the Anti-Terrorism Crime and Security Bill that:

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[974] Ibid, pi.
[975] Ibid.
[976] IPSOS MORI. Nuclear rose to a peak of 11 per cent in February 2003 due to the escalation of the military operations in Afghanistan and Iraq.
[977] IPSOS MORI. The most important issue in both months was "Defence" which rated 60 per cent and 57 per cent.
[978] Brennan, Lord, 2001, International Terrorism, HL Deb 14 September 2001 vol 627 c42
[979] Ibid.
[980] Ibid.
[981] See, for example, Highfield, R., 2001, Security plea for Britain's atom sites, the Telegraph, 22 September 2001; BBC, 2001, 'Sellafield Time Bomb' Warning, London: BBC News, available at http://news.bbc.co.uk/1/hi/uk_politics/1615478.stm, accessed on 05/01/10; Guardian, 2001, Stupidity of Nuclear Shipments to Japan, The Guardian, 4 October 2001.
[982] Some of the Disclosure of Information provisions of ATCSA, for example had been "introduced in (and subsequently removed from" the Criminal justice and Police Bill in 2000. Source: Wood, E., 2002, The Anti-terrorism, Crime and Security Act 2001: Disclosure of Information, House of Commons Research Paper 02/54. London: HMSO

> "one of the many bones of contention across the House is that a Bill which is rushed through this House in order to deal with an emergency terrorist situation is being used for much wider purposes."[983]

As a comparison, the Human Rights Bill was introduced to Parliament in November 1997, and received Royal Assent a year later in November 1998, having been debated extensively by both Houses. The Anti-Terrorism Crime and Security Bill, on the other hand, which many have argued is a much more far-reaching piece of statute, was introduced to Parliament on 19 November 2001 and received Royal Assent on 13 December 2001, a mere twenty-four days later. The accusation that has been levelled against ATCSA since its passage is that it was ill-thought out,[984] hastily rushed[985] and, therefore, flawed.[986]

The criticism of the government in relation to the ATCSA (and its replacements) was in start contrast to the support that the government got in February 2003, however, when an energy White Paper was published which, to many, seemed to suggest that nuclear was off the agenda. Less than three months later, more statute was enacted to extend state support for the privatised nuclear companies. This gave more credence to both British Energy's argument in 1995, and the Labour Party manifesto argument from 1997 (both discussed above) that there was no sound economic basis on which a revival of nuclear power would make sense.

5.2.5: Our Energy Future: A White Paper on Energy 2003:

On 24 February 2003, the Department of Trade and Industry, in association with the Department for Transport and the Department of the Environment, Food and Rural Affairs published the 2003 Energy White Paper, 'Our Energy Future: Creating a Low Carbon Economy'. This White Paper, according to the Foreword by the Prime Minister, gave a new direction for, and was a milestone in, energy policy, as it:

> "sets out a strategy for the long term, to give industry the confidence to invest to help us deliver our goals - a truly sustainable energy policy."[987]

Other than its task in setting out the direction in which the government wished to travel to attain a low-carbon economy as a way of meeting the targets for carbon dioxide reduction set by the Kyoto Protocol – and thus the environment in which existing nuclear-power industry would have to operate – the 2003 White Paper is chiefly remembered for its reference to the potential for new nuclear-power stations:

> "Its current economics make it an unattractive option for new, carbon-free generating capacity."[988]

> "we conclude it is right to concentrate our efforts on energy efficiency and renewables. We do not, therefore, propose to support new nuclear build now."[989]

> "Before any decision to proceed with the building of nuclear power stations, there would need to be the *fullest public consultation* and the publication of a White Paper setting out the Government's proposals."[990]

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[983] Phillips of Sudbury, Lord, 2001, Anti-Terrorism, Crime and Security Bill, HL Deb 27 November 2001, col 629 c247

[984] Mythen, G., & Walklate, S., 2006, Criminology and Terrorism: Which Thesis? Risk Society or Governmentality? The British Journal of Criminology 46(3):379-398

[985] IHRC, 2004, Briefing: Anti-Terrorism, Crime and Security Act 2001, London: Islamic Human Rights Commission.

[986] Fenwick, H., 2002, The Anti-Terrorism, Crime and Security Act 2001: A Proportionate Response to 11 September? The Modern Law Review, Vol. 65, No. 5, pp. 724-762

[987] DTI, 2003, op cit, n822, p3

[988] DTI, 2003, op cit, n822 p12, at para 1.24

[989] DTI, 2003, op cit, n822, p44.

[990] DTI, 2003, op cit, n822, p61 at para. 4.68. The original was in bold in the White Paper, but the italics are mine, as these words would later cause the government severe problems.

This attitude was taken by many observers at the time[991] to signal that the "new nuclear" option was off the agenda for the foreseeable future and would preferably never form part of the energy mix in a low-carbon economy. As was suggested at the beginning of this chapter, however, the environmental lobby was far from united on the issue of whether or not it felt that "new nuclear" should, in fact, be utilised. Professor Lovelock, for example, the eminent environmentalist and author of the Gaia hypothesis, believes nuclear power to be the only viable source of power if we are to ameliorate the enhanced greenhouse effect partly caused by human reliance on fossil fuels. Whilst not necessarily an ardent supporter of nuclear power, Lovelock sees it as the "least worst" option. In a combination of an interview with *The Independent* newspaper and a book preface, both of which were in 2004, Lovelock argues not only that nuclear power is safe but, further, that it is the only sensible option available:

> "Opposition to nuclear energy is based on irrational fear fed by Hollywood-style fiction, the Green lobbies and the media. These fears are unjustified, and nuclear energy from its start in 1952 has proved to be the safest of all energy sources."[992]
>
> "I hope that it is not too late for the world to emulate France and make nuclear power our principal source of energy. There is at present no other safe, practical and economic substitute for the dangerous practice of burning carbon fuels."[993]

This is not the first time Lovelock has used this argument. In 2001, he wrote that "our fear of all things nuclear has that same quality as our forefathers' fear of hell" and argued for the reintroduction of a nuclear programme. Lovelock is not typical of the environmental movement, however, and some have rather mischievously suggested that he is a publicity hound – with respect to the *Independent* interview, May says "one result… was that Lovelock gained a great deal of publicity in the run-up to the publication of his new book."[994] Whatever his rationale, Lovelock's views were echoed by figures from the Department of Trade and Industry, which stated that:

> "In the absence of nuclear generation, emissions of carbon dioxide in 1999 would have been 12-24 million tonnes higher, depending on the mix of generation used to replace it."[995]

This disagreement is nothing new, of course. In 1980, the pro-nuclear astronomer and scientist Fred (later Sir Fred) Hoyle and his son, Geoffrey Hoyle, published their Commonsense in Nuclear Energy,[996] in which they similarly argue for heavy reliance on nuclear energy. Writing not long after the energy crisis of the late 1970s, nuclear power was, they said, the only practicable way to avoid a further energy shortage which itself "seems a sure prescription for nuclear war."[997]

As these three examples show, proponents of the nuclear option (new and old) had well-rehearsed arguments about the problems of the enhanced greenhouse effect and global warming and pointed to nuclear as the only viable carbon-friendly power source. This claim was refuted by many on the basis that, although the actual production of electricity from nuclear power does not *produce* any carbon dioxide:

> "The nuclear fuel cycle does release carbon dioxide during mining, fuel enrichment and plant construction. Uranium mining is one of the most carbon-intensive industrial operations and as demand for uranium grows carbon dioxide

[991] See, for example Morrow, K., On winning the battle but losing the war, Env. L. Rev. 2008, 10(1), 65-71; Newbery, M., & Pollock S., 2008, Rebirth of Nuclear Power in the UK, I.E.L.R. 2008, 3, 66-73
[992] McCarthy, M., 2004, Nuclear Power is the only Green Solution, The Independent, 24 May 2004.
[993] Lovelock, J., 2004, op cit, n6
[994] May, J., 2006, James Lovelock: Deep Nuclear, The Big Issue Alternative Energy Review, Issue 701, p10.
[995] NID, 2008, Nuclear Power Generation Development, London: Nuclear Industries Directorate
[996] Hoyle, F., & Hoyle, G., 1980, Commonsense in Nuclear Energy, London: Heinemann Educational Books.
[997] Ibid., pvii

emissions are expected to rise as ore grades decline."[998]

Despite this statement, and the scientific evidence which was put forward to support it, the total carbon production for a nuclear-power station has been calculated at "an average value of 4.4tC/GWh[999], compared to 243tC/GWh for coal and 97tC/GWh for gas"[1000] which means that, over its lifetime, a nuclear-power station produces over twenty times less carbon than the equivalent gas-fired power station, and fifty times less than the coal-fired equivalent. Since the climate change, and by extension, carbon emission argument is one part of the rationale for the reintroduction of nuclear power, this helps to strengthen the government's case. It does, however, base itself on the presupposition of a unified scientific understanding which, as we have seen, has been symptomatic of decisions in this area since the 1940s.

The cost justification for not going down the nuclear route is an interesting one. The Royal Academy of Engineering (RAE) produced a report a few months after the 2003 White Paper in which it found that a nuclear-fission plant produced electricity at a cost of 2.3p per kWh, making it the second-cheapest method of electricity generation behind CCGT (Combined-Cycle Gas Turbine) plants which were assessed as 2.2p per kWh.[1001] This seems to give the lie to the official justification for ruling out nuclear power given in the White Paper. However, initial costing estimates are just that, estimates, and so they rarely prove to be entirely accurate – as will be show below, the Parliamentary Office of Science and Technology's initial estimate in 2003 for the cost of decommissioning had to be increased by 45 per cent within two years.[1002] The RAE report also takes into account just the cost of electricity production, rather then the lifecycle cost of the power plant, and makes no distinction between the different types of reactor which are in operation.

The reports by Lovelock, Hoyle *père et fils*, Greenpeace and the Royal Academy of Engineering are all accessible online with relative ease. This ready access to information can be combined with the Freedom of Information Act 2000, section 1 of which gives a general right of access to information held by public authorities. Whilst none of the examples cited above are public authorities, the two approaches mean that the public's access to previously unavailable data and ability to question decisions has increased greatly. As with all statute, this general provision is tempered by various exceptions under Part II of the Act. There are several categories of exception, but the main ones concern information on security matters,[1003] issues of national importance,[1004] those which would compromise ongoing legal cases[1005] and those which were readily accessibly already.[1006] In environmental terms, which broadly categorises many of the issues relating to the nuclear debate, the Environmental Information Regulations 1992[1007] predated the Freedom of Information Act, but gave access to a similar range of bodies, but in respect of a far smaller range of information.[1008] The bodies, set out in Clause 2(3) included:

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[998] FOE, 1998, Nuclear Power is no solution to Climate Change: Exposing the Myths, London: Friends of the Earth, p20.
[999] Tons of Carbon produced per gigawatt of electricity produced
[1000] SDC, 2006, The role of Nuclear Power in a Low Carbon Economy, London: Sustainable Development Commission, p5.
[1001] RAE, 2004, The Cost of Generating Electricity, London: Royal Academy of Engineering, p8. The equivalent figure for coal-fired plants varied between 2.5p and 3.2p per kWh, depending on the type of plant. The figures for renewable sources ranged from 3.7p per kWh for an offshore wind farm to 6.8p per kWh for the delightful image of a "poultry-litter-fired bubbling fluidized bed steam plant."
[1002] The revised estimate was £72bn. Source: NDA, 2006, Press Release: Approved Strategy for Clean-up of UK's Nuclear Sites Published, Moor Row: Nuclear Decommissioning Authority Communications Department, p2
[1003] Sections 23-26 Freedom of Information Act 2000
[1004] Sections 27 (International Relations), 28 (Internal Relations) and 29 (the Economy) Freedom of Information Act 2000
[1005] Sections 30-31 Freedom of Information Act 2000
[1006] Section 22 Freedom of Information Act 2000
[1007] The Environmental Information Regulations 1992 (SI 1992/3240)
[1008] For a discussion of the relationship between the 1992 Regulations and the 2000 Act, see: McCreath, D., Freedom of environmental information (2005) 16 4 Cons.Law 17; and Davis, R., 2006, The Environmental Information Regulations 2004: Limiting exceptions, widening definitions and Increasing Access to Information? Enviro LR 8 1 (51)

> "all such Ministers of the Crown, Government departments, local authorities and other persons carrying out functions of public administration at a national, regional or local level as, for the purposes of or in connection with their functions, have responsibilities in relation to the environment"

It is the limitation in the final sentence which restricts these regulations to environment-related information. These were supplemented by the Environmental Information Regulations 2004,[1009] which gave effect both to the 2000 Act and the Århus/Aarhus Convention.[1010] The Convention, which came into force in 2001, will be discussed later.

The 2003 White Paper, with its apparent abandonment of nuclear power as a future option, was not following the figures produced by the DTI or the SDC and thus, helps to illustrate the point that while politicians will sometimes be very keep to use scientific language to justify a decision, they are equally prepared to ignore it. However, as was revealed in 2005, what many *thought* the White Paper said and what it *actually* said were not the same thing at all. This will be dealt with in section 5.3.

It is important to point out that the White Paper is not legally binding in any way and is more of a statement of principles that sets out firm decisions prior to the publication of a Bill.[1011] However, whilst the 2003 White Paper may (or may not) have signalled a level of governmental disapproval of the new nuclear option, the Electricity (Miscellaneous Provisions) Act 2003, which received Royal Assent on 8 May 2003, certainly supported the existing nuclear industry.

5.2.6: Electricity (Miscellaneous Provisions) Act 2003

In July 1996, British Energy (BE) had been floated on the London Stock Exchange as a public company and, at the time, the President of the Board of Trade, Ian Lang MP, had assured the House that "British Energy will be responsible for meeting all its liabilities."[1012] Despite this assurance, BE had always been heavily reliant on government funding in order to be competitive:

> "BE approached the Government in early September 2002 seeking immediate financial support and discussions about longer term restructuring. Government provided BE with a short-term credit facility of up to £650m rescue aid."[1013]

The Electricity (Miscellaneous Provisions) Act 2003 increased the ability of the Crown to cover nuclear liabilities incurred by BE, by removing the reference in paragraph 1 of Schedule 12 of the Electricity Act 1989 to paragraph 4 of the same schedule. This seemingly minor change had quite a large effect. Prior to the 2003 Act, any monies raised by loans or grants to BE would have been paid out of the Consolidated Fund. Equally, any repayments by BE would have been paid into the Consolidated Fund. After the passage of the 2003 Act, the first part of the equation remained unchanged: loans and grants would still be made out of the Consolidated Fund. The requirement that "any sums received… by the Secretary of State shall be paid into the Consolidated Fund"[1014] was removed, however, meaning that there appeared to be no requirement for BE to repay any of the money. By not having to repay money loaned or granted to it into the Consolidated Fund, it meant that British Energy's financial position could only get stronger. In the FY2002/3, British Energy made a £4.2bn loss before tax, whereas the following year after the company made a profit of £232m.[1015]

[1009] The Environmental Information Regulations 2004 (SI 2004/3391)
[1010] 1998 UN/ECE Århus / Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.
[1011] de Smith, S., & Brazier, R., 1999, op cit, n173, p273.
[1012] Lang, I., 1996, British Energy, HC Deb 22 May 1996 vol 278 c269W
[1013] DBIS, 2009, British Energy (BE), London: Department for Business, Innovation and Skills.
[1014] Paragraph 4, Schedule 12, Electricity Act 1989
[1015] BE, 2006, Summary of results for the last 5 years, Livingston: British Energy Group plc

The 2003 Act also removed the limits for nuclear-liability payments, which had been set up by earlier statute. Once the cap in respect of BE had been removed, the Government was recognised as having ultimate liability for costs relating to nuclear safety. The Minister of State for Energy, Brian Wilson MP, agreed, when he introduced the Bill to Parliament, that this was the case and justified it, saying:

> "If the company could not afford its liabilities and were to fail, the Government therefore would have to step in to ensure that they were dealt with properly."[1016]

The company was restructured (again) in early 2005[1017] and again in 2009, when a controlling stake was purchased by the French-owned EDF Energy.[1018] In addition to this removal of the requirement to repay Consolidated Fund money, British Energy Group has had access to the Nuclear Decommissioning Fund (NDF) which:

> "was set up specifically as a means of funding the decommissioning of BE's nuclear stations once they have ceased generating electricity."[1019]

The NDF has since been replaced by a Nuclear Liabilities Fund (NLF), which is administered by the Nuclear Decommissioning Authority (below). The effect of this was to create an uneven playing field: BE is a privatised company, operating in a sector driven by competitive market forces, yet it does not have to take into account the full costs of the electricity it produces. Non-nuclear competitors, on the other hand, must compete on the open market without any government subsidy. This situation was by no means unique, however, as the privatisation and break-up of British Rail and British Coal into a ream of smaller companies in the mid-1990s, and their subsequent support, followed much the same pattern. What it does do, however is skew the financial position of energy generation in favour of nuclear.

