What Stimulants & Impediments Exist in the Application of the Private Finance Initiative to Provide Better Value for Money in Nuclear Energy Generation in the United Kingdom?

Daniel Martyn Cadman

Master of Research
Innovation & Improvement in Property & Construction

University Of Salford

Research Institute for the Built & Human Environment
School of Construction & Property Management

2005
# Table of Contents

<table>
<thead>
<tr>
<th>List of Figures</th>
<th>iv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>vi</td>
</tr>
</tbody>
</table>

## 1.0 Chapter One

| 1.1 Innovation & Creativity as a Platform for Improvement | 1 |
| 1.2 Introduction to Nuclear Power & The Private Finance Initiative | 3 |
| 1.3 Constraints, Limitations, Exclusions & Reservations to the Study | vii |

## 2.0 Chapter Two

| 2.1 The Impending Energy Crisis | 8 |
| 2.2 Renewable Energy | 11 |
| 2.3 Nuclear Power | 14 |
| 2.4 Summary | 29 |

## 3.0 Chapter Three

| 3.1 Background and Evolution of the Private Finance Initiative | 30 |
| 3.2 The Private Finance Initiative | 32 |
| 3.3 The Stimulants & Impediments to the Private Finance Initiative | 37 |
| 3.4 PFI Project Experience | 46 |
| 3.5 Summary | 51 |

## 4.0 Chapter Four

| 4.1 Nuclear Power & the PFI | 52 |
| 4.2 Theoretical Model Development | 56 |

## 5.0 Chapter Five

| 5.1 The Epistemological Framework | 62 |
| 5.2 Semi-structured Interviews for Research Candidates | 69 |
| 5.3 Semi-structured Interview Results | 75 |
6.0 Chapter Six

6.1 Research Interview One:
Photovoltaics in the Private Sector... 76

6.2 Research Interview Two:
The PFI - Local Authority... 110

6.3 Summary of Research... 124

7.0 Chapter Seven

7.1 Conclusions & Further
Theoretical Model Development... 125

7.2 Evaluations &
Recommendations for Further Research... 137

Appendices

Appendix 1
Research Interview One:
Interview Agenda ~
Nuclear Power - Private Nuclear Organisation... 142

Appendix 2
Research Interview Two:
Interview Agenda ~
The PFI - Local Authority... 171

Appendix 3
Interview Contact Pack... 182

Glossary

Glossary & Abbreviations... 196

References

List of References... 199
List of Figures

Figure 2.1 Primary Energy Demand & Electricity Generation in the UK in 2002
Figure 2.2 Progress Against Greenhouse Gas & Carbon Dioxide Targets
Figure 2.3 Primary World Energy Sources Over Time
Figure 2.4 Public Attitudes to Nuclear Power
Figure 2.5 Distinction of Human Factors
Figure 2.6 Elements of Nuclear Costs
Figure 2.7 Projected Costs of Generating Electricity
Figure 3.1 Typical PFI Cashflow
Figure 3.2 Improved Project Delivery Under the PFI
Figure 3.3 PFI Stimulants to Success
Figure 3.4 Price Certainty Experience in PFI Projects Involving Construction
Figure 3.5 PFI Impediments to Success
Figure 4.1 Stimulants to Nuclear Power & the PFI
Figure 4.2 Impediments to Nuclear Power & the PFI
Figure 4.3 PFI/Nuclear Power Stimulants: Theoretical Model
Figure 4.4 PFI/Nuclear Power Impediments: Theoretical Model
Figure 7.1 Critical Appraisal of Theoretical Model Stimulants
Figure 7.2 Critical Appraisal of Theoretical Model Impediments
Figure 7.3 PFI/Nuclear Power Stimulants: Revised Theoretical Model
Figure 7.4 PFI/Nuclear Power Impediments: Revised Theoretical Model
This dissertation is dedicated to

Katrina
'There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to take the lead into the introduction of a new order of things'

(Niccolo Machiavelli, 1469-1527)
Abstract

In February 2003 the Government issued a White Paper reviewing energy policy. Diminishing indigenous natural supplies, the loss of the United Kingdom’s nuclear energy generation capacity, with the exception of the Sizewell B nuclear power station, by 2020 and an increase in both local and global demand for energy are leading toward an energy crisis. The Government must reduce greenhouse gas emissions by 60% of their 1990 levels by 2050; this means the required additional energy capacity should not be achieved by burning further fossil fuels. Renewable sources of energy are not either sufficiently technologically advanced or economically viable to account for the approaching shortfall. New nuclear energy generation facilities could potentially generate the required energy without increasing greenhouse gas emissions. An innovative solution to create economically viable, value for money nuclear energy generation facilities is required. The Private Finance Initiative is a procurement model aimed at providing value for money and the efficient allocation of risk within a project. Through the use of an extensive literature review and two semi-structured interviews a theoretical model was developed and refined to show what stimulants and impediments exist in the application of the Private Finance Initiative to provide better value for money in nuclear energy generation. The main stimulants to the PFI and its use in nuclear energy generation are the ability of nuclear to provide affordable, reliable and secure, environmentally acceptable energy and with the use of PFI achieve those aims through competitive markets, thereby meeting the aims of the White Paper. The main impediments include current political uncertainty over licensing and approvals of new nuclear plants, uncertainty over waste policy and an overall uncertainty over the future of the industry itself.

Keywords: Innovation; Nuclear Energy; Private Finance Initiative (PFI); Stimulants; Impediments
1.1 Innovation & Creativity as a Platform for Improvement

The following research seeks to show how innovation and creativity can be used as a platform for adopting new approaches to nuclear power generation procurement. In order therefore, to be able to provide innovative solutions to the current challenges faced by both the industry and society as a whole we must first understand exactly what we mean by innovation. Kuhn (1993) defines innovation as a new method or mode of operation, viewed as a process that can be managed and moved in new directions. Rouse (1992) suggested that innovation is the ‘introduction of change via something new.’ Some see innovation as an event in its own right with a measurable, specific outcome (Zaltman et al, 1973); others see innovation as a process of providing a new solution to an existing challenge (Kuhn, 1993; Ghoshal & Bartlett, 1987; Meyers & Marquis, 1968). The author prefers Wheatley’s (1992) definition of innovation:

Innovation is fostered by information gathered from new connections; from insights gained by journeys into other disciplines or places; from active, collegial networks and fluid, open boundaries. Innovation arises from ongoing circles of exchange, where information is not just accumulated or stored, but created. Knowledge is generated anew from connections that weren't there before.

(Wheatley, 1992, p.113)

Fagerberg (2003) suggested that innovation is ‘a powerful explanatory factor which explains the differences in performance of competing organisations at all levels from an individual to companies, even between competing countries on a global stage. The survival and prosperity of these organisations, the ability to
create and maintain a competitive advantage, is increasingly dependant on
creativity and the ability to continue to provide innovative ideas and solutions to
perceived challenges (Eaton et al, 2005).

There are, however, barriers to innovation, ‘lack of infrastructure, deficiencies in
education and training systems, inappropriate legislation an overall neglect and
misuse of talents in society’ (Neely, 1998). Neely (1998) further stated that
barriers could exist internally within organisations in the form of rigid
organisational structures, bureaucracy, resistance to change, formal
communication structures, preference for the ‘safe’ option (risk avoidance) and
an overall lack of vision. Communication is important for innovation to thrive,
common barriers to effective communication include individual bias and
selectivity, status differences which involve subordinates withholding
information or superiors underestimating the importance of a subordinates
contribution, fear of retribution from mistakes or bad news, lack of trust, verbal
difficulties relating to ‘jargon’ or level of expertise, and too much information
which overloads the person or system (Cole, 1996). Wiig & Wood (1997)
suggested further barriers to innovation such as the high potential costs of
innovation, a lack of information concerning the challenges faced or the
perceived market and little or no backing from government or legislation. In
order to innovate successfully attention must be given to the barriers to
innovation to ensure that they are well managed in order to eliminate them
where possible or minimise their impact when elimination is impossible.

‘After decades of slow evolution, the world of construction has changed rapidly
in recent years...’ (Paulson, 1995). The study of innovation in construction and
the construction industry presents many challenges; not least due to the
number of differing, competing organisations involved within the industry
(Manseau & Seaden, 2001). The study of the construction of the single most
complex, controversial and potentially dangerous structure/installation
throughout the industry (a nuclear power generation facility) therefore presents
a much greater challenge but also the potential for a much greater scope for
innovative solutions to the challenges identified. Innovation and change are
continually increasing in their importance to modern business organisations (Henry & Mayle, 2002). Innovation and the ability to innovate are crucial in today's market. 'Fast innovators' significantly increase organisations' competitiveness, failure to be competitive leads to reduced market share and ultimately profitability (Rudolph, 1989).

1.2 Introduction to Nuclear Power & The Private Finance Initiative

One of the biggest Clients in the UK's construction industry is the UK Government. The potential benefits from innovation cannot be ignored especially with the vast resources in both capital and expertise that exist within Government. Jackson (2003) suggests borrowing best practice from different industries and combining that with existing technologies in different ways to outperform competition. Borrowing best practice from another industry, or another sector within the organisation's industry, could be expanded to include policies, procedures and models not just technologies. Could therefore, an existing procurement model already used in industry provide an innovative solution to the economic problems faced by nuclear energy generation?

This research intends to identify what stimulants and impediments exist in the application of the Private Finance Initiative to provide better value for money in nuclear energy generation in the United Kingdom. In February 2003 the Government published its white paper on energy policy. The 'Energy White Paper: Our Energy Future – Creating a Low Carbon Economy' (EWP) (DTI, 2003) set out the Government's vision for the provision of energy in the United Kingdom in future years:

Energy is vital to a modern economy. We need energy to heat and light our homes, to help us travel and to power our businesses. Our economy has also benefited hugely from our country's resources of fossil fuels - coal, oil and gas.
However, our energy system faces new challenges. Energy can no longer be thought of as a short-term domestic issue. Climate change largely caused by burning fossil fuels threatens major consequences in the UK and worldwide, most seriously for the poorest countries who are least able to cope. Our energy supplies will increasingly depend on imported gas and oil from Europe and beyond. At the same time, we need competitive markets to keep down costs and keep energy affordable for our businesses, industries, and households...

(The Rt. Hon. Tony Blair MP Prime Minister, 2003, p.3)

Griffiths & Berry (2005) suggested diminishing supplies and an ever increasing demand for energy are leading to an energy crisis. With the steep decline of the UK’s energy supplies, notably gas, oil and coal, the UK will be highly dependant on external sources for those supplies. The EWP’s statistics on the import/export of UK energy over the next 15 years provide a disturbing review of the situation; it estimates that by 2020 over 75% of the UK energy supplies will be imported from an external source (DTI, 2003). Chapter Two of this research reviews the potential for an energy crisis, renewable energy and the issues surrounding both the need for new nuclear power generation facilities and the issues concerning nuclear power itself.

The third chapter reviews the Private Finance Initiative (PFI). The PFI was initially created under the Conservative Government in their economic policies outlined in 1992 (although earlier examples of the PFI philosophy in the form of financially free-standing projects do exist (Fox & Tott, 1999). The purpose of this initiative was to introduce private investment into public services in situations where privatisation was not a practical option (Fox & Tott, 1999). The aim of the Government was to increase the provision of public services whilst keeping a restraint upon public expenditure (RICS, 1995). Chapter three focuses on the PFI, its background, theory and basic process. An in depth investigation of the stimulants and impediments to PFI generally as a procurement route is conducted and finally a review of existing research
conducted on actual PFI projects was undertaken to show evidence supporting the reviewed literature.

The fourth chapter seeks to conclude the literature review. This is achieved by summarising the previous two chapters and identifying the stimulants and impediments uncovered by the literature review. Following this a theoretical model is developed. This model is based upon prior research conducted by Eaton et al (2005) into stimulants and impediments to innovation in the PFI process, following a critical appraisal of Eaton et al’s research the author adapted Eaton et al’s theoretical framework to suit the purposes of this research.

The fifth chapter of this research focuses on the research required and the methodology chosen to acquire this knowledge. The chapter goes on to design an in depth interview aimed at two figures within both the construction and the nuclear industry. These figures were interviewed to ensure that the literature review undertaken was both comprehensive and accurately reflects the industry’s current position, it also enables a critical review of the theoretical model developed. The interviews focused upon current attitudes toward innovation, nuclear energy generation, thoughts on the use and success of PFI as procurement model and the opinions of respected professionals upon the applicability and use of PFI to nuclear energy generation. The results of these interviews can be found in chapter six (full unedited transcripts are included in the appendices).

Finally the seventh chapter draws conclusions based upon the research undertaken and then develops further the theoretical model created in chapter four. The final section of this study conducts an evaluation of this research and summarises potential areas for further research that have been identified throughout this research process.

This research seeks to increase public sector knowledge about innovation, nuclear power generation, the PFI process and how all three can interrelate with
the current Government's policy on sustainability. It also seeks to show how through innovative and creative thought processes and research, new ideas can be developed to provide solutions to old problems.

1.3 Constraints, Limitations, Exclusions & Reservations to the Study

Innovation and creativity, nuclear power generation and the Private Finance Initiative represent three very broad areas of research and it is beyond the remit of this research to cover each topic at a very detailed level. The study of innovation and creativity prior to this research has developed a question. This research intends to identify the stimulants and impediments to the application of the PFI to nuclear power generation. The research does not seek to place those issues identified in any order of significance nor does it seek to offer solutions to eliminate impediments or enhance the stimulants. The identification of those stimulants and impediments is the sole purpose of this research. This does however highlight potential areas for further study following completion of this research.

With respect to the specific topics a general overview of the energy industry is required. This research will not however, discuss the benefits of the various different energy sources or sectors, for example the advantages and disadvantages of each renewable energy source will not be discussed, much research has already been completed in this area and a general summary including directions to prior research is all that is required. Similarly with the PFI a general discussion of its history and the way in which it works will be sufficient to allow the research question to be studied. An in-depth look at the PFI, its contractual intricacies or payment mechanisms for example is not required and will not be included in this research.

Finally there are moral and ethical issues that could be raised with respect to any research and nuclear power is no exception. The moral issue of whether we should be creating more nuclear waste for example, when we have no
ultimate solution for its disposal shows the importance of morals and ethics. This research will not seek to answer those questions although it may highlight them if they are determined to be a specific stimulant or impediment to the research premise.
Chapter Two


2.1 The Impending Energy Crisis

As a result of increased population growth and economic development the demand for energy is continuing to increase (Turner & Weston, 1996). This increase is not only in the UK but globally, estimates in the United States forecast requirements for 393,000 megawatts of new generation capacity by 2020 (ONEST, 2003). The UK's primary energy demand is currently heavily dependant upon gas and oil (see Figure 2.1). This dependence can only increase over the next 15 years; only 3 of the UK's 16 nuclear power stations will still be operational by 2020 (Barker, 2001) and only Sizewell B by 2023 (Bull, 2005) unless they are given operational life extensions by the Government. This would significantly reduce the electricity generated by nuclear sources which currently account for 23% of UK electricity generation (See Figure 2.1). This reliance on gas and oil is not only environmentally unfriendly it is also politically dangerous. The dangers of relying on other nations (primarily Russia, Iran and Algeria (Barker, 2001)) for the UK's energy supplies range from a weakened diplomatic position to threats of terrorism against supply routes/methods.

This dependence on oil is also short-sighted. As McKillop (2005) suggested, unless there is an economic slowdown across the western economies world oil supply will fail to meet the level of demand in the next 3 years. Griffiths & Berry (2005) also suggested that world oil production may peak by 2008, leaving a limited time to prepare for an alternative energy economy. Hirsch et al (2005) suggested that the peaking of world oil production offers an unprecedented risk
management problem. The UK is beginning to feel the effects of this type of problem. North Sea oil and gas is in steep decline and predictions suggest it will be exhausted within 10 years (Griffiths & Berry, 2005).

![UK Primary Energy Demands 2002](image)

![UK Electricity Generation 2002](image)

**Figure 2.1 Primary Energy Demand & Electricity Generation in the UK in 2002 (DTI, 2003)**

Bruntland (1987) suggested that to be sustainable the world must aim to 'meet the needs of present generations, without compromising the ability of future generations to meet their own needs.' The dependence on oil to meet the world’s demand for energy is therefore unsustainable. Supplies are limited and there is also the issue of Carbon and other greenhouse gas emissions to consider. Climate change is the first challenge discussed in the EWP, the DTI (2003) suggested that global temperatures were rising due to human activities and the rising levels of Carbon in the atmosphere. The Kyoto Protocol required the Government to agree to cut Carbon emissions by 12.5% of 1990 levels by 2010 (see Figure 2.2). Furthermore the Government has pledged to cut greenhouse gas emissions by 60% (of 1990 levels) by 2050 (Bull, 2005). The continuing use of fossil fuels to generate electricity will mean a continuation of the emission of Carbon into the atmosphere. Palmer (1999) advocated that only half of the current levels of Carbon being emitted could be consumed naturally by the earth. Griffiths & Berry (2005) suggested that if the continuing
demand for energy is met through further consumption of fossil fuels then global warming, due to the Carbon emissions, would be as great an issue as the energy shortages themselves.

Cook (1999) suggested that fossil fuels will continue to be the key source of energy well into the next century. Fisher (1999) also confirmed that fossil fuels will still be needed but should be regarded as transition fuels in a move toward renewable energy sources. There are also those who believe that the looming shortage of fossil fuels is not as urgent as it would seem, Lynch (2002; 1999) suggested that current supply problems and high oil prices were due to ‘short-term, transient’ problems and that the perception of a crisis could in actual fact cause the crisis itself. Lynch was discussing an economic crisis rather than the problems that would result from the exhaustion of the worlds non-renewable fuel supplies. Chavez (2001, cited by Ackman, 2001) stated:

‘There is no energy shortage... there is so much oil and natural gas in the ground. There are more known reserves now than there ever has been.’

(Chavez 2001, cited by Ackman, 2001, p.1)
The supply and demand for oil is not the only problem facing continuing supplies however, O’Reilly (2005) stated that access to current reserves will continue to grow in difficulty due to both geological difficulties and geo-political instability. These views on the levels of current reserves are not widely held however, especially when, as Griffiths & Berry (2005) stated, Shell downgraded its proven oil reserves by 23% in 2004 and OPEC may also be overstating reserves in order to secure greater production quotas. The consensus in the literature reviewed suggests that the exhaustion of the world’s reserves will happen and sooner rather than later (Griffiths & Berry, 2005; Hirsch, 2005; Koroneos et al, 2003; Cook, 1999; Palmer, 1999; IEA, 1998; Edwards, 1997).

2.2 Renewable Energy

The alternatives to non-renewable fossil fuels, which produce Carbon emissions when used, are renewable energy sources. Renewable energy sources rely on natural energy flows within the environment; they are continually replenished and are therefore sustainable (Elliot, 1997). However as Fisher (1999) pointed out:

‘Inherent in resource development and consumption is exploitation; inherent in maintaining the global environment is preservation or at least conservation, seemingly opposites.’

(Fisher, 1999, p. 191)

The exploitation of the earth’s natural resources is driven primarily by economic factors. Non-renewable energy sources provide a higher energy yield, more cheaply than renewable sources; this enables increased economic output much faster (Edinger & Kaul, 2000). There has however, been a distinct move toward more environmentally sound energy sources (Graedel & Allenby, 1995). The UK Government are keen to pursue solar, wind and wave/tidal technologies to provide indigenous energy. The problem with renewable energy sources is that
the technology is not sufficiently developed to provide an efficient and economic method of energy generation (Koroneos et al, 2003). Christie (2002) goes further suggesting that technical solutions will not provide the answer to allow 'our consumerist-industrialist society' to continue as it has in the past. Renewable sources of energy are still only a marginal source of energy generation, there is a theoretical potential however, to meet all the worlds' energy needs through renewable supplies (Elliot, 1997).

As Edinger & Kaul (2000) suggested however the move toward renewable sources represents as much of a regression in energy usage as it does advancement. Figure 2.3 explains this philosophy:

![Figure 2.3 Primary World Energy Sources Over Time (Edinger & Kaul, 2000)](image)

The UK Government has been pursuing renewable energy for over thirty years. It set up the Energy Technology Research Unit in 1974 to conduct research and development into renewable energy projects (Elliot, 1999). There are a number of renewable sources of energy generation. Elliot (1997) suggests the most popular methods are as follows:

- Solar Power;
- Wind Power;
The UK adopted a number of these sources of energy generation including wind power and waste and energy crops (Turner & Western, 1996). Renewable energy only accounted for 3% of electricity generation in the UK in 2002 (see Figure 2.1). There is also a move toward other renewable energy sources, Stuart-Menteth (2005) reviewed construction projects including the Vauxhall Cross Transport Interchange which utilised solar photovoltaic systems and Ford’s Dagenham plant which has installed wind turbines to provide its electricity requirements.

In order to create a sustainable energy environment it is necessary to look not only at energy generation but also at improving efficiency of both energy generation and it usage (Edinger & Kaul, 2000). The combination of improving energy efficiency and moving toward renewable energy sources will enable a sustainable approach to the creation of energy for the future of society. It is not the aim of this research to review the advantages and disadvantages of each renewable energy source, much work has previously been completed in this area (see Koroneos et al, 2003; Fisher, 1999; Edinger & Kaul, 2000; Elliot, 1999 & 1997; Coiante & Barra, 1996). Although renewable energies are vital to future energy supplies, they are not sufficiently advanced to meet the needs of modern society. Indeed the WEC (1993) suggested that renewable energy sources would take many decades to develop to a point where they could be considered a viable alternative to fossil fuels, even with widespread support and promotion. Coiante & Barra (1996) suggested the limitations to the development of renewable sources of energy were due to the intermittent nature of generation which led to economical barriers to market entry. The
evidence reviewed above has shown it is unsustainable to continue to use fossil fuels, as Cook (1999) has suggested will be the case.

What is required therefore is another option. A method of energy generation that does not exploit the earth’s resources and is sustainable. A method of generation that does not produce Carbon emissions but also a method of energy generation that can meet the required level of demand. Nuclear energy generation would provide a long-term, non-Carbon solution (Barker, 2001). Turner & Western (1996) suggested that due to the UK’s strong technological background and its experience with nuclear power, the opportunity for growth in this ‘sustainable, non-polluting’ energy should not be overlooked.

2.3 Nuclear Power

Nuclear power is generated by splitting the nuclei of naturally occurring radioactive materials, such as Uranium, through a chain reaction known as Nuclear Fission (Elliot, 1997). The heat produced through the process of nuclear fission is used to generate electricity (Ramsay & Modarres, 1998). Hubbert (1956) stated that energy creation from nuclear fission had great potential for meeting future energy demand. Hubbert’s (1956) study into nuclear energy and the fossil fuels predicted the coming oil shortages decades before his theories were proven to be correct. Nuclear energy generation however, has many issues which need to be addressed and understood in order to fully identify the stimulants and impediments to future expansion of nuclear power generation facilities in the UK. There are a number of political, economic, social, technological, legal and ecological issues that need to be explored (Huczynski & Buchanan, 2004), including inter alia the public acceptance of nuclear power, what to do with the nuclear waste that is created, proliferation of nuclear weapons and the current viability of the economics of nuclear energy generation. The EWP states the following with regard to new nuclear power stations in the UK:
Nuclear power is currently an important source of carbon-free electricity. However, its current economics make it an unattractive option for new, carbon-free generating capacity and there are also important issues of nuclear waste to be resolved. These issues include our legacy waste and continued waste arising from other sources. This white paper does not contain specific proposals for building new nuclear power stations. However we do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets.

Before any decision to proceed with the building of new nuclear power stations, there will need to be the fullest public consultation and the publication of a further white paper setting out our proposals. (DTI, 2003, p.12)

The single biggest impediment to the development of nuclear energy generation in the UK is both a political and a technological one. The IEA (1998) suggested that public acceptance of nuclear power plants and the development of the latter stages of the nuclear fuel cycle were inextricably linked. Public opposition to nuclear power plants is strong in the UK and globally, Elliot (1997) stated that 78% of those interviewed in a survey on nuclear power in the UK in 1991 wanted 'no more nuclear plants at present' or for nuclear power to be halted. Opinion in Sweden, who in the early fifties through to the mid-seventies were in favour of nuclear power, changed swiftly following the accidents at Three Mile Island, USA (the accident occurred in 1979, human error led to a reactor core melt down resulting in contaminated material being released into the atmosphere (Cox & Cox, 1996)) and Chernobyl, 1986 (the worst accident in nuclear history in which two explosions blew off the 1000 tonne concrete cap off the Chernobyl-4 reactor releasing molten core fragments and fission products into the atmosphere (Cox & Cox, 1996)). The Swedish government following these accidents (the fall-out from Chernobyl had direct effects in the north of Sweden) and separate reviews into energy production in Sweden decided to phase out nuclear power and close two reactors in the mid-nineties (Price,
Sweden currently has 10 operating nuclear power stations which provide 45% of Sweden's power (UICL, 2005a). Public opinion in Sweden is changing however, in 2004 the following results were obtained:

In April 2004, 77% of people gave top environmental priority to restraining greenhouse gas emissions, 13% to protecting unspoiled rivers from hydro-electric development, and only 7% to phasing out nuclear power. On nuclear power matters, 17% supported a nuclear phase-out, 27% favoured continued operation of all the country's nuclear power units, 32% favoured this plus their replacement in due course, and 21% wanted to further develop nuclear power in Sweden. The pro-nuclear total thus was 80% as the government tried to negotiate a phase out.

(UICL, 2005a, p.1)

Sweden's position is in direct contrast to the UK in which public support for nuclear power has declined in recent years as Figure 2.4 shows.

<table>
<thead>
<tr>
<th>Poll Date</th>
<th>% Favourable</th>
<th>% Neither or Don't Know</th>
<th>% Unfavourable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986 Feb</td>
<td>37</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>1988 June</td>
<td>30</td>
<td>14</td>
<td>54</td>
</tr>
<tr>
<td>1990 Nov</td>
<td>31</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td>1992 Oct</td>
<td>26</td>
<td>14</td>
<td>54</td>
</tr>
<tr>
<td>1994 Oct</td>
<td>24</td>
<td>9</td>
<td>65</td>
</tr>
<tr>
<td>1997 Jan</td>
<td>23</td>
<td>18</td>
<td>58</td>
</tr>
<tr>
<td>2001 July</td>
<td>21</td>
<td>26</td>
<td>53</td>
</tr>
</tbody>
</table>

Figure 2.4 Public Attitudes to Nuclear Power (Hague & Wylie, 2003)

Whi Lee (2002) suggested that negative attitudes toward nuclear power are more prevalent in the western economies. Whi Lee's research focused on nuclear power in Korea in which he identifies the following stimulants to the continuing development of nuclear power in Korea:
• Keeping nuclear power as a major base load option available to meet rapidly rising electric demand;
• Reducing energy import dependence;
• Improving air quality and reducing Green House Gas emissions;
• Easing energy supply logistics;
• Benefiting from the technological spin-offs of high technology.

(Whi Lee, 2002, p.329)

Whi Lee (2002) continued to suggest that the planned pace of nuclear power deployment faced several problems which could be remedied through international co-operation with the International Atomic Energy Agency (IAEA) or the Nuclear Energy Agency/OECD. The article also suggested that this would ensure that nuclear energy would act as the sustainable alternative to fossil fuels in the future. The impediments Whi Lee (2002) identified are as follows:

• Improve Economic Competitiveness;
• Correct Public Misconception;
• Strengthening Safety Culture;
• Improving Effectiveness of Spent Fuel and High Level Radioactive Waste Management;
• Proliferation Resistant.