5.2.7: Energy Act 2004[1020]

The Energy Act was primarily intended to give effect to the policies outlined in the 2003 White Paper, discussed earlier. As it was a wide-ranging White Paper, it is of little surprise that the Energy Act is a vast piece of legislation, which runs to 198 sections and 23 schedules. In fact, the Act incorporated two draft Bills which were presented before Parliament in 2003; the Electricity (Trading & Transmission) Bill, which aimed to create a single electricity market,[1021] and the Nuclear Sites & Radioactive Substances Bill, in which the idea of a Nuclear Decommissioning Agency had originally been floated.[1022]

The Act created two new statutory bodies: the Nuclear Decommissioning Authority (NDA) which, *inter alia*, administers the Nuclear Liability fund discussed above; and the Civil Nuclear Police Authority (CNPA), the prime function of which was to oversee a new subsidiary body, the Civil Nuclear Constabulary (CNC).[1023]

The Nuclear Decommissioning Authority

The business of decommissioning the UK's ageing nuclear reactors is a long-term and potentially highly lucrative one; "expected to be worth at least £50 billion in this

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[1016] Wilson, B., 2003a, Electricity (Miscellaneous Provisions) Bill, HC Deb 27 January 2003 vol 398 c587
[1017] BE, 2005, Report and Accounts for the year ended 31 March 2005, Livingston: British Energy Group plc, p28
[1018] BE, 2009, Combined company will build 'on unrivalled experience of EDF and British Energy', Press Release, 9 January 2009, Livingston: British Energy.
[1019] Sainsbury of Turville, Lord, 2003, Nuclear Decommissioning Agency and Nuclear Liabilities Fund, HL Deb 01 May 2003 vol 647 c123WA
[1020] For in-depth assessment of this Act see Hills, S., Griffiths, J., & Costello, C., Legislative Comment: The UK Energy Act 2004 – changes blowing in the wind? I.E.L.T.R. 204, 5, 124-127
[1021] Wilson, B., 2003b, Electricity (Trading and Transmission) Bill, HC Deb 30 January 2003 vol 398 c49WS
[1022] Hewitt, P., 2004, Energy Bill, HC Deb 10 May 2004 vol 421 c43
[1023] CNPA created by s51(1) EA 2004. Duty to "secure the maintenance of an efficient and effective constabulary, to be known as the Civil Nuclear Constabulary" in s52(1) EA 2004

century"[1024] and the Nuclear Decommissioning Agency (NDA) was set up by Section 4 of the Energy Act 2004 as a non-departmental public body (on much the same basis as the UKAEA had originally been set up in the 1950s).[1025] The purpose of the NDA was to oversee the long-term decommissioning of the UK's ageing nuclear-power stations, and the associated waste disposal issues which this entails. The NDA was created in July 2004[1026] but, for practical purposes, was not set up until April 2005.[1027] The NDA took over the responsibility for decommissioning nuclear sites from BNFL and the UKAEA and will work with both of these organisations to achieve its aims. This means that another level of organisation has been added to the already complex structure dealing with the UK's nuclear legacy.

Within a year of being set up, the £50 billion figure had been revised upwards by the NDA, which announced in March 2006 that it wanted to "put out to tender £72bn worth of clean-up and decommissioning contracts over the next 75 years."[1028] The companies tendering for the contracts are all expected to come from the private sector, which provides a nice synchronicity, as it was private companies that benefitted from the creation of the stations in the first place. To put this enormous figure into some sort of perspective, the 1955 White Paper *A Programme of Nuclear Power*[1029] estimated that would cost around £300m to provide 1500-2000MW of nuclear-generating capacity, a figure which equates to approaching £6bn at 2009 prices.[1030] This means that the costs associated with decommissioning the UK's nuclear power stations are going to amount to more than fourteen times the costs of constructing them. Ironically, as has been shown in previous chapters, the 1955 White Paper made no mention of decommissioning costs whatsoever, and there is no suggestion that even the scientists advising the government had reason to suspect that such costs might one day become contentious.

The Civil Nuclear Police Authority and Civil Nuclear Constabulary

The idea of creating a "standalone force independent of the nuclear industry" to police nuclear-power stations had been raised in July 2002 in the DTI's Report 'Managing the Nuclear Legacy: A strategy for action'.[1031] The Report outlined the creation of such a force as being the logical next step in a process which had started with the transfer of the Office for Civil Nuclear Security from the UKAEA to the DTI in 2000.[1032] Following a period of consultation, the idea was eventually carried forward into the Energy Bill and then the Energy Act 2004.

The parts of the 2004 Act which dealt with the CNC, came into force on 1 March 2005[1033] and the CNC itself started operating on 1 April 2005. As with the "traditional" Police Authorities (of which there are 43 in England and Wales, as well as the British Transport Police Authority and Northern Ireland Policing Board[1034]), the CNPA is represented by the lobbying group, the Association of Police Authorities. However, this is where the similarities end. Normal Police Authorities represent the Constabulary for a particular region – the Northamptonshire Police Authority, for example, is responsible for the Northamptonshire Constabulary. The Police Authority also decides the budget, appoints the Chief Constable and generally "sets the strategic direction for the force."[1035] However, the CNC, despite being a subsidiary body to the CNPA, is under the "strategic

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[1024] POST, 2003, Postnote 208: The Nuclear energy option in the UK, London: Parliamentary Office of Science and Technology/ HMSO
[1025] Section 1(2) Energy Act 2004
[1026] The Energy Act 2004 (Commencement No. 1) Order 2004 (SI 2004/1973)
[1027] NDA, 2005, About the NDA: Purpose, London: Nuclear Decommissioning Authority.
[1028] NDA, 2006, op cit, n1027.
[1029] Lord President of the Council, 1955, op cit, 124
[1030] ONS, 2010, op cit, n709
[1031] DTI, 2002, Managing the Nuclear Legacy: A strategy for action (Cmnd 5552), London: Department of Trade and Industry.
[1032] DTI, 2002, op cit, n1956, p67 at para 8.4
[1033] Schedule 1 of The Energy Act 2004 (Commencement No. 4) Order 2005 (SI 2005/442)
[1034] APA, 2005, About Police Authorities: What is a Police Authority? London: Association of Police Authorities. Available at http://www.apa.police.uk/APA/About+Police+Authorities/, accessed on 22/03/10
[1035] Ibid.

direction of the Department of Trade and Industry."[1036] This is despite the view being aired quite strongly in the House of Lords debate on the Bill that:

> "it would be more appropriate for the Secretary of State concerned to be the Home Secretary who is accountable to Parliament for the vast majority of police forces in the UK."[1037]

The effect that this has is to place the CNC under the guidance of non-elected (and therefore, the Civil Service would argue, above politics)[1038] civil servants and, ultimately, the Secretary of State for Trade and Industry, whereas other police forces are guided by an independent, local and accountable body, comprising local councillors, magistrates and independent members[1039] and under the ultimate authority of the Home Secretary. Another important difference about the CNC, which reiterates the seriousness with which security is being taken in the post-9/11 environment, is that it does not recruit officers directly from the public. All CNC Officers are recruited from among the Authorised Firearms Officers of the Police Force,[1040] which makes the entire force an elite one. The CNC, which operates across seventeen fixed sites in the UK, has a remit to:

> "defend and protect those sites to which it is deployed, with a view to denying unauthorised access to nuclear material and, if necessary, recover control of any nuclear material which may have been lost to any unauthorised persons."[1041]

It is also independent of the UKAEA, which helps to ensure that the potential for a conflict of interests cannot arise. The remit of the UKAEA Constabulary, on the other hand, was narrower, both in terms of what it was required to do and the number of sites on which it had to do it. The 2004/5 Annual Report, which was the final report before the metamorphosis into the CNC, listed eight sites where it operated. Their role was set out as being to:

> "deliver an effective and efficient Police Service complying with National Security requirements for the protection of special nuclear materials on designated UK nuclear licensed sites and in transit, and to provide a secure and safe environment in which the nuclear industry can carry out its business."[1042]

The 2004 Act, therefore, created two new bodies which had responsibility for different aspects of a nuclear industry which at the time was widely believed to be in decline, yet which was at the same time under a higher level of threat from terrorism than at any time in the past. Both of these bodies were more about managing the existing structure and were tailored to fit what had already been created. The rationale for both was similar, and unavoidable; a reactive pragmatic way of updating the infrastructure to take into account new threats and opportunities. In the case of the CNC, it was to create a new body to replace the UKAEA Constabulary, which had operated with a far narrower remit; and in the case of the NDA it was to create a new market, and then create a new organisation to take advantage of it.[1043]

Having considered the key relevant moments between 1995 and 2005, we must now turn to consider the announcement which lies at the core of this whole chapter.

[1036] CNC, 2005a, Welcome to the CNC, Culham: Civil Nuclear Constabulary
[1037] Anelay, Baroness, 2004, Energy Bill, HL Deb 22 March 2004 vol 659 c533
[1038] Impartiality ("acting solely according to the merits of the case and serving governments of different political parties equally well") is one of the four core values of the Civil Service. Source: Civil Service, 2006, Civil Service Values, London: HMSO, p1
[1039] Most police authorities have 17 members: 9 local councillors appointed by the local council; 5 independent members selected following local advertisements; and 3 magistrates from the local area. Source: APA, 2005, op. cit, n1059.
[1040] CNC, 2005b, Recruitment, Culham: Civil Nuclear Constabulary
[1041] CNC, 2009, Civil Nuclear Constabulary Mission Statement, Culham: Civil Nuclear Constabulary.
[1042] UKAEAC, 2005, Chief Constable's Annual Report 2004/5, Culham: UKAEA Constabulary, p5
[1043] Davies, Lord, 2004, Energy Bill, HL Deb 22 March 2004 vol 659 cc491

5.3: The CBI Speech, November 2005

In May 2005, an ICM Poll carried out for the BBC *Newsnight* programme showed that only 21 per cent of respondents believed that nuclear-power stations were the "most feasible way of meeting the UK's energy needs while reducing carbon dioxide emissions."[1044] The poll also showed that 52 per cent of respondents did not think it was right "for the government to consider nuclear power as an energy source for the future,"[1045] compared to 39 per cent who thought it was.[1046]

A MORI poll for the Nuclear Industry Association[1047] in early November 2005 showed that 33 per cent of the public had a "very/mainly favourable" opinion of the nuclear energy industry, whereas only 27 per cent had a "very/mainly unfavourable" opinion. This was the largest margin in that poll for "favourable" for at least seven years.[1048] Equally, 59 per cent believed that nuclear energy would be a major contributor to energy supplies in the future – despite the fact that only a small percentage of Britain's current energy demand is currently met through nuclear power and this figure is going to fall as the decommissioning process continues.[1049] A second MORI poll later in the same month, carried out for the University of East Anglia's Centre for Environmental Risk[1050] revealed that "62 per cent said it doesn't matter what the public think of nuclear power as nuclear power stations will be built anyway."[1051] It is interesting to note that it is not just the UK where public opinion regarding nuclear power is rather fickle (or possibly pragmatic):

> "In Finland and Sweden and Switzerland, as soon as electricity prices started rising like a rocket, people started supporting nuclear power because it is by far the cheapest. The same will happen here before long."[1052]

However, when using date from IPSOS MORI and other polling organisations, McNeill and Chapman's criticisms of surveys must be borne in mind. They argue that conclusions from surveys should not be embraced too enthusiastically, as:

> "the survey method finds out what people will say when they are being interviewed or filling out a questionnaire. This may not be the same thing as what they actually think or do"[1053]

Against a background of a nuclear-power programme which had not seen a new power station commissioned for nearly twenty years, a White Paper which called nuclear power "an unattractive option" [1054] and a general public which was 52 per cent opposed to the building of new nuclear-power stations, (but 62 per cent resigned to the fact they would be built anyway), the Prime Minister gave the CBI speech in which he announced a new review of how well the 2003 White Paper goals had been achieved and said that the review would:

> "include specifically the issue of whether we facilitate the development of a new generation of nuclear power stations."[1055]

Despite the fact that the speech did not say categorically that nuclear-power stations

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[1044] ICM, 2005, Nuclear Power Survey: May 2005, London: ICM Research, Question 1.
[1045] Ibid., Question 2.
[1046] Ibid.
[1047] MORI, 2005a, Attitudes to nuclear energy: November 2005, London: MORI. All of the remaining polling statistics in this paragraph are taken from this report unless otherwise stated.
[1048] Ibid.
[1049] In 2006-7, nuclear power contributed about 18 per cent of the UK's total electricity generation. Source: UIC, 2007, World Nuclear Power Reactors 2006-7 and Uranium Requirements 2008, Melbourne: Uranium Information Centre.
[1050] MORI, 2005b, Attitudes Towards Nuclear Energy and Climate Change, London: MORI.
[1051] Ibid.
[1052] Lovelock, J., 2005, Interview by the Creel Commission, August 2005. Available at http://www.creelcommission.com/interviews.php, accessed on 11/09/07.
[1053] McNeill, P., & Chapman, S., 2005, op cit, n104, p47
[1054] DTI, 2003, op cit., n820, p12, at para 1.24
[1055] Blair, T., 2005, op cit, n1

would be built (any more than the 2003 White Paper had said that they would not), there was a delay when two Greenpeace protestors climbed into the roof of the conference centre to protest at nuclear even being considered as a future option.[1056] Since the MORI poll (above) suggested that most people did not think it right for government to consider new nuclear power, the announcement cannot be regarded as a populist move and it does not even seem to fit with the government's own rhetoric of just eighteen months earlier. Instead, it was more of a reaction to perceived changes in the stability of global energy supplies and prices.[1057] From February 2003, when the earlier White Paper was published, to the time of the CBI speech, crude oil prices had risen by almost two thirds from around $30 a barrel to around $50 a barrel[1058] so the underlying economic premise was no longer accurate.

In the United States, a few weeks after the Prime Minister's announcement, President George W Bush introduced the idea, if not the phrase, of nuclear new build in his State of the Union address of January 2006, saying that "America is addicted to oil, which is often imported from unstable parts of the world",[1059] and that the new Advanced Energy Initiative would be looking at new nuclear as one way "to replace more than 75 percent of… oil imports from the Middle East by 2025."[1060] In other words, support for nuclear may be seen as a way of supporting a reduced reliance on oil from the Middle East. The background to this announcement was a public which appeared to be much more strongly in favour of new nuclear power, with 62 per cent of respondents in a series of polls by Washington-based Bisconti Research[1061] agreeing with the idea of "definitely building more nuclear power plants" and only 32 per cent disagreeing.[1062] In December 2007, the figures for favouring the use of nuclear power as part of the energy mix in the United States were 64 per cent, with 30 per cent opposing the idea.[1063]

The CBI speech, therefore, marks the tentative beginnings of the revival of nuclear power in the UK and, perhaps, the first inkling that the previous two decades of decline were coming to an end. The 2003 White Paper had promised that no new nuclear build would take place without "the fullest public consultation"[1064] and this duly took place in the early part of 2006.

5.3.1: The First Consultation and the Results

The current policy of reviving nuclear power was brought in after the government decided that the nuclear option was the only sensible way to reduce the UK's carbon emissions in line with the Kyoto Protocol targets. Unlike the original post-war policy, this change was supposed to have been carried out "[a]fter a period of public consultation and analysis"[1065] had led to the conclusion that:

[1056] BBC, 2005, Nuclear protest hits Blair Speech, London: BBC News. Available at http://news.bbc.co.uk/1/hi/uk_politics/4478946.stm, accessed on 30/07/09.
[1057] Blair, T., 2005, op cit, n1
[1058] WTRG, 2009, op cit, n682
[1059] Bush, G. W., 2006, State of the Union 2006 Speech given by President George W Bush at the United States Capitol, Washington DC, 31 January 2006. Transcript available from the White House at http://www.whitehouse.gov/stateoftheunion/2006/, accessed on 14/02/06.
[1060] Ibid.
[1061] Bisconti's client list includes several companies active in the nuclear energy arena, including the Institute of Nuclear Power Operations, Institute of Nuclear Safety System (Japan), International Atomic Energy Agency, Japan Atomic Power Company, Nuclear Energy Institute, and the OECD Nuclear Energy Agency. Source: BRI, 2010, Clients, Washington, DC: Bisconti Research Inc.
[1062] In 1998, 45 per cent were in favour, and 50 per cent opposed, and there has been a gradual rise in support over the last decade. Source: BRI, 2007, Perspective on Public Option: December 2007 – Nuclear Energy as a Global Climate Change Solution, Washington, DC: Bisconti Research Inc.
[1063] This series of polls goes back to 1983, when support for nuclear was at around 50 per cent. After a minor dip in support from a peak of 67 per cent in 2005 to 62 per cent in April 2007, the figure has started to rise again. Source: Ibid.
[1064] DTI, 2003, op cit, n822, p61 at para 4.68
[1065] DTI, 2006, op cit, n822, p161.

> "nuclear has a role to play in the future UK generating mix alongside other low carbon generating options. Evidence gathered during the Energy Review consultation supports this view."[1066]

The consultation process began on 20 January 2006 and ended twelve weeks later on 14 April. That the process was subsequently regarded as flawed (and certainly not the "fullest" consultation possible) is clear, and will be explored in more depth in section 5.4 below but, whilst it would be relatively easy to dismiss the government's talk of consultation as mere window-dressing, it is fair to say that, during the three-month consultation period, over 1,000 individuals and over 400 organisations responded to the invitation of the Department of Trade and Industry (DTI).[1067] The responses were all published on the website; however, the extent to which the Energy Review gave any weight to these suggestions (or equally the extent to which any of the suggestions were balanced or useful) is debatable. What it does show, however is that the government was, at least, going through the motions of consultation, as a way of laying the groundwork for the announcement of policy that would follow. The advantage this has is that it allows the policy to be ostensibly based on a unified view from consultees (who were drawn from the wider public, industry and science), when in fact it was a pragmatic response to the growing problems of climate change and energy security. In other words, the consultation is being portrayed as underpinning the decisions, but is actually being used as the justification for a decision making process that had already been concluded.

There have been some arguments supporting[1068] and criticising[1069] the use of online consultations in general, but criticism of this particular example will be discussed below. Once the consultation had been finished, the results were collated and assessed and the resulting publication ("of a White Paper setting out the Government's proposals"[1070]) emerged.

5.3.2: 2006 Report: Energy Review: The Energy Challenge

The announcement made by the Prime Minister in 2005 that energy policy was "back with a vengeance"[1071] had a dual explanation behind it. On the one hand, the idea of "energy security" was mooted as a rationale – keeping supply out of the hands of overseas governments. On the other, carbon emissions, and the will o' the wisp that is "climate change,"[1072] are being used as the driving force, as they are in the United States. Neither of these roles has avoided criticism. The Chairman of the Sustainable Development Commission, for example, claimed in 2006 that:

> "a new nuclear-power programme would make no difference at all to achieving our 20 per cent carbon dioxide reduction target for 2010 and will make only a limited impact by 2020."[1073]

Equally, in April 2006, the Joint Energy Security of Supply Working Group (JESS), set

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1066 Ibid.

1067 DTI, 2006, op cit, n822, p214. This information was verified by the DTI Consultations Submissions website (http://www.dti.gov.uk/energy/review/consultation-submissions/page27883.html) which listed all the suggestions and responses made to the Energy Review consultation. In July 2007 the DTI became the Department of Business Enterprise and Regulatory Reform (DBERR), and it was DBERR which completed the consultation.

1068 See, for example, McCullagh, K., 2003, E-democracy: potential for political revolution? I.J.L. & I.T. 2003, 11(2), 149-161 in which the author argues that online engagement with political decision making "has the potential to reinvigorate the democratic process and re-engage citizens positively in political life."

1069 See, for example, Saxby, S., 2006, A critical analysis of the synergy between eGovernment and related policies in the United Kingdom, C.T.L.R. 2006, 12(6), 179-215

1070 DTI, 2003, op cit, n822, p61 at para 4.68

1071 Blair, T., 2005, op cit, n1

1072 The issue of the anthropogenic or otherwise nature of climate change is far too large to be tackled seriously here. For more information, see: Scott, K., Tilting at offshore windmills: Regulating wind farm development within the renewable energy zone (2006) 18 JEL (89); Brunnée, J., The United States and International Environmental Law: Living with an Elephant, EJIL 2004 15 (617).

1073 Porritt, J., 2006, Is Nuclear the answer? London: Sustainable Development Commission, p5.

up by the Department of Trade and Industry[1074] and OFGEM, predicted that, by 2020, the total UK energy demand would be roughly the same as it was for 2005, although the contribution from nuclear "is expected to drop from its peak of 90 TWh in 1998 to 34 TWh in 2015 and 26 TWh in 2020."[1075] Bearing in mind the timescales involved in heavy construction of this type, it is highly unlikely that any nuclear build approved under the new plans could contribute greatly to that gap. This means that there will have to be an increase in energy from other sources. JESS further reports that there are many new projects being planned, but these will also take time to develop fully. RWE npower, for example, was granted permission to construct a 1,630 MW CCGT station at the site of the Staythorpe Power Station in Nottinghamshire in November 2000 but construction did not start until April 2009, after various disputes.[1076] In total, if all of the "planned major new electricity projects" are approved and constructed, they will contribute slightly less than 25,000 MW,[1077] which is larger than the shortfall that will have been created by planned closures of existing nuclear plants. It is almost inevitable that some of these proposed developments will be rejected at the planning proposal stage, however, and thus the final total will be some way short of 25,000 MW. For all large proposed developments an Environmental Impact Assessment (EIA) must also be carried out under the terms of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. As far as electricity generation is concerned, only an EIA is mandatory for nuclear-power stations and "thermal power stations and other combustion installations with a heat output of 300MW or more."[1078] For smaller plants, Schedule II of the Regulations apply, meaning that an EIA will only be required if the development is in a sensitive area or likely to give rise to significant effects on the environment.

On 16 May 2006, before the publication of the Energy Review, but after the comments by the SDC and JESS, the Prime Minister again chose to deliver a speech to the Confederation of British Industries, this time at its annual dinner. In the speech, he announced that carbon dioxide targets and reliance on foreign sources of gas:

> "put the replacement of nuclear power stations, a big push on renewables and a step-change on energy efficiency, engaging both business and consumers, back on the agenda with a vengeance."

The pre-emption of the Energy Review by the Prime Minister was criticised at the time and has since been criticised even more vociferously, especially in the 2007 Greenpeace case. Whilst it may have represented an unfortunate example of poor timing, there are two elements which perhaps make the situation less problematic than it might appear. Firstly, the Prime Minister was basing his comments on the draft Energy Review, which had already been circulated through Whitehall and, secondly, the speech did not say that new nuclear-power stations were going to be built; it simply put the discussion back on the agenda.

The Energy Review was eventually published in July 2006.[1079] The preface by the Prime Minister no longer concentrated solely on the threat of climate change, as his pre-publication comments all appeared to have done, but added that:

> "without action to ensure reliable supplies and replace power plants, there will be

[1074] In October 2008, Just over a year after the creation of DBERR, it's Energy section was moved to the new Department for Energy and Climate Change, and the rest of DBERR's work stayed in a new Department for Business, Innovation and Skills.
[1075] JESS, 2006, Joint Energy Security of Supply Working Group: Sixth Report, London: Department of Trade and Industry and OFGEM, p35. 1 TWh is equivalent to 1,000 GWh, or 1,000,000 MWh.
[1076] Pitcher, G., 2009, Protest at Staythorpe Power Station over foreign subcontractors, Construction News, 19 January 2009.
[1077] JESS, 2006, op cit, n1099. There are nine CCGT plants being processed which will have a total output of 11,990 MW, several CHP (Combined Heat and Power) plants totalling 1,211 MW, two ICGCC (Integrated Coal Gasification Combined Cycle) plants totalling 910 MW, and 79 plants classified as "renewables, and energy from waste" which will total 10,680 MW. The total for these is 24,791 MW.
[1078] Schedule 1, Para 2(a), Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 (SI 1999/293).
[1079] DTI, 2006b, op cit, n907

a dramatic shortfall in our energy capacity and risks to our energy security."[1080]

Table 5.1: 2006 Government Nuclear Proposals.[1081]

	Proposals
1	Nuclear has a role to play alongside other low carbon generation options.
2	New stations will be financed by the private sector, taking into account decommissioning and long-term waste management plans.
3	HMG will help identify potential sites, but it is up to the developer to discuss access etc.
4	The HSE and EA have both been asked [i.e., told] to introduce systems of pre-licensing authorisation.
5	HMG will publish a further White Paper later in 2006/7 outlining possible changes to planning inquiries
6	An alternative to a public inquiry is desired, to focus on the "relationship between the proposal, the local plans and local environmental impacts"
7	A new high-powered inspector is proposed to ensure "planning inquiries are run to clearly defined timescales"
8	Arrangements for meeting decommissioning and long-term waste storage costs will be made with industry
9	A new post will be created for a senior manager to "lead the development of arrangements for the costs of new-build decommissioning and waste management", supported by the DTI.

The review ran to over 200 pages and devoted only thirteen to a discussion about nuclear power (paragraphs 5.93-5.143). The section finished with a list of nine proposals which the Government were putting forward. The key points of these initial proposals are reproduced as Table 5.1 but, in short, every one of the proposals was geared towards making the process of approving new nuclear plant faster and more straightforward (and thus cheaper). This in itself was a pragmatic move, since the costs of any new build would be shared between the private and public purses, and the spectre of a repeat of the Parker Inquiry into Sizewell B would not have looked attractive to any of the participants.

5.3.3: Climate Change and Sustainable Energy Act 2006[1082]

In the aftermath of the Prime Minister's speeches saying that energy policy, and specifically nuclear power, were back on the agenda in order to tackle climate change and make energy use more sustainable, one might have assumed that the Climate Change and Sustainable Energy Act 2006 would contain a reference to nuclear power, and shown the signs of a coherent energy policy. The Act instead:

> "is in many ways typical of the hybrid measures taken to link energy and environmental issues."[1083]

What it does is group together a number of provisions which can all be linked to either climate change or sustainable energy, or both, but which do not represent a comprehensive framework for dealing with either. In the DTI's Final Regulatory Impact Assessment of the Act, which was also published in 2006, they outline the main objective as being:

[1080] Foreword by the Rt Hon. Tony Blair MP.
[1081] DTI, 2006b, op cit, n907, pp124-5.
[1082] For in-depth assessment of this Act see: Dow, S., Legislative Comment: Climate Change and Sustainable Energy Act 2006, Env L Rev 2007, 9(4), 279-284
[1083] Dow, S., op cit, n1106, p279

"to enhance the UK's contribution to tackling climate change. It is also aimed at alleviating fuel poverty, promoting microgeneration and the use of heat produced from renewable sources."[1084]

These are all undoubtedly laudable aims, but Dow goes on to argue that:

"Until very recently, the government's approach to energy policy was somewhat limited."[1085]

This is a slightly unfair accusation, since Dow does not go on to quantify why he felt it was limited, but it echoes criticisms made of the Thatcher government which, it was claimed, had "no coherent energy policy."[1086] As we have seen throughout this work, rather than being labelled as 'somewhat limited' the approach of the government (and, indeed, all governments), should be regarded as a series of reactive pragmatic decisions based on external events. A comprehensive energy strategy might, for example, have foreseen the near-vertical price rises for crude oil following the Yom Kippur War and the Iranian Revolution in the 1970s, but it could not have foreseen the events themselves. Even if Dow and Orme's desires for a coherent, not limited approach to energy policy had been met, therefore, external events would still have derailed them.

Where the 2006 Act does differ, is that it marks a continuation of a relatively new approach to energy legislation, in that it takes a very long-term view. The Parliamentary debates show that the earlier statute discussed here did not consider for a moment the impact that its provisions would have in forty or fifty years. Neither was there a great deal of concern expressed about the finite nature of oil supplies – indeed, in 1961, when Shadow Cabinet member, Ray Gunter MP, suggested that:

"It is sometimes thought, perhaps, that those who mention the nonrenewability of our carbon deposits are, somehow, melodramatic and a bit feverish; but, nevertheless, we must bear in mind, in 1961, the fact that the carbon resources of the world are finite."[1087]

The Minister of Power, Richard Wood MP replied that:

"In fact, the proportion of proved reserves of oil, leaving aside coal for the moment, to world consumption over the last few years has continually been rising, although world consumption, as is evident to us all, has been rising very rapidly itself and behind these proved reserves lie vast quantities of oil still to be discovered."[1088]

If the 2006 Act is a good example of long-term planning and thinking, the 2006 Energy Review turned out not to be when Greenpeace challenged the legality of the consultation process, shortly after the results were published.

5.4: The 2007 Greenpeace Case

Some of the main environmental groups which arose in the twentieth century started off as single-cause groups and evolved into multi-cause international organisations, although most of those causes can be put under the wider "environmental" umbrella.[1089] The best example of this type of group is Greenpeace, which started out in 1971 as the "Don't Make a Wave Committee", protesting about US nuclear-weapons testing in

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[1084] DTI, 2006c, Climate Change and Sustainable Energy Act 2006: Final Regulatory Impact Assessment, Report No URN 06/1464, London: Department of Trade and Industry, p4 at para 4
[1085] Dow, S., op cit, p279, n1106
[1086] Orme, S., 1986, op cit, n782.
[1087] Gunter, R., 1961, Fuel and Power, HC Deb 20 February 1961 vol 635 c36
[1088] Wood, R., 1961, Fuel and Power, HC Deb 20 February 1961 vol 635, c50
[1089] Friends of the Earth, for example campaigns on "economic justice; resisting neoliberalism; forests and biodiversity; food sovereignty; and climate justice and energy." At a stretch, most of these can be classed as loosely "environmental" causes. Source FOEI, nd, What we do, Friends of the Earth International. Available at http://www.foei.org/en/what-we-do, accessed on 15/01/10.

Amchitka, off the Alaskan coast.[1090] The group has expanded hugely since then and now has an official standpoint on many environmental and social issues. In cases like this, the focus will be on the nuclear-power-related work carried out by an organisation, rather than any of its other work. This is important to bear in mind as many pressure groups were formed for a specific one-off purpose, more often than not of local importance, and remain at that scale. This means that their funding, influence and longevity were (and are) lower than those for an international group such as Greenpeace, with a total gross income in 2004 of €158.5m, and membership of close to 3 million.[1091] The campaign against the Newbury Bypass, for example, lasted for only two years, despite at one time holding the largest ever anti-road demonstration in Britain.[1092] That campaign did not involve groups on the scale of Greenpeace, however.

As was discussed in the previous chapter, in the 1994 Greenpeace Case, the courts recognised this importance, granting Greenpeace and, by extension, other large multi-issue pressure groups the *locus standi* (or right to appear) to give evidence in cases from which they would traditionally have been barred. The implications of this decision are far-reaching, and the decision that nationwide environmental pressure groups could bring judicial review actions meant that the untouchable nature of decision-making in relation to nuclear power had been, at least theoretically, reversed.

Nuclear energy is not the sole concern of Greenpeace, naturally, nor is it for many of the other pressure groups, and this needs to be borne in mind when addressing their particular standpoints on the topic, as small, single-issue groups are often less willing, or less able, to take a broad view of the topic area than large, multi-issue groups. As unfortunate as it may be, despite the measures put in place by case law, financial constraints mean that small protest groups rarely have a significant impact on large single companies, let alone entire industries. As the Public Law Project points out:

> "The cost of bringing a judicial review claim is considerable: in the region of £10,000 to £20,000 for a straightforward case, higher for a more complex matter. If the claimant is unsuccessful, they are likely to be liable for the defendant's costs as well as their own. They are therefore looking at a legal bill of upwards of £30,000 if they lose."[1093]

Against this background of an anti-nuclear power organisation having the right to appear and challenge government decisions, and considering the reaction of Greenpeace to the vaguest hint in November 2005 that the nuclear option might be reconsidered, it was unsurprising when, shortly after the publication of the Energy Review, Greenpeace launched a legal challenge to the 12-week consultation process. The basis of the challenge was that under the terms of the Aarhus Convention,[1094] environmental consultation was no longer "a privilege to be granted or withheld at will by the executive"[1095] and, since consultation was, therefore, necessary, it followed that the promise by the government to carry out the "fullest" public consultation ought to have been just that, rather than a shortened process the results of which appeared to have been pre-empted (and, in the argument of Greenpeace, influenced) by the Prime Minister. In any event:

> "Consultation serves a potentially very useful function for those seeking to avoid public law challenges - it flushes out the objections and problems at a stage when (in most cases) it is possible to take these into account and address them. It is far better to know what the best objections are, and what might have been left

[1090] Greenpeace, 2007, The History of Greenpeace, Amsterdam: Greenpeace International BV.
[1091] Greenpeace, 2005, Annual Report 2005, Amsterdam: Greenpeace International BV.
[1092] FOE, 1997, Anniversary of Newbury Protest, Friends of the Earth Press Release, 8 January 1997, London: Friends of the Earth.
[1093] PLP, 2007, Information Leaflets for Practitioners 2, Public Law Project
[1094] UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters 1998
[1095] R v Secretary of State for Trade and Industry, ex parté Greenpeace [2007] EWHC 311 (Admin), at para 48

out of account, miscalculated or misunderstood, before the decision is made."[1096]

Instead, the government argued that the consultation was adequate, if one were to keep in mind the fact that the twelve-week period was the minimum set out by the Cabinet Office,[1097] and also that the 2006 consultation had been:

> "carried out against the background of the substantial amount of information which had been gathered in preparing the 2003 White Paper."[1098]

This was the overt stance taken by the government in preparation of the Energy Review; a stance which the High Court decided, in its judgement of February 2007, did not reflect the reality of the review. The presiding judge, Sullivan J, based his discussions on what did and did not constitute a valid consultation exercise on the decision of the Master of the Rolls, Lord Woolf, in the 2001 Coughlan case.[1099] Lord Woolf's stated that:

> "A lawful consultation must (a) take place at a time when proposals are still at a formative stage, (b) give reasons for any proposal so as to permit intelligent consideration and response, (c) give adequate time for consideration and response and (d) give the product of the consultation conscientious consideration."[1100]

Using this as the basis for his decision, Sullivan J described the consultation process as "seriously flawed" [1101] "procedurally unfair… [and] unlawful."[1102] He also said that:

> "As an issues paper it was perfectly adequate. As the consultation paper on an issue of such importance and complexity it was manifestly inadequate. It contained no proposals as such, and even if it had, the information given to consultees was wholly insufficient to enable them to make "an intelligent response."[1103]

Interestingly, in an interview with the BBC shortly after the Energy Review was so heavily criticised by the High Court, the Prime Minister said "this won't affect the policy at all"[1104] perhaps suggesting that the new review would not be as open as it had been promised to be either, and raising the question of whether the purpose of consultation is to be seen to have consulted, or genuinely to seek consultation.