(Whi Lee, 2002, p.329)

As Whi Lee (2002) and the IEA (1998) identified one of the key impediments to nuclear power generation, and a key stimulant to public opposition to nuclear power is the development of waste management and reprocessing procedures. Ramsay & Modarres (1998) maintain that to ensure continued efficiency in nuclear reactor performance one third of the spent fuel has to be replaced every eighteen months. This waste has to be comprehensively treated to ensure that
the environment is protected from radioactivity (Hare & Aikin, 1984). Nuclear waste is first stored temporarily until it can be reprocessed. Reprocessing the waste extracts recyclable material which is converted back into new nuclear fuel, the remaining material is then stored in nuclear waste repositories (Ramsay & Modarres, 1998). Ramsay & Modarres (1998) continued to suggest that only 4% of nuclear waste would require disposal following advanced reprocessing techniques, they even suggest that this 4% could be reprocessed using advanced isotope technologies, the current economics however are not suitably favourable for this to take place.

Storage of the final waste product aims to remove the waste from any contact with the living environment, Hare & Aikin (1984) stated the following options for storing nuclear waste in an ‘engineered’ site:

- Surface or shallow sub-surface permanent storage;
- Burial in glacial ice (Antartica for example);
- Dispatch to space by rocket vehicle;
- Burial of canisters in the deep ocean;
- Geological containment on land.

(Hare & Aikin, 1984, p.334)

Currently geological containment on land is the preferred method of storage (Van der Zwaan, 2002; Hare & Aikin, 1984). Van der Zwaan (2002) stated that there is currently no final solution to the long-term storage issues, primarily due to the uncertainty over the integrity of spent fuel canisters over thousands of years; it takes approximately 240,000 years for the toxicity level of non-reprocessed Plutonium-239 to be considered safe (ten times its half-life) (Lai, Morrison, 2005). Europe and Russia reprocess nuclear waste so it can be used as further fuel in the nuclear reactor (UICL, 2005b).

Turner & Western (1996) stated that nuclear waste amounts to only 1% of the total chemical waste produced in the UK; additionally many of the chemical
wastes produced remain hazardous for longer than radioactive nuclear wastes. Hare & Aikin (1984) conclude that, in the short-term, disposal and storage of nuclear waste is both technically feasible and very safe and environmental and health risks are negligible. Ultimately, as the IEA (1998) suggested 'the demonstration of nuclear safety' is synonymous with 'public acceptance.'

A key barrier to the expansion of nuclear power identified above as a major influence on public perception and acceptance are nuclear accidents and safety. As Ramsey & Modarres (1998) pointed out society wishes to benefit from the innovations of technology but at the same time want to remain free of the dangers that new technology may pose. In April 1998 the nations of the G8 agreed that safety was the absolute priority with respect to nuclear power (IEA, 1998).

There are currently approximately 400 nuclear reactors worldwide and with the current technical improvements in nuclear safety the potential for a serious accident has been reduced to approximately one per century (Van der Zwaan, 2002). Eyre (1993) suggested that predicting possible nuclear accidents was entirely speculative and predictions ranged from 1 per 100,000,000 GW years to 1 per 1000 GW years, the latter figure being based on actual operating experience. These predictions should be viewed in the context that there have been three major nuclear accidents in the last 50 years, the Windscale fire in the UK in 1957, the Three Mile Island incident and Chernobyl, both discussed above (Elliot, 1997).

The safety issue also raises a further problem, the nuclear industry in the UK, although heavily regulated, is still a privatised industry with a remit to make a profit from its undertakings. Launet (1996, cited by IEA, 1998) put forward the argument that competition in the nuclear industry could lead to lower safety levels. The NEA (2000) suggested that 'the market discipline of competition... will make these [waste disposal and decommissioning] costs and the associated economic risks more apparent.' The two solutions to this problem are either stringent regulation or nationalisation of the industry. Nationalisation
is not a concept that the Government in the UK favours. Heavy regulation on the nuclear industry is therefore the key to ensuring nuclear power remains safe, this may harm competitiveness however. The NEA (2000) suggested that nuclear power could prove more competitive if other electricity generation methods were subject to environmental penalties such as a tax on Carbon emissions. A further review of nuclear competitiveness is undertaken later in this chapter.

The main result of a serious nuclear accident would be the release of radioactive materials into the environment. Radiation causes damage in living cells leading to cancerous growths and at high levels can result in death (Elliot, 1997). Eyre (1993) suggested that approximately 10,000 people would be killed should an accident occur that released 10% of the core fragments from a pressurised water reactor, this was based on a typical Western European location.

In order to ensure public acceptance of a new nuclear policy the possibility for accidents must be either eliminated or minimised. There are procedures in place for this and as the technology improves so should the safety levels. Ramsay & Modarres (1998) suggested that through a process of risk reduction and designing nuclear power plants for safety requirements as opposed to economic ones, safety can be improved. Ramsay & Modarres (1998) also outlined the ‘defence-in-depth’ principle which advocates that a number of layers of safety are utilised so that if one should fail emergency back-ups would prevent an accident from occurring. Ultimately however an accident cannot be predicted and as Reason’s (1990) research showed failures are usually due to a failure by the human operators. Dorel (1996) stated that man plays a key role in the reliability of any industrial process. Stanton (1996) shows this process more clearly by identifying human factors as an overlap between engineering productivity and human psychology and functioning, see Figure 2.5.

As Cox & Cox (1996) stated and as discussed earlier in this chapter the accidents at both Three Mile Island & Chernobyl were as a result of human
error, in the case of Chernobyl safety procedures were wilfully ignored by the human operators in order to advance their own specific agendas. The potential for an accident to occur is a major impediment to the expansion of the nuclear power industry.

![Diagram of Psychology, Human Factors, and Engineering]

**Figure 2.5** Distinction of Human Factors (Stanton, 1996)

A further impediment to the development of nuclear power is the dangers associated with nuclear technology and the potential for proliferation of nuclear weapons. RCW (2005) stated that the development of nuclear weapons is a definite possibility for those states that have acquired nuclear technology for peaceful purposes. Alfven (cited by Miller & Schienman, 2003) stated in the 1950's that 'atoms for peace and atoms for war are siamese twins.' Price (1990) stated that proliferation is controlled through an 'extensive armoury of political controls.' The non-proliferation of civil nuclear materials to be used in nuclear weapons is a key concern for countries seeking to develop nuclear power (IEA, 1998). Indeed Article 4 of the 1970 non-proliferation treaty (NPT) stated that access to nuclear technology for peaceful purposes should be an 'inalienable right' (RCW, 2005). The NPT, which has since been strengthened and expanded has helped to ensure that nuclear weapons programmes discovered to date have not used civil nuclear materials (IEA, 1998).
Nuclear technology still presents the possibility for the development of nuclear weapons of mass destruction however. The illegal trafficking of nuclear materials has always been a threat to global security and stability, this threat has increased exponentially since the dissolution of the Soviet Union (Ford & Schuller, 1997). The ANS (1996) stated that the key to the ‘sustainability of nuclear power is the management of plutonium.’ The plutonium produced from nuclear fission can be used in the production of weapons and this was thought to be the main threat from nuclear power production, however as technology has improved and knowledge and economic barriers to nuclear technology decrease (Ford & Schuller, 1997) proliferation becomes a much larger threat. Especially as the failure of countries like India, Pakistan and Israel to join the NPT have increased proliferation risks. The current agenda of the US Government focuses on the nuclear regimes in Iran and North Korea but the ideals within the NPT need to be embraced by all nuclear capable states (Miller & Schienman, 2003).

In the past the focus of the dangers of nuclear weapons has been on the proliferation of nuclear material to be used to form weapons. However it is the authors view that in a post September 11 global community, nuclear power generation facilities themselves could be viewed as potential nuclear weapons. This view is supported by the BBC (2002) who interviewed an Arab journalist who in turn allegedly interviewed two senior members of Al-Qaeda who stated that one of the initial targets on September 11 was a nuclear facility. The Indian Point nuclear facility in New York is within 50 miles of 20,000,000 people and is only one of six licensed nuclear sites in New York State (PRN, 2005). PRN (2005) described an attack on a nuclear power installation as a 'poor mans' nuclear weapon but nevertheless would be lethal to those downwind of the plant. This issue must be of paramount concern when researching the location and defence of both new and existing nuclear facilities.

One of the main issues with respect to nuclear powers future viability is whether or not it can be competitive with other energy sources. As discussed above safety is of paramount importance to nuclear power expansion, stringent
regulations to ensure safety remains at the highest possible levels has had economic impacts (Price, 1990). Nuclear power also has very high capital and decommissioning costs compared to fossil-fuels. High capital costs raise further issues, delays in plant construction will adversely affect the cost, it also means that nuclear power construction would be highly sensitive to interest rate changes (Ramsay & Modarres, 1998; Price, 1990). Figure 2.6 breaks down the associated costs of nuclear power into specific elements of cost.

Figure 2.6 Elements of Nuclear Costs (Bull, 2005)

Figure 2.7 shows that nuclear power is amongst the cheapest forms of power generation. However, a study conducted by the NEA (2000) showed that nuclear power would not be the cheapest option for power plants commissioned in the next five years (2005-2010). The NEA concluded that nuclear power was only found to be cheaper in 5 of 14 countries studied and only at a low discount rate (5%), at a discount rate on 10% or above natural gas became the cheapest method in the majority of countries, this was due to the high capital expenditure requirement for nuclear power plants.
The trend over the past twenty years has been for an economic deregulation of electricity markets across the western economies and the promotion of competition within those markets (IEA, 1998). In the UK the Government set out a strategy as early as 1994 which suggested that the open market could meet the Government’s energy and environmental policies more efficiently (DTI, 1995). The UK Government, which put a moratorium on the building on new nuclear power plants in the early 1990’s, effectively stated that further investment in nuclear infrastructure would have to be privately funded following the privatisation of the industry in 1996 (IEA, 1998; Elliot, 1997). Developing countries are also experiencing competition in their energy markets, due to high costs and low resources they are increasingly dependant on private finance to provide essential services (IAEA, 1999). It seems clear however, that competition within electricity markets will continue to increase, the advantages that competition is expected to bring are as follows:

- Concentrate efforts to reduce expenditure on generation and maximise returns by plant owners;
- Re-orient decision making to incorporate private rather than public costs and benefits;
• Lead to more transparent and effective pricing to better reflect costs.

(IEA, 1998, p.49)

The NEA (2000) suggested that nuclear power plants take longer to plan and construct and investment costs are higher, therefore private investors may see nuclear power as having too high a risk than projects with greater flexibility and shorter payback periods. The advantages of privately owned plants however, include secure and clean electricity at the lowest possible cost (IEA, 1998), the benefits secured on the basis of competition. Private investment will also encourage further research and development in order to continue to innovate, to remain competitive. Creativity and innovation are increasingly important to company performance (Eaton et al, 2005). Private companies are much more concerned with competitive advantage than state-run enterprises, what must be ensured is that innovations within the nuclear industry aimed at increasing competitive advantage are not to the detriment of the environment or safety considerations (Turner & Western, 1996). This can be ensured through legislation and severe enough penalties for those private enterprises that do not put safety first.

The commissioning of new nuclear power plants gives rise to other possibilities as well; the IAEA (1999) published a number of strategies for ensuring competitiveness in new nuclear construction:

• **Make efficient design choices** - make the most profitable choice among the fuel and technologies that are available and recognise that plant design can affect profitability under differing market conditions;

• **Secure all economic risks and liabilities efficiently**
  Allocate the risks of plant construction and operation efficiently and reward the party that is accepting risk. Specify the allocation of plant completion risks, including allocation of and terms for risks due to policy change. Establish liability for
political and policy based risks during operations. Allocate safety risks among operations and plant design areas and establish patterns of liability for safety risks. Potential domestic and foreign liabilities from plant operations and failures must be specified and allocated among plant managers, governments, and appropriate agencies. Responsibilities and funding for waste fuel management, retired plant disposal, and other perceived open-ended liabilities after plant closure must be clearly allocated;

- **Focus on profitability** - Meet financial criteria for net returns and for risks in order to assure the availability of funding. Design construction plans to minimize the net financial effects of interest during construction and delays. Design the plant to reduce the net costs of downtime from operational failures and reduce capital costs;

- **Know and serve your markets** - Design the plant to meet the capabilities and interests of the electricity grid and potential market structures. Identify and develop market niches for the power plant. Consider revenue sources other than power generation (cogeneration, desalination, etc.)

(IAEA, 1999, p. 24-30)

Competition could be used to strengthen public support for nuclear power. The public are currently mistrustful of nuclear due power to the low level of public information not only about the safety and technology but also the economics. Economic information about the cost of nuclear power has not been transparent in the past, especially in state-run operations where costs are met by the taxpayer and there was no incentive for efficiency (IEA, 1998). If nuclear power becomes a realistic market choice, through competition, just as such choice exists in other utility markets, public perception will change. Good performance and service, coupled with competitive costs will be as important as ensuring public safety in improving nuclear powers 'corporate image' (IEA, 1998).
The economic advantages of nuclear power include low fuel costs and minimal environmental impacts (IAEA, 1999). The fuel costs associated with nuclear power not only benefit from being lower than traditional fuels to begin with but also have greater stability over time. Investors may also hold large stocks of fuel to ensure continued supply in the short to medium term (NEA, 2000). Nuclear energy also has a further economic advantage, current economic forecasts and pricing aim to include all aspects of nuclear power's costs, including capital costs, life-cycle costs, decommissioning costs and the cost of nuclear waste disposal. These costs may therefore show nuclear power to be more expensive than traditional alternatives. What is not considered however is that traditional alternatives are not so robust in their pricing, Carbon emissions for example are not priced in the cost of fossil fuel generated electricity (Van der Zwaan, 2001).

Competition is not just restricted to the nuclear energy generation sector, waste disposal is also beginning to utilise the benefits of the open market. Companies are beginning to emerge that are bringing the benefits of lower costs, greater flexibility and greater efficiency to the process of nuclear waste disposal (IAEA, 1999). The scope for efficiency driven by market conditions can only improve the competitiveness and attractiveness of nuclear power.

The broad consensus of literature suggests that from an economic perspective nuclear power can be competitive with traditional power generation methods (Van der Zwaan, 2001; NEA, 2000, IAEA, 1999; IEA, 1998; Price, 1990). If we consider the advantages from sustainable development and carbon free energy generation, this becomes an even greater possibility. The nuclear economic situation also has the advantage that costs of fossil-fuel based generation will increase in the future as supplies dwindle and/or become uneconomical to extract. Creativity and innovation will also help to improve economic efficiency for nuclear power as private investors seek further competitive advantage to ensure their business is a successful one.
Nuclear power is generated through a process known as nuclear ‘fission’ which involves splitting heavy atoms to generate heat which can be used to generate electricity. Technology is constantly changing however, and nuclear power is no exception. Nuclear fusion is a process that seeks to fuse light atoms together in the same way in which the energy within a star is created (Ramsay & Modarres, 1998; Elliot, 1997; Price, 1990). Nuclear fusion has the advantage that unlike fission there are no waste products created from the process of fusing the atoms together. Nuclear fusion has the following advantages:

- Ample supply of raw materials for fuel;
- The amount of fuel in the reactor at any time is so small that an accidental large release of fuel would be impossible;
- Inherent safety due to no danger of overheating;
- Minimum problems of radioactive release and waste disposal,
- High thermal efficiency for the conversion of fusion energy into electrical energy.

(Ramsay & Modarres, 1998, p.13)

Nuclear fusion’s biggest advantage is that compared to fission there are relatively small amounts of nuclear waste and none is created as a by-product of the fusion process itself. Keen & Maple (1994) suggested however, that the equipment used in the process would become radioactive and need to be replaced and disposed of periodically. This type of waste however would be dangerous for much shorter periods of time than current fission waste. Europa (2005) stated that nuclear fusion is comparable to renewable energies when discussing external costs such as carbon emissions or acid rain.

Currently nuclear fusion is not a realistic option to provide for our energy needs. Nuclear fusion requires temperatures of up to $10^6$ degrees Kelvin, much higher than nuclear fission (IAEA, 2004). As Price (1990) stated the energy required to sustain a fusion reaction is currently about 500 times more than the energy emitted by the reaction. Elliot (1997) suggested that a commercial fusion
reactor was 'at best' decades away. Progress is being made however, the technology is far more efficient now than Oliphant's first experiment in 1934 (Price, 1990). Europa (2005) currently suggests that nuclear fusion could be introduced commercially in the second half of this century and will generate a significant portion of the world's electricity by 2100. Nuclear fusion will also suffer from the problem of public perception and opinion. Europa (2005) studied public attitudes in Germany and Spain and found that the public had little to no understanding of the difference between nuclear fission and fusion and regarded them both in the same negative way.

The world's first nuclear fusion reactor is to be built in France at a cost of £6.6bn. The International Thermonuclear Energy Reactor project (Iter) is a joint scientific project being conducted by the European Union, the USA, Japan, China, Russia and South Korea (BBC, 2005). Prospects for commercial construction of these reactors remain in the distant future; meanwhile the expansion of new nuclear fission reactors may provide a viable intermediate alternative.

2.4 Summary

This chapter of the research has focused on the impending energy crisis, the prospects for renewable energy to meet the looming shortfall and the issues surrounding the expansion of nuclear power as a further option to traditional power generation methods. A number of stimulants and impediments generally to nuclear power have been identified; further research is needed to explore the depths of these issues. The next chapter will move away from the topic of future power generation and focus on the issues surrounding the utilisation of the Private Finance Initiative to provide a solution to public requirements.
Chapter Three

The Private Finance Initiative
Past, Present & Future

3.1 Background and Evolution of the Private Finance Initiative

The Private Finance Initiative (PFI) was the name given to policies regarding private sector investment in the provision of public services introduced by the Conservative Government in the Autumn Statement of 1992 (RICS, 1995). The main aim of the policies described by the then Chancellor of the Exchequer, the Right Honourable Norman Lamont MP was to increase the involvement of the private sector in the provision of public sector services (Allen, 2001) in order to deliver higher quality, more cost effective public services (Blackwell, 2000).

The PFI allows the Government to take advantage of the skills and expertise available in the private sector to manage public sector investment over the lifetime of an asset (HM Treasury, 2003). The key philosophy behind the PFI is to change the role of the public sector from owner and provider to enabler and purchaser (Fox & Tott, 1999). The PFI is different from outright privatisation in that the public sector retains a major role in the project (Allen, 2001) and is able to enforce penalties, usually in the form of cessation of unitary payments should the private sector owner/operator fail to provide the standard of services contracted for (Fox & Tott, 1999).

Following the change of Government in 1997, the Labour Government initiated a review of the PFI schemes undertaken over the previous five years (Allen, 2001). The review undertaken by Sir Malcolm Bates endorsed the use of the PFI, substantially improved the process and simplified the market (CIC, 1998). The Bates Review made 27 recommendations to the Government and also led
to the creation of the Treasury Taskforce which was charged with focusing all PFI activity across Government (Allen, 2001). In 1999 a second Bates Review was undertaken which recommended that the Treasury Taskforce be transformed into a Public/Private partnership known as Partnerships UK. Partnerships UK’s priority was to make the public sector a more effective Client in public private partnership and PFI projects (HM Treasury, 2003).

The Labour Government remains committed to the PFI. Blair (2005, cited by PPP Forum, 2005a) identified PFI as the primary reason that investment in the NHS infrastructure is now greater than at anytime since the creation of the NHS. Milburn (2004) stated that PFI was a partnership that worked, that it was an intrinsic part of the modernisation of public services and that it was a policy that was ‘here to stay.’ The Conservative Opposition remain broadly in favour of PFI. The then Shadow Chief Secretary, Flight (2003) suggested that PFI was not only a fundamental agent in the change and improvement of public sector services but also a key catalyst in the reform of public sector culture. The Liberal Democrats recognise both the potential benefits and weaknesses of the PFI but remain sceptical of its perceived values and are more concerned with ensuring the most efficient procurement route is undertaken for the provision of public services (PPP Forum, 2005b).

It could be argued that the background of the PFI from a project perspective began in 1987 (HM Treasury, 2005). The Queen Elizabeth II Bridge, Dartford River Crossing project was opened in 1991, the Secretary of State determined the project contract completed in 2002 (Robertson, 2005). The privately funded project was a precursor to PFI and was a huge success as tolls from the bridge were far higher than predicted resulting in the much earlier recouping of the capital costs of the bridge (CIC, 1998). HM Treasury (2005) records the current value of signed PFI projects in the United Kingdom at approximately £43bn.

The use of private finance in the public sector before the launch of the PFI policies in 1992 was strictly regulated by the ‘Ryrie Rules’ which stated:
(i) Decisions to provide funds for investment should be taken under conditions of fair competition with private sector borrowers; any links with the rest of the public sector, Government guarantees or commitments, or monopoly power should not result in the schemes offering investors a degree of security significantly greater than that available on private sector projects;

(ii) Such projects should yield benefits in terms of improved efficiency and profit from the additional investment commensurate with the cost of raising risk capital from financial markets.

(Allen, 2003, p.12)

Essentially for private finance to be utilised on a public sector project the project had to be shown to offer better value for money than could be achieved by procuring the project through public sector means, this was still the case even if the public sector did not have the budget to fund a project (Hall, 1998).

3.2 The Private Finance Initiative

As discussed above the PFI is one of a number of initiatives that involve private sector investment in the provision of public services. The PFI should not be confused with Public Private Partnerships (PPP) which is the term used to describe the whole range of private sector investment initiatives available. The PFI is the most common PPP initiative (Unison, 2005a). The focus of PFI projects is the provision of a service by the public sector, not the acquisition of a capital asset (Fox & Tott, 1999).

A project that is being procured via the PFI model has two parties, the public sector client and the private sector supplier (RICS, 1995). The private sector supplier is usually a company created for a specific PFI project and will usually
be a consortium consisting of a contractor, a finance company/bank and a facilities management company (Unison, 2005a). The company created by the consortium to deliver the project is known as the Special Purpose Vehicle (SPV) (Fox & Tott, 1999). AMA Research Ltd (2001) suggested the PFI procurement process consisted of the following elements:

- Significance of transfer of risk for project approval;
- Development of service specification – definition of user/client requirements with reference of different sector requirements;
- Establishment of the payment mechanism – availability and service standard requirements; deductions for non-performance;
- Tendering system – pre-qualification; initial proposals; negotiations with preferred bidder; signature;
- Importance of Whole Life Cycle Changes, WLCC, in assessment of tenders provisions – latent defects, staged delivery of project, maintenance, reviews, etc.;
- Risks typically left with the contractors (and sub-contractors).

(AMA Research Ltd, 2001, p.1)

There are essentially four key elements to a PFI project; Design, Finance, Build and Operate (DFBO) (Unison, 2005a). The Client enters into a long-term contract with the SPV, usually 25-40 years, and agrees to pay a sum of money to the SPV each year throughout the life of the contract; this regular payment is known as the 'Unitary Payment' (Fox & Tott, 1999). PFI contracts represent a long-term contractual commitment; the Client needs to consider those long-term ongoing commitments, especially as those commitments may reduce the Client's future flexibility to manage its expenditure (NAO, 1999). The SPV in return agrees to provide a service to the Client, for example, a hospital procured through the PFI route will be designed (theoretically) and constructed by the SPV. The hospital will then be maintained throughout the period of the contract by the SPV. This is the important point; the costs of maintaining the hospital
are borne by the SPV and are deemed to be covered in the Unitary Payment paid by the Client. This puts heavy emphasis on the link between design and construction of a building and the management of that building throughout the building's lifespan. These 'life-cycle' or 'whole-life' costs can include anything from maintaining the buildings envelope to employment of low-level, non-clinical staff such as cleaners, porters, etc. (RICS, 1995). This will generate better value for money from the asset in the long-term (Raynsford, 1998). The Client defines a standard of service that the SPV must provide for the duration of the contract. The SPV is free to determine how they will deliver this standard (Fox & Tott, 1999). Should the SPV fail to provide part or the entire standard of service specified the Client may make deductions from the 'Unitary Payment' accordingly; this test is known as 'Unavailability' (Fox & Tott, 1999). Figure 3.1 shows the cash flow of a typical PFI scheme.

Timms (2005) stated that the purpose of PFI projects was to take advantage of private sector management skills which are given added incentive by having private finance at risk. Whilst there are numerous advantages and disadvantages of the PFI (discussed later) there are essentially two primary aims of the PFI, value for money and risk transfer (RICS, 1995).
It may seem paradoxical to say that utilising private money to finance projects will provide better value for money when the public sector can borrow more cheaply than the private sector (RICS, 1995). Value for money however, is achieved by offsetting the additional cost of private financing through the transfer of risk to the private sector (risk of construction cost, time overrun and project performance, etc.) (PPP Forum, 2005c), increased efficiency through utilisation of industry best practice techniques such as 'Lean Construction' (CPN, 2005) and the potential for private sector creativity and innovation in the design, construction and maintenance of the project assets (CIC, 1998; Birnie, 1999). The NAO (1999) suggested there were four pillars to a good PFI project that will achieve value for money; these pillars are the setting of clear objectives, applying the proper procurement process, getting the best available deal and ensuring that the deal makes sense.

The RICS (1995) stated that risk transfer is one of the main benefits associated with the PFI. The ideal objective is however to transfer the risks to the party best able to cope with the specific risk (HM Treasury, 1995). The SPV will only be able to reduce the cost of a risk if it can either reduce the overall level of risk or manage those risks more effectively (Hall, 1998). The SPV will usually bear all the risk derived from design, construction, maintenance, operation and facilities management on the project (Akintoye et al, 1999) whereas the Client will still bear the risk of changes in Government policy or planning decisions which are outside of the SPV's control (RICS, 1995). Other types of risk include volume risk; which is the risk associated with the level of demand for the public services being provided, this is also outside of the SPV's control and it would not prove cost effective to transfer this type of risk to the SPV (Hall, 1998). Residual value risk concerns the value of the asset at the end of the contract. The Private Finance Panel (PFP) (1996, cited by Hall, 1998) argued that the Client, in a well structured PFI contract, should not concern itself with the residual value of an asset. Hall (1998) also suggested that value for money in PFI projects will be compromised if risk transfer is more apparent than real, i.e. the SPV does not actually bear the risks it is contracted to bear, although, as
Hall (1998) concludes there is little evidence to support this potential situation. Risk allocation and pricing is a key part of the negotiations between the Client and the SPV when reaching a mutually acceptable outcome for both parties (Li & Akintoye, 2003; Fox & Tott, 1999).

There are broadly three types of PFI project; these include financially free-standing projects, joint ventures and services sold to the public sector. Financially free-standing projects, such as the Queen Elizabeth II Bridge, involve the private sector designing, constructing, operating, maintaining and financing the project. The private sector then recoups its cost direct from the end user as opposed to a public sector Client e.g. in the form of road tolls as with the Queen Elizabeth II Bridge project (Fox & Tott, 1999) or the Skye Bridge (Hall, 1998). Joint ventures involve projects where there is a mix of end user charges and public sector subsidy or contribution of assets (such as the provision of land for urban regeneration projects (Fox & Tott, 1999) or the Government has a minor equity stake (Tonkiss, 1995). The main requirements for joint venture projects are:

- Private sector partners in a joint venture should be chosen through competition;
- Control of the joint venture should rest with the private sector;
- The Government’s contribution should be clearly defined and limited. After taking this into account, costs will need to be recouped from users or customers;
- The allocation of risk and reward will need to be clearly defined and agreed in advance, with private sector returns genuinely subject to risk.

(Allen, 2001, p.12)

Services sold to the public sector include the majority of PFI projects. The private sector is responsible for the designing, financing, building and operation of a capital asset in order to provide a specific level of service to the public
sector Client (Fox & Tott, 1999). Allen (2001) gives the following examples of potential services that could be provided to the public sector by the private sector:

- A private sector firm selling kidney dialysis services to a hospital;
- The private sector providing accommodation and day-to-day care for the elderly;
- The provision of prison places by the private sector through designing, building, financing and operating new prisons.

(Alien, 2001, p. 13)

Hall (1998) suggested Bridgend Prison, the DFBO road schemes and new trains for London Underground’s Northern Line as examples of this type of PFI project. HM Treasury (2005) contains a full list of PFI signed projects to date, of the more notable ones are the Derby City General Hospital PFI valued at £312m and the Nottingham Light Rail Link valued at £172m.

3.3 The Stimulants & Impediments to the Private Finance Initiative

The main political stimulant to the PFI is the acquisition of public sector service without Government expenditure funded through Government borrowing (Case, 2002; Blackwell 2000). Allen (2003) suggested that the Government could use PFI to disguise the underlying position of public finances. Unison (2005b) take this a step further by suggesting that the whole PFI initiative is being driven by the advantageous effect on current public finances not the effect on public services. Government also has an intrinsic belief that public sector management is inefficient (Case, 2002) thus private sector management is therefore an advantage especially due to the added incentives derived from the risk to the private sector of using private finance (Timms, 2005). The PFI is also attractive to local authorities who cannot raise the required finance for the project elsewhere (Case, 2002; Allen, 2001). This is especially the case in
major projects with a number of component parts. Li & Akintoye (2003) suggested that the enhancement of a Government’s ability to provide integrated solutions to address a key public sector need is a definite benefit derived through the PFI.

The fundamental ideas of value for money and risk transfer that underpin the PFI represent its main stimulants. The level of the effectiveness of this stimulus however depends upon the deal negotiated with respect to value for money (NAO, 1999) and how the risk has been allocated and the rigidity of the contracts developed for the PFI project (Case, 2002).

Innovation and creativity can be cultivated as a further stimulant to the PFI. This is achieved through the use of commercial efficiencies and the risks associated with private sector finance (PPP Forum, 2005e). As the aims of PFI projects are output/service driven and the private sector is free to determine how the specified outputs are to be achieved there is great scope for innovative approaches to products (Birnie, 1999). Eaton et al (2005) suggested that access to competitive advantage for modern organisations is relying more and more on creativity and new innovations as opposed to asset possession, economies of scale and access to capital.

Li & Akintoye (2003) suggested that the PFI offers the potential to reduce cost of a project or deliver a higher standard of quality for the same price. It is certainly in the private sector’s interest to keep costs (Fox & Tott, 1999) and programme (PPP Forum, 2005c; Hall, 1998) to a minimum; this factor is one of the main drivers for the innovations discussed above. The NAO (2003) found that PFI projects were consistently more successful with respect to budget and time than traditionally procured projects, as shown in Figure 3.2.
Construction projects where cost to the public sector exceeds price agreed at contract (1999 Government survey) 73% 22%¹

Construction projects delivered late to public sector (2002 NAO census) 70% 24%²

¹ the increases in PFI price after contract award were due to changes led by the consortium alone. For example, in some of the department changed some of the specifications from those for which the consortium had bid, so the price to reflect the changes. Some of these specification changes arose due to new factors affecting the department’s at contract award. These changes would also have led to price increases under traditional procurement.

² In only eight per cent of PFI projects surveyed was the delay more than two months. No comparative data for this statistic are available for traditionally procured projects. Previous studies of traditional projects had referred to the percentage of time overruns rather than the number of months.

---

Cost savings could also be achieved through increased competitiveness resulting from both new innovations (Eaton et al, 2005) and the solicitation of a larger pool of potential tenderers (Li & Akintoye, 2003). NS (2000, cited by Li & Akintoye, 2003) suggested that cost reductions are apparent in PPP procured projects due to acquired synergies, economies of scale and reduced life-cycle costs.

Life-cycle costs (Whole-life costs) are also a major component of a PFI project. As PFI projects include the long-term maintenance of the asset being constructed it is in the private sectors own interest to consider the facilities management cost of the asset throughout its life (HM Treasury, 2003). This gives added potential for green/sustainability issues to be considered by the private sector in order to improve the operation of their asset over its lifespan (ODPM, 2002). Garwood et al (2002) reinforced this argument and also suggested that sustainability can add competitive advantage to a PFI bid.
Sustainability is also a major priority for the Government. The Government held a 'Sustainable Communities Summit' in Manchester, United Kingdom in January 2003. Cabinet ministers, international experts, academics and practitioners assembled to discuss and encourage development that meets the economic, social and environmental needs of future generations as well as succeeding now (Benfield, 2005). The Rt. Hon. John Prescott MP, Deputy Prime Minister has instigated a sustainability master-plan that has sufficiently taken hold of policy makers to outlast his influence in office (Contract Journal, 2005 cited by Benfield, 2005). The Government is keen for the construction industry to embrace sustainable design and construction in order to protect the environment and natural resources (Hill, 2005 cited by CIOB, 2005).

The condition of our surroundings has a direct impact on the quality of life and the conservation and improvement of the natural and built environment brings social and economic benefit for local communities.

(ODPM, 2005, p.7)

Sustainability can be incorporated into PFI project briefs to reduce life-cycle costs, it will increasingly be used by the public sector to evaluate bids and there is also a direct link between functionality and sustainability (Garwood et al, 2002). Sharma (2002) recognised that corporations have a responsibility to include both society and the environment into sustainable processes. Sustainability therefore is an economic stimulant to the PFI as well an environmental and a social one. The importance of the sustainability issue will also be discussed in the following chapter.

PFI is also stimulated by allowing the public sector to access private sector skills, experience and technology (Timms; 2005; PPP Forum, 2005; HM Treasury, 2003; Li & Akintoye, 2003). The PFI allows the Government to concentrate on making policy, not providing services (RICS, 1995) this may lead to better regulation as Government focuses on the role of regulator, planner and monitor (Cullen, 2001).
Eaton & Akyibikli (2005) suggest the stimulants, shown in Figure 3.3 below, to the success of the PFI process. Eaton & Akyibikli’s (2005) and Eaton et al’s (2005) work is discussed in more detail in Chapter Four.

<table>
<thead>
<tr>
<th>External environment level</th>
<th>Organisation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clients</td>
<td>• Encouragement of creative problem solving</td>
</tr>
<tr>
<td>• Competition</td>
<td>• Fair, constructive judgement of ideas</td>
</tr>
<tr>
<td>• Government</td>
<td>• Reward and recognition for creative work</td>
</tr>
<tr>
<td>• Professional bodies</td>
<td>• Mechanisms for developing new ideas</td>
</tr>
<tr>
<td>• Sharing of ideas in the industry</td>
<td>• Clear shared vision</td>
</tr>
<tr>
<td>• Supply chain</td>
<td>• Encouragement of risk-taking and risk management</td>
</tr>
<tr>
<td></td>
<td>• Attraction of creative people</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project level</th>
<th>Job role level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Supervisory encouragement</td>
<td>• Challenging and interesting tasks and projects</td>
</tr>
<tr>
<td>• Clear and appropriate goals</td>
<td>• Time control over work</td>
</tr>
<tr>
<td>• Motivation and commitment to the project work</td>
<td>• High autonomy</td>
</tr>
<tr>
<td>• Diverse and suitable background of individuals</td>
<td>• Freedom</td>
</tr>
<tr>
<td>• Good communication</td>
<td>• Access to appropriate materials and facilities</td>
</tr>
<tr>
<td>• Openness to new ideas</td>
<td>• Access to necessary information</td>
</tr>
<tr>
<td>• Trust and help for others within the team</td>
<td>• Adequate funds</td>
</tr>
<tr>
<td>• Constructive criticism of ideas</td>
<td>• Training and development</td>
</tr>
<tr>
<td></td>
<td>• Creativity training</td>
</tr>
<tr>
<td></td>
<td>• Creativity element of job description and appraisal</td>
</tr>
<tr>
<td></td>
<td>• Conducive physical environment</td>
</tr>
</tbody>
</table>

**Figure 3.3 PFI Stimulants to Success (Eaton & Akyibikli, 2005)**

Taylor (2005) suggested the following regarding the PFI:

...PFI is prohibitive in cost, flawed in concept and intolerable in consequence to the taxpayers, patients and NHS workers.

(Taylor, 2005, col. 1675)

The PFI does have disadvantages which have the potential to act as impediments to its use as a procurement option. Fundamentally the public
service ethos, the provision of social, economic and environmental well-being is threatened by the intrusion of private companies (Unison 2005b). Case (2002) argued that the PFI provides finance for projects which otherwise would not exist. The IPPR (2002) pointed out that this does not mean there is extra money for PFI projects, the funding following the completion of the contract will all come from the Government, albeit spread over a number of years. Unison (2005b) argued that the Government's enthusiasm for the PFI is due to the positive effect on public borrowing and not on the perceived improvements to public services. The IPPR (2002) suggest this is an 'Enron-style' accounting trick and the argument in favour of PFI due to its effect on Government borrowing is a superfluous one.

In opposition to the findings of the NAO (2003) that PFI projects are being completed cheaper than in the past, Unison (2005b) suggested that, in fact, PFI projects cost more due to the high borrowing rates faced by the private sector compared to Government borrowing rates. Unison also stated that the pre-contract costs and the profit margins also drive up the cost of PFI projects compared to publicly funded projects. HM Treasury (2003) argued that the Government only use the PFI to fund projects where it will provide value for money and this is based on a strict appraisal process including assessment using the public sector comparator (PSC). The PSC is a notional publicly financed alternative to the PFI in order to judge value for money, the IPPR (2002) question the robustness of the PSC however referring to it as having 'dubious quality.' HM Treasury (2003) stated that PFI projects only go ahead where value for money can be proven at the outset; therefore, assuming the projects have a good degree of price certainty, value for money should be achieved. Figure 3.3 shows that there is a high degree of price certainty in PFI projects.
<table>
<thead>
<tr>
<th>Number of Projects</th>
<th>Percentage of Projects Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>No price increase after contract let for any reason</td>
<td>26</td>
</tr>
<tr>
<td>No price increase after contract let for any reason related to construction</td>
<td>29</td>
</tr>
<tr>
<td>No construction related price increase of over £10,000 to the annual unitary payments</td>
<td>31</td>
</tr>
</tbody>
</table>

Note: None of the increases in PFI price after contract award were due to changes led by the consortium alone. They mainly related to further work which had not been part of the original specification at contract award. These changes would also have led to price increases under traditional procurement.

Figure 3.4 Price Certainty Experience in PFI Projects Involving Construction (NAO, 2003)

For a PFI project to go ahead the private sector is bound by a set of regulations with regard to existing staff. The Transfer of Undertakings (Protection of Employment) Regulations 1981 (TUPE) ensure that when employees are transferred to a new company they maintain their existing terms and continuity of service, there are severe financial penalties for dismissals due to the transfer and employees have to be made aware of the transfer and its potential impact upon the workforce (Fox & Tott, 1999). Unison (2005b) suggest that the PFI creates a two-tier workforce, new staff receive worse remuneration than existing staff, pensions for existing staff were considerably better than those for new staff due to the transfer of undertakings from a public sector employer. Unison argued that this enables the private sector to gain additional profit from the workforce.

A major argument between both PFI's detractors and its proponents is whether the PFI provides value for money. The IPPR (2002) showed evidence to
suggest good value for money in road and prison schemes but notional improvements in schools and hospitals. Unison (2005b) suggested that value for money in PFI projects was only achieved through risk transfer and based on its research most calculations of risk were 'arbitrary and unreliable.' The IPPR (2002) evoked the premise that trade unions, such as Unison, have an ideological dislike for the private sector and would prefer to revert to historical methods of public service procurement which did not involve the private sector. The IPPR (2002) continued suggesting that private companies have always been involved in the construction of new public buildings and services. Unison (2005b) argued that the private sector makes unacceptable profits from PFI deals reinforcing the IPPR's (2002) premise regarding their ideological dislike for the private sector. SPV's can make profits in addition to the mark up included in the Unitary payment by refinancing the PFI project. Refinancing is when the SPV either renegotiates the terms of its original borrowing or repays the original borrowings early with borrowings from a new source. The new terms or source of capital would be at an improved rate to the original loan thus increasing the return for the SPV (PPP Forum, 2005c).

The PFI can present difficult contractual issues for all those involved, the public sector must ensure there is a strong business case for the project, the private sector will incur substantial tendering costs and the trade unions have numerous human resources issues as a result of the transfer of staff (Cullen, 2001). With the advent of standardised PFI contracts and familiarisation with the procurement route itself legal costs of PFI’s, cited by Unison (2005b) as a major disadvantage of the PFI, are substantially lower than in the early schemes (PPP Forum, 2005c).

Eaton & Akyibikli (2005) suggest the following impediments to the success of the PFI process:
### External environment level
- Client procurement route
- Coalition nature of construction
- Lack of communication
- Legislation

### Organisation level
- Internal political problems
- Destructive internal competition
- Harsh criticism of new ideas
- Conservatism and avoidance of risk
- Rigid structures and strict processes
- Lack of mechanisms for developing new ideas
- Lack of rewards and recognition

### Project level
- Format of project contract
- Rigid project demands
- Segmentation of project disciplines
- Poor collaboration
- Poor communication
- Lack of openness and trust
- Poor project management

### Job role level
- Extreme time pressures
- Unrealistic expectations for productivity
- Distractions from creativity
- Financial constraints

---

**Figure 3.5 PFI Impediments to Success** (Eaton & Akyibikli, 2005)

Ezulike et al. (1997) identified six further impediments to entry into the PFI market by Contractors, these are as follows:

- **Lack of appropriate skills** – PFI concentrates on designing, financing, constructing and maintaining the project concerned. Many contractors do not have the necessary skills to complete this, especially the Smaller to Medium size Enterprise’s (SME);

- **High participation costs** – bidding costs for a PFI project are approximately six times greater than a traditional procurement route; this represents the single most fundamental barrier to entry into the PFI market;

- **High project values** – PFI projects tend to be of a high value, usually in excess of £30m. This puts PFI projects out of reach for most contractors;
• High risk – the principle that underpins PFI is the transfer of risk to the private sector, this represents very high exposure for the contractors involved;
• Lack of credibility and contacts – smaller contractors are less likely to have the contacts or credibility needed to form part of a PFI consortium;
• Demands on management time – due to the complexity of PFI bidding the costs of management time are substantial; this represents a further barrier to entry.

(Ezulike et al, 1997, p.183-190)

The research in this section has shown that a number of stimulants and impediments exist to the use of PFI itself; the following section will underpin this literature with actual experiences of those involved in PFI projects past and present.

3.4 PFI Project Experience

This section reviews actual project experience from a variety of people involved on five different PFI projects providing a range of public services. The research has been reviewed to either confirm or discredit the theoretical stimulants and impediments discussed in the previous section. The research related below was carried out by the PPP Forum and a full transcript of the interviews can be found on their website (see PPP Forum (2005d)).

Walsgrave Hospital: Project Value £400m (Capital Value)

The PPP Forum (2005d) interviewed David Roberts, Chief Executive of University Hospitals Coventry and Warwickshire. The project is for a 1212 bed acute hospital and a clinical services teaching facility and is due to be completed in 2006. The key points identified in the interview were as follows:
- PFI contracts are complicated and reliance upon professional legal advice is essential;
- The Contractor committed £40m to deliver the new teaching facility before the start of the new academic year, showing a big commitment of funds on their part. The Contractor has been responsive to our issues. PFI has enabled quick rectification of problems to achieve the standard required. In terms of quality some aspects are adequate; the CSSB however is of higher quality than would have been expected under conventional procurement;
- The Contractor has proved to be both professional and competent. This project has been undertaken alongside a working hospital and the Contractor has been considerate to this despite the major disruption as a result of the works;
- The relationship with the Contractor changes over time. At the beginning following contract signature there was a feeling of elation, tensions have developed through construction but this has been well managed, the relationship will change again when construction is complete and the facilities management phase begins;
- PFI gives us real accountability for the money we spend, standards can be demanded. It is imperative that the contract is correct as it is difficult to incorporate changes later;
- PFI will enable a more powerful position for the trust than available previously to deliver better public services. PFI has enabled a state of the art facility to be developed which may not have been available under conventional funding;
**Glasgow Schools: Project Value £1.2bn (Contract Value)**

The PPP Forum (2005d) interviewed John Curley, Senior Education Officer of Glasgow Council. The project is a group schools project to update the councils school buildings. The key points identified in the interview were as follows:

- The council could not afford to make the improvements to its school buildings that they required. The existing schools were also in the wrong locations;
- PFI enabled increased competition and reduced costs. Following the output specification developed the private consortia had to develop the design and innovation to deliver that output. This led to some schools being rebuilt as opposed to being refurbished providing better value for money;
- PFI has enabled new facilities to be built which has improved the social atmosphere leading to a reduction in vandalism and its corresponding cost to the council;
- Following problems with some of the schools the council has used its penalty deduction mechanism. The problems are not the responsibility of the council;
- The PFI works well as long as the output specification is correct.

**HMP Forest Bank: Project Value £50m (Capital Value)**

The PPP Forum (2005d) interviewed Ivor Woods, Director of Forest Bank. The project was for the design, construction, financing and maintenance of a new 800 bed, category B local prison. The key points identified in the interview were as follows:
HMP Forest Bank, a PFI project, was delivered on time and on budget;
The project represents a successful partnership between the public and private sector. It has provided local employment and is a real asset to the community;
The design of the prison has led to a number of innovations both in prison design and in the choice of materials used in the prison's construction;
The private sector has greater focus than the public sector. Revenues are performance related which provides a great incentive to achieve performance targets.

**Nottingham Light Rail: Project Value £200m (Capital Value)**

The PPP Forum (2005d) interviewed Chris Deas, Service Manager of NET Development and Transport Communications. The project was to design and operate a 13km light rail line for 30 years and 6 months. The key points identified in the interview were as follows:

- Funding for light rail at the time was scarce; the decision open to the local authority was either a PFI deal or nothing;
- The goals between the public and private sector partners on this project are complimentary. The private company wants to maximise the number of people using the system to generate additional revenue whereas the public sector receives further economic and environmental benefits;
- PFI is a performance based arrangement; if the private sector doesn't perform they don't get paid. PFI takes away the opportunity for the Client to interfere, perhaps this is a positive aspect;
Nottingham embraced PFI cautiously and received its requirements, a system that works.

**Pevensey Coastal Defences: Project Value £30m (Capital Value)**

The PPP Forum (2005d) interviewed Peter Midgely from the Environment Agency, Ian Thomas from Pevensey Coastal Defence Limited and Ron Gardener from Westminster Dredging. The project involved maintenance of flood defences for a 25 year term. The key points identified in the interview were as follows:

- PFI has enabled the completion of construction works within the project much faster than traditional procurement would have allowed;
- The project has been very successful and PFI will be used again in future projects;
- The Output Specification determines what width the beach should be. The method of maintaining that width is our responsibility;
- PFI has enabled long-term planning and investment commitments which has led to investment in new technology.
- The project has been successful due to the accessibility of all those involved to the end user, the general public;
- PFI has enabled the delivery of the project much more quickly and to a much higher standard than conventional procurement would have allowed.

The above research carried out by the PPP Forum has reinforced the stimulants and impediments discussed previously. The overall opinion of those interviewed was in favour of PFI, both the private and the public sector have gained from the use of the initiative in the projects studied. The PPP Forum
was established in 2001 by organisations within the private sector to promote the benefits of public private partnerships (PPP Forum, 2005e). Their approach is:

- To demonstrate the success that PFI is achieving in delivering modern public service infrastructure;
- To take part in public debate and present an accurate and business based perspective on PFI and the issues surrounding it;
- To monitor Government and to engage with Government Departments and related organisations involved in developing and promoting PFI from the public sector side.

(PPP Forum, 2005e, p.1)

It is in the interest of the PPP Forum for PPP’s and the PFI to be viewed in a positive light, the above research should therefore be viewed with the knowledge that the negative side to the PFI and/or projects that have gone badly are less likely to be reviewed by the Forum. Further case study research which resulted in Figures 3.3 and 3.5 can be found in Eaton & Akbiyikli’s (2005) report ‘Quantifying Quality.’

3.5 Summary

This chapter of the research has focused on the PFI, its background as a Government policy to introduce private finance to provide public services. The theory and basic process was then defined followed by an in depth investigation of the stimulants and impediments to PFI as a procurement route. Finally a review of existing research conducted on actual PFI projects was undertaken to show evidence supporting the reviewed literature. The next chapter will review and record the stimulants and impediments identified in the literature review conducted in the preceding chapters of this research.
Chapter Four

Stimulants & Impediments to Nuclear Power and the PFI: Theoretical Model Development

4.1 Nuclear Power & the PFI

The literature reviewed in the previous chapters has focused on two key areas; nuclear power generation and the PFI. The literature review has identified a number of potential stimulants and impediments to both of these areas and uncovered a number of issues both positive and negative. The purpose of this section of the research is to conclude the literature review and also to create a modicum of synergy between the two subjects. This will be achieved by developing a theoretical model based on the reviewed literature. This model will also be based upon prior research conducted by Eaton et al (2005) into stimulants and impediments to innovation in the PFI process, following a critical appraisal of Eaton et al’s research the author will adapt Eaton et al’s theoretical framework to suit the purposes of this research.

In order to understand the relevance of an article, paper or other literature source it is necessary to undertake a critical appraisal of the said source to establish its worth in both its own right and its worth with respect to the research question. As Potter (2002) suggests our understanding of what others have done must inform our own research, this allows us to show where our own research is applicable to the field as a whole. The literature review should comprise a coherent synthesis of past and present research, not list and catalogue that research (Bruce, 1994 cited by Potter, 2002). The following review will focus upon the following paper:
The title of the paper 'Theoretical Stimulants and Impediments to Innovation Within PFI/PPP Projects' is an accurate representation of the content of the paper. This is useful in immediately identifying a paper which covers the required issues. The abstract contains a concise overview of the content of the paper specifically showing its aims, the theory that subsequently developed and discusses the development of a theoretical model. Significantly the abstract fails to discuss one of the more important points raised by the paper in both the narrative and final conclusion. Specifically the identification of the four levels of analysis including the external environment level, the organisation level, the project level and the job role level.

The paper could benefit from an expansion of its discussion of the methodologies proposed for refining and improving this model. The paper explicitly suggests a further paper which focuses on this research. The paper also suggests by implication that further research could be conducted on applying the model developed within the paper before project letting to review its effect on eliminating constraints and stimulating innovation within the PFI
process. The paper specifically identifies the 'influence of work environment factors on the creativity of individuals' in a construction industry context as having little to no prior research conducted upon it and attempts to address that issue.

The main point of the paper provides a comprehensive review of creativity literature and seeks to develop an argument for the application of this research to construction. The literature reviewed by the paper identifies the four levels of analysis discussed above. Following this identification of levels a theoretical model is developed which addresses the stimulants and impediments to creativity in the PFI process in relation to these specific levels. A brief summary of the main points of the paper is shown below:

- Innovation & creativity are imperative to maintaining a modern business's competitive advantage;
- The focus of the research is based upon identifying the social and contextual factors that influence creative behaviour within a construction organisation, within the boundaries of a project procured via the PFI;
- The paper's key objectives are to identify potential stimulants and impediments to creativity in PFI projects and to develop a theoretical model based on this information;
- Creativity literature is reviewed and appraised concluding that innovation is dependant upon a complex combination of both people and the four levels of influence;
- Following a specific review of construction innovation literature a hierarchical model is presented showing the stimulants and impediments to creativity in PFI.

All of the above points are accurately reviewed with substantial referencing to support the argument put forward by Eaton et al (2005). The concepts put forward are supported by existing literature and also support and enhance the
author's existing perception of creativity and the PFI based upon the literature reviewed. The paper's main points are an invaluable summary of the content of the paper and provide a quick and easy reference to aid in the evaluation of the papers worth in both its own right and its worth with respect to the author's research.

With respect to the meaning of the paper, it is clear that the paper is trying to review the applicability of creativity research in the context of the built environment and more specifically in the context of the PFI. The paper achieves this and proceeds to put forward a hierarchical theoretical model, discussing the stimulants and impediments to creativity and the PFI, based on the reviewed literature.

The paper is weak with respect to primary research to underpin its theory development; however this is addressed in the paper's conclusion which points to further research conducted to address this issue. The paper's final conclusion seems to repeat earlier statements made in the literature review rather than offer a conclusion based on the theoretical model developed. There was no evaluation of the ability, or level of success, of this paper and its research to meet the original objectives identified by the paper. No recommendations for further areas of research were made (with the exception of a minor reference to potential research discussed in the abstract), the author was directed to a further paper outlining the empirical evaluation of the model however.

The main concept of significance to the author in this paper was the identification based on the literature reviewed of four categories of work environment influences. The paper identified the following four levels of analysis:
Job role or work role influences;
Project team or work group influences;
Organisational influences;
Influences in the environment external of organisations.

The author believes this to be an important informative, well referenced, paper. Its main strength is the depth of literature reviewed, its main weakness (as a paper in its own right) is the minimal conclusion and evaluation undertaken. The paper does not raise any challenges to the author's concepts; it has raised the opportunity to develop a deeper understanding of creativity with respect to the PFI however. It has been a useful tool in determining further reading in order to confirm the direction of this research. The model developed focused upon creativity and the PFI, it is the author’s belief that the four levels of analysis (the external environment level, the organisation level, the project level and the job role level (the job-role level which may be applicable to a lesser extent in the author’s research)) identified by this paper can be further progressed and developed to establish a basis for a model based on the stimulants and impediments to nuclear power and the PFI.

4.2 Theoretical Model Development

Figures 4.1 and 4.2 below show the stimulants and impediments to nuclear power and the PFI as identified in the literature review. There are a number of stimulants to both nuclear power and the PFI that share a common result. Similarly there are a number of obstacles that share common characteristics.
Stimulants

<table>
<thead>
<tr>
<th>Nuclear</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Carbon emissions</td>
<td>No upfront government expenditure</td>
</tr>
<tr>
<td>No penalties from future Carbon emissions</td>
<td>Solution integrated to public sector need</td>
</tr>
<tr>
<td>Improved air quality</td>
<td>Improvements in efficiency and productivity</td>
</tr>
<tr>
<td>Sustainable power generation</td>
<td>Improved programme</td>
</tr>
<tr>
<td>Non-reliance on external primary power sources</td>
<td>Open &amp; transparent cost management</td>
</tr>
<tr>
<td>Provides 'base-load' power generation</td>
<td>Increased competition</td>
</tr>
<tr>
<td>Technological innovations</td>
<td>Potential cost reductions</td>
</tr>
<tr>
<td>Improved research &amp; development through private investment</td>
<td>Concentrates on value for money</td>
</tr>
<tr>
<td>Future technical improvement due to high technical nature</td>
<td>Comparison with public sector comparator</td>
</tr>
<tr>
<td>Realistic, robust pricing</td>
<td>Standard of service can be defined</td>
</tr>
<tr>
<td>Low primary fuel costs</td>
<td>Improved quality</td>
</tr>
<tr>
<td>Efficiency through competition</td>
<td>Long-term planning encourages future investment</td>
</tr>
<tr>
<td>Improved public awareness through competition</td>
<td>Risk transfer/allocation</td>
</tr>
<tr>
<td></td>
<td>Client power to penalise for non-performance</td>
</tr>
<tr>
<td></td>
<td>Life-cycle costing</td>
</tr>
<tr>
<td></td>
<td>Improved opportunities for innovation and creativity</td>
</tr>
<tr>
<td></td>
<td>Improved sustainability</td>
</tr>
<tr>
<td></td>
<td>Increased management expertise</td>
</tr>
<tr>
<td></td>
<td>Increased levels of accountability &amp; standards</td>
</tr>
<tr>
<td></td>
<td>Improve local social environment</td>
</tr>
<tr>
<td></td>
<td>Reduction in local unemployment</td>
</tr>
</tbody>
</table>

Figure 4.1 Stimulants to Nuclear Power & the PFI

Figure 4.1 identifies sustainability as a common stimulant to both subjects. PFI encourages sustainable design through life-cycle costing, nuclear power promotes sustainability due the primary fuel it uses (non-fossil fuel) and the lack of Carbon emissions. Innovation is another analogous area, the PFI encourages innovation and creativity; nuclear power encourages innovation due to the high technical skills and expertise involved. There is incentive for greater research and development through private investment in nuclear power, which due to the PFI's focus on long-term planning should be at even greater levels. Nuclear power is also realistically priced which complements the PFI approach.
to open and transparent cost management. Finally competition is increased through PFI which leads to the greater efficiencies discussed with nuclear power which in turn will help to improve public awareness about nuclear power.