5.4.1: Meeting the Energy Challenge: A White Paper on Energy 2007

The DTI published a new White Paper in May 2007[1105] which, although never explicitly mentioning the court case which had criticised the handling of the preliminary consultation, did make reference to a second consultation. The Paper stated that:

> "Alongside this White Paper, we are publishing a consultation document on nuclear power so that we can take a decision before the end of the year on whether it is in the public interest for companies to have this option available when making their investment decisions."[1106]

That document 'The Future of Nuclear Power, The Role of Nuclear Power in a Low

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1096 Philpot, H., Judicial review: some practical guidance for local planning authorities, J.P.L. 2008, 11, 1551-1562
1097 Morrow, K., op cit, n1016, p66.
1098 R v Secretary of State for Trade and Industry, ex parté Greenpeace [2007] EWHC 311 (Admin), at para 45.
1099 R v North & East Devon Health Authority, ex p. Coughlan [2001] QB 213.
1100 R v North & East Devon Health Authority, ex p. Coughlan [2001] QB 213 per Woolf MR at 222
1101 R v Secretary of State for Trade and Industry, ex parté Greenpeace [2007] EWHC 311 (Admin), at para 116.
1102 Ibid, at para 118.
1103 Ibid, at para 116.
1104 BBC, 2007, Blair defiant over nuclear plans, London: BBC News. Available at http://news.bbc.co.uk/1/hi/uk_politics/6366725.stm, accessed on 01/02/08.
1105 DTI, 2007a, op cit, n914.
1106 Ibid, p5.

Carbon UK Economy' and 'http://nuclearpower2007.direct.gov' the website which accompanied it, were duly launched on 23 May 2007. Both parts of the process were prefaced by the promise that:

> "We want to hear from members of the public, industry, non-Governmental organisations (NGOs) or any other organisation or public body.
>
> We are seeking views on whether the Government has considered the relevant arguments; whether we have considered the arguments reasonably and whether there are other important arguments we have overlooked.
>
> Your views will contribute to the shaping of the policy on the future of civil nuclear power in the UK. They will help Government assess the arguments before it reaches its final decision on the future of new nuclear build.
>
> We will consider carefully the responses we get and this will enable us to take a decision on nuclear power later in the year."[1107]

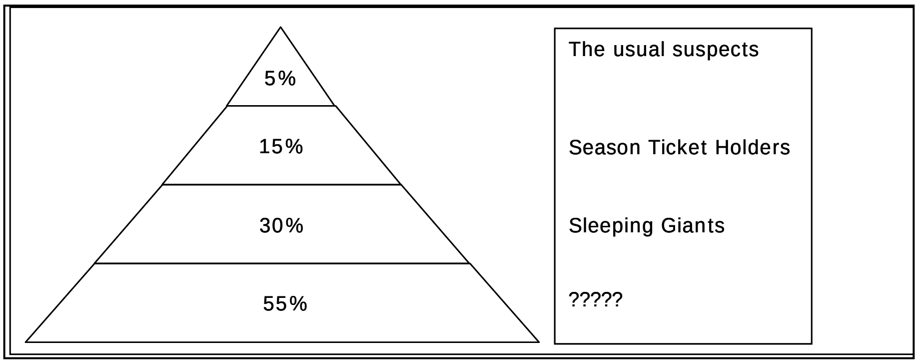
The consultation period finished on 10 October 2007 (after five months this time, rather than twelve weeks) and an analysis of the consultation responses was published in January 2008.[1108] The findings (by consultancy firm Dialogue by Design Ltd) show that:

> "2,728 organisations and individuals responded to some or all of the 18 questions in the main consultation. A majority of this self-selected group is in favour of allowing energy companies to invest in new nuclear power stations."[1109]

Although these numbers clearly represent a small proportion of the UK general public and, indeed, are less even than the 5 percent "usual suspects" category outlined by Bosworth and Donovan (see Figure 5.1), they are still larger than a similar, but two-stage consultation in 2002, which was also run by Dialogue by Design Ltd, and which had just over 150 respondents, although:

> "a total of 178 people went into the website to view the results and 78 people responded to the Session 2 questions."[1110]

Figure 5.1: Public Participation Pyramid[1111]



Calls for improved consultation and access to information were part of the rationale behind the consultation and are based, in no small part, on the principles established by

[1107] DTI, 2007b, The Future of Nuclear Power: The role of nuclear power in a low carbon UK economy, London: Department of Trade and Industry. Only available at: http://nuclearpower2007.direct.gov.uk/, accessed on 24/05/07.

[1108] DBERR, 2008b, Meeting the Energy Challenge. The Future of Nuclear Power: Analysis of consultation responses, London: Department of Business Enterprise and Regulatory Reform

[1109] DbD, 2007, The Future of Nuclear Power. Analysis Report – Written responses to the public consultation May to October 2007, Dialogue by Design Ltd, London: Dialogue by Design Ltd

[1110] DbD, 2005, The Practice of Online Consultation: Process Models and Case Studies, London: Dialogue by Design Ltd, p19.

[1111] Based on Bosworth, M., Donovan, J., 2002, Portland Metro's dream for public involvement, in Craig, W., Harris, T., & Weiner, D., Community Participation and Geographic Information Systems, New York, NY: Taylor and Francis, p383.

the Århus/Aarhus Convention[1112], which was mentioned briefly earlier in the chapter. The Convention's overall objective is:

> "In order to contribute to the protection of the right of every person of present and future generations to live in an environment adequate to his or her health and well-being, each Party shall guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters in accordance with the provisions of this Convention."[1113]

As mentioned above, the access to information provisions of the Århus Convention, and the regulations which implemented it in the UK,[1114] overlap slightly with the Freedom of information Act 2000, but the right of "public-participation in decision making" is not found elsewhere in statute. These rights, though fundamental, are not absolute,[1115] and the commercial interests of the EU have been used as a reason for not granting access to such information.[1116]

However, whether it is through Freedom of Information type legislation, or by relying on Convention rights, or via the Internet, or at the gift of the authorities, the public has access to information at a level unprecedented in history. Coupled with this high level of accessibility, there is, at least at a surface level, far greater potential to have an impact on legislation and policy through some form of public participation.[1117] In theory, this combination should result in high levels of public participation, however, according to Bosworth and Donovan, writing about participation in the field of urban planning, more than half of the population who are eligible for involvement:

> "were disinclined to become involved. Only fewer than fifteen per cent were prepared to take part and these include some five per cent who could be considered militant participants or the type who are always inclined to get involved in any issue."[1118]

Bosworth and Donovan's argument essentially appears to be that public consultation is a blind alley, since the "silent majority" of the public never respond, whilst the "vocal minority" respond to everything. Figure 5.1 illustrates Bosworth and Donovan's breakdown of the public by how they participate, and it is argued that even though the "2,728 organisations and individuals" that Dialogue by Design claim responded to the 2007 nuclear consultation is a respectable figure, they nevertheless represent the top end of "the usual suspects" category. Ian Ratcliff, the Solicitor for the New South Wales Environmental Defenders Office argues, echoing Teichmann and Jasanoff, that some "decisions are technical matters that do not gain from substantial community involvement."[1119]

If any element of the extended process of reintroducing discussions about nuclear power to the energy mix can be argued to be pragmatic, it is this second consultation process, which was reactively pragmatic. That the government did not want to carry it out is clear – they went to the High Court to deny there was anything wrong with the first

[1112] 1998 UN/ECE Århus / Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.
[1113] Article 1, Århus / Aarhus Convention.
[1114] The Environmental Information Regulations 1992 (SI 1992/3240), as amended.
[1115] See, Lee, M., & Abbot, C., 2003, The usual suspects? Public participation under the Aarhus Convention. Modern Law Review, 66 (1). pp. 80-108
[1116] Case T-264/04. WWF European Policy Programme v European Union Council [2007] All ER (D) 235
[1117] This could be indirectly through membership of an NGO, or directly through a citizens' jury, consensus conference, interactive panel, opinion poll or as a member of a research panel. Source: Grimston, M., 2002, Nuclear Energy: Public Perceptions and Decision-making, World Nuclear Association Annual Symposium 2002, London: World Nuclear Association.
[1118] Bosworth, M., Donovan, J., 2002, op cit, n1135, p383. This point is echoed by Bell and Etherington, who state that less than 2 per cent of respondents to government consultations on waste were categorised as "general public." Source: Bell , S., & Etherington, L., Out of Sight, Out of Mind: A Study of the Transposition and Implementation of the Groundwater Directive in the United Kingdom, Env L Rev, 2007 (9), 6-24
[1119] Ratcliffe, I., Wood, J., & Higginson, S., Technocratic Decision-Making and the Loss of Community Participation Rights, Sydney, NSW: EDO.

consultation – but when pressed to do so it introduced extra points which had not been in the original consultation. The not-very-surprising outcome of the consultation was revealed in the January 2008 publication of yet another Energy White Paper.[1120]

5.4.2: Meeting the Energy Challenge: A White Paper on Nuclear Power 2008

This White Paper was produced in the light of the second consultation and despite the lengthier and more comprehensive consultation period (which, to date, no group has formally challenged), many environmental groups felt that their views had not been given sufficient weight. Friends of the Earth, for example, issued a press release saying:

> "Building new nuclear plants would be a costly, dangerous and ineffective way to cut UK carbon emissions. It would also divert valuable resources from sustainable solutions for tackling climate change. This White Paper should have set out ambitious policies on energy efficiency, renewable power, carbon capture and cleaner systems of transport. Unfortunately Ministers have been taken in by the nuclear lobby yet again."[1121]

Greenpeace, which triggered the second consultation, agrees that the nuclear lobby has exerted its influence on the decision and argues that "investment in nuclear energy and its infrastructure is a dangerous and expensive distraction"[1122] from the wider issues around climate change. We have seen arguments earlier that NGO scientists are more likely to be trusted than government or industry scientists, but the Eurobarometer survey "Attitudes towards radioactive waste" carried out in all EU member states in the Spring of 2008[1123] (i.e. in the months after the 2008 White Paper) suggested that those totally or fairly in favour of "energy production by nuclear power stations" had risen to 44 per cent, up from 37 per cent in 2005,[1124] suggesting perhaps that government scientists are not as distrusted as previously thought.

Whilst gaining criticism from some in the environmental lobby was no surprise, given the reaction to the Prime Minister's November 2005 speech discussed earlier, it was equally no shock when the White Paper echoed the standpoint adopted by the Government after the earlier consultation that:

> "it is in the public interest that new nuclear power stations should have a role to play in this country's future energy mix alongside other low-carbon energy sources; that it would be in the public interest to allow energy companies the option of investing in new nuclear power stations; and that the Government should take active steps to open up the way to the construction of new nuclear power stations."[1125]

What the White Paper effectively manages to do is steer a middle ground in relation to nuclear power. It does not say that nuclear will be the primary source of future UK electricity, and neither does it say that nuclear should be avoided at all costs. What it says is that nuclear will have a role to play in the energy mix for the future, and this is something which was echoed by the independent UK Energy Research Centre (UKERC) in their 2009 report, which says that alongside developments in Carbon Capture and Storage technology:

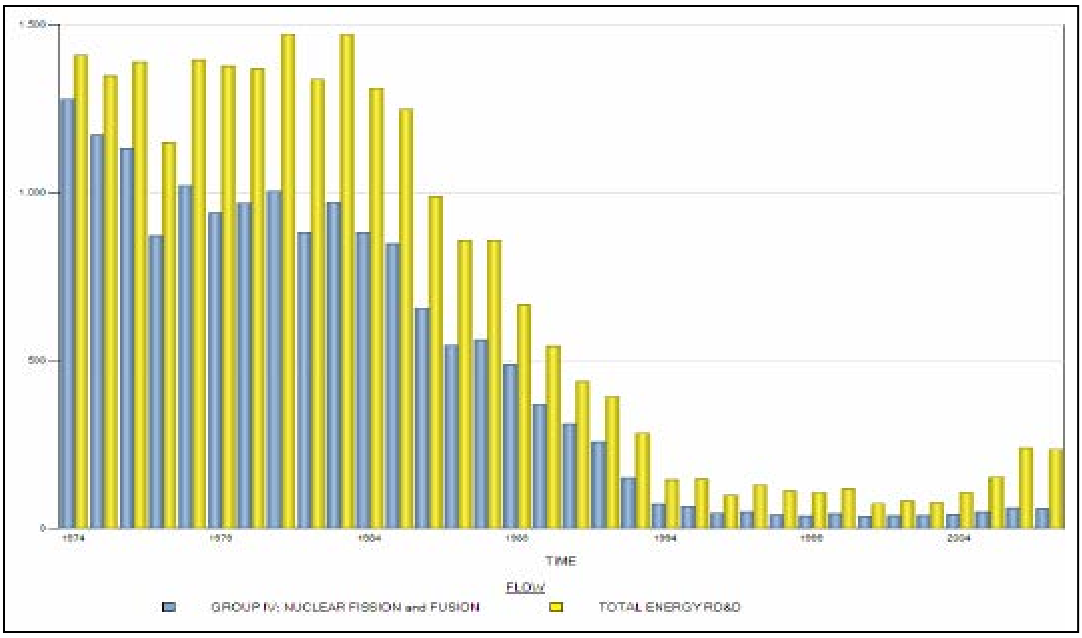
> "Accelerated development of nuclear power allows for a more sustained nuclear

[1120] See also Morrow, K., op cit, n1016.
[1121] FOE, 2007, Energy White Paper Reaction, Friends of the Earth Press Release, 23 May 2007, London: Friends of the Earth.
[1122] Greenpeace UK, 2009, Nuclear Power, Greenpeace UK. Available at http://www.greenpeace.org.uk/nuclear, accessed on 22/03/10
[1123] EC, 2008, Attitudes towards radioactive waste, Special Eurobarometer 297, Brussels: European Commission
[1124] Ibid, p5
[1125] DBERR, 2008b, op cit, n1132, p10 at para 1

contribution over time than in non-accelerated scenarios."[1126]

The UKERC is a relatively new body, being formed only in 2004, but its roots are partly in the Council for the Central Laboratory of the Research Councils (CCLRC), which itself grew out of the National Institute for Research in Nuclear Science (NIRNS), based at Harwell and Warrington, and which was discussed earlier in Chapter Two.

Figure 5.2: UK R&D spend on Total Energy and Nuclear Power (US$m) 1974-2007[1127]



These figures show that investment in nuclear power research and development had fallen by over 95 per cent from a peak of around US$1.3 billion in 1974 to around US$50m by 1994, and has remained more or less constant since then. R&D spending on energy in total, also fell by over 90 per cent from a peak of close to US$1.5 billion in 1984 to a low of US$100m in 2002, but since then it has doubled to about US$200m.

By the time the White Paper had been published, and another reason why its suggestions were not surprising, the Health and Safety Executive had already issued version 1 of their guide to the regulatory processes[1128] for the Generic Design Assessment (GDA) process for new nuclear power stations, which provided companies with details of how the GDA process would work, and presupposed that such a guide would be needed.