<table>
<thead>
<tr>
<th>Impediments</th>
<th>Nuclear</th>
<th>PFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public opinion and acceptance</td>
<td>Long-term financial commitment</td>
<td>Disguises true position of public finances</td>
</tr>
<tr>
<td>Public knowledge and awareness</td>
<td>High private sector borrowing rates</td>
<td>Refinancing damages public perceptions</td>
</tr>
<tr>
<td>Safety concerns generally</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease in safety levels due to increased competition</td>
<td>High costs both pre-contract and due to high profit margins</td>
<td></td>
</tr>
<tr>
<td>Production and storage of nuclear waste</td>
<td>Complex legal issues leading to increased costs</td>
<td></td>
</tr>
<tr>
<td>Proliferation of nuclear weapons</td>
<td>Inefficient public sector comparator</td>
<td>Perpetuates belief of public sector inefficiencies</td>
</tr>
<tr>
<td>Increased threat from terrorism</td>
<td>Arborite &amp; unreliable risk transfer</td>
<td>Reduction of the 'Public Service Ethos'</td>
</tr>
<tr>
<td>Economics due to safety</td>
<td></td>
<td>Creation of a 'two-tier' workforce</td>
</tr>
<tr>
<td>Economics due to capital costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economics due to decommissioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased requirement for legislation and regulation</td>
<td>Market is difficult to enter for SME's</td>
<td></td>
</tr>
<tr>
<td>High risk for private investors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With respect to Figure 4.2 and the impediments the biggest related impediment is cost and finance. The issues identified under the PFI such as the long-term financial commitment, potential high costs due to pre-contract negotiations and legal issues could compound the economic concerns due to safety, capital cost and decommissioning cost of nuclear power generation facilities. The refinancing issue that damages the perception of the PFI would also add to the current public mistrust of nuclear power affecting public opinion and acceptance of nuclear power. The increased requirement for legislation and regulation would also add to the legal complexity that already surrounds PFI. Finally if the potential for arbitrary and unreliable risk transfer were realised through the PFI then the risk transfer that took place would be ineffective (based on the premise that risk should be transferred to the party best able to deal with it (HM
Treasury, 1995)) which would either create or reduce risk to the private investor, the ideal for both parties would be to transfer the risk effectively.

There are also potential conflicts between nuclear stimulants and the PFI impediments and vice-versa. For example the PFI advocates no government expenditure however this is in conflict with the fact that an increase in government legislation and regulation will result in additional cost, both in order to implement it but also to monitor that legislation over time. Competition increasing due to the PFI approach may increase the potential degradation of safety levels discussed.

Following this review and summarisation of the stimulants and impediments to both nuclear power and the PFI and the review of Eaton et al's (2005) work on the four levels of analysis the following figure, Figure 4.3 below, shows a theoretical model of potential stimulants in applying the PFI to nuclear power broken down by each level of analysis:
PFI/Nuclear Power Stimulants: Theoretical Model

External Environment Level:
- Reduced Government capital expenditure;
- Increase ability of Government to meet Kyoto targets;
- Environmental benefits from improved air quality;
- Improved public knowledge and awareness leading to improved levels of public acceptance of nuclear power;
- Reduced reliance on external primary power sources, UK retains self-sufficiency;
- Social service needs met;
- Comparison with Public-Sector Comparator;
- Social environment improvement;
- Increased employment.

Organisation Level:
- Protection from potential Carbon emissions tax;
- Benefits from new technology patents;
- 'Base-load' generation providing constant demand;
- Low primary fuel costs;
- Efficiency through increased competition;
- Open and transparent cost management;
- Standard of service defined;
- Encourages future investment;
- Client ability to apply penalties for non-performance;
- Opportunity for innovation and creativity.

Project Level:
- Sustainable design benefits;
- Technological innovations;
- Improved construction programme;
- Improved efficiency and productivity;
- Value for money;
- Cost reductions;
- Improved quality;
- Efficient risk allocation;
- Increased management expertise.

Job Role Level:
- High level technological research and development opportunities;
- High remuneration due to high level of expertise required.

Figure 4.3 PFI/Nuclear Power Stimulants: Theoretical Model

Figure 4.4 below shows the theoretical model developed to show the potential impediments in applying the PFI to nuclear power:
PFI/Nuclear Power Impediments: Theoretical Model

**External Environment Level:**
- Current levels of public knowledge, awareness, opinion and acceptance;
- Nuclear waste;
- Proliferation of nuclear materials and weaponry;
- Terrorism;
- New legislation and regulation required;
- Inefficiencies in public-sector comparators;
- Reduction of public service ethos and perpetuates belief of public-sector inefficiency;
- Long-term public financial commitment.

**Organisation Level:**
- Potential for decrease in safety levels due to competition;
- Storage of nuclear waste produced;
- Economics, safety, capital cost and decommissioning;
- High risk projects;
- Creation of 'two-tier' workforce;
- Market difficult to enter for SME's;
- High private sector borrowing rates.

**Project Level:**
- General safety concerns;
- Production of nuclear waste;
- High pre-contract and legal costs;
- Unreliable risk transfer.

**Job Role Level:**
- High risk work environment;
- Lack of freedom;
- Decreased opportunity for individual initiative and innovation;
- Strict rules and procedures.

Figure 4.4 PFI/Nuclear Power Impediments: Theoretical Model

In order to establish the validity of the theoretical models above further research is required. The research must seek to identify any further issues within these areas that have not been addressed by the literature review and model development. The following chapter provides a review of the epistemological framework for this research. It develops a basis for a series of semi-structured interviews to be undertaken and then records the results of those interviews.
Chapter Five

Research:
Framework & Interview Development

5.1 The Epistemological Framework

Research design is an action plan from getting from one place to another, from the initial questions ('here') to a set of conclusions ('there') (Naoum, 1998). The collection and analysis of relevant data which enables you to get from 'here' to 'there' follow a number of major steps (Yin, 1994). There are a number of factors which will influence the outcome of any research. The methodological approach of the researcher is one of the key factors and as Amaratunga & Baldry (2001) suggested a thorough understanding of the research process and identification of the correct methodology is important because:

'...an understanding of fundamental issues pertaining to different types of research typologies is important [and] is likely to affect the whole research process, as the success of a research project will be largely dependant on the robustness of this strategy'

(Amaratunga & Baldry, 2001, p. 146)

There are essentially three principle paradigms upon which all research is based. There is the positivistic approach based on social structure and facts which tests hypotheses in a quantitative manner; quantitative research. The second is a phenomenological approach based on the concepts of social construction and meanings used to develop hypotheses in a qualitative way; qualitative research (Silverman, 1998). The third approach is a mixture of both quantitative and qualitative research, a mixed methodology. The methodologies
represent fundamentally different approaches to research. Subsequently the results obtained from the research will be fundamentally different.

The research objectives or the research question is probably the single most important factor which will influence the outcome of the research. The specific purpose of the research is a major factor in the design of the project (University Of Salford, n.d. a). The research question will direct the research, influence the choice of methodology and also has the potential to influence the choice of the research strategies used. It is important to select a methodology that answers the research question. The aim of this research is to identify what stimulants and impediments exist in the application of the Private Finance Initiative to provide better value for money in nuclear energy generation. An approach is required that allows observation of current practice and derivation of current opinions within the industry.

The qualitative research approach is based upon the interpretative science/phenomenological school of thought. The basic points of this philosophy are that the world is socially constructed and subjective. The observer forms part of what is observed and that the science is driven by human interest. The researcher should therefore focus on meanings, try to understand what is happening, look at the totality of each situation and develop ideas through induction from the data. Small samples are usually investigated in depth or over time using multiple methods to establish different views of the phenomena (Easterby-Smith et al, 1991 cited by Amaratunga & Baldry, 2001). This approach will enable the process of investigation essential to achieving the required outcomes. As Amaratanga & Baldry (2001) suggest through a process of inquiry and investigation a systematic and methodical process to increase knowledge within the chosen subject area will be undertaken. Qualitative research is however, subjective by nature; it describes a topic or event linguistically rather than mathematically (Naoum, 1998). Quantitative research would also be useful to show statistical information and/or make decisions based upon mathematical data. The use of a mixed approach would also allow triangulation of the results; this allows for the development of converging lines
of inquiry using multiple sources of evidence (Yin, 1994). For the purposes of this research however the author believes that the 'qualitative exploratory research' approach will be the most useful.

Qualitative research is a term which covers a variety of differing methods of conducting research. It is concerned with meanings and the way people understand things and with patterns of behaviour (Denscombe, 2003). Theory is less clear than in quantitative research. The outcome of qualitative research in this case would be the production of a theory which will require further testing, potentially through quantitative methods (Naoum, 1998). Qualitative research is often seen as a preparatory stage of quantitative research. Bryman (1988) suggests that this implies that qualitative research is a 'second rate' form of research as it requires quantitative verification. Proponents of qualitative research see it as viable research in its own right. The outcome of qualitative research is usually rich, complex data which does not lend itself to generalisations or quantifiable causes and effects (University of Salford, n.d. b).

Cresswell (1994) suggests that qualitative research should be employed in a manner consistent with the type of qualitative design; it should be used inductively so that it does not become something to test, but rather something to develop and be shaped through the process of research. Qualitative research should create a visual model of the theory as it emerges and compare and contrast that theory with other theories. Filstead (1979) suggests qualitative research is concerned with the discovery of a theory rather than the verification of one. Therefore, followed to its logical conclusion this statement suggests that the outcome of qualitative research is the 'discovery' of a theory. Qualitative research does not lend itself to generalisation. This is frequently due to the qualitative researcher conducting a single investigation which generates ideographic data (Bryman, 1988). The quantitative approach tends to be data informed by theory, qualitative on the other hand would be theory informed by data (Wield et al, 2002). A qualitative approach will lead to a more interpretative research process. This will create richer, deeper results and lead to the emergence or development of theory. The results generated from the
interviewing of industry figures involved in the processes being researched, being rich and deep will enable the development of a theoretical model which will not only review the current viability of the theory developed but also help to direct further research.

Denscombe (2003) suggests that decisions regarding method and strategy are usually taken before the research begins and that changing the method or strategy later on is difficult especially when resources are finite. Therefore research outcomes are influenced heavily by the methodological approach adopted by the researcher. The aspects which affect the outcome of a research project create a virtual hierarchy which may determine the path the research follows, which in turn determines the final destination of that research. The hierarchy begins with the research objectives, the objectives will be a major factor in the choice of methodology. The methodology will impact upon the choice of research strategy. The strategy will yield the research findings and results and determine the final outcome. Running parallel with this hierarchy are the researcher's philosophy and encompassing the whole process is the availability of resources.

Qualitative research differs fundamentally from quantitative when considering the researcher's participation in the research. In qualitative research the observer is part of what is being observed (Easterby-Smith et al, 1991, cited by Amaratunga & Baldry, 2001). This is an essential principle to understand. If a researcher is participating in what is being researched then that researcher has the ability, both consciously and unconsciously, to alter the direction of that research. This will have significant impact upon the outcome of the research; Gans (1967) gives an example of how the researcher can affect the outcome of the research:

[The] activities cast me in three types of research roles; total researcher, researcher-participant and total participant. As a total researcher I observed events in which I participated minimally or not at all...As a researcher participant, I participated in an event but as a
The researcher rather than a resident... As a total participant I acted spontaneously as a friend or neighbour and subsequently analysed the activities in which I had participated.

(Gans, 1967, p. 440)

The different parts that the researcher plays in the research will have an affect on the type of outcome that is achieved. As a total researcher Gans observed events; as a total participant he was able to take part and understand the process from a participant's perspective, he was then able to subsequently analyse this and report the findings.

The differing research techniques result in different outcomes and it is important to understand and identify what role the researcher plays in the research. This research is being based on a 'Hypothetico-deductivist' model which suggests that research should begin with a prior body of theory. The prior body of theory is used to generate a hypothesis which is then tested by research. This is opposed to a 'Hypothetico-inductivist' model which suggests that all facts should be collected and then the theory emerges from the facts by a process of induction. (Wengraf, 2001). In the case of this research the reviewed literature has enabled the formation of a basic theoretical model which can now be tested by further primary research, in the form of semi-structured interviews. This research will therefore see the author cast in the role of 'Researcher-Participant.' Through semi-structured interviews the author will try to establish whether the stimulants and impediments to applying PFI to nuclear power identified in the literature review are applicable, the research should also uncover any areas of the literature review which may have been deficient. A professional from both the PFI and construction perspective and the nuclear power generation perspective will be interviewed. The interviews will seek to confirm or deny the knowledge uncovered in the literature review and theory development and also add to that knowledge. The author will seek to understand current attitudes toward nuclear energy generation, thoughts on the use and success of the PFI as a procurement model and the opinions of respected professionals upon the applicability and use of PFI to nuclear energy
generation. In order to ensure a broad understanding of all the issues involved those persons interviewed will have differing backgrounds. The author intends to interview one person with a background in the PFI and one with experience in the nuclear industry. More information concerning those interviewed can be found in the following chapter.

A semi-structured interview is based around a number of topics and is used to gain the greatest amount of information about those topics possible (Naoum, 1998). Semi-structured interviews differ from structured ones in that there is no set line of questioning and the interviewer can improvise and digress from the basic plan during the interview, unlike structured interviews where the researcher must follow a predetermined route (Holt, 1998). This flexibility is ideal for the research required in this case as there is currently little existing research in this field. There are a number of options when conducting interviews, the interview can be a joint study to achieve a goal between interviewer and interviewee or the interview can be, as in the case of this research, initiated and planned by the researcher on a question and answer basis (Le Voi, 2002).

The interviews to be undertaken will require a certain amount of preparation and forethought. A number of questions will be prepared, however, those questions will be sufficiently open-ended to allow for a broad response. This will require a certain amount of improvisation of the part of the researcher to enable rich, deep and applicable results (Wengraf, 2001). Semi-structured interviews give the interviewer great freedom to explore both planned and unplanned areas during the interview (Le Voi, 2002). Wengraf (2001) suggested that successful semi-structured interviewing requires the following:

- As much preparation before the session, probably, and certainly;
- More discipline and more creativity in the session, and certainly;
More time for analysis and interpretation after the session.

(Wengraf, 2001, p.5)

It is also necessary to understand, as Mishler (1986) pointed out, that the meanings which are generated within an interview situation are dependant both upon how the questions are phrased but also how those questions are answered. A significant amount of analysis and interpretation of both the results obtained and the underlying flow of the interview process itself will be undertaken in conjunction with the literature reviewed. This analysis can then be used to derive conclusions and further develop the theoretical model in order to understand what stimulants & impediments exist in the application of the PFI to provide better value for money in nuclear energy generation in the United Kingdom. The use of less structured interviews is more applicable to this research due to the emergent and exploratory nature of the research (University of Salford, n.d. a). The researcher's interpretation of the findings represents another potential influence on the outcome of the results. Bryman (1988) offers a laconic summation of this concept below:

‘...the researcher, the discipline, the culture to be translated and the culture to which it is translated to form an interwoven amalgam of elements.’

(Bryman, 1988, p. 80)

Interviews are one of the most widely used qualitative research strategies in the built environment (Amaratunga & Baldry, 2001). King (1994) states that the interview is a highly flexible method that results in rich and deep results. Fellows and Lui (1997) consider the following:

‘Considerable research in the built environment involves asking and obtaining answers to questions through conducting surveys of people by using questionnaires and interviews. Often, responses are compared to “hard data”, such as total cost of a construction project. Survey techniques, such as questionnaires, interviews, etc., are
highly labour intensive on the part of the respondents and particularly on the part of the researcher...’

(Fellows & Lui, 1997 cited by Amaratunga & Baldry, 2001, p.140)

The interview technique will clearly influence the outcome of any research as the interviewees own opinions will shape that research. There is also the possibility that the researcher’s interpretation of the results may influence the outcome (Denscombe, 2003). It is clear that the framework chosen for the research will have an impact on the outcome of the research. Amaratunga & Baldry (2001) offer a succinct conclusion of how to choose the strategy:

‘The overall choice needs, of course, to be the most suitable one to achieve the objectives of the specific piece of research.’

(Amaratunga & Baldry, 2001, p.146)

The most suitable approach for this research is the approach that has been detailed above. Using a qualitative methodology based on interviews with relevant figures within the industry concerning the research question a significant and real contribution to the existing knowledge base can be achieved.

5.2 Semi-structured Interview Questions

This section of the chapter focuses on the development of the questions to be used in the interviews. The interviews will be intrinsically the same although the format will alter depending upon who is being interviewed. The author will also allow a flexible interview technique which may uncover deeper information not covered by the literature review. The emergent nature of this research is why semi-structured as opposed to structured interviews are proposed.
Interview Agenda – Nuclear Power

Preliminaries

Switch on tape recorder
Thank Interviewee for agreeing to be interviewed
State Name, Company & Date for the recording

Part 1: Background

1. What is your position within the company and how long have you held that position?
2. What is your background? – Engineer, QS, etc.
3. What types of projects have you been involved in and what are you currently involved in?
4. Are you a member of any professional bodies?

Part 2: Nuclear Power

5. Why do you believe nuclear power should be used in electricity generation?
6. What issues are you aware of in relation to nuclear power and in what order of importance would you rank them? Discuss issues as portrayed in model.
7. What do you believe are the main stimulants/drivers to nuclear power?
8. What do you believe are the main impediments/barriers to nuclear power?
9. Do you believe the UK would benefit from an expansion of its current nuclear power generation facilities?
10. Do you believe the UK Government’s current position on Nuclear Power is the correct position?
11. What, in your opinion, is the most fundamental issue globally regarding the environment, at this current time?
12. What is the most fundamental environmental issue with respect to the construction industry?

13. Does the failure of the USA to sign up to the Kyoto Protocol regarding Carbon emission effectively render it useless?

14. How is your company working to improve awareness and application of sustainability and sustainable design into your activities?

15. Do you think the Government should introduce a Carbon Emissions tax?

16. Do you think the nuclear industry should be Nationalised?

17. If proposals were put forward to build a nuclear power station in your area (county) what would be your reaction?

18. Sweden generates 45% of its electricity requirements through nuclear power, France generates over 75% of its requirements, the UK currently generates just over 20% which is set to fall substantially over the next 15 years, combined with the exhaustion of North Sea oil what alternatives to nuclear power do you believe are viable to meet the UK’s increasing requirement for electricity?

19. Do you know the difference between nuclear fission and nuclear fusion?

Give a brief outline of nuc. fusion and its main differences and then ask:

20. Would you be in favour of constructing a series of nuclear fusion reactors in the UK?

Part 3: PFI

21. What is your understanding of the Private Finance Initiative?

If their understanding is limited give a brief outline and move on.

22. Have you been involved in projects that have utilised the PFI?

23. Why, in your opinion, were those projects procured via this route?

24. Were those projects successful?
25. What type of project or industry sector (i.e. health, education, residential, commercial, etc.) do you believe the PFI is best suited to?

26. What do you believe is the main purpose or driver behind the use of PFI?

27. What do you believe are the main stimulants to PFI?

28. What do you believe are the main impediments to PFI?

29. Do you believe PFI to be a successful method of procurement?

30. Do you believe PFI could or should be expanded to other sectors of the industry?

31. Would you advocate a PFI route to a prospective Client?

32. What alternatives are there to a PFI approach?

**Part 4: Modelling**

*Give them the PFI/Nuclear model(Figures 4.3 & 4.4) and ask them if they agree with it. Is there anything that should not be there or are there any glaring omissions?*

33. Do you think the PFI could be utilised to provide new nuclear power generation facilities in the UK? Give reasons.

34. To your mind are there any aspects of the PFI and its philosophy that conflict with the nuclear power industry?

35. Do you think your industry, and at a lower operational level, your firm would welcome the introduction of PFI to nuclear energy generation facility construction?

36. Is there anything else you would like to add to this discussion?

*Thank them for their time

Issue the contact pack.*
Interview Agenda – The PFI

Preliminaries

Switch on tape recorder
Thank Interviewee for agreeing to be interviewed
State Name, Company & Date for the recording

Part 1: Background

1. What is your position within the company and how long have you held that position?
2. What is your background? – Engineer, QS, etc.
3. What types of projects have you been involved in and what are you currently involved in?
4. Are you a member of any professional bodies?

Part 2: PFI

5. What is your understanding of the Private Finance Initiative?
6. Have you been involved in projects that have utilised the PFI?
7. Why, in your opinion, were those projects procured via this route?
8. Were those projects successful?
9. What type of project or industry sector (i.e. health, education, residential, commercial, etc.) do you believe the PFI is best suited to?
10. What do you believe is the main purpose or driver behind the use of PFI?
11. What do you believe are the main stimulants to PFI?
12. What do you believe are the main impediments to PFI?
13. Do you believe PFI to be a successful method of procurement?
14. Do you believe PFI could or should be expanded to other sectors of the industry?
15. Would you advocate a PFI route to a prospective Client?
16. What alternatives are there to a PFI approach?
Part 3: Nuclear Power

17. Have you had any experience in either the nuclear industry or the construction of nuclear power stations?
18. What is your personal opinion regarding the use of nuclear power in electricity generation?
19. What issues are you aware of in relation to nuclear power and in what order of importance would you rank them? Discuss issues as portrayed in model.
20. What do you believe are the main stimulants/drivers to nuclear power?
21. What do you believe are the main impediments/barriers to nuclear power?
22. Do you believe the UK would benefit from an expansion of its current nuclear power generation facilities?
23. Do you know the difference between nuclear fission and nuclear fusion?

Give a brief outline of nuc. fusion and its main differences and then ask:

24. Would you be in favour of constructing a series of nuclear fusion reactors in the UK?

Part 4: Modelling

Give them the PFI/Nuclear model (Figures 4.3 & 4.4) and ask them if they agree with it. Is there anything that should not be there or are there any glaring omissions?

25. Do you think the PFI could be utilised to provide new nuclear power generation facilities in the UK? Give reasons.
26. To your mind are there any aspects of the PFI and its philosophy that conflict with the nuclear power industry?
27. Do you think your industry, and at a lower operational level, your firm would welcome the introduction of PFI to nuclear energy generation facility construction?
28. Is there anything else you would like to add to this discussion?

Thank them for their time
Issue the contact sheet and appendices.

5.3 Semi-structured Interview Results

Chapter Six, contains the results of the primary research conducted as part of this study. The interviews have been edited for brevity and to enable the reader to more easily read the interviews. The author's input into the interviews has been highlighted in italics. The full transcript (edited only for confidentiality purposes) can be found in Appendix One and Two.
Chapter Six

Research: Results of Semi-structured Interviews

6.1 Research Interview One: Interview Agenda – Nuclear Power

Specialist Area: Nuclear Power
Company: Private Nuclear Organisation
Job Title: Head of Energy Policy Studies
Background: Engineering, Nuclear Power & Energy Policy
Interview Duration: 2 hours 20 minutes (approx.)

Part One: Background

Firstly, what is your position in the company?

I'm what's called the Head of Energy Policy Studies. I work in a team of about a dozen people here called the Energy Unit which is part of corporate [The Company], helping to work with the Government to make the case for nuclear, help Government understand the implications of it's energy policy decisions in so far as nuclear is concerned because the Government isn't full of nuclear specialists. The Government owns [The Company] through the Department of Trade and Industry shareholder executive within the DTI. So we're owned by Government but we're also trying to help or advise, or in a very small way lobby and persuade Government about the role of nuclear.

I and the rest of the team here work very much with other companies in the nuclear industry. One of the things I do in my particular role is have a wider view as well looking at how nuclear stacks up against Renewables and some of the other alternatives and some of the wider energy policy and electricity policy issues. We've got people for instance in nuclear economics or nuclear waste or
safety regulations. So my remit is to look a little bit more broadly at nuclear as one player amongst many.

Are you a member of any professional bodies?

I was a member of the Institute of Mechanical Engineers that’s lapsed because I don’t do a lot of engineering but I’m a member of the British Nuclear Energy Society and I’m on the North-West branch of the committee of the British Association for Advancement of Science.

Part Two: Nuclear Power

Why do you believe nuclear power should be used in electricity generation?

I’ll try and give an overview answer. Basically Government did an energy white paper in 2003 and set three functional objectives for energy policy. Particularly electricity was the focus and the fourth objective they set was about achieving it all through competitive markets. So the three things to achieve were affordability of supplies, environmental acceptability particularly in respect to Carbon Dioxide emissions and reliability of supply. Without looking at all the other alternatives the most recent studies whether it’s internationally or UK indicate that nuclear is there or thereabouts with the cheapest forms of electricity generation in the future, on a pence per Kilowatt-hour (Kwhr) basis across the full life-cycle. So I think nuclear gets a tick in the affordability box.

It also gets a tick alongside that in terms of the robustness of the cost because the Uranium cost, the thing you are dependant on the global market to identify, it’s outside your control, is only about 5% of the total generating cost of nuclear. If you look at something like gas then the raw gas cost is about 60% of the cost of generating with gas fired power stations. You might be aware that gas is the way we are heading in the future, about 80% by 2020. About 80-90% of it imported. So from an affordability point of view and in terms of the confidence you can have in those costs of generation nuclear scores very well.
When you look at reliability of supply again we look at the gas as being the primary component of our electricity mix. Gas coming from a long way away, whether it's coming via long pipelines or whether it's coming via liquefied natural gas and being transported to specialised import terminals, there are lots of things that can go wrong with that, there are a lot more dominoes in the pack that all have to stay in the right place.

If you're looking at reliability of the electricity network in general and you're looking at a future with 80% gas and 20% Renewables and not much of anything else anything that can add to that mix ideally by displacing gas is going to present a much more balanced mix and a balanced mix in general is likely to be much more immune to common mode failure than something that is much more heavily dominated by one technology.

And equally our other primary component from the energy white paper is Renewables and that means particularly wind. When we look at what wind does, Germany and Denmark have been leading the way in that respect. They've had to build very noticeable back-up conventional power generators alongside the wind farms for those times when the wind doesn't blow. Germany in particularly had a report out from EON, which is actually the utility that owns the bulk of the wind farms in Germany and their figures for 2003 were the average what they call load factor or capacity factor through the year from their wind farm fleet was 16%. So basically they were getting \( \frac{1}{6} \) of the rated output on average. So if you want that full output reliably through the year you've got to be building at least \( \frac{5}{6} \) of that capacity in reserve. Actually if you want it on at every single hour during the year virtually the full capacity. I think again German figures say that the full wind fleet in terms of what it displaced of conventional capacity was about 6% of the total. So it's nice to have, it's a bonus when you can get it, but you've actually got to solve the problem twice by building a wind farm then by building something else for when the wind farm doesn't work, it's not really looking good economically.
So there are security of supply questions about both gas and wind. When you look at nuclear, the fuel requirements are very small. If you’re looking at only 300tns of fuel per year to support the whole of the replacement fleet of reactors if we were to build one to fuel that fifth or quarter of the power supplies of the UK. They operate at very close to 100% so it’s ‘base-load’ generation round the clock 24hrs a day very reliably without any concerns about whether the fuel can reach the stations or whatever else. So we’ve ticked the affordability box, we’ve ticked the reliability box and a further point on reliability is the Uranium when we do get it, comes from places like Canada and Australia, so in terms of geopolitics and whatever else they’re fairly politically stable.

When we get to the environmental side. Nuclear is essentially Carbon free, it doesn’t produce any Carbon emissions. I mean there are Carbon emissions associated with the nuclear fuel cycle because Uranium has to be mined and it has to be transported and you have to enrich the Uranium to make the fuel. But when people have done fuel life cycle assessments of nuclear versus coal, gas, whatever else, nuclear does stack up very, very well. It’s a small number of percent of gas or coal and it’s about level with Renewables because there are Carbon emissions associated with building a lot of wind farms as well, you’ve got to put a big block of concrete at the bottom of each one, which requires quite a big bit of manufacturing effort and you’ve got to move the blades and the wind, stacks and everything else to where you want them so there are emissions associated with pretty much everything and nuclear is right at the bottom of the scale. So it makes a very substantial contribution to Carbon emissions. So really when we look at the plus side of nuclear and how it scores against energy policy objectives it gets a win, win, win score in my book.

So on the negative side what issues are there and what rank of importance would you put them?

The issue with nuclear is really about deliverability in the kind of market we have at the moment. So the fact that it’s a very capital intensive project, you’re talking £1.5-2bn pounds probably for a nuclear station, in terms of just the
capital cost. If we were to start today then the earliest we would get any electricity out of a new nuclear station would be in about 10 years time. That's because you’d have a 3 year process period when you’d have to get the design licensed because we wouldn't be building the same kind of designs we’ve got at the moment, we’d take an international standard design. We haven't got any of those approved in the UK at the moment. A lot of them are licensed in other countries but we have our own set of requirements, we have to satisfy ourselves and meet UK regulations, so there’d be at least 3 years to do that, taking a design off the shelf from an international marketplace.

Then having done the design, we’d have to choose where we wanted to build it, we’d have to have a public enquiry. We’d have to make sure, if we wanted to hit that 10 years, the public enquiry’s scope is limited to things we haven’t already looked at. We’ve ended up with reactors being redesigned in the licensing process and then redesigned again at the public enquiry. You end up with a design that is unique in the world and because it’s a one of a kind in the world it’s quite expensive. It’s difficult to build, you get into problems with construction because you end up using the same bit of space for two bit’s of pipe work that you thought you’d add in, and also it’s a pain to maintain because it’s the only one of its kind, so from an operability point of view it becomes difficult.

Then there is a 2 year approvals and enquiries stage. There could then be a 5 year construction and commissioning stage so roughly 10 years minimum. Now at the moment that could drag on for an awful lot longer because there’s no guarantee the public enquiry wouldn’t go into all sorts of complicated detail. There’s certainly no guarantee that the licensing process wouldn’t ask itself ‘how could we make this design a lot better and a lot more familiar to the UK regulator?’ Rather than asking the question you need to ask, which is ‘does this design meet the specification that we have, the criteria that we have?’ No investor is going to want to invest in a one of a kind, hybrid evolution of something which is a standard design elsewhere. Sizewell B, which was the last reactor in this country, was meant to be effectively a carbon copy of a tried
and tested, proven design from the States. By the time our regulators had finished with it you wouldn’t have recognised it, it was a complete nightmare. So that’s one question, at the moment if you entered into that approvals process you have no confidence of what would come out the other end or even when it would come out the other end.

The other big issue for potential investors is waste. The UK doesn’t have a policy at the moment for how we will manage higher active wastes. So that’s anything above the very low level material, like laundry and overalls and paper towels and stuff. Anything to do with reactors or spent fuel is being stored safely and managed safely at places like Sellafield and other reactor sites but there is no long term disposal policy for radioactive waste. Other countries do have it, countries like Sweden, Finland, the States. They’ve all actually concluded the same thing, a deep underground repository where we put this material and then leave it. Without some conclusion from that from an investors point of view, without knowing what the policy is, it’s effectively an uncapped liability. You’d be investing in something that you would have no control over what the Government told you to do with that waste at the end of it. So from a purely due diligence point of view they could tell you to do anything with it. So there’s no certainty there. I think those are the two biggest show stoppers; Government policy on planning and regulation and Government policy on waste. If those were both tightened up I think investors would be much more serious.

There is something else that Government might do, which might be helpful which is look at the electricity market and see whether a nuclear plant producing reliable Carbon free energy would be getting the same credit in terms of contributing towards those energy policy objectives that other technologies might get for making their contribution.

_Do you think from the other point of view that it would be beneficial to have a Carbon emissions tax on say fossil fuel generating facilities?
Well something like a straight Carbon tax that penalised producers of Carbon in general, yes would help nuclear. If you wipe the slate clean and start again and if you introduced a Carbon tax then nuclear would be on exactly the same footing as Renewables because we don’t produce any worth speaking of therefore we’re not paying a tax all the fossil fuel people will be paying. They tend to be the price setters, the price setter is mainly gas at the moment because of the tax being paid by coal and by gas it’s perhaps going to push the revenue up without pushing the nuclear industries costs up. So yes that’s going to be hugely helpful. But, and that’s a big but, how long is that guaranteed for? Because if the Government of the day are able to bring in a Carbon tax, that works with no guaranteed longevity on it, we’re talking about a project that isn’t going to generate it’s first Kwhr of electricity until 2015. So in order for that to be bankable for an investor, it has to be guaranteed to be around in 2015 and probably guaranteed to work until 2025 to 2030. A guaranteed tax or incentive that stretched out through the first twenty or thirty years of it’s operation would be a huge incentive to investors on a project like that. So it isn’t just a nuclear issue it’s a high capital long timescale project issue.

So I think that the two real show stoppers in terms of investors are the planning process which can just drag on forever and this big question mark over waste policy. An additional incentive might be, can the Government do something in the market to provide a level playing field [which encourages] low Carbon technologies or penalises Carbon production. So for instance you could have a diversity tax which means that if you want to build yet another gas station when we’ve already got 75% of our mix as gas already you might penalise for adding another gas station to the mix. But you might be rewarded or whatever for providing something that currently provides only 5% of our generation or nothing at all to help bring forward newer technologies.

*Are there any other stimulants or impediments to the expansion of nuclear power?*
The real impediment is decision makers perception of public perception. If I just explain what I mean by that. We've done opinion polls that asked the question 'would you support or oppose the building of new nuclear power stations to replace the power stations that we already have?' I think there might have been something about helping to reduce dependence on imported gas and helping to cut emissions. But that was basically the question, would you support new nuclear and 35% of respondents said they would and 30% said they wouldn't and the others didn't know. We often found it was fairly even but it was normally slightly weighted towards the don't support it than they do. However, if we ask MP's, what MP's think public perception is, the MP's believe that the public are about 80% opposed to nuclear. So there is a feeling that it is going to cost them votes or be unpopular with their constituents to take any measures that would encourage nuclear, but actually that's not true.

*Do you think there is enough knowledge in the public arena regarding nuclear power?*

No, not at all. The biggest survey that's done right across Europe was called the Euro-barometer Study in, I think it was 2002 in all fifteen countries of the EU and they asked, ‘does nuclear power contribute to global warming, i.e. is nuclear part of the problem.’ Right across Europe about 47-48% of people said yes it did contribute and about 28% of people said no it didn't. So almost 2:1 people thought it was part of the problem rather than part of the solution. In the UK we were almost exactly on those numbers, strangely enough, we're not usually in step with the rest of Europe. In France where they've got nearly 80% of nuclear they were even more wrong than we were. 54% in France thought it contributed to global warming. The only sense I can make out of that, is that because they're so used to nuclear in France they just don't have the debate about whether it's good, bad or indifferent. It's so much a part of their lives that they don't even think about it, probably they do feel that it's, well obviously because they haven't got the information they're making the wrong judgement.
The two countries that came out most strongly knowledgeable were Finland and Sweden. Now both countries have had a big debate over the last several years about whether they should have nuclear in that country or not. Finland have just decided a year or so ago that they will have another nuclear power station. They have four already, they’re just building a fifth. But that’s been a very, very wide ranging public debate so in Finland you would expect people to know much more about the issue. The Government have actually worked quite hard to make that debate happen and encourage the flow of information into it. In Sweden they have been having a debate about whether to shut down their existing nuclear fleet, they have decided to close down their fleet steadily. So even though they’ve come to very different answers because they’ve had a very big debate about nuclear, people did actually understand the pros and cons a lot better in those two countries and it was 50-60% the right way in terms of their responses to that question.

*Do you think the nuclear industry would welcome that debate?*

Absolutely. We try very hard to make that debate happen but inevitably as soon as you say you’re from the nuclear industry people know what you’re going to say. So people will interpret us as having a vested interest but we do encourage and are fairly active in not just participating ourselves but encouraging people like academics who we know are very well informed on the issues to participate as well.

*Is the Government’s position on nuclear power, that we’re not going to build any more nuclear power stations and the ones that we’ve currently got are, most of them are due to end by 2020?*

No, well not quite. What they’ve consistently said is that they will keep the nuclear option open. So, they have recognised the environmental benefit’s of nuclear with respect to cutting Carbon emissions and that was recognised in the white paper. But they felt at the time that it was right to put their priorities on energy efficiency and Renewables as ways of meeting the huge climate change
challenge that we face. Our feeling is that increasingly Government are realising that whilst both of those can make a contribution they’re not going to solve the problem on their own. The UK set the target of cutting Carbon emissions by 20% by 2010 which we’re going to miss, we’ll probably hit 13-14% if we’re lucky that’s relative to 1990, the Kyoto baseline. We’ve said that we want 20% of our electricity to come from Renewables by 2020. Now that’s hugely ambitious, we’re about 3.5% Renewable at the moment but most of that is Hydro that’s been in Scotland for the last twenty years and we’ve used all the good sites for it. So that 1%, at most, of our power comes from new Renewables sort of wind farms, etc. We’re already in 2005, we’ve got fifteen years to get that up to 20%. That’s of power generated not capacity because the fact that they’re not always running, they’re not always at full speed, so 20% of actually Kwhrs out of them all from Renewables is hugely ambitious. People are doubting whether we’ve actually got the number of boats and cranes or whatever to just put up that many wind farms in that time. It’s about two turbines a day between now and 2020.

But even if we did it, if we achieved all of that with all the Renewables obligations and subsidy payouts and everything else that would go with it, all we would do is replace the 20% Carbon free nuclear that’s going to be closed by 20% of Carbon free Renewables and we’ll have worked really hard and spent a load of money. In Carbon emissions terms we’ll have just trodden water for fifteen years and we actually need, and the Government has committed us to making a 60% cut against 1990 levels by 2050. If we spend the next fifteen years of that 45 year journey doing nothing effectively then we’re not going to get there, we’re really not. So we argue for Renewables, for energy efficiency, for nuclear as well as Clean Coal and Carbon capture technologies.

What impact do you think the United State’s unwillingness to sign up to Kyoto is having on those that have signed up to, to meet their own targets?

It’s not, I mean the US approach isn’t actually helping the Kyoto process because the fact that they haven’t signed it has been a barrier to people taking
it as seriously as people might have done. The fact that it's now actually been ratified by Russia has been helpful. And actually in many ways even though the US hasn’t signed it, the US has been doing an awful lot to cut their own Carbon emissions. The US have developed things like Clean Coal technology, they put billions of dollars into the Hydrogen economy which may be the next step towards a 60% reduction by cutting out all the vehicle emissions. They've got the new energy bill which is in the process of going through at the moment which offers benefits to nuclear, in the form of subsidies for the early plans and certain designs that you would build to help get those designs into the system. They're doing lots of things to encourage Carbon free technology but they haven't actually signed up to Kyoto because actually making that commitment for them is a very big step given where their economy is.

*What is the United State's position in terms of building new nuclear plants?*

They have an initiative called nuclear power 2010 which was launched by the last energy secretary Spencer Abraham and George Bush. When it started the 2010 was we want a nuclear power station on the books producing electricity by 2010. That's shifted now to we'd like to be building it by 2010 but it's still helpful and they have consortia of utilities over there who together are looking at different reactor designs. There's always been a reticence to build the first one and what they're now looking at is getting a group of different utilities together to say between us we'll buy four or five of these so that we'll share the cost of that first one so we can all equally share the cost of the second, the third and the fourth.

That's something that nuclear power 2010 initiative has been helpful in moving towards. There are a couple of consortia at the moment the leading one is called Nustart which is looking at a couple of technology options. They also have a very different licensing approach over there because they take the technology of the reactor and they look at that and say yes we will approve that reactor. Then they take a site and without thinking about one specific reactor, think about having a nuclear station there. There's an equivalent of a public
enquiry where they'll look at the transportation issues and they'll look at the local environmental impact and jobs and what it might affect in terms of wildlife and everything else around the site and they'll say yes you can have it or no. So as a utility all you need is a site permit and a reactor that's got a tick in the approved box and you put the two together and off you go. That approach makes it much more straightforward because the reactors, they've already licensed the Westinghouse design called the AP1000 which is one that's being considered in the UK, that's already been licensed in the States, even though nobody's come forward and said we want to build it yet, they've done the licensing of it up front. We consistently argue or try to persuade Government that this might be something they could usefully do over here to reduce that 10 years, which doesn't apply a commitment to build anything it just means you've taken the first 3 years work out of the process. I think the US will build new nuclear and I think they'll take the decisions to build it before we do and hopefully that might encourage the UK and other countries to sort of follow suit.

What's the process in building new plants, I mean are there specific contractors that would be looked at or would it be just go to the market...?

It would probably be go to the market but I suspect we'd have an idea of who the people that would come forward would be. It would more likely be people who were familiar with the industry and although we haven't built reactors we have built plants of one sort or another. To be fair I think a lot of [contractors] are very keen to make it happen as well.

It is a very political industry to work in and so anybody would want to make sure that they weren't going to suddenly find they'd made a huge investment of their own capital and then a political decision is taken and the rug gets pulled from under the whole project and you're not in any way indemnified from that. So getting that contractual model signed sealed and delivered from Government that says we are not going to interfere in this and we're quite keen to see it happen. That in itself would be a hugely valuable role that Government could play. At the moment the Governments saying we're keeping the option open.
and we recognise it might be good but we’re not really going to do anything to push it forward is being interpreted as you can start a project if you like but we reserve the right to come and meddle in it and tell you we don’t like it and allow the approvals processes to go on for a year and a day.

On a similar sort of theme do you think that the nuclear industry would be better off in the way it is now, or do you think a move towards nationalisation would be beneficial?

I’m going to have to caveat that answer by saying it’s a personal view rather than any [The Company] policy. My personal view is that you can see the way in which Government in the past has been owner and driver of the nuclear industry that has made projects happen. What we’ve now got is a deregulated market where Government is saying it’s waiting for the private sector to come forward but this kind of project doesn’t lend itself to the private sector taking that kind of risk unless Government is prepared to put some constraints on the risk. So even if it’s just Government saying we will indemnify you to the extent that we guarantee not to change the waste policy once you’re halfway through running your reactor and tell you you’ve then got to put your waste on planet Pluto instead of a hole in the ground in west Cumbria or whatever it might be. It might be Government saying we’re not going to, we undertake not to, if there is a nuclear accident somewhere else in the world, if there is a sort of Chernobyl II in somewhere you’ve never heard of we undertake not to just shut down all your power stations the following morning in a knee jerk response rather than a reasoned technical argument even though we might feel that the same thing couldn’t happen in the UK because that’s the kind of thing that could happen because of the nature of the industry.

So if Government were saying that we will indemnify you as private sector investors in this project that that’s the sort of act of Government control. That might be a thing that Government would need to do. That pushes you towards nationalised it because you’ve said it’s only private sector so long as everything’s chugging along perfectly fine. Now that’s not to say that the private
sector doesn't bear commercial risk in terms of the price of electricity going up and down or cost of fuel going up and down and all the other things that you would expect a normal widget manufacturing company to have to cope with day in day out. But the widget manufacturer isn't going to be shut down on the Monday morning because some plant on the far side of the world has gone boom on the Sunday night whereas a nuclear industry organisation might.

How long does it take to decommission a nuclear power station?

What we tend to do with the stations that we've shut down already, is take all the fuel out and all the major removable radioactive components. Then we basically lock the door and say we're going to come back in about 100 years, which sounds a bit dramatic. The only reason for doing that is unless you need that land for something else you're far better leaving that building in a safely managed way for 100 years while the rest of the radioactivity largely decays away and then when you do want to go in and deal with that building decommissioning it and turning it into a green field site or whatever you're actually dealing with something that is by then 80% less radioactive than it is today. So people think, oh it takes 100 years to do it, isn't that hugely expensive? We could do it straight away, if there was a need for that land for some other specific purpose. But in most cases we tend to leave it safe stored for fifty, a hundred years and then it's not that difficult it's about demolishing the building, taking away the waste and, and managing the concrete waste or steel or reactor components.

Well have there been any power stations that have been decommissioned?

Not down to completely green field, there's been one in Spain that was decommissioned to effectively a concrete foundation block which was fairly impressive. We have decommissioned university research reactors down to green field site in this country. I think overseas they have done the same, even to the extent of having the site used for some common agricultural use. But those are research reactors rather than full scale commercial reactors. The
main reason we haven’t is just timing, the earliest commercial nuclear station in the world was Calder Hall in Cumbria and that closed about three or four years ago so we just haven’t had the time to be doing that. Unless there is a commercial driver to do it, the actual best health and safety practice would be to defer a lot of that activity until some considerable time later on. And particularly, a lot of them are on existing, operating nuclear sites anyway so it’s not really a question of turning it into pasture land or a kids playground. Calder Hall is on the edge of the Sellafield site within the nuclear licensed site boundary so what are you going to do with that land anyway.

More of a personal opinion type question for you, if there were proposals put forward to build a new nuclear power station, or new nuclear power stations within a five or a ten mile radius of where you actually live what would your reaction be?

I’d think great I might get a job there. I genuinely wouldn’t mind.

What do you think the overall opinion in the area would be?

I’ll answer the question but then I’ll say something else after I’ve said that. I suspect that, I mean I live in North Manchester which is quite heavily populated. I suspect there’d be a lot of opposition to it by people who hadn’t really thought about it before and if they stopped and said do I want a nuclear station or not then not would probably come out highest. I suspect a lot of people would object without really being sure what they were objecting to, but the thing I wanted to say was in all the policy work that we’ve done and all the campaigning that the industry has done for new nuclear in this country one of the things that we have been absolutely consistent on is what we are looking for is for new nuclear stations to be built on existing licensed sites so that’s on or adjacent to the existing power stations for a whole number of reasons.

They do have them in the States next to heavily populated areas though don’t they, in New York City…
They do as in relatively near so in the UK they tend to be about as far away from population centres as you can get them. But then when you look at UK geography compared to US geography that is still not so far as you can’t have people who work there and travel into work and then you can’t transmit the electricity from where you’ve generated it to where you want to use it over 100 to 200 miles.

The reason I ask the question is because there are five or six nuclear power stations in New York State, there is actually one nuclear power station that was within twenty to forty miles of a city of 20,000,000 people, so that was where the question came from.

That’s closer than there is one to London for instance, Sizewell’s probably, well Sizewell; Dungeness; Bradwell; I think none of them are more than 100 miles or so from London. We’ve got a slightly different history, we’ve tended to put them on what might have been military sites or other sites around the UK, there’s other issues. I was going to mention three reasons; one is getting the nuclear license you’re better off looking at the existing site and then extending the boundary of an existing nuclear license that you might have. Secondly the populations around those sites are almost entirely supportive of nuclear. Again for a number of reasons, there’s obviously the selfish reason that a lot of people are employed by them, but also because they tend to live there they tend to find out a bit more about what a nuclear station involves and a little bit about pros and cons and the safety records and so on. When they do that in general they are reassured rather than more worried so it works in that way. And there’s actually the question of the infrastructure. We’ve got the nuclear fleet at the moment that’s due to close so when those power stations close you’ll have all the transmission line that goes up to the site and you’ll have no power generation capacity on the end of it. So if you’re looking to build a new station, where better to build it than where you can plug it straight into an existing wire than go 100 miles up the coast.
What are the current concerns regarding safety. I mean what’s different today than it was in 1950 when we started building nuclear?

One of the things is that reactor safety has always evolved as the industry has progressed and particularly as the industry has become more international. A reactor like Chernobyl would not have been licensed in the west anyway, it simply couldn’t have been because of the way it was designed. Now worldwide we’ve got much more consistent safety standards that mean that reactors like that are no longer operating. And that isn’t obviously a guarantee that something somewhere won’t happen through a different cause but certainly the very obvious safety flaws in that reactor would have been nipped in the bud in any western country.

We’ve are moving to what’s called either passive safety or something very close to it, which means you don’t rely on having three or four different electrical safety systems or three of four different sort of intervention systems to the reactor if something doesn’t appear to be working. What you have is you rely on things like gravity, natural thermal circulation to automatically bring the reactor back to a safe condition should something start to look as if it’s going awry. So reactors have failsafe features, a sort of dead man’s handle. So we have safety systems which are actively preventative of coming into operation until the rest of the plant is working safely. Something like the AP1000 for instance, that is a fully passively safe reactor, so anything that could happen in that reactor to look like an abnormal event would shut the reactor down by things like natural thermal circulation and gravity control rods. They’re held up again by systems that rely on the reactor working appropriately. So as soon as that stops to happen the things will fall in and shut down the neutrons in the reactor.

So that’s a big safety plus and actually it’s been very helpful economically as well because in the past when we’ve had safety systems you have to have at least; if it’s an important safety critical system; you’ve got to have three completely independent ways of sensing the same parameter in the middle of a
reactor. Now making things passively safe you don’t actually need all that sensing to drive you’re safety systems. As soon as you rely on passive safety then you take out a lot of that redundant sensing, cabling, piping, valves, motors and everything else. So if you look at the parts list of a modern reactor compared to the ones that are operating today it’s only about half the number of valves about a third of the amount of pipe work and cabling and so on.

So that’s a huge economic saving and it’s a huge saving on commissioning because you don’t have to go and test all those independent systems because they’re just not all there anymore. So the construction time is much shorter, the reactor design is much simpler and that makes the thing much more economic, as well as being even safer than the ones we’ve got operating today. Now that’s not saying that the ones we’ve got operating today are not safe, they meet all the standards and everything else but they do it in a rather over-engineered way and you’ve got a lot of systems in there you are never going to use.

Do you think competition or further deregulation would have a negative impact on safety?

I don’t actually. In the nuclear sector we have an independent safety regulator the Nuclear Installations Inspectorate which is a branch of Government which is there solely to insist on the highest possible standards of nuclear safety.

How is the nuclear industry deal with terrorists and terrorist threats?

There has actually been as you might expect a bit of work done in recent years to study that. The Electric Power Research Institute in the States did some good modelling work on that. Inevitably I’m going to be talking about modelling work now because it’s not the kind normal of thing you can run a couple of experiments on, although there have been experiments. There was an experiment in the States before 9/11 where they ran a fully laden Phantom jet fighter into a concrete wall in the middle of the Nevada desert I think it was to
see how this wall would respond to it, it basically wrote off the plane and made about a six inch dent in the wall and it was a reactor grade wall. I know that's a Phantom jet not a 747 or whatever else.

One of the interesting things that came out of the EPRI study was firstly the conclusion that nuclear stations were pretty robust and would withstand an aircraft impact without major release of radioactivity. Four reasons; one is that they're built to be strong and robust anyway because they have reason to keep the stuff on the inside in rather than to keep the stuff on the outside out but it obviously works both ways. So they found in the modelling work that they did that it would withstand an impact. Some countries have already said they have, sort of, anti-aircraft facilities around their nuclear stations. France have said that they've installed anti-aircraft facilities around their nuclear stations. In the UK we don't talk about what measures we've taken or what we do take we just say we have methods in place and then the Office of Civil Nuclear Security reassure themselves that those measures are adequate.

So you've got the fact that it's small and hard to hit. You've got the fact that you know it's well protected and you've got the fact that even if you did hit it you wouldn't be guaranteed to achieve a result necessarily other than some sort of political point scoring of having crashed a plane into a nuclear power station. If you think of all the other targets you've got, you can't help thinking that whilst [nuclear stations] might look like an attractive target, in terms of consequence and likelihood of realising that consequence it's by no means a done deal that the worst would happen.

Now that isn't a rigorous safety argument that says it wouldn't, but that sits alongside the modelling work that people have done. If that were to happen then the consequences wouldn't be catastrophic. Now there is still the public perception that these things might be a terrorist target even if it were to be ultimately unsuccessful and that is an issue that we have to look at. Just to round it off, we are increasingly recognising in a world where it's difficult to
guarantee the safety of anything that 100% safety anywhere is just no longer something that we can take for granted.

What's the current position and what's the future viability of nuclear fusion?

The first thing to say is [The Company] as a company doesn't have any interest in fusion, we're not developing fusion technology, we're not a partner in JET or any other fusion projects, so this is a detached view rather than a fusion industry view because the fusion industry and the fission industry are relatively disconnected. I think we're talking about thirty or forty years realistically for anything to happen. What people have said and David King the Government Chief Scientist has said and I don't think it's an unreasonable view to hold today is, he sees the next generation of nuclear fission as being the bridge to nuclear fusion coming along. We build one more fleet of fission stations and then if the fusion technology is there and it's commercially viable and everything else falls into place then fusion may well be the thing that takes over. I think if that happens then we'll have done our job collectively in terms of Carbon emission and sustaining a sustainable future. It might actually be some completely different technology, it might be Clean Coal with Carbon Capture, and it might be Renewables technology that takes some sort of step change forward in terms of it's economic attractiveness or whatever else it could be sub-sea marine devices or whatever, there's a lot of potential things out there which are at their fairly early stages of development that clearly aren't going to contribute for the next fifteen to twenty years but might contribute in thirty or forty. So I think it does have a lot of potential, its for something to maybe replace the next fleet of fission stations that we would build rather than as an excuse for not building fission reactors.

Part Three: The PFI

The next section of questions is about PFI. I don't think there's anything actually.
Is there anything that will merge nuclear and PFI, is there anything that stimulates the coming together of the two or is there anything that conflicts between the nuclear industry and the point of the PFI. Now from what I have done with my research is I’ve come up with two tables. Basically a table of stimulants and a table of impediments to applying the PFI to nuclear power. Now what I’d like to do is just have a look at first of all all the stimulants and cast your eye through the table, if I just give you a brief overview, this is split into four levels, the external environment level which is basically Government, anything external to the industry, industry wide a general sort of level. There is an organisational level itself with stimulants at a kind of business level and there is the specific project level, so a specific station or new station and there is the job role level, the people that actually work in there, which is less relevant to this research but its included to have an overall view of everything. So this is basically trying to identify stimulants to PFI in nuclear power. So if there is anything that you think shouldn’t be there or anything that has been omitted.

Yes, reduced capital expenditure, I guess that means in terms of reducing the amount they have to spend on other things, if the other alternatives like Renewables are more expensive.

This is also from a PFI point of view, the Government wouldn't actually have to stump up...

Oh right, ok, because Government aren’t forking out for this are they. I’ve got you. Increase the Government’s ability to meet Kyoto targets. How Kyoto or its successors evolve in terms of setting longer term targets is going to be quite important particularly those nations that find themselves committed to it because as I think I said to you before new nuclear in this country is not going to do anything on 2010 targets that we’ve set ourselves or 2012 Kyoto targets other than maybe give us a vehicle to maybe catch up if we fall behind them. So environmental benefits from improved air quality, yes. Improved public
knowledge and awareness to improve levels of public perception... Reduced reliance on external primary power sources.

*As in fuels.*

Yes, so you mean things like imported gas with that, then yes. I mean the Government's, the first energy review the thing that proceeded the white paper by a year was done by the Cabinet Office actually concluded that we could regard Uranium as an indigenous fuel because it was so secure. Social service needs met?

Yes, *this is a PFI, sort of, derived benefit.* In this case the social need is to obviously have a reliable source to maintain supply all the time.

So that's reliability of supply in my language then yes. Comparison with public sector comparator.

That's a PFI based one as well, *where basically with a PFI project you have to go through and show that procuring your power station via PFI, the PFI procurement route would provide better value for money than if it was procured through a traditional means and the PSC is basically a model which shows if you build through traditional means this is how much it would cost and this is the value for money and PFI is better than that.*

Yes, I'm sure that would feature somewhere. Social environment improvement, I mean I guess does that link to, sort of affordable electricity in a reliable supply, you know, and not cutting off hospitals when they're in the middle of an operation, that kind of thing.