5.5: Conclusion

Neither the Home Energy Conservation Act 1995 nor the Environment Act 1995, which were assessed first in this section were intended to have any great effect directly on the nuclear industry. Both touched briefly on the area of energy consumption and, as such, did have a bearing on the wider electricity market, of which nuclear plays a part. The do fit with one the threat from climate change however, which was to become one of the lines of justification used by Tony Blair in 2005 for reconsidering nuclear power. The Environment Act was a huge piece of legislation and focused primarily around the single aim of creating a new, unified Environment Agency; part of the role of which would be to take on the role of some of inspectors of nuclear sites. The wider rationale for both of

[1126] UKERC, 2009, Decarbonising the UK Energy System: Accelerated Development of Low Carbon Energy Supply Technologies: UKERC Energy 2050 Research Report No. 2, London: UK Energy Research Centre, p iv.
[1127] Source: UKERC, 2009, op cit, n1148, Figure 6.1, p66
[1128] The current version is v3, HSE, 2008, New nuclear power stations: Generic Design Assessment: Guidance to Requesting Parties, London: HSE/HMSO

these pieces of legislation may have been concerns about the environment, and the ideas of sustainability as outlined in the Rio Summit in 1992, however the elements of that legislation which impacted on the nuclear industry were instead pragmatic, cost-cutting, efficiency measures.

Both of the other pieces of statute considered here had the same basic premise – to ratify an international instrument, and make it part of the legal makeup of the country. As such, they fit a pattern that has been established in previous chapters – that of reactive pragmatism triggered by external, and uncontrollable, events. Neither the Prohibitions and Inspections Act nor the Safeguards Act were particularly contentious and neither has really made it into the public awareness since their enactment – they were simply pragmatic measures designed to give effect to an earlier treaty signature.

A further example of this type of reactive pragmatism was the creation of a new approach to countering terrorism in the Anti-Terrorism Crime and Punishment Act 2001, which was rushed through Parliament in the aftermath of 9/11. As with the Human Rights Act, this drew criticism from different quarters for being too hard and too soft but, unlike the HRA, sections of it were struck down as being unlawful by the House of Lords. This Act, again like the HRA, did not do a great deal that directly impacted upon the nuclear industry, but it did fundamentally affect the climate of security in which the industry would operate.

Moving from areas of law which only tangentially affected the nuclear industry, the last three items considered here were the 2003 White Paper which said, *inter alia*, that there was no economic case for nuclear power, the Electricity (Miscellaneous Provisions) Act 2003, which backed British Energy to the tune of £650m, and the Energy Act 2004, which brought into existence two new bodies – the Nuclear Decommissioning Authority and the Civil Nuclear Constabulary. As the sole body in charge of a £70bn budget over 50 years to decommission the UK's existing reactors, it might be thought that the NDA would satisfy the criteria for being a policy-making technocratic élite. It is clearly an élite, as it has sole charge of the next few decades of decommissioning, and the allocation of the budgets that go with that control. It can also accurately be described as a technocratic body, since the key members are all high-level people with considerable expertise in the field. However, as with the UKAEA, the NDA is expressly removed from the policy making sphere and, rather than becoming a technocratic decision making élite thus becomes a technocratic policy-implementing élite. The creation of the NDA was also a pragmatic move – partly, as with the previous examples, in a reactive sense to deal with the changing nature of nuclear sites themselves, both in terms of the requirements of security and decommissioning, but partly in a proactive way to try and shape the future development (and funding) of the remains of the old nuclear industry. For that is what the NDA really relates to, not the new, as-yet-unbuilt, clean and efficient twenty-first century nuclear industry, but the old, tired, worn out, potentially unsafe nuclear industry with its roots in the 1940s.

The rescue of British Energy, which followed a long-established pattern of similar funding moves for BNFL, was a financially pragmatic move – the nuclear power industry could not be allowed to effectively go into liquidation, for the nuclear contribution to national energy production, though down from its peak, was still significant.

Science played a role in this period too. Fully half of the legislation considered here relates to ideas about climate change which, even as early as 1995, had become one of the driving forces of policy. This despite the science not being as universally agreed as the politicians suggested, as we saw in previous chapters. NGOs played a significant role here, as Greenpeace was able to challenge the consultation process and force a re-run against the express wishes of the government. The fact that the result of the second consultation was essentially the same, and was predicted to be by the Prime Minister, only added to what Professor Worcester has called the public's lack of faith in government science.

Chapter 6
Conclusions

This thesis began and ended with the announcement by the Prime Minister, Tony Blair, that energy policy was back on the agenda with a vengeance, and that there would be a reconsideration of the previous policy relating to nuclear power. This announcement, the Prime Minister argued, was based on two key factors – the growing threat posed by climate change, and the issue of security of energy supply. Actually, it was argued, what the Prime Minister had done was to present a theory relating to climate change as though it was incontrovertible scientific fact, in order to justify a pragmatic decision about the re-adoption of nuclear energy, and this is the thread that has run through this entire thesis.

From the beginning, the thesis set out to show three things. Firstly, that the decisions made during this period in relation to nuclear power were all based on political pragmatism, and Diego's idea of "what works." Secondly, that in order to justify these decisions, politicians have consistently used scientific discourse as a justification, having first morphed the scientific data into a format that is presented as though it is unified, what Jordan and Davidson have termed the "political closure of scientific certainty." and, finally, that the arguments of Jasanoff and Teichmann for the presence of a technocratic decision making élite do not hold water in this scenario, and that Technocratic Decision Making has not held sway. These arguments will now be expanded in turn.

The first premise set out at the beginning of this work was that policy decisions made in the realm of nuclear power in the UK were based predominantly on politically pragmatic considerations, the idea that "what works" is the most important criteria. This idea was unpicked in the early chapters, and a temporal aspect was inserted, making the standard "what appeared to be most likely to work at the time," and this led to ideas of proactive political pragmatism and reactive political pragmatism.

Reactive political pragmatism is used to deal with situations that have either occurred outside the UK, or over which the UK has been unable to exercise any control. Often, the decisions need to be taken quite rapidly, as the cause is some sort of emergency (for example the Suez Crisis, the Yom Kippur War, or the accident at Chernobyl), which requires immediate action. In other examples, which are still classed as reactively pragmatic, there is no emergency, but the decisions still need to be taken. Examples that illustrate this point would include the need to enact the UK's ratification of various international treaties by using the Nuclear Installations (Licensing and Insurance) Act 1959, the Nuclear Materials (Offences) Act 1980 or the Nuclear Safeguards Act 2000.

There are several variables at play in the relationship between the impact of external events on the UK's nuclear power policy and the decisions taken. Some of the events related directly to nuclear power, and some were only tangentially linked, however the decisions taken to either give them force, or mitigate their effects, were all reactively pragmatic.

In addition to what has been termed "reactive political pragmatism," many of the decisions covered here can be classed as "proactive" political pragmatism. These are decisions which are taken to shape the future direction of policy, and have not been triggered by any specific event or circumstance. As a result, they are not so time-dependent as the others, and often have more far-reaching consequences. It has also been shown that within each time period there have been certain overriding considerations to which politicians have always returned.

In the 1944-8 period, the considerations were financial, both because Britain was just starting to rebuild after the Second World War, and because there was a fledgling industry that Attlee wanted to nurture, and security-related, in terms of espionage and the beginnings of the Cold War. The legislation introduced in the period was partly reactive, as it was initially to create an industry to use the by-products of the weapons manufacturing process, and partly proactive, as it wanted to set out both how that industry would develop, and who would have access to information about it (although, as we have seen, the UK didn't approach this aspect with as much vigour as the USA). The selection of the Ministry of Supply to control the area illustrates this – if it had been truly intended to develop atomic energy as a useful, nationwide energy source, then control would doubtless have come under the remit of the Minister of Fuel and Power. The 1948 Act, on the other hand was proactive, and gave the radioactive materials industries a framework within which their commercial exports could flourish.

The considerations in the 1973-8 period were also financial and security related, although the latter was less focused on international security, and more of safety and security of nuclear plants. The UK was in the grip of a recession, and some aspects of the nuclear industry had been hived off to operate on a semi-commercial basis, but with the continued financial support of the government. The need to keep putting money into BNFL was shown to be a driver for the extension of the credit and banking offered to (and taken by) the company. This decision was mainly a reactive one , as BNFL repeatedly found itself in financial hot water, although there are elements of proactive political pragmatism as well, since the intention was to leave the company in a state when it could survive without further assistance. The safety and security considerations of the period were mainly linked to the accidents that had occurred both inside and outside the UK in the preceding decade or so. The liability that operators of nuclear facilities faced was starting to become large enough that investors were dropping out of the nuclear sphere, as shown by the reduction in nuclear consortia from five to one. Faced with this, the international community drew up several agreements to limit operator liability in the case of an accident, and the UK adopted the ratifying instruments to these agreements in a reactive, politically pragmatic manner.

The 1992-5 period was marked by underlying financial considerations which, given the title of the chapter, will come as no surprise. The concerns over plant safety and security, which had first surfaced in the previous chapter, were continued, and the period was also marked by the beginnings of concerns about what has subsequently been branded as "energy security." The financial aspect of the period was again partly triggered by external events, in this case the slow recovery after the recession of the 1980s, but there were internal drivers as well, namely the Prime Minister's determination to keep the Public Sector Borrowing Requirement as low as possible. To this end, the nuclear industry was excluded from the privatisation of the electricity network, and the two companies that had been hived off a decade or so earlier were finally sold into the private sector.

The very real dangers posed by poorly operated and poorly maintained nuclear reactors were amply illustrated by the well-publicised accidents at Three Mile Island and Chernobyl. Despite the UK not having any of the reactor types used at either site in operation, the accidents helped to create the background against which the announcement was made that any new nuclear reactors would be funded wholly by the private sector. Further safety concerns about the risks posed by transporting radioactive material by road led to new legislation to restrict and redefine the regulations in that area. This was an example of reactive political pragmatism, not in the sense of reacting to a specific crisis, but in terms of reacting to alleviate a set of concerns about risk. Energy security had also started to be a consideration in this period, as the flow of North Sea Oil made the country's position with regard to energy self-sufficiency much stronger, thus weakening the case for any new nuclear programme.

The underlying considerations in the final period, are partly continuations of previous considerations – financial, security, both international and energy-related and plant safety, but they were added to by a new consideration, that of the dangers of climate change. The financial consideration were given effect by the rescue of British Energy (BE)outlined in the Electricity (Miscellaneous Provisions) Act 2003. This was a reactive move, as BE had found itself in financial dire straits, and it was politically pragmatic as the alternatives to bailing out BE would be either for the government itself to take on the cost of running the plants, or to somehow "switch off" the reactors – a potentially dangerous process that takes many months and is very expensive.

Another financial-based pragmatic measure was the creation of the Nuclear Decommissioning Agency and Civil Nuclear Constabulary in 2004. As has been shown above, this was proactively pragmatic insofar as it was an attempt to shape the future development (and funding) of the remains of the old nuclear industry. For, as we have seen, it is the old, tired, worn out, potentially unsafe nuclear industry which the NDA will be linked to, as opposed to the new, as-yet-unbuilt, clean and efficient twenty-first century nuclear industry.

The various security considerations (international, energy, plant safety) were all in play during this period, and all triggered decisions that have been shown to be politically pragmatic. The Anti Terrorism Crime and Security Act 2001 and its impact, albeit limited, on nuclear sites was a reactively pragmatic measure, triggered by the terrorist attacks in New York and Washington in 2001, and the perceived threat of similar occurrences in the UK.

Energy security was part of the rationale given by Tony Blair for the reconsideration of nuclear power in 2005, as the increased reliance on imported energy would leave the UK more vulnerable, as illustrated in Figures 1.2 and 4.1, showing the rate at which the UK imports and exports oil. In 2005, the graph suggested, the UK would become a net importer of crude oil, and thus be reliant on the fluctuating global market to an extent not seen since the discovery of North Sea Oil. The push for non-fossil fuels, which is the wider agenda into which nuclear power has been placed, is a pragmatic attempt to increase indigenous energy supply and ensure greater stability in energy prices. It is partly reactive, as it is responding to the pre-existing levels of imports and exports, but it is also partly proactive, as it is an attempt to shape the future direction. It also marks the closure of a circle which began in 1955 with the government backing private companies to build new power stations based on technology that was largely unknown in the UK, and ends in 2008, with the government backing private companies to build new power stations based on technology that is still largely unknown in the UK.[1129]

The new consideration that was used in this period was that of climate change. The argument is that the anthropocentric effects on climate are going to cause severe problems in terms of weather patters, sea levels and so on, and that reducing emissions of carbon dioxide is the most effective way of tackling this. the scientific aspects of this will be discussed below, but the energy-related decision making was clearly a pragmatic move and was again partly reactive (this is what works to deal with the current situation) and partly proactive (this is what will work to shape the future energy mix of the UK).

Having shown that decisions taken in this area of policy were politically pragmatic, either reactively or proactively – or in some vases, both – the second of the underlying themes of this thesis needs to be examined, that of the use of science by politicians.

Science, Nowotny argues, has long since stopped being a single community and is now pluralistic in everything from status, to codes of conduct, to competence, to the willingness to go beyond the bounds of obtaining scientific data towards advocating particular courses of action. Others took up this idea of the fracturing of science, which is partly based around the ideas put forward by Thomas Kuhn[1130] relating to periodic scientific revolutions, once the dominant and accepted ideas of the time are sufficiently challenged. Despite the clearly acknowledged fracturing of science, politicians have always displayed a desire, or even a need, to present scientific data as though it was the result of consensus - what Jordan and Davidson refer to as “the political closure of scientific certainty.” On some occasions this is done because a reactively pragmatic decision needs to be made in a relatively short space of time, and full scientific certainty is not something which can be awaited. The 2001 outbreak of Foot and Mouth Disease covered in Chapter One is an example of this type of decision, as the “do nothing” option was clearly not feasible, either scientifically or politically. Other examples include the response to the

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[1129] None of the type-approvals for generators has ever been used in the UK before. See Appendix III for more details.
[1130] Kuhn T.S., 1970, op cit, n41.

1957 accident at Windscale, where restrictions on the movement of milk were quickly imposed, and then quickly lifted, as discussed in Chapter Three.

If some of the science was limited to rapid reactions to urgent crises, then other areas of science were, as we have seen, much more wide-ranging. In the early days of nuclear power, when it was still widely regarded as being an interesting if not commercial sideline from weapons production, led to an apparent acceptance of the science by the politicians themselves. Clement Attlee argued for the introduction of nuclear power because scientists had agreed that change was inevitable, and effectively that if the UK did not place itself in the vanguard of atomic generation, it would be “in the guard’s van.”[1131] The 1955 White Paper presented the scientific advice that nuclear power would be cheap, clean and safe, and did little to question the rigour of those assertions. Later decisions, such as the one made by Tony Blair in 2005, were much more explicit in their use of scientific rhetoric to justify the decisions.

None of the Prime Ministers in office during the periods assessed here has had a background in science, with the exception of Margaret Thatcher,[1132] and yet each has been willing to use the rhetoric of science to ‘trump’ dissenting arguments. Despite Worcester’s assertions that the public has a decreasing faith in ‘science,’ particularly that promoted by governments or industry, we have seen that there is very little difference in approach between government scientists, industry scientists and NGO scientists. We have also seen that the organisations themselves, whether government, industry or NGO are willing to present scientific theories as though they were mathematically certain. Greenpeace and the nuclear industry both presented their version of the scientific data to argue for the abandonment of Sizewell B, for example.

As this area is without doubt a “technology-heavy” area of policy-making, some consideration of the more formalised Technocratic Decision Making model has been made throughout the piece. This assessment was based initially on Kantrowitz’s three decision types and then refined using the distinctions put forward by DeSario and Langton concerning the “what is” nature of technical decisions, and the “what should be” nature of value decisions.[1133] To this model were added two further sets of ideas. Firstly those of Teichman about the actual process of Technocratic Decision Making which, although using examples from South America, hinged on “small technocratic élites [that have] insulated themselves from both extra and intra state pressures”[1134] in order to make their decisions. Secondly, those of Jasanoff were added, foreseeing the eventual replacement of these technocratic élites by a system of rule by scientific experts. These ideas were overlain on key events of these periods, and two different outcomes were discerned. Firstly, the existence of a technocratic élite, which could feed the science to the politicians, but play no direct role in the decision making process. Secondly, a decision making élite which had direct input into the decision making process, but which was not technocratic in its nature.

The decision in 1946, for example, to give the duty to promote nuclear power to the non-scientific Minister of Supply, supported from several high-ranking scientists, and reporting directly to the Prime Minister certainly created an élite, it was argued. This élite was also the primary force in creating new policy for the development of nuclear power. What was less clear is the extent to which this group could be classed as technocratic. Without the Minister, and without the oversight of the Prime Minister, the group would certainly have been able to be classed as technocratic and, as a policy maker, we would have had a situation that came under the TDM banner. In the event, it was felt that the group was semi-technocratic at best, and so there was felt not to be TDM.