Yes, *that kind of thing.* I mean it's basically that's an overall of the social benefits from it.
I guess the affordability of energy, particularly when you get to the heating, lighting and winter and fuel poverty and Government call it consideration which in the end is very much linked to their policy target. The last one's interesting. I mean it's a difficult one, there are jobs in nuclear but actually with jobs, as the number of jobs in a supply sector industry like electricity generation goes up so the economics work against you. So somebody said to me if you really want to remedy unemployment we should have men on treadmills making electricity and that would be hugely capital, hugely labour intensive. One of the arguments against the Renewable industry to some extent is there is so much man effort involved in the manufacture of wind turbines and their operation and maintenance that it actually makes them not as free to run as people sometimes think they are. So there is employment but I wouldn't, if you could add to that something about high value employment, with technologies and skills that are deemed to be valuable, you've got engineers, you've got technologists, you've got a lot of professional staff, what are seen by Government as high value jobs.

One of the things that's just occurred to me actually as we've been talking is the fact that if we did have new nuclear power stations they would be in the most part replacing the old ones, and the fact that those new stations are a far simplified design in the future would that mean that there would actually be less employment. Could it lead to a decrease in jobs?

Potentially, yes. I mean the aim of the industry is to get you know bigger stations which require less, smaller teams of operators to run them but whether that's maintenance, whether its routine operation whatever. So that, as in every industry you would expect the utility operator to be cutting its cost base as far as is practical and safe to do so. So I would certainly say there is a jobs angle to it, in terms of, if you look at nuclear versus, you know, coal or gas or Renewables we would say that the employment that we bring is of the high value technical professional jobs.

It's worth knowing that the trade unions are very supportive of nuclear, for two reasons. One because of the members that work in the sector but also
because of some of these other social benefits that feed into economic, there's nothing explicit there about economic competitiveness and I think if you look at and maybe link it back to self sufficiency of external power sources and fuels but there's two angles to that, the reliability of supply angle but there is also the fact that if we, for the sake of argument, lets compare ourselves with our nearest major commercial competitor which is France, they've got 80% nuclear and most of the rest is sort of hydro and whatever, very little fossil. If we're 80% gas and the world gas price is going up, so the bulk of our economy is then driven by oil and gas used directly in industry, gas used to generate electricity in industry, whichever way you look at it we're screwed frankly. So, I mean that's not a problem if all your other competitors have got the same mix that you've got, virtually all the heavy engineering users or heavy energy users are supportive of a balanced mix that includes nuclear for that reason. The CBI are very supportive the Major Energy Users Council I think it's called are very pro-nuclear, Energy Intensive Users.

So this is now the utility that's running the power station, so that organisation which probably isn't [The Company] but I'll put my utility hat on. Yes you obviously, protection from Carbon tax or other Carbon measures like a trading scheme or whatever. New technology patents?

*I'm thinking because this is very much driven from an innovation point of view and because it's such a high level technical industry that to remain competitive...*

There might be something there in the very small add on bits of technology but the point I was trying to make before we would want to take a technology that was in the global shop window and just build it unchanged in this country so we wouldn't be looking to tweak new. I mean there might be jobs in the service sector, obviously, patents in the technology developments in the service sector who come to maintain it, do the necessary things about radiation protection and all the rest of it to do with managing the station and the fact that we have a nuclear industry that needs serving in all sorts of ways by a whole supply chain.
You know, there is technology there, there's technology in the sort of control room systems and all the rest of it for the reactors and the regulation monitoring technology and so forth that has to fit around the actual reactor piece itself but that's perhaps not quite as high up as, or maybe there not meant. It might be a bit peripheral that one.

Yes, base load generation providing constant demand. For a utility under the current market conditions that's very important. Being able to say I'm going to do 98% of capacity and hitting 98% is very valuable. Yes low primary fuel costs, its low controllable costs in general. Efficiency through increased competition as a benefit to the organisation? But you're right if this is PFI and nuclear as a combination and that's a PFI derived benefit. Open and transparent cost management. Yes I guess you could say if you're looking at life-cycle cost management rather than day to day management of the facility then you, yes I guess that is a benefit compared to our competitors.

Encourages future investment, I mean is that because you know that the nuclear stations are going to be around for fifty years, so you've got...

Basically if you're putting money into a technology and then the Government are actually putting their weight behind it then it guarantees future investment because its effectively going to be a new wide open industry sector with which there is going to be future investment...

No that's fair enough then. I mean you're right about the last one, there is an opportunity for innovation and creativity I think provided its properly focused. But I mean it links back to the discussion we had about patents doesn't it, there's plenty of second order or secondary service side where you've got scope for that and equally you've got, it probably links to that one about increased employment and having high technical and professional and skilled people working in the industry, it gives you the opportunity to stimulate innovation and creativity through the workforce you've got. When you get to the
project level are we now more looking at the PFI type ones than... I guess there is potential for all of those to improve...

*Innovation and programme, productivity and value for money these are all PFI, because obviously the quicker you get that thing built, producing electricity the quicker you’re seeing a return on your income. Risk allocation at the bottom there is a very important concept in PFI with the Government, whoever is in the best position to manage the risk whoever that person is should bear that risk.*

Which is the exact opposite of the way the nuclear industry used to work. We used to have what we called cost plus contracts, it wasn’t very helpful in driving the industry into a commercial world. Was there anything specific you wanted to pick upon at project level I think in general terms I’d agree with you there, the potential for all of those is there but...

*And at the job role level we’ve really looked at just talking about the high level skills that you’ve got, driving it and obviously the higher level of skilled people you’ve got the more they cost.*

Yes, I mean there might be one other, which probably belongs right at the top there that I’m just thinking about this jobs and skills thing that the Government I think recognise that nuclear skills is a strategic area of importance and what they have said was even when they were looking at what they just called keeping the option open, one of the things that they were most keen to do was to make sure that we didn’t allow the UK nuclear skill base to dwindle away in case we did need it again in the future. I think they recognise that there is a skill base there that they might need to draw on at some point in the future if wind turned out to be exceptionally expensive or gas prices were going up through the roof or there was political instability in all those sensitive parts of the world...

One of the things that we’ve been conscious of in the industry is, the heyday of the industry was the sixties and the early seventies, perhaps into the early eighties and people who were joining the industry then and in senior positions
then are now close to retirement, so we've got quite a hump of people in terms of numbers who are all getting quite close to retirement and in ten, fifteen years when they've gone if we've not taken the opportunity for them to pass on those skills to a similar number of people or young people coming into the industry, so we're keeping that skills conveyor belt going then we really run the risk of not being able to switch it...

But I suppose that's highly difficult due to the uncertainty to the future of the industry.

Yes it is and, you know, whilst when I joined the industry and when people who joined maybe ten years ago thought they were joining an industry that was an industry of the future, there might very well be new reactors built as these current ones start to close down. I won't say becomes less unlikely because with my optimistic hat on it looks more unlikely that in the next energy review at the end of the year we will conclude that we need to take some steps to do this but if we don't then we're, sort of, last chance saloon really, and the nuclear industry starts to look like an industry in decline and an industry that's just there to clean up after itself. That doesn't attract high calibre talent that has the choice of joining the oil industry, the pharmaceutical industry, the xyz, you know, IT based industry and all the rest of it. They are not going to see nuclear as first resort its going to be last resort. I mean you don't get the best people unless you're prepared to pay disproportionate rates and what that's likely to mean is that we get less good intake of human capital than we would otherwise have. So I think keeping that whether its through research and development activities and what we have just got is, we've got Government support to invest in some, to participate in some international reactor development programmes partly to help bring in new people into the universities and then into companies to provide those skills to be a repository for those skills and experience that's leaving. So there is an argument there at a macro skills level rather than just the power plant electricity creation level.
Ok, moving on to the barriers, the impediments. It's the same kind of thing PFI and nuclear combination.

Current levels of public knowledge and opinion, awareness and acceptance... I would link that back to that comment I made earlier on about people's perception of public perception. It's like opinion formers or decision makers' perception of public perception is a very real barrier, perhaps more than the actual public acceptance itself. I think acceptance is the right word there. Support is not something that we actually need but acceptance, lack of opposition is the key thing.

Nuclear waste, yes, One thing I didn’t say when we talked about waste was just to give you the facts and figures as we talked about the policy side of it, but there's an important issue which is we already have a nuclear waste inventory in this country from the historic operation through the forties, fifties, sixties, seventies. No decision we take about new nuclear stations affects the fact that we've got to manage that and we are managing all that safely and effectively. If we were to build a new fleet of say ten reactors which would push our level up to about 25-30% again and operate for the next sixty years, which would be the design life of those stations, so that's longer than the industry has operated so far, but if we were to do that we would add just 10% to the amount of waste we've already got. So we're not talking about doubling or tripling the existing problem, we're talking about adding a thin volume layer of up to one tenth to the size of the challenge we've already got and actually all the technical difficulties would still be in the old stuff because nowadays people design reactors thinking about waste management and so forth.

So there is a philosophical argument that says if you haven't sorted out completely your current problem you shouldn't be adding to it but there's perhaps a more pragmatic argument that says look if I've got to sort all that stuff out anyway and it's not really a technical problem, it's a political problem in terms of Government just not saying what people have to do with it. So there are a lot of perception issues I think around nuclear waste.
Proliferation of nuclear material, that's another perception one, terrorism, let's do them all together. Proliferation, again if you take the pragmatic view, if one were running a hostile nation or group and wanted to get hold of nuclear materials and weaponry and all the technology and everything to go into that, my personal view is whether the UK has built power stations under all the right safeguards and regimes or not isn't going to affect your ability to do that because you're probably not going to come to the UK to do it anyway. You're going to go to other parts of the world where that technology and potentially those materials are more available to you. The technology genie is out of the bottle effectively, you can't put it back in, the clear separation now between civil material and military material is sort of overseen by the International Atomic Energy Agency very rigorously, you know, we have their inspectors full-time on sites like [Named Plant] making sure that everything goes where it needs to go and so forth. So there is a perception that the two are linked, for some people that perception goes back decades in some cases to when civil nuclear and military nuclear were two-sides of a national security interest the same coin almost. It is still a barrier to some people but practically I don't think it makes a difference. I mean there is an issue there about whether we should be developing technologies that we as far as the global community, are not prepared to share with every other country in the world and there are certainly countries in the world that we would say yes we've got nuclear energy as a way of dealing with our energy policy objectives, but we're not prepared to share it with you at the moment for political reasons. I don't think that's a barrier to us doing ostensibly the right thing just because there's a small fraction of the countries in the world you would have to prevent from having the same option available. In some ways it makes it more important because if you're condemning them to burning coal and oil we should be doing even more to make sure that we're not. Terrorism I think we talked about before. I mean there is a big perception slant to all of those top four. New legislation and regulation, licensing and all of that and the need for a streamlined but not shortcut approach to approvals and regulation, planning.
Public sector comparators, the problem is a lot of public sector comparators when PFI came on stream were just not very realistic in terms of how their models were created and they didn’t give a realistic view of the construction industry. So it’s just a potential barrier to PFI. The next one public service ethos, PFI tends to perpetuate the belief that the public sector is inefficient in what it does because one of the benefits of PFI tends to be increased efficiency through private sector management. So that itself was perpetuated or it originated from the Trade Unions...

I couldn’t quite see how that was a barrier to the PFI but I suppose if its seen as a kick in the teeth for the public sector every time then...

The Trade Unions, especially...they’re very negative towards PFI they see it as a danger to workers and they’re very against it which is one of the reasons the Government has problems with the use of it.

I was speaking to TU representatives in Glasgow, some of the leaders of the Scottish Trade Union Movement. I said something about the market and deregulation and private sector finance, nothing wrong with that and when it got to the end they were queuing up to jump me.

At the moment its only the Government that are acting as Client in PFI's but if...

If its pure PFI as configured according to the current model then that does imply some...right organisation, nuclear waste, but I mean its worth just bearing in mind, perhaps the higher level picture again nuclear is one of the few forms of power generation that does actually manage its own waste production. You know, if you see Carbon emissions as a waste or an environmentally damaging product then gas and coal fired stations just spew it out into the atmosphere and may or may not pay a cost according to how much of it they spew out, but that isn’t necessarily the full cost of either sweeping back up or the societal cost of the environmental impact by any means and so they pay a bit of a fine but they don’t actually pay the full cost of cleaning the mess up whereas the nuclear
industry does pay all the cost of its waste management. So you can argue from a, sort of, environmental acceptability point of view that nuclear is the only one that is, sort of, sweeping up after itself properly.

*The economics one is obviously going to be significant, I mean the capital cost, the decommissioning cost and the safety costs are just going to be higher.*

Yes I mean those are all, I mean capital and the financing cost of capital are two of the biggest contributors to the overall cost. Decommissioning is not actually a big component, its only about a couple of percent of the total life-cycle generating cost.

*I suppose it's more from a time perspective.*

From a time perspective it means you always have a long-term commitment to pay the decommissioning, that bill is the same whether you've operated it for two days or sixty years so there is that risk if you finish early you may not have filled up your decommissioning fund to the level it needs to be in order to pay for the cost of decommissioning.

*The high risk one actually came from a perception point of view but I think the risk is actually, from what we’ve discussed more from the uncertainty currently with…*

There is the waste, there is the political nature of the industry which does always leave you with that, are the Government going to implement some policy about nuclear that is damaging to an investor or operator. So I think that if you look at it as operational revenue and financial risk.

*The two-tier workforce is a PFI derived one. It's the regulations, I think it's the Transfer of, it's the TUPE regulations.*
Yes TUPE, yes we've had similar, with company reorganisation we've had the same issues cropping up so I understand the issue with it. I'm not quite sure whether you would, in the energy sector always see one power station as the replacement for another one, in some cases... I think it might crop up in some very specific circumstances.

The next one is...

Difficulty for SME's, well it's difficult for SME's to become the operator of the station.

Its just that it's a very high capital area to operate in so smaller...

But having said that, yes at certain levels it is high capital but when you get into the, sort of, service side, you know, instrumentation, safety systems, you know, there are a lot of SME's that are set up specifically for these services to meet certain needs either at one station or at a number throughout the industry in certain specialised areas.

I think from actual construction of a power station point of view...

Yes, its hard for SME's to be involved in the actual delivery of the project, in that sense your right.

And obviously the last one is a purely PFI one, it just costs more for the private sector to borrow money than Government.

True.

I think we've already talked about these in the project.

There are issues around the perception of nuclear but actually its one of those things the closer you get to it the more people are reassured I think by having
increased knowledge. Yes I guess the ones about legal costs and unreliable risk transfer are more to do with the PFI and the fact that you’ve got a lot of risk in different places rather than all in one place.

*It's one of the big things with PFI and all the legal costs in actually setting up an agreement are phenomenal compared to traditional methods.*

Yes and add the nuclear dimension into that and you’ve got a real lawyer’s paradise.

*And at the job role level I think it's just things we've discussed because there's obviously…*

What’s the top one? Is that linked to safety concerns?

*It probably would have been when I wrote it.*

The nuclear industry has got one of the best safety records of any sector. We’ve just done a bit of work pulling stats together from the nuclear industry and comparing them with published safety statistics from other Government sectors and we’re far better than things like the rest of the construction industry and we’re better than the oil and gas industry, we’re better than the health service, we’re about level with retail and financial services and the things that you really wouldn’t worry about.

*It's been documented somewhere, a thing called the healthy worker effect in the nuclear industry and which is one of those counter intuitive things. But the thinking behind it is because we work in the industry that we do, and virtually everyone in this building gets an annual medical, whatever they do. People who work in radioactive environments get the health check much more frequently. If you carry a little dose meter or whatever then they all get taken away and analysed. But just in terms of people's general health I don't think in
a lot of industries, either the general health service or retail or financial service or whatever, the employer isn’t going to give you a medical every year...

*It's interesting about the medical that it's one of the things that the construction industry is working very hard to bring in, but because of the, sort of, transient nature of the workforce in the construction industry it's very hard to do it, but its something they really do want to bring in.*

I mean we don’t have that barrier and it has worked very well in our industry

*I think we've actually covered an individual working in a power plant is not going to have room for innovation just because…*

Yes, I mean there are parts of the industry that are very highly regulated in terms of what people can do. There are other parts of the industry, if you look at the sort of associated supply chain and some of the positives on there about the technology and innovation that’s stimulated by having a highly skilled workforce and looking at new technologies and new ways to serve that very regulated plant there might very well be a lot of opportunity for creative freedom in the right part of the supply chain…

*But in the reactor its, sort of…*

Working in the reactor, no it’s not like that. Oh lets just see what happens if we turn that up a bit… No, I mean the closer you get to reactor operation you’re quite right that wouldn’t apply. That’s probably just as true if your operating a gas-fired power station or chemical plants and other sectors as well.

*I think that pretty much covers it, thank you for your time.*

No problem, no problem, happy to help.
6.2 Research Interview Two: Interview Agenda - The PFI

Specialist Area: The Private Finance Initiative
Company: Local Authority
Job Title: PFI Programme Manager
Background: Education & The PFI
Interview Duration: 1 hour 10 minutes (approx.)

Part One: Background

What is your position here?

My official job title is PFI Programme Manager.

How long have you been doing that?

I have been undertaking now on a full time basis since 2002. It must have been about 18 months ago that, because we've got other PFI projects on the go apart from the schools one, the job was renamed PFI Programme Manager to distinguish between the exclusive role I had on the schools and the role that I now have.

What other projects are you involved in, apart from the schools?

Well, we've got a street lighting PFI project in [the City]. We've also got, in its fairly early stages, a housing PFI project. We have another massive project which is only just beginning really and that's a project to try and identify new accommodation for the Council but at the moment that's not a PFI project.

What is your background with regard to before you got involved in PFI? Do you have a construction background for example?
My background has been in Education and before I became the fulltime Project Manager for the schools project I was an Assistant Director within the education services in [the City]. I was responsible for things like capital programmes and resources generally. I actually formerly left Education and became part of Corporate Finance which is currently where I still am. My background has been in education and project management managing fairly major projects within an education services environment.

Part Two: PFI

We have talked about projects, why do you think the projects we’ve talked about and why is the council house refurbishment going to use that route?

Certainly at the time that we were considering the schools project and the housing project and to a lesser extent the street lighting project, PFI was probably the only way in which Local Authorities could put together the amount of capital that is needed. There have always been some quite difficult constraints on Local Authorities in terms of what we can borrow, for what, when and how it’s repaid. To the extent that projects like the schools project for example, you just couldn’t have done it with existing Council borrowing regimes. The Prudential Borrowing regimes that are now in place have freed up that quite considerably. At the time PFI was the only way really you could get your hands on that kind of money.

Have the projects with the schools been successful through PFI, I know they’re not finished yet, but so far?

There are two sides to the schools project really. The schools are designed and built by a Contractor usually known as the Council’s preferred bidder, and its a competitive bidding scenario that you’re into, so the schools are designed and built and then significantly they’re also responsible for maintaining those schools for 25 years to certain standards and specifications stipulated by the
Council. There are financial penalties in the payment mechanism so if they
don't perform they lose money. So far, the construction side in particular, has
been incredibly successful. They are ahead of schedule by a significant amount
of time now on two of the four schools, between four and six weeks ahead of
schedule. The fifth site is due to start in August [2005].

What’s the quality been like?

It's too early to tell. The quality of the school, as with any building, is only
something that you can be really satisfied with in the fullness of time. Usually
with PFI projects the Council and the Contractor appoint, on a jointly agreed
basis, somebody called an Independent Certifier. They are responsible for
signing off various elements and stages of the project. Until that signing off
process is complete the Contractor doesn’t get paid, so it's in their interests to
make sure they get it right.

Out of the projects you have been involved in do you think PFI is more suited to
a specific sector such as education, housing or health?

It's used in any sector where there is major capital investment. So, for instance,
[another City] are considering a huge highways PFI. That's another sector that
[PFI] is being used in. Social Services have used it, in [the City] we've currently
got two homes for the elderly, they want to make the operation more cost
effective. So they're thinking of closing the two currently separate homes and
through PFI building a new 120 bed residential care home. In Education it's
becoming common place and many, many, many Councils have now got into
PFI.

Do you still go through the process of comparing against a public sector
comparator?

Yes, in your outline business case, this is called the OBC. The contents of the
OBC and the parameters that you have to address are dictated by Government
and in particular the Treasury. It's a requirement of the OBC that you demonstrate that PFI represents value for money. The way you do that is by comparing it against the PSC, what cost would you incur if you were to build five new schools in a more traditional way and you have to be able to demonstrate that PFI, effectively, is cheaper. Its sometimes the thing which can really make moving these projects forward difficult. Behind the PSC issue you've got the unwritten expectation within Government that PFI will be seen to work although it was the brainchild of the Conservatives, one of the first things Labour did when they were re-elected was to say by the way PFI is going to continue. So politically they have a vested interest in making it work. It's a big debate in PFI about whether PFI is value for money. It is an expensive way of doing things particularly for a Local Authority and for business.

In what way is it expensive?

Well for a Council the most significant element of expenditure is appointing external advisors and I don’t know of a Council involved in a significant PFI project which hasn't had to appoint external advisors and very often they fall into one or all of three categories financial, legal and technical. Particularly legal costs are absolutely astronomic, that really does ratchet up the cost of the exercise. If you were trying to build five new schools in a more traditional way you would find that you'd got the expertise and capacity in house, so you wouldn't be spending these huge amounts of money on these external people. Added to that is that its quite a long drawn out process so not only are you spending quite a lot of money on external advice, its over quite a long period of time as well. Its often one of the criticisms that's levelled against PFI that its just too expensive. It may represent value for money at its core but actually delivering the project brings with it a whole load of expenditure.

Is the timescale, compared to more traditional methods, is it longer pre-contract, post-contract or about the same?
It's about the same up to the point at which the Local Authority decides who its preferred bidder is and from that point onwards you're into what can be called negotiations. There are different kinds of public procurement approaches and one of the elements, the one we've used, is negotiation. It's the negotiations with the bidder that really are much longer than you would get usually in a more traditional procurement route.

*What stimulants do you believe there are to the PFI, why do people do it, apart from the value for money and the perceived advantages from programme, construction programme are there any other advantages?*

Well to some extent it is still the only show in town. If you want to do something badly enough, as we did with the schools project. It is attractive to have a potential source of a solution and that to some extent is still the case with PFI. If you want to build new affordable rented homes, which is what lies at the heart of the housing project there's no other way of doing it other than to embrace the PFI process. So it's attractive in the sense that it offers potentially a solution to meet your needs.

*And that's due to the capital expenditure aspect of it?*

Yes but it's about providing the facilities management with it for 25 years. Now that can be quite attractive to a Local Authority or a school because the responsibility for doing that and making sure its done well is effectively passed onto somebody else. Now the Council pays for that but it's the risk in a sense which is being transferred from the Council to the private sector and it's a price that has to be paid.

*Are there any barriers that you perceive with PFI, anything that you think would stop you using it, or would stop it expanding?*

It's not a cheap process although the ability to negotiate something with bidders is potentially valuable to the Council. The Council could come out with a better
set of proposals than it went in with. It's the negotiation bit that can drag on and on and on. People could think we can't cope with that, it could be a disincentive. It also tends to be more suitable for fairly significant, significantly sized contracts. If you're looking at a project, or an estimated total contract value of anything less than about £20m, PFI is not usually going to be cost effective and you'd dismiss it on those grounds. Experience has shown if you were to approach the Department of Transport about street lights, for example, and say we want to replace a quarter of [the City's] street lights, its going to about £10m they'd say its not worth doing and they would not be prepared to support that. Its about size as well, that can be a disincentive.

*If you were a private consultant would you advocate the PFI route to a prospective Client?*

Yes. PFI is suitable to some projects and not others so I wouldn't go in with both guns blazing regardless, its right for some things and not for others. I wouldn't make judgements about that until I knew a bit about the project that the Client wanted.

*But it would definitely be an alternative?*

Oh yes, it would definitely be on the shopping list, oh yes, absolutely.

*What alternatives are there to the PFI approach?*

Well I mentioned one, the Prudential Borrowing regime. I mean in a sense there aren't any.

*Just due to the capital expenditure?*

Yes. There is an alternative, maybe in one way or another [the City] could have rebuilt five schools over ten years or fifteen years. With all the grief and, mess that that would bring with it and it would do that by trying to identify each
financial year whether it has the capital to do that. So that is an alternative but it's not really a very satisfactory one for all sorts of reasons. I suppose another alternative is of course that you don't do anything, but of course that's not an option really.

So the five schools that you chose on this particular project, why were they chosen because I imagine there are more than five schools in the area that need attention?

Oh yes we could have a series of PFI projects and still have schools left in [the City] which are not fit for the 21st century. The thing that drove the schools project, it was about improving the pupil attainment and achievement because you can't do that easily if you're working in [deficient] buildings. You need a decent environment to do that, that's what drove it. The end was about improving the performance of kids in all sorts of ways not just in exams and in that sense having identified the schools with the most significant condition issues we then looked at the OFSTED reports for those schools to see if there were performance issues. So it was about putting together different perspectives of a school really and we came up with the five.

Part Three: Nuclear Power

Ok, I'm going to move on from PFI, the research that I'm doing is to use PFI in another industry sector. So I have a few questions about nuclear power, just general questions. Have you have had any experience in the nuclear industry?

No.

What is your opinion on the use of nuclear power for the production of electricity generally?

I'm quite neutral. Do you mean personally or in terms of a PFI project?
Well, first personally, then we’ll come on to PFI...

I’m not anti-nuclear power, I’m not pro it either really. It’s a solution to a particular problem and like any solution it will have its strengths and its weaknesses. If it was a cost effective and a reasonably environmentally friendly way of providing energy it wouldn’t cause me any sleepless nights.

*From a PFI point of view do you think nuclear power would fit the scope?*

I think it probably would actually. That kind of major infrastructure project is likely to be very, very attractive to certain elements of the bidding market. What you find in PFI is that you get firms who get involved in particular sectors more than others do and they acquire an expertise. I don’t know if their have been any PFI’s in the nuclear power industry, there may have been...

*There may have been in sort of isolated areas like nuclear waste disposal things like that.*

Well PFI and waste disposal, waste management, that’s not uncommon. But whether that extends to nuclear waste management I don’t know. I could see a number of firms being interested in any type of proposals for a PFI project with nuclear although there would be a lot of issues about health and safety and absolute certainty that the Contractor was capable of looking after the buildings.

*Do you think it was a good idea when the Government privatised the nuclear industry or do you think it would be better as a nationalised industry?*

I’m no disciple of PFI in that sense I tend to think that very often, not always, but very often operations that remain in the public sector particularly those that appear to be working reasonably probably would be best if they continued to be in the public sector. I mean the railways are a classic example of something that has gone really pear-shaped since it was taken out of the public sector and
put into the private sector. My gut feeling I suppose for a whole variety of reasons is that unless you can prove at the outset that private sector ownership control is going to be better, then I don't think you should do it.

What issues are you aware of in relation to nuclear power?

I live in [another city] and in [the other city] for some peculiar reason there is a railway line that runs right the way through the town centre virtually which carries, periodically, nuclear waste and because well because of the nature of [the other city] and where this railway line is, I think its coming from whatsit in Cumbria...

Sellafield?

Yes, Sellafield that's right, it brings the waste from there. That's a big issue for lots of people in [the other city], you see these terribly decrepit looking trains, I've actually seen one, with these sealed waste containers on, with the radioactive signs and you think god there going to fall apart what happens to [the other city] if they disintegrate. So I suppose that's an issue I'm aware of, actually physically moving the waste.

So if there was going to be a new nuclear power station procured through PFI and it was going to be on the outskirts of [the other city] what would your opinion on that be?

I think my attitude to it, whatever reservations I may have about it would not be about PFI as the procurement process, it would be about the power station. I have got a pragmatic view to nuclear energy and provided I felt satisfied that everything that could have been done to secure the safety of local people had been done I wouldn't kick up a fuss about it. And you know if I felt that PFI was the most appropriate procurement route then so be it.
Do you think there is enough knowledge in the public arena about nuclear power for the general public?

In my opinion there probably isn't. I mean it's probably there to be got so maybe it's about people having the incentive to dig it out but it's not something you see. You know, you get little flurries in the media about nuclear power but it's not something that's there on a regular consistent basis.

Overall, generally what do you think the public's perception towards nuclear power is, from your point of view?

I should think it's probably negative

Why do you say negative?

Because I think it's the association with nuclear. You know with it's association with radioactivity and bombs and god knows what else. The benefits of it, one of which you've alluded to, lack of emissions, is not often at the forefront of peoples thinking. I'm sure if the word nuclear was used it triggers images in people's minds and associations which may be complete rubbish but I think it's probably negative.

Do you think nuclear power stations would be a target for terrorism, do you think there would be an increased threat if we had an increased number of stations?

Yes, I mean they're classic installations to take out aren't they? It would be like multiplying the opportunities. If you build more potentially vulnerable installations you're bound to.

A quick technical question do you know the difference between nuclear fission and nuclear fusion?

No.
Part Four: Modelling

Right I am going to move on to a model that is basically a theoretical model of stimulants and impediments to applying PFI to nuclear power. I'll let you have a look at the stimulants first. It's split into four levels, basically the External Environment level which is a general level, and then an organisational level from a firm's point of view, then a specific project level and then a job role level which is less important in this research but I've included it so that it's a complete overhaul of the whole sort of area. Is there anything in this table that you think shouldn't be there or is there anything that you think has been omitted that is glaringly obvious?

Lets have a look, these are stimulants yes?

Yes.

What do 'social service needs met' mean?

If there's a need in the social community, say a need for extra schools or a service need is there then PFI provides a way to meet that need. Say, for example, if [the City] was suffering from brown-outs or black-outs a new nuclear power station would provide for that additional demand.

Right, I'm with you. No I think that's fine, I can't see anything that either should not be there or that's been missed.

One question that has just occurred to me from looking at that. Do you think PFI increases the opportunity for innovation and creativity in projects?

Yes it does because it's a competitive process and bidders are continually looking for ways to win bids but at the same time to safeguard their profit margins. One of the ways that they do that is by looking for innovation. When we were talking to the Architect about one of the designs for the schools we
were talking wall finishes and we were making some comparisons between traditional plaster and paint [and] plastic sheeting that was claimed to have a number of benefits. It’s probably money that drives innovation but if it results in something which is beneficial to the Client it is something which should be supported. So yes I think it does.

*On a similar aspect do you think PFI drives the private contractor to look at methods to save money over time?*

Oh absolutely, absolutely. Certainly in our schools project, [the Contractor] is responsible for maintaining those buildings for 25 years. It is therefore in their interest to make sure the design and construction of that building is as effective and efficient as it can be and if they don’t they get clobbered, so there is an incentive right at the outset to get the design solutions right and to get them capable of being maintained over that length of time because they’re storing up problems for themselves if they don’t.

*Would they necessarily, spend additional money on the capital cost of the building to recoup savings in later years?*

I think they probably would. The way in which the allocation between capital and revenue in PFI works is very, very complex but we know again, from the schools project, that they have come up with design solutions that, [the Village] Primary actually, which originally they weren’t considering because of the cost they have taken a long hard look at the projected revenue and expenditure of that building over 25 years and decided that by spending more now with some adjustment to corridors or whatever they are going to save themselves some money further down the line.

*Ok, we’ve looked at the stimulants…*

Yes.
This one is basically the opposite, the impediments. Same sort of thing really, is there anything there that shouldn't be or is there anything that should be there that isn't?

What do you mean here? When you say unreliable risk transfer, at the project level?

This is something that has come out of the research on various PFI projects. That if a PFI project is put together hastily and risks are transferred arbitrarily rather than going through and producing a risk register and seeing who is best to cope with that risk, either the Client or the Contractor, and its just a case of the Client who wants to get rid of all risk regardless, basically unreliable risk transfer doesn’t help, its not the most efficient way of a project going ahead.

The concept of risk transfer is absolutely fundamental to PFI. But the associated difficulty that goes with it is where the Contractor takes the risk they price it.

I mean the unreliable side is basically if there is a risk that would have been better borne by the Client, but the Client doesn't want any risk at all and gives it to the Contractor, the Contractor is going to charge him for that and that is an inefficient way because there is no way the Contractor can do anything about it there's no point him taking the risk.

No, that’s right. No again I don’t think there is anything you have missed there.

Are there any aspects of PFI which could possibly conflict with nuclear power?

Not really no. There are two key drivers to PFI. One is about allocating risk to the party best able to manage it. There is certainly nothing inherent in the nuclear power industry which would mean that that couldn’t be achieved. The second driver is the cost of the transaction doesn’t show up directly on the Government’s books and that’s a fact the cynics use to beat PFI over the head
with continually. Again there is nothing in a nuclear power proposal which would be difficult to secure from that point of view as well.

*Isn't there a danger that we are procuring services today and putting the burden on future generations to pay from them?*

It’s not a danger it’s a reality. The minute you sign that project agreement you are committing the Council to pay X-millions of pounds over 25 years to a private sector partner, some how that money has to be found. It doesn’t all come from central Government in terms of PFI credits. I’ll give you an example. On the schools project we got from the DFES PFI credits of about £48m, the actual contract value to [the Contractor] is somewhere just under £60m. That £12m gap has to be made up by the Council and that has implications for community charge and council tax payers in [the City]. So inevitably it’s not a risk that your committing people to its an actuality you are making that commitment. On the other hand you would be doing that through any procurement process and future generations would be paying for that in one way or another. However Councils raise money in one way or another it will get transferred to local council tax payers so I think it might be a bit of a red herring that.

**General Questions**

*OK, two kind of final general questions, what is the most fundamental issue globally regarding the environment at the current time?*

Climate change because that brings with it a whole host of sub-issues.

*Secondly, what do you think is the most fundamental environmental issue for the Council when it’s involved in construction?*

If you wanted a general word that concerns the Council its Sustainability.
What's driving that? Is it purely cost savings or is it Government agenda?

It's a combination of things. Part of it is financial. Part of it is a genuine concern within the Council to do as much as they can to protect the local environment of [the City] and increasingly Local Authorities have to take account of and abide by national regulations about energy efficiency and stuff like that. I think it's probably those three elements.

Well that concludes my questions, so thank you for your time.

No problem, Thank you.

6.3 Summary

The interviews conducted have either highlighted new issues that were not uncovered in the prior research, confirmed those issues that were or provided an argument against some of those issues raised. The research has shown that applying the PFI to nuclear power generation is achievable. There are no specific conflicts between the PFI process and the construction of a nuclear power generation facility. The research however does identify numerous stimulants and impediments to the application of this premise. In order to progress this we must take those factors identified and seek to enhance the stimulants and eliminate the impediments. The following chapter will draw conclusions from all of the research conducted and further develop the theoretical model created in chapter four.
Chapter Seven

Conclusions, Evaluations & Recommendations

7.1 Conclusions & Further Theoretical Model Development

Interviewee One highlighted the fact that there were essentially four policy objectives in the EWP, these included affordability of supplies, environmental acceptability with particular emphasis on Carbon emissions, reliability of supplies and achieving those three aims through competitive markets. Interviewee One stated that nuclear power could meet all of these stated Government aims.

The affordability of supplies is achievable due to the robustness of nuclear economics compared to other fuels, in the sense that other fuels do not include for the whole life-cycle costs and environmental costs in their pricing, nuclear does. There is also the fact that the primary fuel, Uranium, is very cheap and only contributes about 5% to the total generating cost and can be considered an indigenous resource. Reliability of supply is also achieved. Due to the 'indigenous' status of Uranium the worries highlighted by Interviewee One about security of fuel transportation are not applicable to nuclear. Nuclear power provides a constant 'base load' generation that is not dependant on external factors such as the environment, unlike Renewables. Renewables also have the potential drawback, economically, of having 'back-up' generation facilities to provide for 'when the wind doesn't blow.' The other issue with reliability of supply is the diversity issue. Both the energy industry and those industries that are heavily energy intensive recognise the benefits of having a balanced energy mix, so anything that adds to the diversity of that mix, such as a nuclear element, which currently the UK will lose, must be a stimulant to that diverse element. The introduction of a diversity tax system which encourages energy
sources which add to a broader mix and penalises those that are already heavily accounted for in the current mix would act as a stimulant to nuclear.

Environmentally nuclear scores highly, it is essentially Carbon free, more so, potentially, than some Renewables as discussed in the interview. There is also the point that the nuclear waste issue already exists and to abandon nuclear construction on this basis does not remove or resolve this existing problem. Interviewee One pointed out that the replacement of the redundant nuclear stations by new ones over the sixty year lifetime of those stations will only increase current nuclear waste stocks by ten percent; this is not, therefore a major barrier to nuclear expansion. The nuclear industry is also one of the few, if not the only industry that effectively manages all of its waste produce, especially if you consider Carbon emissions to be a waste product of other energy production methods. This shows considerable environmental awareness and acts as a further stimulant to nuclear power. Finally the ability to achieve this through competitive markets would not only be feasible through the utilisation of the PFI approach but would have improved viability due to the nature of PFI, namely value for money and risk allocation.

One of the issues that could act as both an impediment in the short-term but a huge stimulant in the long-term is the fact that new nuclear facilities would not generate any electricity until 2015 at the earliest. This could be an impediment because it could be argued that nuclear will do nothing to help towards the Kyoto targets, but longer term nuclear will help the UK to maintain its current energy mix and also its targets with respect to Carbon emissions, this is due to the fact that the current nuclear industry will suffer a severe decrease in Carbon free electricity generation by 2020, which under current policy will be replaced by Carbon producing electricity generation through the use of imported gas.

Potential stimulants to nuclear investment include either a credit for technologies that advance the Governments position with respect to its energy policy objectives or penalties, such as a Carbon tax, on technologies that detract from that position. Those credits or penalties must have longevity to be
effective in order for them to be attractive to nuclear investors who will not see a return from their investment for some time.

A very physical stimulant to the case of nuclear power is the uncertainty over whether there are enough resources available to create the amount of energy required to be delivered by the Government’s current policy and targets for Renewables. In order to meet Carbon targets and reduce the UK’s reliance on external fuel sources, Renewables need to account for twenty percent of the energy mix. Nuclear would reduce the burden on Renewables, a burden that Interviewee One stated that some believe cannot be met. Even if the Renewables targets are met, if nuclear power is not sustained then the UK will have spent much time and effort and achieved nothing with respect to a reduction in Carbon emissions because those Renewables will only replace current nuclear energy generation.

PFI usually represents the only way in which a project could be funded from a capital perspective, there is just no other way of securing funds to proceed. Interviewee Two also stated that PFI had major advantages from a facilities management responsibility perspective to achieve or stimulate better quality in design and construction and also significantly improve construction programmes. The overall point was that PFI could be used wherever there is major capital investment required to meet a social need. Interviewee Two also highlighted size of the project as a factor in PFI schemes, there needs to be significant capital investment to make PFI worthwhile. Nuclear power stations require £1.5-2bn to construct, so this represents a huge capital investment and therefore a huge stimulant to the use of PFI in nuclear power. Interviewee Two suggested that PFI is becoming much better known especially in the Education sector, the Health sector has also used PFI for major capital investment. Government are keen for PFI to be used in these industries where it can deliver value for money (as discussed in Timms, 2005) due to the benefits derived through PFI, value for money, effective risk allocation as well as a lack of Government expenditure resulting in reduced Government borrowing.
A further stimulant and an issue that is becoming of paramount importance, not only in the nuclear industry but in other industries, such as construction for example, is that of Knowledge Management. Interviewee One stated that a lot of the industry's staff began their careers in the sixties, seventies and eighties and they were close to retirement age. If the knowledge that those people retain is not effectively captured and dispersed throughout the industry before they leave that will be a major blow to the industry's knowledge base. The uncertainty over the future of the nuclear industry is acting as an impediment against new, high quality staff joining the industry. So even if that knowledge is captured will there be anyone left in the industry with the ability to use it to its full potential?

The United States' approach to nuclear energy will also act both as a stimulant and an impediment to the UK approach. The US approach to Kyoto has been an impediment to its effectiveness even though the US has achieved much with respect to alternative technologies and Carbon emissions. The US approach to licensing, separating nuclear site from nuclear reactor and considering them independently would be a definite stimulant to the UK approach. Also a decision by the US to build new nuclear stations may act as an incentive to the UK to do the same. New legislation and regulation will be required. Currently, UK policy on two aspects of nuclear power is acting as an impediment to any private sector investment in the industry.

The policy on planning approval, site licensing and reactor licensing needs amending or streamlining as Interviewee One vocalised it. This is to ensure that an approval process for new reactors does not take a commercially unacceptable amount of time. Secondary to this issue is a further impediment; one that was realised during the building of Sizewell B; is the redesign of standard international reactors for perceived safety benefits. Interviewee One put across the premise that redesigning an internationally accepted standard, as was the case with Sizewell B, is not only unnecessary but also uneconomic in both capital and from a facilities management point of view; both of which are fundamental to the PFI philosophy.
The second aspect of UK policy is its policy, or rather lack of policy on waste. If the UK wishes the private sector to invest in the nuclear industry it must clarify its position on both the current stocks and the minimal future amount of nuclear waste that needs to be dealt with. Uncertainty is a definite impediment to private sector investment in any future nuclear project. Internationally the answer appears to be to store nuclear waste in a deep underground repository.

A very important impediment to nuclear expansion that was not highlighted directly in the pre-interview research is that of the decision makers' perception of the public perception to nuclear power. Interviewee One stated that MP's believe the public to be strongly against nuclear power which does not appear to be the case. Nuclear power is a political issue as much as an energy issue and will require the support of those decision makers so it is important to recognise this very motivational impediment to nuclear power.

Public perception rather than the decision maker's perception of the public view appears to be generally even between those in favour and those against. The wish of the nuclear industry and the evidence across Europe supports a public debate on nuclear power as this would stimulate knowledge and awareness of the benefits of nuclear power and would help to fully understand its negative aspects. Lack of knowledge is a real impediment that could be eliminated. Both Interviewees agreed that public knowledge and lack of support for nuclear stemmed from a lack of proper knowledge about the issues.

Government also has a role to play. In the past they have driven the industry by building the stations. The future role in a privately financed industry could include things like assurances that they will not change policies, such as waste policy, halfway through the running of a new reactor or from a safety point of view. If as Interviewee One discussed there were to be a 'Chernobyl II' somewhere else in the world, the UK did not suddenly decide to cease nuclear operations. Indemnities such as these would act as a huge stimulant if implemented but remain as an impediment while the uncertainty persists.
Decommissioning could be seen as an impediment to nuclear expansion. The cost has been shown to be small relative to the life-cycle costs of a nuclear plant but the time aspect is much longer compared to non-nuclear alternatives. Interviewee One stated it takes about 100 years to decommission a station safely and effectively, this is a definite impediment. This is somewhat mitigated by the nuclear industries policy to build the first fleet of new stations on existing nuclear sites. The stimulants gained from this are economic, social and environmental, being able to re-use existing infrastructure which is good for the economics. From the social perspective the surrounding public have a degree of acceptance to the nuclear site and finally you are using Brownfield sites which is an environmental plus.

Stimulants from a safety perspective include the fact that modern reactors are designed to be both passively safe and also with waste management principles in mind. Passive safety also has the benefit of reducing the systems required in a modern reactor with the associated economic benefits. Safety concerns due to competitive markets should also be minimal due to the totally independent Nuclear Installations Inspectorate who will still seek to maintain the highest standards of nuclear safety whoever owns and runs the facilities. The terrorism aspect has been proven to be more of a perception issue than a safety one. Modelling work discussed by Interviewee One has shown that nuclear stations are robust enough to withstand an attack; it was also shown that there are more attractive targets than a nuclear station. Interviewee One also made the point that 100% safety cannot be guaranteed in any industry. A further perception issue is that of proliferation, it is unlikely that the expansion of civil nuclear power in the UK would lead to proliferation of material for military purposes. This is due to the safeguards in place and also the fact that nuclear material would probably be easier to procure elsewhere in the world.

The nuclear industry consists of very highly skilled workers and the Government is keen to retain that knowledge base. The building of a new fleet of reactors would sustain that employment level to a degree and this is a stimulant to
nuclear. However, Interviewee One stated that the aim of the industry is to have bigger reactors which require less staff to run them, so potentially there is a possibility of a loss of jobs in the industry. This would depend upon the level of nuclear power the Government wished to produce.

With respect to new technologies and patents it has been shown through the interviews that with respect to the next generation of nuclear plants the opportunity for new technology is limited because the industry wishes to procure existing designs without alteration. The potential here is in the secondary service sectors to the industry and also in the field of nuclear waste management and clean-up. This can also be linked to the opportunities for innovation and creativity; Interviewee One highlighted the fact that there was a lot of opportunity for innovation and creativity due to the high levels of skill within the workforce. The impediment with respect to SME’s could also be seen as less of an issue in the secondary nuclear market, they may not have the ability to invest in new nuclear stations but the services those stations require may represent an area for SME expansion. Interviewee Two also suggested that the PFI stimulates innovation and creativity in order to maintain competitive advantage.

Impediments included the high external costs associated with PFI due to the external advisors required. Interviewee Two suggested that external third party advisors are needed for technical issues, such as an Independent Certifier who signs off the stages of a project. There were advisors required for financial reasons and the biggest cost was in legal advisors. In fact as Interviewee One pointed out combining a legally complex issue such as PFI with the legally challenging status of the nuclear industry the legal costs could be a significant impediment to these projects going ahead. These external costs also fuel the argument that PFI may not represent the value for money that is central to its philosophy. Should this prove to be the case this would be a major impediment to PFI expanding into the nuclear industry.
Interviewee One also believes that nuclear fusion should not be seen as an impediment to fission. The Government also believes the next age of fission should be seen as a bridge towards fusion which is still too technologically immature to act as commercial competition to fission.

It should be remembered however, that the goal of a PFI project is not the construction of the facility itself but the delivery of the final service provided by that facility. Therefore in the case of nuclear power, the goal is not the construction of the station itself but the production of affordable, reliable and secure, environmentally acceptable base load electricity generation through a competitive market.

Further to the research conducted it is clear that there are numerous issues with respect to nuclear power and the PFI. From the stimulants identified in the literature review and the subsequent primary research the model put forward in Figure 4.3 has been critically appraised (see Figure 7.1) to enable the model to be further refined and developed.

<table>
<thead>
<tr>
<th>PFI/Nuclear Power Stimulants: Original Theoretical Model</th>
<th>Confirm</th>
<th>Reject</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Environment Level:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced Government capital expenditure;</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase ability of Government to meet Kyoto targets.</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental benefits from improved air quality;</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Environmentally acceptable, Kyoto targets are redundant following 2012, greenhouse gas targets are not, combine with improved air quality, add existing waste issue.
- Public debate required.
- Due to reliability of supply.

- Moved to Project level
- Potentially employment could decrease.
Added

Government policy on Renewables potentially physically unachievable,
Economic competitiveness leading to affordability of supply;
Uranium considered indigenous to the UK,
Nuclear fusion too technically immature to provide real alternative;
High value employment

<table>
<thead>
<tr>
<th>Organisation Level</th>
<th>Highly skilled workforce.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection from potential Carbon emissions tax;</td>
<td>✓</td>
</tr>
<tr>
<td>Benefits from new technology patents;</td>
<td>✓</td>
</tr>
<tr>
<td>'Base-load' generation providing constant demand</td>
<td>✓</td>
</tr>
<tr>
<td>Low primary fuel costs;</td>
<td>✓</td>
</tr>
<tr>
<td>Efficiency through increased competition;</td>
<td>✓</td>
</tr>
<tr>
<td>Open and transparent cost management;</td>
<td>✓</td>
</tr>
<tr>
<td>Standard of service defined;</td>
<td>✓</td>
</tr>
<tr>
<td>Encourages future investment;</td>
<td>✓</td>
</tr>
<tr>
<td>Client ability to apply penalties for non-performance;</td>
<td>✓</td>
</tr>
<tr>
<td>Opportunity for innovation and creativity</td>
<td>✓</td>
</tr>
</tbody>
</table>

Added

Increased use of Knowledge Management to capture existing industry knowledge.

<table>
<thead>
<tr>
<th>Project Level</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable design benefits,</td>
<td>✓</td>
</tr>
<tr>
<td>Technological innovations;</td>
<td>✓</td>
</tr>
<tr>
<td>Improved construction programme;</td>
<td>✓</td>
</tr>
<tr>
<td>Improved efficiency and productivity;</td>
<td>✓</td>
</tr>
<tr>
<td>Value for money;</td>
<td>✓</td>
</tr>
<tr>
<td>Cost reductions;</td>
<td>✓</td>
</tr>
<tr>
<td>Improved quality;</td>
<td>✓</td>
</tr>
<tr>
<td>Efficient risk allocation;</td>
<td>✓</td>
</tr>
<tr>
<td>Increased management expertise</td>
<td>✓</td>
</tr>
</tbody>
</table>

Added

Nuclear reactor passive safety technology,
Comparison with Public Sector Comparator

<table>
<thead>
<tr>
<th>Job Role Level</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High level technological research and development opportunities.</td>
<td>✓</td>
</tr>
<tr>
<td>High remuneration due to high level of expertise required</td>
<td>✓</td>
</tr>
</tbody>
</table>

Added

Nuclear industry promotes 'Healthy Worker' effect.

Figure 7.1 Critical Appraisal of Theoretical Model Stimulants

The impediments identified and put forward in Figure 4.4 have also been critically appraised to enable the impediments theoretical model to be further refined and developed, see Figure 7.2 below.
<table>
<thead>
<tr>
<th>PFI/Nuclear Power Impediments: Original Theoretical Model</th>
<th>Confirm</th>
<th>Reject</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Environment Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current levels of public knowledge, awareness, opinion and acceptance, Nuclear waste;</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proliferation of nuclear materials and weaponry; Terrorism; New legislation and regulation required,</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Inefficiencies in public-sector comparators, Reduction of public service ethos and perpetuates belief of public-sector inefficiency; Long-term public financial commitment.</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Added</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government perception of public perception, New nuclear would not come online to help with Kyoto targets.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organisation Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential for decrease in safety levels due to competition, Storage of nuclear waste produced, Economics, safety, capital cost and decommissioning;</td>
<td>✓</td>
<td>✓</td>
<td>Time issues with respect to decommissioning, see Added.</td>
</tr>
<tr>
<td>High risk projects, Creation of 'two-tier' workforce; Market difficult to enter for SME's, High private sector borrowing rates.</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Added</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time issues with respect to decommissioning, Political nature of the industry.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project Level:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General safety concerns; Production of nuclear waste, High pre-contract and legal costs; Unreliable risk transfer</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Added</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential redesign of international standard designed reactors.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Job Role Level:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High risk work environment, Lack of freedom, Decreased opportunity for individual initiative and innovation, Strict rules and procedures</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Added</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.2 Critical Appraisal of Theoretical Model Impediments
Following the critical appraisal of the original theoretical model for the stimulants to nuclear power and the PFI (Figure 4.3) that model has been further refined as shown in Figure 7.3 below:

<table>
<thead>
<tr>
<th><strong>PFI/Nuclear Power Stimulants: Theoretical Model</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Environment Level:</strong></td>
</tr>
<tr>
<td>Government policy on Renewables potentially physically unachievable;</td>
</tr>
<tr>
<td>Economic competitiveness leading to affordability of supply;</td>
</tr>
<tr>
<td>Environmental acceptability, greenhouse gas targets, existing waste issue, improved air quality;</td>
</tr>
<tr>
<td>Social service needs met through reliability of supply;</td>
</tr>
<tr>
<td>Reduced Government capital expenditure;</td>
</tr>
<tr>
<td>Public debate leading to improved public knowledge and awareness leading to improved levels of public acceptance of nuclear power;</td>
</tr>
<tr>
<td>Reduced reliance on external primary power sources, UK retains self-sufficiency;</td>
</tr>
<tr>
<td>Uranium considered indigenous to the UK;</td>
</tr>
<tr>
<td>Social environment improvement;</td>
</tr>
<tr>
<td>Nuclear fusion too technically immature to provide real alternative;</td>
</tr>
<tr>
<td>High value employment.</td>
</tr>
</tbody>
</table>

| **Organisation Level:**                           |
| Benefit from greenhouse gas target credits or protection from potential Carbon emissions tax, diversity tax; |
| Increased use of Knowledge Management to capture existing industry knowledge; |
| Benefits from new technology patents; |
| 'Base-load' generation providing constant demand; |
| Low primary fuel costs; |
| Efficiency through increased competition; |
| Open and transparent cost management; |
| Standard of service defined; |
| Encourages future investment; |
| Client ability to apply penalties for non-performance; |
| Opportunity for innovation and creativity. |

| **Project Level:**                                |
| Nuclear reactor passive safety technology; |
| Sustainable design benefits; |
| Technological innovations; |
| Improved construction programme; |
| Improved efficiency and productivity; |
| Value for money; |
| Cost reductions; |
| Improved quality; |
| Efficient risk allocation; |
| Comparison with Public-Sector Comparator; |
| Increased management expertise. |

| **Job Role Level:**                               |
| Nuclear industry promotes ‘Healthy Worker’ effect; |
| High level technological research and development opportunities; |
| High remuneration due to high level of expertise required. |

**Figure 7.3 PFI/Nuclear Power Stimulants Revised Theoretical Model**
Figure 7.4 shows the revised impediments (previously Figure 4.4) following the research conducted.

**PFI/Nuclear Power Impediments: Theoretical Model**

**External Environment Level:**
- Government perception of public perception;
- Government policy on licensing, legislation and regulation;
- Government policy on nuclear waste management;
- New nuclear would not come online to help with Kyoto targets;
- Current levels of public knowledge, awareness, opinion and acceptance;
- Perceived proliferation of nuclear materials and weaponry;
- Perceived threats of terrorism;
- Inefficiencies in public-sector comparators;
- Reduction of public service ethos and perpetuates belief of public-sector inefficiency;
- Long-term public financial commitment.

**Organisation Level:**
- Storage of nuclear waste produced;
- Time issues with respect to decommissioning;
- Political nature of the industry;
- High risk projects;
- Creation of 'two-tier' workforce;
- Market difficult to enter for SME's;
- High private sector borrowing rates.

**Project Level:**
- Potential redesign of international standard designed reactors;
- Perceived safety concerns;
- Production of small amounts of further nuclear waste;
- High pre-contract and legal costs;
- Unreliable risk transfer.

**Job Role Level:**
- Decreased opportunity for individual initiative and innovation;
- Strict rules and procedures.

Figure 7.4 PFI/Nuclear Power Impediments: Revised Theoretical Model

The major factor which has been consistent throughout the research with respect to both the PFI and nuclear power is that the UK Government has a key role to play in the future of both. The Government is in a key position, especially with regard to eliminating the impediments identified. A decision regarding policy on nuclear waste and a 'streamlining' of licensing and nuclear regulation systems would be a huge stimulant to the private sectors willingness to invest in nuclear power. Private sector investment remains at the heart of the
PFI philosophy and will remain prevalent in other sectors, especially Health and Education. The Government could encourage its use in the nuclear industry and with the vast capital sums required to produce nuclear power generation facilities, PFI would become the highest value procurement route for construction projects in the UK. This would ensure the Government's wish for PFI to become the prevalent procurement route to construct the buildings and infrastructure required to meet the ever increasing demands of society would be met.

7.2 Evaluation & Recommendations for Further Research

The research began with three very different lines of enquiry, namely innovation and creativity, nuclear power generation and the private finance initiative. The literature review covered the basic definitions of innovation and quickly moved on to the topics of nuclear power and the PFI. The study of innovation and creativity led to the development of the question for this research, the research has led to an emergent theory which has been developed and shaped through the research process and this did, to some extent, lead away from the study of innovation and creativity. The study of innovation began the process however.