A similar situation arose with the Advisory Committee set up under the Radioactive Substances Act 1948 – there was undeniably an élite, and it was very much technocratic,

[1131] O’Neill, H., 1981, Back on the Job, Industrial and Commercial Training, 13(11)382-4
[1132] Thatcher obtained a Chemistry degree at Somerville College, Oxford. Source: Thatcher, M., 1993, op cit, n576.
[1133] Desario, J., & Langton, S., eds., 1997, op cit, n90.
[1134] Teichman, J., 1997, op cit, n93.

but it was not involved in the decision making process, as the statutory requirement on the Ministers was only to consult with the committee, not to follow their advice. That pattern continued with the creation of the UK Atomic Energy Authority in 1954, despite some initial fears that it would be “a new private empire ruled by the atomic knights.”[1135] The Board of the Authority was an eight-strong combination of scientists and industrialists, all of whom had been knighted at some point, and more than half of whom were subsequently ennobled, so again the existence of a technocratic élite cannot be denied. The Atomic Energy Authority Act 1954 expressly stated that the Authority was a policy *advisory* body, and not a policy *making* body. This became a useful distinction in the 1970s, when the UKAEA became a 35 percent shareholder in the National Nuclear Corporation, which had been set up (at the UKAEA’s advice) to build the new generation of power stations.

Both of these outcomes - a technocratic élite and a decision-making élite – matched parts of the requirements of the models proposed by Teichmann and Jasanoff. However, since the models both presuppose the existence of a technocratic, decision-making, élite on order for TDM to be a factor, it was determined that, in this area of policy making, TDM did not apply.

The theme that has run through this entire work is the way in which politicians are willing to use science when it suits their pre-existing agenda, and equally willing to ignore it, or even dismiss it as “crackpot” when it does not. In his speech to the Royal Society in Oxford in 2006, Tony Blair said that the future of the UK would be lit by the “brilliant light of science.” As it turns out, that brilliant light is favoured by politicians as they control the switch.

[1135] Freeman, J., 1954, op cit, n399.

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Nuclear Industry (Finance) Act 1981

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Uranium Enrichment Technology (Prohibition on Disclosure) Regulations 2004/1818

US Atomic Energy Act of 1946

Appendix I: A Glossary of Possibly Uncommon Terms & Abbreviations[1136]

AEN	Agence pour l'energie Nucléaire. See NEA.
AERE	Atomic Energy Research Establishment. Founded in Harwell, Oxfordshire, in 1946 by John (later Professor Sir John) Cockcroft, under the terms of the AEA 1946. Worked under the authority of the Ministry of Supply. Incorporated into UKAEA (q.v.) in 1954, and renamed as Harwell International Business Centre in 1996. Still houses the Headquarters of UKAEA.
Almelo, Treaty of	1970 Tripartite Treaty signed by the British, German and Dutch governments. The Treaty was "the basis for collaboration between the three countries for the development and industrial exploitation of centrifuge technology to enrich uranium."[1137] BNFL (q.v.) was able to collaborate with international partners as a result of this Treaty.
Alpha Radiation	Alpha radiation (α) is the last penetrating of the three types of radioactive particles (alpha, beta (q.v.) and gamma (q.v.)). As alpha particles cannot penetrate the outer layer of human skin, it represents no danger as an external source. However, if alpha particles are emitted by a source which is inside the body, the radiation is taken up very close to the source of emission, and alpha particles are the most hazardous when internal.[1138]
AWRE	Atomic Weapons Research Establishment. The UK's nuclear weapons design programme moved form Fort Halstead to AWRE in Aldermaston, Berkshire in 1950.[1139] AWRE (together with a trials range at Foulness in Essex), became the UKAEA Weapons Group until 1973, when it was transferred to MOD ownership by the Atomic Energy Authority (Weapons Group) Act 1973.
AWE	Atomic Weapons Establishment. In 1987, the AWRE (q.v.) was combined with two Royal Ordnance factories (in Cardiff and Burghfield, Berks.) to become the AWE.[1140]
Baruch Plan	The plan was presented before the UN AEC (q.v.) on 14 June 1946, and proposed the creation of an International Atomic Development Authority "to which should be entrusted all phases of the development and use of atomic energy" The Plan represented an offer by the United States to destroy all of its atomic weapons if other nations agreed to do the same, on the basis that "if we fail, we have damned every man to be the slave of fear"[1141] Unfortunately, the USSR rejected the plan, and detonated its first atomic bomb in 1949.[1142] With the collapse of the plan, the International Atomic Development Authority was never created, and there are now seven

[1136] This phrase was taken from: Winchester, S., 2006, *A Crack in the Edge of the World: The Great American Earthquake of 1906*, London: Penguin Books, p387.
[1137] Boureston, J., 2004, *Fuel Cycle: Tracking the Technology*, Nuclear Engineering International Magazine.
[1138] Ramsay, C., & Modarres, M., 1998, op cit, n993, p76
[1139] MOD, 2009, op cit, n311
[1140] Ibid.
[1141] Baruch, B., 1946, *Speech before the UNAEC on 14 June 1946* , United Nations Atomic Energy Commission, Hunter College, NY: New York.
[1142] Norris, R. S., & Arkin, W. M., 1998, op cit, n284

	states that have declared their nuclear weapons.[1143] In addition, Israel is widely believed to possess nuclear weapons, though officially denies this.[1144]
Becquerel	(Bq). A measure of radioactivity, equal to one decay per second, measured by a Geiger Counter.[1145]
Beta Radiation	Beta radiation (β), also called beta rays or particles, is more penetrating than alpha radiation (q.v.) but less so than gamma radiation (q.v.). It has a range of about a metre in air.[1146]
BNFL	British Nuclear Fuels Limited. Set up by the Atomic Energy Authority Act 1971, to take over part of the work of the UKAEA.
CNPA	Civil Nuclear Police Authority. Created by section 51(1) of the Energy Act 2004 as a replacement for the UKAEA Constabulary (q.v.). The operational and oversight aspects of the CNPA are discussed above, in Chapter 5.
CP-1	Chicago Pile-1. The name of the reactor which went critical in Chicago on 2 December 1942, and was the first self-sustaining nuclear reactor.
Curie	(Ci). The main unit used to measure radioactivity. Initially defined as "the amount of radon in equilibrium with 1 gramme of radium".[1147] It is the equivalent to 3.7 x 10^{10} Bq (q.v.).[1148] The Curie is a large unit of activity, and the submultiples, millicurie (mc) and microcurie (μc) are frequently used.[1149]
EBR-1	Experimental Breeder Reactor-1. The name of the INEEL (q.v.) reactor built by Westinghouse Electric Corporation, and which first produced electricity in 1951. It was partly destroyed by an accident in 1955.[1150]
EFDA	European Fusion Development Agreement. EFDA provides a framework for implementing European fusion research, development & design work. One of its primary activities is concerned with the use of the JET Facilities. The EFDA is intended to strengthen the co-ordination of work within the EU and Switzerland on controlled thermonuclear fusion. It will further develop the necessary scientific, technical and organisational basis in the EU fusion laboratories and in European Industry for the possible construction of an experimental fusion power plant and will reinforce the European capability for international co-operation. EFDA runs from 1999 until at least the end of 2004 and could be extended.[1151] See also Appendix IV for an explanation of nuclear fusion.
Euratom	European Atomic Energy Community. Founded in 1958
Gamma	Gamma Radiation (γ) is the most penetrating type of radiation, and is

[1143] The confirmed nuclear states are the USA, Russia, China, France, the UK, Pakistan, and India. North Korea and Iran are both believed by the UN to be working on secret nuclear weapons programmes.
[1144] See, for example, Sunday Times, 1986, op cit, n684
[1145] Czarnecki, L., 2002, *Nuclear Physics*, Homepage Wissenschaftlicher Themen. Available at http://www.hpwt.de/Kern2e.htm, accessed on 01/02/08.
[1146] Ramsay, C., & Modarres, M., 1998, op cit, n993, p76
[1147] Valentine, J.M., 1963, *Teach Yourself Atomic Physics*, London: The English Universities Press, pp76-7
[1148] Czarnecki, L., 2002, op. cit, n10.
[1149] Valentine, J. M., 1963, op. cit, n1179, p77
[1150] Weaver, 1995, op cit, n350.
[1151] All information taken from EFDA-JET, 2003, *The European Fusion Development Agreement*, Culham: European Fusion Development Agreement Joint European Torus

Radiation	similar to that used in medical x-rays. "It comes in the form of electromagnetic waves that have only energy and no substance at all."[1152]
GLEEP	Graphite Low Energy Experimental Pile. The first nuclear reactor operating in the United Kingdom. Built in 1946, and operating from 1947, the reactor was closed in 1990. The decommissioning process for GLEEP began in 1994, and is expected to be completed in 2005.[1153]
Heavy Water	Heavy water (D_2O) is chemically the same as normal (light) water (H_2O), but with the two hydrogen atoms replaced with deuterium atoms. Deuterium is an isotope of hydrogen; it has one extra neutron. This extra neutron is what makes heavy water about 10% more "heavy".[1154]
HLW	High Level Waste. HLW is extremely radioactive, and very long-lived. It in two types – spent fuel (not intended for reprocessing) and fission products released from spent fuel by reprocessing.[1155] See also ILW and LLW
IAEA	International Atomic Energy Agency. Established in 1956 by the United Nations, which set the Agency's objective as being to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."[1156] The general aim of co-operation between members is illustrated in Article VII of the Statute, which states that members should make available all information that they feel would be useful, but shall make available scientific data developed with the Agency's help.[1157]
ILW	Intermediate Level Waste. ILW requires some shielding, and generally consists of chemical sludge and equipment used in decommissioning. Treatment and disposal of ILW varies depending on the waste form and whether it is short- or long- lived.[1158] See also HLW and LLW.
INEEL	Idaho National Engineering and Environmental Laboratory. Site of the EBR-1 reactor (q.v.) which first produced usable amounts of electricity on 20th December 1951.
JET	Joint European Torus. A magnetic field used to speed up plasma in the development of nuclear fusion. The JET Joint Undertaking was set up in 1978 as a separate legal entity.[1159] The Joint Undertaking ran the project until 31 December 1999, when JET was transferred to the UKAEA (q.v.), and the overall implementation and co-ordination of further scientific exploitation was carried out under the EFDA (q.v.).[1160] See also Appendix IV for an explanation of nuclear fusion.

[1152] Ramsay, C., & Modarres, M., 1998, op cit, n993, p76
[1153] UKAEA, 2004, op cit, n164
[1154] SNO, 2002, *Heavy Water,* Sudbury Neutrino Observatory, Kingston, Ontario: Queens University, available at http://www.sno.phy.queensu.ca/sno/D2O.html, accessed on 01/02/08.
[1155] WNA, 2004, *Radioactive Wastes*, London: World Nuclear Association
[1156] Article II, Statute of the International Atomic Energy Authority 1956
[1157] Article VII, Statute of the International Atomic Energy Authority 1956
[1158] WNA, 2004, op cit, n1187
[1159] EFDA-JET, 2006, *The History of JET*, Culham: European Fusion Development Agreement Joint European Torus.
[1160] Ibid.

LLW	Low Level Waste. LLW contains small amounts of short-lived radioactivity. Rags, gloves filters and so on are included in this category, which is usually incinerated or compacted[1161]. See also HLW and ILW.
Marshall Plan	The offer in June 1947 of American aid to help with the economic recovery of Europe. Britain and France accepted the aid, but the USSR rejected it. The aid, administered through the OEEC (q.v.), totalled $17 trillion between 1948 and 1952.[1162]
MAST	Mega Amp Spherical Tokomak. A magnetic field used to speed up plasma in the development of nuclear fusion. Experimentation began in December 1999, when the MAST project took over from the START (q.v.) Project. See also Appendix IV for an explanation of nuclear fusion.
NEA	Nuclear Energy Agency. Created in 1957 by the OEEC (q.v.), as an intergovernmental organisation of industrialised countries, and now run by the OECD (q.v.). Its mission is to: "to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for the safe, environmentally friendly and economical use of nuclear energy for peaceful purposes."[1163] As with most OECD organisations, the NEA is also referred to in French as L'Agence pour l'énergie nucléaire (AEN).
NIA	Nuclear Industry Association. Formed in the early 1960s (as the British Nuclear Industry Forum), the London-based NIA currently has 94 member companies in the UK.[1164] It is a trade body, and also acts as a lobbying group in favour of nuclear energy.
NIRNS	National Institute for Research in Nuclear Science. Set up in 1957 with the establishment of the Rutherford High Energy Laboratory in Oxfordshire, and the Daresbury Laboratory in Cheshire five years later. Absorbed by the Science Research Council in 1965.
NRPB	National Radiological Protection Board. Established by section 1 of the Radiological Protection Act 1970.
OECD	Organisation for Economic Co-operation and Development. Took over from the OEEC (q.v.) in 1961 after the 1960 Convention on the Organisation for Economic Co-operation and Development was signed in Paris. The OECD has two official languages, English and French, and is referred to in both, so it's other name is L'Organisation de coopération et de développement économiques (OCDE) It had a mission to: "help governments achieve sustainable economic growth and employment and rising standards of living in member countries while maintaining financial stability, so contributing to the development of the world economy"[1165]
OEEC	Organisation for European Economic Co-operation. Founded in 1948,

[1161] WNA, 2004, op cit, n1187
[1162] US DoS, 2005, *Basic Readings in US Democracy: Part IX – The Marshall Plan*, Washington DC: United States Department of State.
[1163] NEA, 2005, op cit, n180.
[1164] NIA, 2010b, *List of member companies*, London: Nuclear Industry Association.
[1165] OECD, 2005, *Overview of the OECD*, Organisation for Economic Co-operation and Development, Paris France.

	under the Marshall Plan (q.v.). This Paris-based organisation was set up to: • promote co-operation between participating countries and their national production programmes for the reconstruction of Europe, • develop intra-European trade by reducing tariffs and other barriers to the expansion of trade, • study the feasibility of creating a customs union or free trade area, and • study multi-lateralisation of payments, and achieve conditions for better utilisation of labour.[1166] Replaced in 1961 by the OECD (q.v.)
Quebec Agreement	Name given to the 1943 "Articles of Agreement Governing Collaboration Between the Authorities of the USA and the UK in the Matter of Tube Alloys" signed by Franklin Roosevelt and Winston Churchill in Quebec.
Radioactivity	The phenomenon whereby atoms undergo spontaneous random disintegration, usually accompanied by the emission of radiation.[1167]
RCL	The Radiochemical Centre Limited. Formed by the Atomic Energy Authority Act 1971 from the Radiochemical Centre, which had been established in 1940 to "work on the purification of radium for luminous paint on aircraft and submarine instrument faces".[1168] The Radiochemical Centre had been absorbed by the UKAEA (q.v.) in 1954.[1169] In 1982 RCL was the first company to be privatised under the Conservative government of Margaret Thatcher, as Amersham International.[1170]
Rem	Radiation Equivalent Man. Different radioactive elements and their isotopes emit different types of radiation. Beta (β) and Gamma (γ) radiation are far less damaging (by a factor of around 20) to living tissue than Alpha (α) radiation, and so measuring radioactivity in Curies (q.v.), Röntgens (q.v.) or Becquerels (q.v.) does not give an accurate picture of this difference.[1171]
Röntgen (The)	(or Roentgen) (R). A unit used to measure exposure, which can only be used to describe an amount of gamma and X-rays, and only in air.[1172]
RPS	Radiological Protection Service. Operated by the Medical Research Council from 1953, until it was subsumed by the NRPB (q.v.) in 1970. Not to be confused with the Dstl Radiological Protection Service, which is still operated by the Ministry of Defence in relation to Depleted Uranium weaponry.[1173]
START	Small Tight Aspect Ratio Tokomak. A magnetic field used to speed up plasma in the development of nuclear fusion. Work ceased on the Culham-based START Project in 1998, when it was replaced by the

[1166] OECD, 2004, op cit, n451
[1167] CORWM, 2006, *Glossary of Terms*, London: Committee on Radioactive Waste Management.
[1168] Amersham UK, 2004, op cit, n727
[1169] Ibid.
[1170] Ibid.
[1171] Source: Close, D., & Ledwidge, L., 2000, *Measuring Radiation: Terminology and Units*, Science for Democratic Action, 8 (4)
[1172] ISU, nk, *Radiation Related Terms*, Idaho State University Physics Department. Available at http://www.physics.isu.edu/radinf/terms.htm, accessed on 01/02/08.
[1173] MOD, 2003, *Proposal for a Research Programme on Depleted Uranium*, London: Ministry of Defence, Section 6.1.2.

	MAST Project (q.v.) Not to be confused with the Strategic Arms Reduction Talks (START I and START II) between the United States and the USSR/Russia on reducing levels of nuclear weapons. See also Appendix IV for an explanation of nuclear fusion.
WANO	World Association of Nuclear Operators. Organisation set-up in the aftermath of the Chernobyl-4 reactor accident in 1986, and based in Chicago. Their mission is stated as being: > To maximise the safety and reliability of the operation of nuclear power plants by exchanging information and encouraging communication, comparison and emulation amongst its members.[1174] WANO, which is non-governmental, claims as members all organisations operating nuclear power generating plant world-wide.
U^{235}	Uranium-235. The fissile isotope of natural Uranium, about 0.7% by mass. Chemically identical to U^{238} (q.v.), but slightly different in mass, which enables the isotopes to be separated. This makes possible the "enrichment" of the U^{235} percentage of Uranium – to 4% in civilian reactors, and 90% in weapons.[1175]
U^{238}	Uranium-238. The main isotope of natural Uranium, accounting for more than 99% by mass.
UKAEA	United Kingdom Atomic Energy Authority. Established by the Atomic Energy Authority Act 1954.
UKAEAC	UKAEA Constabulary. Created under the Atomic Energy Authority Act 1954. The force, of approximately 500 officers, protects UKAEA (q.v.), BNFL (q.v.) and Urenco sites in the UK. The UKAEC was replaced by the Civil Nuclear Police Authority (CNPA) (q.v.) in the Energy Act 2004
UNAEC	United Nations Atomic Energy Commission. Established in 1946 and tasked with ensuring the peaceful use of atomic energy. Reached an impasse in 1952, and was dissolved by the UN General Assembly.
US AEC	United Stated Atomic Energy Commission. Created by the Atomic Energy Act 1946, and charged with establishing health and safety regulations relating to atomic material. It was abolished by the Energy Reorganization Act 1974, and partly replaced by the UC NRC (q.v.)
US NRC	United States Nuclear Regulatory Commission. Established by the Energy Reorganization Act 1974, to take over some of the role of the US AEC (q.v.).

[1174] WANO, 2004, *The WANO Mission,* Chicago, IL: World Association of Nuclear Operators.
[1175] Settle, F., 2003, op cit, n992

Appendix II: Nuclear Legislation 1946-

UK Acts

Atomic Energy Act 1946

Radioactive Substances Act 1948

Atomic Energy Authority Act 1954

Atomic Energy Authority Act 1959

Nuclear Installations (Licensing and Insurance Act) 1959

Radioactive Substances Act 1960

Nuclear Installations (Amendment) Act 1965

Nuclear Installations Act 1965

Nuclear Installations Act 1969

Radiological Protection Act 1970

Atomic Energy Authority Act 1971

Atomic Energy Authority (Weapons Group) Act 1973

Atomic Energy Authority (Special Constables) Act 1976

Nuclear Industry (Finance) Act 1977

Nuclear Safeguards and Electricity (Finance) Act 1978

Atomic Energy (Miscellaneous Provisions) Act 1981

Nuclear Industry (Finance) Act 1981

Nuclear Material (Offences) Act 1983

Atomic Energy Authority Act 1986

Atomic Energy Act 1989

Electricity Act 1989

Radioactive Material (Road Transport) Act 1991

Radioactive Substances Act 1993

Atomic Energy Authority Act 1995

Nuclear Explosions (Prohibition and Inspections) Act 1998

Nuclear Safeguards Act 2000

Anti-Terrorism, Crime and Security Act 2001

Electricity (Miscellaneous Provisions) Act 2003

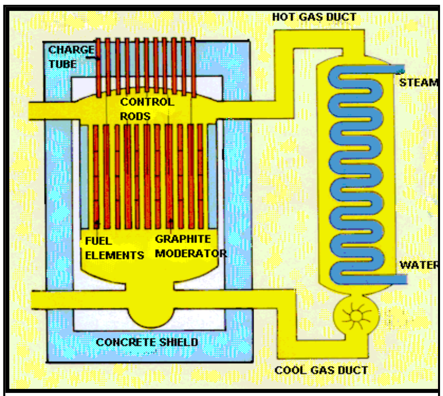
Energy Act 2004

Appendix III: Current Types of Nuclear Reactor

TYPE: ***MAGNOX REACTOR***[1176]

UK EXAMPLES: ***Berkeley, Bradwell, Calder Hall, Chapelcross, Dungeness A, Hinkley Point A, Hunterston A, Oldbury, Trawsfynydd***

The first commercial nuclear stations in the UK were of the Magnox type named after the magnesium alloy used to make the fuel can containing the uranium fuel. Magnox reactors use natural uranium metal as the fuel, have a graphite moderator and use pressurised CO_2 as the coolant. Early designs have the core contained within a steel pressure vessel surrounded by a steel and concrete biological shield over one metre thick and have the boilers located outside the shield. Later designs have a steel lined pre-stressed concrete pressure vessel, which also acts as the biological shield, with the boilers contained inside.

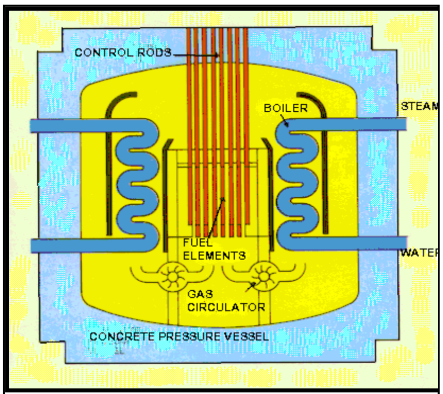


Source: DTI, 2002b

TYPE: ***ADVANCED GAS-COOLED REACTOR (AGR)***[1177]

UK EXAMPLES: ***Dungeness B, Hartlepool, Heysham 1, Heysham 2, Hinkley Point B, Hunterston B, Torness, Windscale***

The AGR design has only ever been used in the UK. AGRs use enriched uranium clad stainless steel cans and also have a graphite moderator and use pressurised CO_2 as the coolant. These allow them to operate at a higher temperature than the Magnox reactor. The AGR is encased in a steel-lined pre-stressed concrete pressure vessel several metres thick which acts as the biological shield, with the boilers inside. The coolant conveys heat from the reactor to the boilers which, in turn, heats water in an isolated steam circuit which is then used to turn the turbines, just as in coal, oil or gas-fired stations.

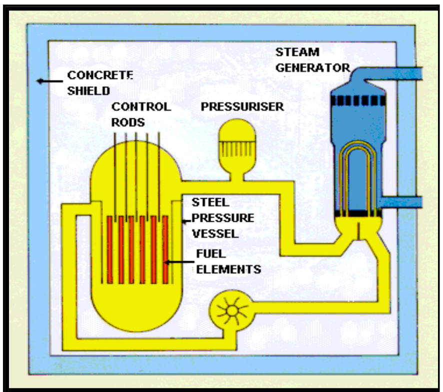


Source: DTI, 2002b

TYPE: ***PRESSURISED WATER REACTOR (PWR)***[1178]

UK EXAMPLES: ***Sizewelll B***

The PWR is contained in a steel pressure vessel. Pressurised water, which acts as both moderator and the coolant, is pumped around the reactor and through the boilers. The pressure vessel, boilers and connecting pipe-work form a sealed primary pressurised circuit, which is contained within a steel-lined pre-stressed concrete containment building, which also acts as a biological shield. The remainder of the generation process is similar to that for other power stations. Despite there only being one PWR in the UK, it is actually the most common reactor type used in the world.



Source: DTI, 2002b

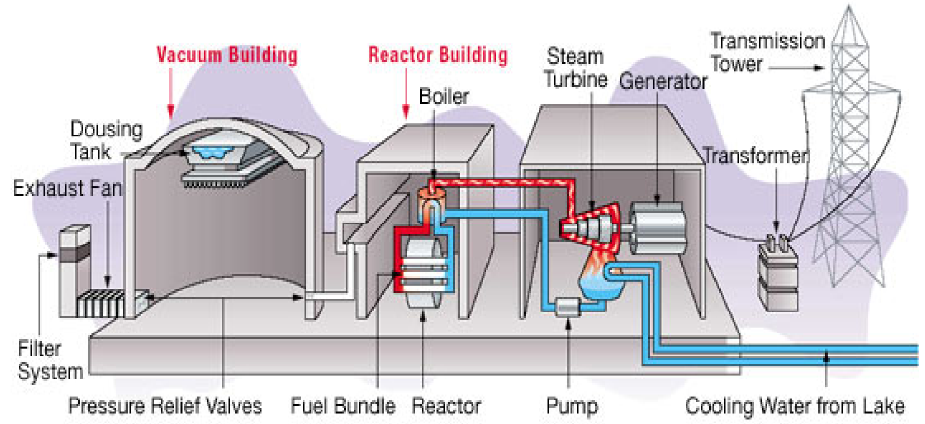
A further type of PWR is the Soviet-designed Light Water Cooled-Graphite Moderated Reactor (LGR) of the type

[1176] DTI, 2001, *Nuclear Reactors*, London: Department of Trade and Industry.
[1177] Ibid.
[1178] Ibid.

made infamous by the Chernobyl accident in April 1986. These reactors are also known by their Russian designation RBMK (for **Р**еактор **Б**олшой **М**ошкностай **К**аналнай, or Reactor Bolshoy Moshchnosty Kanalny)[1179]

TYPE: ***PRESSURISED HEAVY WATER REACTOR (PHWR)***[1180]

UK EXAMPLES: ***NONE***



Source: Ontario Ministry of Energy, 2007

These reactors are also called CANDU Reactors (**CAN**ada **D**euterium **U**ranium). CANDU is Canadian-designed power reactor of PHWR type that uses heavy water (D_20, or deuterium oxide) for moderator and coolant, and natural uranium for fuel.

CANDU is the most efficient of all reactors in using uranium: it uses about 15% less uranium than a pressurized water reactor for each megawatt of electricity produced.

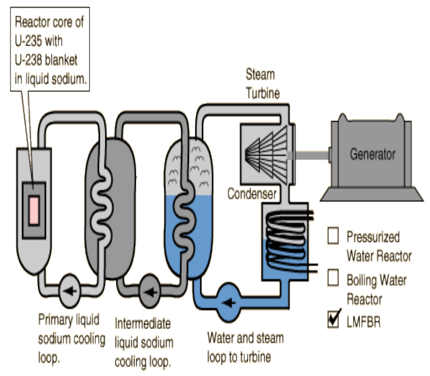
PHWRs can be refueled while at full power, which makes them very efficient in their use of uranium (it allows for precise flux control in the core). Most are in Canada, but units have been sold to Argentina, China, India, Pakistan, Romania and South Korea.

TYPE: ***LIQUID METAL FAST BREEDER REACTOR (LMFBR)***

UK EXAMPLES: ***NONE***

The fundamental principle behind the fast breeder reactor concept were discovered before the end of World War II, and the potential impact of breeder reactors on future energy supplies was immediately recognized. EBR-1 (see chapter 1), which produced the world's first nuclear-generated electricity, was an LMFBR.[1181] The term "fast breeder" refers to the types of configurations which can actually produce more fissionable fuel than they use.

France has made the largest implementation of these reactors with its Super-Phenix reactor and smaller BN-600 reactor on the Caspian Sea for electric power and desalinization.[1182]



Source: Nave, 2005

[1179] Source: INSC, 2006, *Maps of Nuclear Power Reactors*, International Nuclear Safety Center, Argonne, IL: Argonne National Laboratory.
[1180] OME, 2007, *How Nuclear Energy Works*, Toronto: Ontario Ministry of Energy.
[1181] Shi, R.R., 2003, *Liquid Metal Fast Breeder Reactor*, Department of Nuclear Engineering, Berkeley, CA: University of California.
[1182] Nave, C.R., 2005, *Hyperphysics: Fast Breeder Reactors*, Atlanta, GA: Department of Physics and Astronomy, Georgia State University.

Appendix IV
Breakdown of the Nuclear Consortia 1954-80[1183]

Phase 1

Atomic Power Group (1955-68)

English Electric Co Ltd	40 per cent (merged with GEC, 1968)
Babcock & Wilcox Ltd	40 per cent
Taylor Woodrow Ltd	20 per cent

Atomic Energy Group (1955-60, 1965-8)

General Electric Co Ltd (merged with English Electric, 1968)
Simon Carves Ltd
Motherwell Bridge Eng Co Ltd
John Mowlem Co Ltd

Atomic Power Construction (1955-60, 1965-8)

International Combustion (Holdings) Ltd
Richardson Westgarth Co Ltd
Fairey Co Ltd
Crompton Parkinson (withdrew in 1961)
Nuclear Civil Constructors—(a partnership of Trollope & Colls Ltd and Holland and Hannen and Cubitts)

Nuclear Energy Company (1955-60)

Associated Electrical Industries Ltd
John Thompson Ltd
Associated with this group (in the construction of Berkeley power station) were:
- Balfour Beatty & Co Ltd-
- John Laing & Son Ltd
- Morgan Crucible Co Ltd
- Nuclear Graphite Ltd

The Nuclear Power Plant Company Ltd (1955-60)

Clarke Chapman & Co Ltd
Head Wrightson Processes Ltd
Sir Robert McAlpine & Sons Ltd
C A Parsons & Co Ltd
Whessoe Ltd
Alexander Findlay & Co
A Reyrolle & Co Ltd
Strachan & Henshaw Ltd
Parolle Electrical Co Ltd (Parson & Reyrolle)

Phase 2

United Power Company (1960-5)

General Electric Co Ltd
Simon Carves Ltd
Motherwell Bridge Eng Co Ltd
John Mowlem Co Ltd
International Combustion (Holdings) Ltd
Richardson Westgarth Co Ltd
Fairey Co Ltd
Nuclear Civil Constructors—(a partnership of Trollope & Colls Ltd and Holland, Hannen & Cubitts (bought by Tarmac, 1976))

[1183] Source: MMC, 1981, op cit, n483, p359-61

The Nuclear Power Group (1960-9)

Sir Robert McAlpine & Sons Ltd
Associated Electrical Industries Ltd (bought by GEC, 1967)
Clarke Chapman & Co Ltd (merged with John Thompson Ltd, 1970)
John Thompson Ltd (merged with Clarke Chapman & Co Ltd, 1970)
C A Parsons & Co (merged with A Reyrolle & Co Ltd, 1968)
A Reyrolle & Co Ltd (merged with C A Parsons & Co, 1968)
Head Wrightson Processes Ltd
Strachan & Henshaw Ltd
Whessoe Ltd

The Nuclear Power Group (1969-1973)

UKAEA 20 per cent
Reyrolle Parsons 20 per cent
Sir Robert McAlpine & Sons Ltd 15 per cent
John Thompson Ltd 10 per cent (to 1970)
Clarke Chapman & Co Ltd 10 per cent (to 1970)
Clarke Chapman John Thompson Ltd 20 per cent (post 1970)
Industrial Reorganisation Corp 10 per cent (sold 5 per cent to Sir Robert McAlpine and 5 per cent to Head Wrightson in March 1971)
Head Wrightson & Co Ltd 5 per cent
Strachan & Henshaw Ltd 5 per cent
Whessoe Ltd 5 per cent

Phase 3

British Nuclear Design & Construction Ltd (BNDC) (1968-73)

UKAEA 20 per cent
Babcock & Wilcox Ltd 25 per cent (sold its boiler making business to Clarke Chapman John Thompson Ltd in 1973)
English Electric Co Ltd 25 per cent (merged with GEC, 1968)
Taylor Woodrow Construction Ltd 4 per cent
Industrial Reorganisation Corp 26 per cent

Phase 4

National Nuclear Corporation Ltd (NNC) (1973-80)

GEC Ltd 30 per cent
UKAEA 35 per cent
British Nuclear Associates Ltd 35 per cent
(in which the shareholding is:
Taylor Woodrow Construction Ltd 14.3 per cent
Clarke Chapman John Thompson Ltd 28.6 per cent
Babcock & Wilcox Ltd 34.3 per cent
Sir Robert McAlpine & Sons Ltd 7.1 per cent
Head Wrightson & Co Ltd 8.6 per cent
Whessoe Ltd 5.7 per cent
Strachan & Henshaw Ltd 1.4 per cent)

Appendix V
Initial members of the UKAEA

Sir John Cockcroft was the Member for Scientific Research.[1184] He had set up, and been the Director of, the AERE in 1946 and, amongst many other achievements, had also been a joint winner of the Nobel Prize for Physics in 1951.[1185]

Sir William Penney was the Member for Weapons Research and Development.[1186] He had been head of the team which had designed Britain's first atomic bomb, and was himself to become Chairman of the UKAEA Committee in 1964.

Sir Christopher Hinton (later Lord Hinton of Bankside) was the Member for Engineering and Production.[1187] He had been Deputy Controller of Atomic Energy (Production) at the Ministry of Supply since 1946.[1188] Hinton, along with Penney and Cockcroft, were often referred to in Whitehall as "England's Atomic Knights".[1189]

Sir Donald Perrott was the Member for Finance and Administration,[1190] and has since been lost to posterity.

Lord Cherwell, as Frederick Lindemann, was made a Professor of experimental philosophy (the name by which physics was known at Oxford at that time) at the University of Oxford in 1919.[1191] He was made Baron Cherwell in 1941, and worked as Churchill's Paymaster General from 1942 until 1945 and, again, between 1951 and 1953. In July 1945, Major-General Groves (of Manhattan Project fame) had written to Cherwell in an attempt to get his help with discrediting Leo Szilárd, who had previously worked at Oxford. Szilárd was the force behind a petition against the use of atomic weaponry, which had been signed by 69 fellow scientists and sent to President Truman in 1945.[1192] Cherwell's response was that Szilárd had "rather a bee in his bonnet about the awful implications of these matters", but that he did not represent a security risk.[1193] Baron Cherwell was promoted to Viscount in 1956.

Sir Luke Fawcett had been President of the Amalgamated Union of Building Trade Workers between 1935 and 1945.

Sir Ivan Stedeford was to make his name as the Group Managing Director of Tube Investments Ltd which, in 1958, had mounted the first hostile takeover of a public company, wresting British Aluminium (which had had Lord Plowden as its Chairman) from the bid put together by of Lord Portal of Hungerford.[1194] In an interesting circle, when Lord Portal was with the Ministry of Supply, he had been the first controller of production of atomic energy.[1195] Stedeford had also been variously on the Boards of the Bank of England and the Commonwealth Development Finance Corporation and was also a Governor of the BBC. In 1960, at the invitation of Harold Macmillan, he was to relinquish his post in the UKAEA to take on the Chairmanship of an Advisory Group on the State of British Transport (the Stedeford Committee).[1196] Stedeford was created a KBE[1197] in 1954

[1184] UKAEA, 1955, *United Kingdom Atomic Energy Authority: First Annual Report for the Period 19th July 1954 – 31st March 1955*, London: HMSO.
[1185] Nobel, 2003, op cit, n262
[1186] UKAEA, 1955, op. Cit, n1216.
[1187] Ibid.
[1188] Cockcroft, J.D., 1959, *The Miracle of Atomic Energy*, in Empire Club, 1960, *The Empire Club of Canada Speeches 1959-1960*, Toronto: The Empire Club Foundation, pp. 82-91.
[1189] Hennessey, P., 2003, n218, p52.
[1190] Ibid.
[1191] OP, 2006, *Physics at the University of Oxford*, Oxford: Oxford Physics, available at http://www.physics.ox.ac.uk/history, accessed on 01/02/08.
[1192] Szilárd, L., 1945, *A Petition to the President of the United States*, Independence, MO: Truman Presidential Museum and Library
[1193] Dannen, G., 1998, *Groves seeks evidence against Szilárd*, July 4, 1945. Available at http://www.dannen.com/decision/lrg-fal.html, accessed on 01/04/10.
[1194] Hatch, S., & Fores, M., 1960, The Struggle for British Aluminium, *The Political Quarterly*, 31 (4) 477-487.
[1195] Gray, P., 2002, op cit, n228, pp11.
[1196] IDEA, 2006, *Lessons from History: Sustainable Transport*, London: Improvement and Development Agency

and a GBE[1198] in 1964 for his work in public service.

[1197] Often incorrectly referred to as “Knight Commander of the British Empire”, but actually “Knight Commander of the Most Excellent Order of the British Empire”. Source: Robertson, M., 2002, *United Kingdom: The Most Excellent Order of the British Empire*. Available at http://www.medals.org.uk/united-kingdom/united-kingdom024.htm, accessed on 01/02/08.

[1198] Knight Grand Cross of the Most Excellent Order of the British Empire. This is the highest rank which is available within the Order.

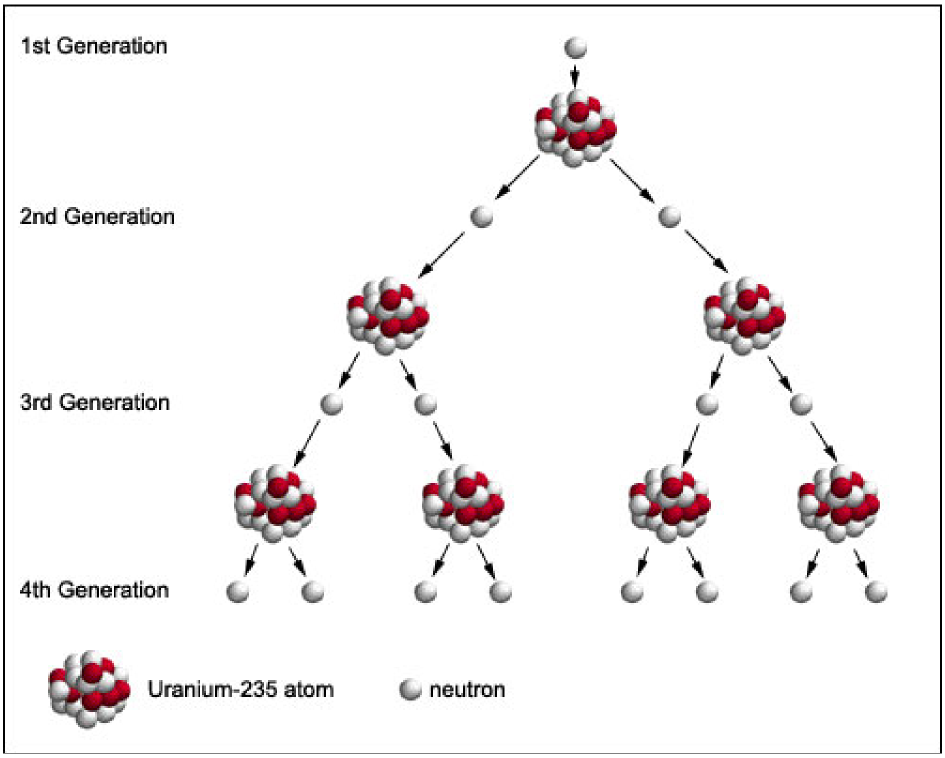
Appendix VI: The Nuclear Chain Reaction[1199]

Nuclear Fission: Basics

When a nucleus fissions, it splits into several smaller fragments. These fragments, or fission products, are about equal to half the original mass. Two or three neutrons are also emitted. The sum of the masses of these fragments is less than the original mass. This 'missing' mass (about 0.1 percent of the original mass) has been converted into energy according to Einstein's equation. Fission can occur when a nucleus of a heavy atom captures a neutron, or it can happen spontaneously.

Nuclear Chain Reactions

A chain reaction refers to a process in which neutrons released in fission produce an additional fission in at least one further nucleus. This nucleus in turn produces neutrons, and the process repeats. The process may be controlled (nuclear power) or uncontrolled (nuclear weapons). If each neutron releases two more neutrons, then the number of fissions doubles each generation. In that case, in 10 generations there are 1,024 fissions and in 80 generations about 6 x 10^{23} (a mole) fissions.



[1199] Atomic Archive, 2010, Nuclear Fission. Only available at http://www.atomicarchive.com/Fission/, accessed on 12/04/10

Appendix VII: Key nuclear sites in the UK[1200]

SITE NAME	REACTOR TYPE	OPERATOR	START DATE	POWER (MW)	END DATE[1201]
Berkeley	Magnox	BNFL	1962	Decommissioning	1989
Bradwell	Magnox	BNFL	1962	Decommissioning	2002
Calder Hall	Magnox	BNFL	1956	Closed	2003
Capenhurst	Fuel Production	BNFL/Urenco	1949	Decommissioning	1991
Chapelcross	Magnox	BNFL	1959	200	2005
Culham	Fusion Research	UKAEA	1963	n/a	2007
Dounreay	Experimental	UKAEA	1955	Decommissioning	1994
Dungeness A	Magnox	BNFL	1966	Decommissioning	2006
Dungeness B	AGR	British Energy plc	1983	1110	2018
Hartlepool	AGR	British Energy plc	1983	1210	2014
Harwell IBC	Experimental	UKAEA	1966	Decommissioning	
Heysham 1	AGR	British Energy plc	1983	1150	2014
Heysham 2	AGR	British Energy plc	1988	1250	2023
Hinkley Point A	Magnox	BNFL	1965	Decommissioning	2000
Hinkley Point B	AGR	British Energy plc	1967	1220	2016
Hunterston A	Magnox	BNFL	1964	Decommissioning	1990
Hunterston B	AGR	British Energy plc	1967	1190	2016
Oldbury	Magnox	BNFL	1968	600 / 434	2008
Sellafield	Fuel Production	BNFL	1947	Decommissioning	
Sizewell A	Magnox	BNFL	1966	Decommissioning	2006
Sizewell B	PWR	British Energy plc	1995	1188	2035
Springfields	Fuel Production	BNFL Westinghouse	1946	n/a	2023
Torness	AGR	British Energy plc	1988	1250	2023
Trawsfynydd	Magnox	BNFL	1965	Decommissioning	1993
Windscale	AGR	UKAEA	1962	Decommissioning	1990
Winfrith	Experimental	UKAEA	1957	Decommissioning	1990
Wylfa	Magnox	BNFL	1971	1180 / 980	2010

[1200] NIA, 2009, *Nuclear Energy: Locations in the UK*, London: Nuclear Industry Association.
[1201] Sources: DTI, 2003, op cit, n822, London; WNA, 2006, Decommissioning of Nuclear Facilities – Berkeley Magnox UK, London: World Nuclear Association; BNFL, 2002, Decommissioning, Warrington: British Nuclear Fuels Ltd; JESS, 2006, op cit, n1099; Ham, A., & Hall, R., 2006, op cit, n573. Where sites are listed with two power capacities, the higher figure is the maximum load, and the lower figure is the standard operating load.

Appendix VIII: Project Plowshare

Despite the growth in awareness of the potential for injury or harm attributable to peaceful uses of nuclear technology, and the licensing and liability regimes that were to spring up around it, the mid to late 1950s saw a number of plans being discussed at quite high levels for the use of the least acceptable member of the nuclear family, nuclear weapons. One of these plans was the US programme known as Project Plowshare, which was established in the summer of 1957:

> "[O]ne of the great visions of the [Plowshare] programme is a sea-level 'Panama' canal, which could be produced by a number of explosions… in each case the cost would be much lower with thermonuclear explosive."[1202]

As the existing Panama Canal was opened to traffic in 1914, it may be assumed that this plan (which never came to fruition) was for a second canal in the same style as the Panama Canal. The Sandia Corporation considered the use of nuclear explosives to create this second canal, using the plans drawn up for a second canal by the Panama Canal Company in 1947[1203] (see Figure 5.1). The proposed route was further Southeast in Panama, "away from any cities of 5000 or more inhabitants"[1204] and would require the use of "651 nuclear devices with a combined yield of 42 megatons."[1205] Other plans were being mooted along similar lines elsewhere in the world. A group known as ARTEMIS (Association de Recherche Technique pour l'Étude de la Mer Intérieure Saharienne) was set up in 1957 with the intention of opening up the Sahara for transport and agriculture:

> "a twenty megaton hydrogen bomb buried at a depth of 750m would create a crater 3km in diameter; fifty such bombs, detonated simultaneously, would within seconds blast the world's largest man-made waterway and flood almost 5,000km^2 of desert."[1206]

The ARTEMIS project failed to attract enough support and went into liquidation in 1959, having never achieved anything more than to create the plans.[1207] Unlike the Plowshare Program discussed below, the ARTEMIS project and the plans of the Sandia Corporation were privately financed, and neither possessed their own atomic weapons. These were serious flaws to achieving their aims.

This period also saw an interesting divergence of government opinion regarding the dangers of nuclear technology. On the one hand, the governments of the UK, US and other signatories of the Paris or Vienna Conventions were creating a liability scheme which would cover any damage attributable to an accidental release of radiation. On the other hand, we have seen that the US government was seriously giving thought to the use of nuclear explosions in shaping (and improving) the world, in the belief that the issue of radiation was not problematic:

> "With the data now available, however, we can say that radioactive contamination in a nuclear explosion should not be considered an insurmountable obstacle to the use of such explosions in mining and construction. On the basis of the many advantages of nuclear explosions, we conclude that the time is ripe to begin actual experiments in this field."[1208]

This belief was not initially restricted to the United States government. Indeed, the quotation above was actually nothing more than a translation of a statement by Professor

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[1202] Gaines, M., 1969, Atomic Energy, London: Hamlyn, p151.
[1203] Sanders, R., 1962, op cit, n355 pp120-1.
[1204] Ibid.
[1205] Ibid.
[1206] Fleming, F., 2004, The Sword and the Cross, London :Faber and Faber Limited, p309.
[1207] Ibid.
[1208] US Congress, 1960, Frontiers in Atomic Energy Research: Hearings before the Sub-committee on Research and Development of the Joint Committee on Atomic Energy, 86th Congress, 2nd Session, Washington, DC: Government Printing Office, p75.

Pokrovskiy, an engineer in the Soviet Union, writing in the Gornyi Zhurnal (Russian Journal of Mining) in 1956.[1209] Despite this initially common (though not shared, in the traditional sense) belief in the possibilities of using peaceful nuclear explosions, the USSR missed no opportunity in lambasting their opponent's activities once Plowshare became a reality.

The Chief Soviet Delegate to the Second International Conference on the Peaceful Uses of Atomic Energy in Geneva in 1958 "disavowed past statements by Soviet scientists, engineers and politicians expressing interest in such applications and condemned such explosions"[1210] by the United States. Despite this professed lack of belief in such systems, research carried out by the University of California on behalf of the US Department of Energy's Lawrence Livermore National Laboratory asserts that "between 1965 and 1988, the Soviet Union's 'programme for Utilization of Nuclear Explosions in the National Economy' carried out 122 nuclear explosions to study and put into use some 13 applications."[1211]

<u>Potential Routes for second "Panama Canal" (1962)</u>[1212]

The Plowshare Program, named from the New Testament passage Isaiah 2:4 ("they shall beat their swords into ploughshares, and their spears into pruninghooks: nation shall not lift up sword against nation, neither shall they learn war any more"), was spawned by the Manhattan Project of the 1940s. The project ran from 1957 until 1975 and carried out a total of 29 explosions. mainly on the Nevada Test Site; ranging from 0.03kt (Flask-Red, in 1970), to 105kt (Flask-Green, also 1970).[1213] To put these tests into perspective, over the same time period the United States carried out nearly 600 atomic weapons tests of

[1209] Pokrovskiy, G.I., 1956, On the use of nuclear explosives for industrial purposes, Gornyi Zhurnal, Vol 1, p29-36.
[1210] Nordyke, M.D., 2000, The Soviet Program for Peaceful Uses of Nuclear Explosions, Livermore, CA: US Department of Energy / Lawrence Livermore National Laboratory, p4.
[1211] Ibid, p70.
[1212] Sanders, R., 1962, op cit, n355, p121.
[1213] Ibid.

various types, with a combined yield of over 90Mt.[1214]

The US Atomic Energy Commission's information film about Project Plowshare begins with the enthusiastic introduction:

> "To bring water and food where there is only parched earth. And people where there is desolation. To bring freedom of movement where there are imposing barriers. And commerce where nature has decreed there will be isolation. To bring forth a wealth of material where there are vast untapped resources. And a wealth of knowledge where there is uncertainty. To perform a multitude of peaceful tasks doe the betterment of mankind, man is exploring a source of enormous potentially useful energy. The nuclear explosion."[1215]

The film continues in much the same vein, extolling the virtues of such a programme, both within the US, but more likely in other countries and, although the potential threat from radiation is mention in passing toward the end of the film, the level of risk is greatly underemphasised.

Despite the enthusiasm of the nuclear industry for the use of Plowshare development, the project never came to fruition. A combination of public opposition and the lack of willing sites for further tests led to the abandonment of Plowshare on 30th June 1975.[1216] Later, the signature by the United States of and Russia of the 1996 UN Comprehensive Test-Ban Treaty would make the resurrection of any similar ideas increasingly difficult, if not impossible.

[1214] DoE, 2000, United States Nuclear Tests: July 1945 through September 1992, Document Number DOE/NV-209-REV 15, Las Vegas, NV: US Department of Energy, Nevada Operations Office, pp9-61. The largest single test (codenamed Poplar), was part of Operation Hardtack I, detonated on 12 July 1958, and had a yield of 9.3Mt.

[1215] US AEC, 1965, Peaceful uses of Nuclear Explosions, U.S. San Francisco, CA: Atomic Energy Commission, San Francisco Operations Office

[1216] BBC, 2002, Project Plowshare – 'Peaceful Nuclear Explosions', BBC, London. Available at http://www.bbc.co.uk/dna/h2g2/A685109, accessed on 12/04/10.