The initial literature reviewed was very insular in each field as little research existed that combined the topics together, especially nuclear power and the PFI. The literature reviewed in each field represented a broad range of information including many forms of published literature from refereed journal articles, text books, industry publications, press articles and results from various seminars attended. There is however still a vast amount of research that could be reviewed and some of the issues identified could be further pursued. A good example of this is nuclear waste and the issues surrounding it. There is a vast array of research in that area alone that could be researched further. In-depth research could be achieved to show why nuclear waste is perceived as an impediment to new nuclear power generation when, in fact, the issue of waste within the nuclear industry (excluding the uncertainty over Government policy) is
a very minor one, especially technically speaking. The same could be said of other major issues identified such as nuclear economics and the validity of the PFI claim to be value for money. The purpose of this research was however, to uncover and highlight these issues and then classify them as either a stimulant or impediment to applying the PFI to new nuclear power generation in the UK, the research has achieved that aim.

The drawing together of the various strands of enquiry resulted in the emergence of the theoretical model developed in Chapter Four. This represented an important part of the research project as up until this point the 'lines of enquiry' were still very much focused on their own respective fields. The importance of drawing those lines together to form a cohesive argument or theory cannot be understated. The creation of the theoretical model acted as a basis to underpin the latter stages of the research. Indeed the model itself was discussed at length in the proceeding interviews. At this point credit should be given to Eaton et al (2005) whose research into stimulants and impediments into innovation and the PFI and subsequent model development was invaluable in developing the initial framework for the author's model. Eaton et al's (2005) model has since been further developed resulting in its publication by the RICS (Eaton & Akyibikli, 2005).

The development of that initial model in Chapter Four was critical to ensuring the successful development of the interview agendas in the next chapter. The depth of the literature reviewed allowed for the majority of the issues concerning nuclear power and the PFI to be, at least, identified by the theoretical model. The subsequent research then proceeded to confirm a lot of the theory uncovered by the literature review. The research interviews did not highlight further issues as much as they gave more detail about those issues already highlighted. The interviews also resulted in a 'streamlining' of those issues identified to ensure greater accuracy in the way they were presented.

The research interviews themselves were highly valuable experiences which resulted in rich, deep, complex data that was invaluable in further developing
and refining the theoretical model. The data gathered from the first research interview had a greater impact on this research but the interview duration was too long and this led to difficulties in transcription, editing and analysis of that interview. The data gathered however was very pertinent to the research. The second interview was by contrast well timed but the information gathered was more general and less valuable to the specifics of this research. The information regarding the workings and perceived benefits of the PFI was still important in confirming the research uncovered in the literature review however, especially with the levels of uncertainty and argument that exist when discussing the advantages and disadvantages of the PFI. This research may have benefited from one or two more interviews, this would have added a contrasting dimension to the interviews conducted and would also have enabled greater perception of the real 'key' issues concerning the research. The PFI side of the research would have especially benefitted from further interviews, possibly with a contracting organisation involved with the PFI. As discussed in Chapter Five however, resources are finite. One further point that should be raised with respect to the interviews is the editing process that was undertaken to ensure a laconic record of the interviews was presented. The full transcript of the interviews (included in the appendices) represents a much greater amount of information. This was removed as it was not precisely relevant to the research question, at a broader level however it represents an interesting review of the myriad of issues that surround nuclear power and the PFI.

The final section of this research, the conclusions, initially represents a summary of the information discovered through the interviews. The aim of this research was to identify stimulants and impediments to nuclear power and the PFI through the development of a theory based on a qualitative, phenomenological approach. The conclusion therefore was the development of the theoretical model showing the stimulants and impediments to nuclear power and the PFI. The main body of work in developing this model was conducted through Chapter's Two to Four, the subsequent research helped to refine and confirm that research. The model enhanced in Chapter Seven therefore
represents an amalgam of all the research in the preceding chapters of this research thesis and is a conclusion in its own right.

The areas for future research therefore are defined by the conclusion of this research. The issues identified as either stimulants or impediments to nuclear power and the PFI represent individual areas that require further research, as shown by the nuclear waste example discussed earlier in the conclusions. Each of these issues needs to be addressed in order to discover the level of impact they have. Suggestions could then be made on how to increase the potency of a stimulant and/or decrease the influence or hopefully eliminate altogether any impediments to the application of the PFI to provide better value for money in new nuclear energy generation facilities in the United Kingdom.
Appendices
Appendix One

Research Interview One ~ Interview Agenda – Nuclear Power

Private Nuclear Organisation

Part One: Background

It's a general discussion on nuclear power really that I'm after...

Think I can probably manage that one...

I am looking at the finance side of it with some other people who are more involved with the private finance initiative it's a, it's basically a pilot study to see if the private finance initiative, which I'm not sure whether you're aware of how it works...

Only very sketchily, and I also should say as well, some more background, that's one of the things I was going to do between three and four, so rather than leave you sitting there while I read it I thought well I'll bring it in, if we want to touch on it, or if you want to talk me through it...

It's nothing of major importance...

I mean I've looked at the one page thing.

I mean that was my early Research Proposal that I did sort of early last year although it was handed in, in March but basically the principle is that a private consortium will get together including a Contractor and a Client will get together and fund the building of, at the moment it's used for schools, hospitals, thing like that. They'll pay for it and the Government, through local councils pays for that facility or the service that facility provides over a period of twenty-five to forty years, it's just a permanent contract. So basically the private sector builds maintains and runs and potentially can decommission as well, which would be an important part if it was used for nuclear power and the Government just pays for that and...

It pays for the service that it gets rather than the, sort of the facility itself...

The benefit to the Government is, that obviously they don't have the capital expenditure, the capital outlay all at the start of the project they're paying for it over time which is, which is why it's so popular.

I guess in a nuclear context then given that Government isn't the only person that or the only customer for electricity in the country Government wouldn't necessarily be, well it might be a customer amongst many or a primary customer that then sells on the electricity in some way through, to others.

I mean that at the moment it's only the Government that are acting as the client for PFI projects but the principle could be applied that way...

So I guess in principle there wouldn't need to be any Government involvement in a nuclear station or any kind of power station for instance under PFI.

No, no. It's just a way of basically providing for communities needs without Government...

Government stumping up for it.
Yeah. Right well what I've got... This is only a pilot study so it's only going to be a very sort of general overview, general questions about nuclear power, I have a few questions about PFI but if you don't know anything about it we can skip over that.

I'll probably be asking you more questions than the other way around.

Right I'm going to first start with just a few questions about your background.

Yeah fine.

Firstly, what is your position in the company?

I'm what's called the Head of Energy Policy Studies. I work in a team of about a dozen people here called the Energy Unit which is a little bit of effectively corporate [The Company], helping to work with the Government to make the case for nuclear, help Government understand the implications of sort of, it's energy policy decisions in so far as nuclear is concerned because the Government isn't full of nuclear specialists and Government owns [The Company] through the Department of Trade and Industry shareholder executive within the DTI. So we're owned by Government but were also effectively trying to help or advise, or in a very small way lobby and persuade Government sometimes about the role of nuclear but in doing that I and the rest of the team here work very much with other companies in the nuclear industry. One of the things I do in my particular role is have a wider view as well looking at how nuclear stacks up against Renewables and some of the other alternatives and some of the wider energy policy and electricity policy issues, rather than just, we've got people for instance in nuclear economics or nuclear waste or safety regulations. So my remit is to look a little bit more broadly at nuclear as one player amongst many.

Ok, What's your background? Have you always done that?

No, my background was an engineering degree at university. I joined; I was a sponsored student for [The Company] because my father worked for [The Company] before me. So I ended up getting a sponsorship, because of that I ended up getting first bite of the, sort of, interviews and admissions cherry when I was at university. That was 22 years ago coming up, in fact just this last week, sorry no, in a couple of weeks time it was the middle of August I started, '83. Mainly in a technology and engineering role to begin with, then moved in sort of general technology management and largely by accident because our energy policy and Government liaison work was being run by our technology director at the time it was leading on all those energy policy issues I ended up working quite closely with her and her, sort of, small team and I gradually drifted into what is now a full time job on the energy policy side.

Have you ever had any experience in the construction industry, or anything like that?

No, all my employment has been with [The Company] so no we do work with some companies like [Main Contractor] and [Main Contractor] and so on in some of the collaborative studies that we do. We commission work from them on certain aspects of the industry as well as having much more, the company having much more formal arrangements with them for construction projects but I personally have, sort of, only really worked with them, sort of, them as a consultant type role.

Are you a member of any professional bodies?

I was a member of the Institute of Mechanical Engineers that's, sort of, lapsed because I don't do an awful lot of engineering but I'm a member of the British Nuclear Energy Society and although it probably doesn't count as a professional body I'm on the North-West branch of the committee of the British Association for Advancement of Science, people who do the science festivals and science week.
Part Two: Nuclear Power

**Why do you believe nuclear power should be used in electricity generation?**

Phoaar, going from the quite closed questions to the rather bigger ones. I'll try and give sort of an overview answer so when you've got bored of me, just sort of, fall asleep or something. Basically Government did an energy white paper in 2003 and set three, sort of, functional objectives for energy policy. Particularly electricity was the focus and the fourth objective they set was about achieving it all through competitive markets. So the three actually things to achieve were affordability of supplies, environmental acceptability particularly in respect to Carbon Dioxide emissions and reliability of supply. And without looking at all the other alternatives the most recent studies whether it's internationally or UK indicate that nuclear is there or thereabouts with the cheapest forms of electricity generation in the future, on a pence per Kilowatt-hour (Kwhr) basis across the full life-cycle. That may not have historically always been the case but if terms of the way we would do things in the future in a deregulated market then nuclear would come out very cheap. So I think nuclear gets a tick in the affordability box.

It also gets a tick alongside that in sort of terms of the, sort of, robustness of the cost because the Uranium cost, the thing you are dependant on the global market to identify, it's outside your control, is only about 5% of the total generating cost of nuclear. If you look at something like gas then the raw gas cost is about 60% of the cost of generating with gas fired power stations. And you might be aware that gas is the way we are heading in the future, about 80% by 2020. Most of it imported, about 80-90% of it imported. So when you look at the alternative, that scenario, our electricity bills are going to be dependant upon what President Putin’s successor decides what they want to charge us for the gas there going to be piping us, or other player’s in the world’s market, but it ain't going to be our decision. So from an affordability point of view and in terms of the confidence you can have in those costs of generation nuclear scores very well.

When you look at reliability of supply again we look at the gas as being the primary component of our electricity mix. Gas coming form a long way away, whether it’s coming via long pipelines or whether it’s coming via liquefied natural gas and being, you know, transported to specialised import terminals, there are lots of things that can go wrong with that. You can either have the guy at the other end doesn’t want to sell you the gas, or he's not prepared to sell you the gas or if they are prepared to sell you the gas it's not, you know, just like passing down the road to get it from Northern Russia to wherever we might need it in this country you’re looking at maybe three thousand miles of pipeline through lots of countries that maybe get no benefit from having it there and countries which are not particularly politically stable. Even if the source countries themselves are, you know the Russians, the Irans, the Algerias, the Qatars are not particularly the most politically, or don’t have the best history of political stability in those countries or in those regions. But you've also got the likes of the Ukraine, Belarus, you know, places the pipeline would have to pass through.

When you look at LNG, LNG Liquefied Natural Gas is becoming a much more increasingly important international commodity are we going to be able to secure the gas that we need? Are we going to be able to secure the access to the very specialised LNG tankers that we need? To get all the gas that we need on a, you know, on an almost a daily or a weekly basis to have those supplies delivered to us. So there are lots of questions about that. I wouldn’t say, I’m not trying to scaremonger to say all these things can go wrong but there are a lot more, you know, sort of a lot more dominoes in the pack that all have to stay in the right place.

And equally our other primary component from the energy white paper is Renewables and that means particularly wind. When we look at what wind does, it’s inherently variable we get wind power generated when the wind blows, not when it doesn’t and there is lots of evidence from countries that have got substantial amounts of wind power, particularly Germany and Denmark, which have been, sort of, leading the way in that respect. That they haven’t, that they’ve had to build, you know, very noticeable back-up conventional power generators alongside the wind farms for those times when the wind doesn’t blow. Germany in particularly had a report out from EON, which is actually the utility which owns the bulk of the wind farms in Germany and
their figures for 2003 were the average, sort of, what they call load factor or capacity factor through the year from their wind farm fleet was 16%. So basically they were getting $\frac{1}{6}$ of the rated output on average. So if you want that full output, you know, reliably through the year you've got to be building you know at least $\frac{5}{6}$ of that capacity in reserve. Actually if you want it on a, at every single hour during the year virtually the full capacity. I think again German figures say that the full wind fleet in terms of what it displaced of conventional capacity was about 6% of the total. So it's nice to have, it's a bonus when you can get it but you've actually got to, you know, you've got to solve the problem twice by building a wind farm then by building something else for when the wind farm doesn't work it's not really looking good economically.

So there are security of supply questions about both gas and wind. And when you look at nuclear, the fuel requirements for nuclear are very small. If you're looking at only 300tns of fuel per year to support the whole of the replacement fleet of reactors if we were to build one to fuel that fifth or quarter of the power supplies of the UK. Now that's not a huge amount of material to import equally we have got a lot of Uranium in the country at any one time already so even if we sort of put the shutters up today and say we're not going to import any Uranium from, you know, whatever it is, the 5th August, it would probably be summer next year before we actually noticed that at the power stations, you know, if not later than that. So we've got storage, plenty of storage by virtue of the fuel being manufactured at any one time, the reactors only have to be refuelled once a year or every 18 months. And also the reactors themselves are not dependant upon weather conditions or anything else. They have maybe one predictable, scheduled power outage for maintenance every year. The rest of the time they operate at very close to 100% so if it's 'base-load' generation round the clock 24hrs a day very reliably without any concerns about whether the fuel can reach the stations or whatever else. So we've ticked the affordability box, we've ticked the reliability box and just the other point on reliability is, sorry two points. The Uranium when we do get it, comes from places like Canada and Australia so in terms of geopolitics and whatever else they're fairly politically stable and, there was another point, I've forgotten it...

Environment?

No, no something else on reliability and I've forgotten what it was but it will come back to me. Forgotten my sort of, stream of consciousness, I'll have a mouth full of tea and see if it comes back to me... no it's gone, it will come back in a minute I'm sure. And, no when we get to environmental, the environmental side. Nuclear is essentially Carbon free, it's doesn't produce any CO$_2$ emissions. I mean there are, there are CO$_2$ emissions associated with the nuclear fuel cycle because Uranium has to be mined and it has to be, you know, transported and you have to enrich the Uranium to make the fuel and whatever. But when people have done those sort of fuel life cycle assessments of sort of nuclear versus coal, gas, whatever else, nuclear does stack up very, very well. It's a small number of percent of gas or coal and it's there or thereabouts with Renewables because there are CO$_2$ emissions associated with, you know, building a lot of wind farms as well, you've got to put a big block of concrete at the bottom of each one, which requires quite a big bit of manufacturing effort and you've got to move the blades and the wind, stacks and everything else to where you want them so there are emissions associated with pretty much everything and nuclear is right at the bottom of the scale. So it makes a very substantial contribution to, to CO$_2$ emissions. So really, you know, when we look at the, you know, the plus side of nuclear and how it scores against energy policy objectives it gets a win, win, win score in my book.

So on the negative side what issues are there and what rank of importance would you put them?

The issue with nuclear is really about deliverability of it in the kind of market we have at the moment. So in the past every station we've built has been built essentially by Government. CGB was a Government owned body or it's predecessors decided were going to have nuclear in this country lets get on with building it with Government money. And so the fact that it's a very capital intensive project, you're talking £1.5-2bn pounds probably for a nuclear station, in terms of just the capital cost. If we were to start today then the earliest we would get any electricity out of a new nuclear station would be about ten years time. So that's because you'd
have a five year, well about a three year process period when which you'd have to get the design licensed because we wouldn't be building the same kind of designs we've got at the moment, we'd take an international standard design. We haven't got any of those approved in the UK at the moment. A lot of them are licensed in other countries but we have our own set of requirements, you know we have to satisfy ourselves and meet UK regulations, so there'd be at least three years to do that, taking a design off the shelf from an international, sort of market place.

Then having done the design, we'd have to choose where we wanted to build it, we'd have to do things like have a public enquiry. We'd have to make sure if we wanted to hit that ten years, we'd have to make sure the public enquiry scope is limited to things we haven't already looked at. In the past when we've done it, public enquiries have gone off wandering into reactor safety issues again. So we've ended up with reactors being redesigned in the licensing process and then redesigned again at the public enquiry, when people say 'well you could make it a bit safer by sticking one of those on or having another of those systems.' And you end up with a design that is unique in the world and because it's a one of a kind in the world it's quite expensive. It's difficult to build you get into problems with construction because you end up using the same bit of space for two bit's of pipe work that you thought you'd add in, and also it's a pain to maintain because it's the only one of it's kind, so you have to learn all about Sizewell B you know you don't have to learn about that reactor design in Finland or France or the States somewhere. So from an operability point of view it becomes difficult.

Then there is a two year approvals and enquiries stage. You could then be a five year construction and commissioning stage so roughly ten years minimum. Now at the moment that could drag on for an awful lot longer because at the moment there's no guarantee the public enquiry wouldn't go into all sorts of complicated detail. There's certainly no guarantee that the licensing process wouldn't sort of ask itself 'how could we make this design a lot better and a lot more familiar to the UK regulator?' Rather than asking the question you need to ask, which is 'does this design meet the specification that we have, the criteria that we have?' Because no investor is going to want to invest in a one of a kind, sort of hybrid, Keith Robinson, evolution of something which is a standard design elsewhere. They will want to build something which is established and proven and the same as being operated in other countries of the world. And at the moment there isn't that confidence that the licensing will be approached on that basis. Sizewell B, which was the last reactor in this country, was meant to be effectively a Carbon copy of a tried and tested proven design from the states. By the time our regulators had finished with it you wouldn't have recognised it, it was a complete nightmare.

I mean the analogy I always use is if you and I went into the car park now and took any car out there and spent an hour thinking of ways we could make that car safer, you know with a purely safety perspective, we'd fill that hour easily. We'd think of all sorts of things you could do to make that vehicle safer to drive but neither of us would want to own it, drive it and get it serviced every twelve months because it would be the only one like it in the world and all those things that we'd added on to make it better would actually make it just impossible to own and operate. So what we want is, as I say, something standard that says does it meet my safety criteria, is it safe enough. Not how do I make it that little bit safer. Is it safe enough, if it's safe enough I'll buy it and I'll be confident that I'm driving round in something that is a tried and tested product that I can get maintained and fixed and everything else by lots and lots of people. So that's one question, at the moment if you entered into that approvals process you have no confidence of what would come out the other end or even when it would come out the other end.

The other issue, big issue for investors, potential investors is waste. The UK, I'll say some more about waste in a minute, but the UK doesn't have a policy at the moment for how we, the Government has decided we will manage higher active wastes. So that's anything above the sort of very low level material, like sort of laundry and overalls and paper towels and stuff. Anything to do with reactors or spent fuel is being stored safely and managed safely at places like Sellafield and other reactor sites but there is no long term disposal policy for radioactive waste. Other countries do have it, countries like Sweden, Finland, the States. They've all actually concluded the same thing, a deep underground repository where we put this material and then leave it. We have a committee, Government committee, not surprisingly which has
been set up to report back in 2006. We are optimistic that they will do that and then when they
report back and make their recommendations to Government, Government might then
implement what they’ve recommended and that will be a huge step forward if and when that
happens but they have been criticised for spending a lot of time whittling down their long list of
about fifty different options to a shorter list of about ten different options, so all they seem to
have accomplished in the first year was ruling out things like shooting it into space and burying it
under you know deep ice flows in the artic, things that nobody really thought stood a cat in hells
chance anyway. So there is a perception by some people that this committee is sort of dragging
the issue out as long as it can because without some conclusion from that from an investors
point of view, without knowing what the policy is, it’s effectively an uncapped liability. You’d be
investing in something that you would have no control over what the Government told you to do
with that waste at the end of it. So from a purely due diligence point of view they could tell you
to do anything with it. So there’s no certainty there. I think those are the two biggest show
stoppers sort of Government policy on planning and regulation and Government policy on
waste. If those were both tightened up I think investors would be much more serious.

There is something else that Government might do, which might be helpful which is look at the
electricity market and see whether a nuclear plant producing reliable Carbon free energy would
be getting the same credit in terms of contributing towards those energy policy objectives that
other technologies might get for making their contribution to. So for instance, you know,
Renewables get a reward essentially or a premium subsidy, however you want to look at it,
through the Renewables obligation which amounts to about 3p/Kwhr at the moment. It varies
but it’s sort of at least 3p/Kwhr for anybody who generates power from wind. That was intended to,
sort of bring forward the new Renewables technologies and helping contribute and whatever
but that obligation is still guaranteed for the next ten to fifteen years by which time if things are
on track these are not going to be new and emerging technologies, they’re going to be widely
established. So they’re still going to be getting that premium at that point for producing they’re
Carbon free contribution...

Do you think from the other point of view that it would be beneficial to have a Carbon emissions
tax on say fossil fuel generating facilities?

Well something like a straight Carbon tax that penalised producers of CO\textsuperscript{2} or Carbon in
general, yes would help nuclear because nuclear then, I suppose part of the question is that as
well as the Renewable obligation or instead of. If you wipe the slate clean and start again and if
you introduced a Carbon tax then nuclear would be on exactly the same footing as Renewables
because we don’t produce any worth speaking of therefore we’re going to be not paying a tax all
the fossil fuel people will be paying a tax because they tend to be the price setters, the price
setter is mainly gas at the moment, you know because of the tax being paid by coal and by gas
it’s perhaps going to push the revenue up without pushing the nuclear industries costs up. So
yes that’s going to be hugely helpful. But, and that’s a big but, how long is that guaranteed for.
Because if the Government of the day bring in, are able to bring in a Carbon tax, say we’re
going to bring in a Carbon tax see how that’s works with no guaranteed longevity on it, you
know, we’re talking about a project that isn’t going to generate it’s first Kwhr of electricity until
2015. So you’ve got at least two general elections before that, you’ve probably got half a dozen
Secretaries of State for Trade and Industry or for energy or whatever the department might
transmute into. Who’s to say that none of those are going to want to fiddle with that Carbon tax
in the meantime, and that’s before you’ve generated your first unit of electricity. So in order for
that to be sort of bankable for an investor, it has to not only be guaranteed to be around in 2015
but probably guaranteed to work until 2025, 2030. That’s not to say you couldn’t change the
scale or the shape of it or whatever, but investors would want to know that it wasn’t just a sort of
flavour of the month incentive because if it were it would obviously shape things that could be
delivered quickly like Renewables, but wouldn’t really have a big impact on, well even with
Renewables, well probably it would help wind, wouldn’t help something like, something like a big
tidal project like the Severn barrage for instance that people have looked at. There is a
guaranteed tax or incentive that stretched out through the first twenty or thirty years of it’s
operation would be a huge incentive to investors on a project like that. So it isn’t just a nuclear
issue it’s a high capital long timescale project issue.
And while I've been talking to you I'll say it now while it's come back into my head the thing I was going to say before about reliability of supply, which was about diversity because if you're looking at reliability of the electricity network in general and you're looking at a future with 80%, 60, 70, 80% gas and 20% Renewables and not much of anything else. Anything that can add to that mix, you know, ideally by displacing gas is going to present a much more balanced mix and a balanced mix in general is likely to be much more immune to sort of common mode failure whatever sort than something that is much more heavily dominated by one technology and so, I knew it would come to me in the end.

So I think that, you know, the two sort of real show stoppers in terms of investors are you know planning process which you know, can just drag on forever and this big sort of, question mark over waste policy and I suppose the thing that might be an additional incentive or might help to get over those two hurdles if they couldn't be taken away completely would be can the Government do something in the market to provide a sort of level playing field that incentivises [sic], doesn't just pick wind and says we'll have Renewables and then we'll have an obligation to encourage Renewables to come forward. We say we'll incentivise [sic] low Carbon technologies or penalise Carbon production, which is what you were saying with the tax. We'll encourage some or all aspects of security of supply. So for instance you could have, you could imagine a, sort of, diversity tax which means that if you want to build yet another gas station when we've already got, you know, 75% of our mix is gas already you might penalise for adding another gas station to the mix but you might be rewarded or whatever for providing something that currently provides only 5% of our generation or nothing at all, so to help bring forward newer technologies. Now that's quite simple because that only looks at what's the fuel going in. It doesn't look at where does the fuel come from, how many alternative source have you got for your gas or whatever what are the risks in getting it into the UK, storage issues and all the other things we talked about before.

So an overall, sort of, security of supply index you could write a PhD thesis on, which I don't know what that might look like but. Carbon is dead easy; you say well we'll charge you for each tonne of Carbon you chuck out, so there's lots of very simple ways you could measure that. Security and diversity is much more open to debate I suppose.

Are there any other stimulants or impediments to the expansion of nuclear power?

Yes, you knew the answer to that, you've probably got some written down. One is public perception but actually it isn't. If that doesn't sound too daft, no the real impediment is decision makers perception of public perception. If I just explain what I mean by that. We've done opinion polls and other people have done opinion polls about what people think of nuclear and the short answer is people don't think about nuclear much until you ask them. If we go out, if we ask the question or MORI on our behalf, so you know a fairly reputable polling people asked the question on our behalf just around Christmas. If I remember rightly the wording was something like 'would you support or oppose the building of new nuclear power stations to replace the power stations that we already have?' And I think they might have been something about helping to reduce dependence on imported gas and helping to cut emissions. But that was basically the question, would you support new nuclear and 35% of respondents said they would and 30% said they wouldn't and the others didn't know. So we actually had more people saying yes we support it than no we don't and that's the first time for a long time with a, you know, straight yes or no question we come out with more people saying that they'd be supportive. We often found it was fairly even but it was normally slightly weighted towards the don't support it than they do. However, if we ask MP's and again we've done this or MORI have done this on our behalf in the past, what MP's think public perception is, the MP's believe that the public are about 80% opposed to nuclear. So there is a feeling that it is going to cost them votes or be unpopular with their constituents that to take any measures that would encourage nuclear, but actually that's not true.

Do you think there is enough knowledge in the public arena regarding nuclear power?

No, not at all. Again, I'm sorry for quoting statistics and things at you but, but certainly it's one of the things that sticks with me because I work in the field and I go out and speak to people
quite a lot. The biggest survey on, well that’s one very interesting question, there’s a survey
that’s done right across Europe, something called the Euro-barometer Study in, I think it was
2002 and they asked this question in all fifteen countries of the EU and they asked does nuclear
power contribute to global warming, i.e. is nuclear part of the problem. And right across Europe
about 47-48% of people said yes it did contribute and about 28% of people said no it didn’t. So
almost 2:1 people thought it was part of the problem rather than part of the solution. In the UK
we were almost exactly on those numbers, strangely enough, we’re not usually in step with the
rest of Europe. In France where they’ve got nearly 80% of nuclear they were even more wrong
than we were. You know, 54% in France thought it contributed to global warming. The only
sense I can make out of that, is that because they’re so used to nuclear in France they just don’t
have the debate about whether it’s good, bad or indifferent. So it’s so much a part of their lives
that they don’t even think about it, probably they do feel that it’s, well obviously because they
haven’t got the information they’re making the wrong judgement.

The two other countries that came out most strongly knowledgeable if you like, the most
knowledgeable about that question were Finland and Sweden. Now both countries have had a
big debate over the last several years about whether they should have nuclear in that country or
not. Finland have just decided a year or so ago that they will have another nuclear power
station. They have four already, they’re just building a fifth. But that’s been a very, very wide
ranging public debate so in Finland you would expect people to know much more about the
issue than they do. The Government have actually worked quite hard to, sort of, make that
debate happen and encourage the flow of information into it. In Sweden they have been having
a debate about whether to shut down their existing nuclear fleet, they have decided to close
down their fleet steadily. So even though they’ve come to very different answers because
they’ve had a very big debate about nuclear people did actually understand the pros and cons a
lot better in those two countries and it was 50-60% the right way in terms of their responses to
that question. Which says something I think, if you actually get into having the debate about it
people then start to become more aware that there is a plus side to it. Certainly I think, I don’t
know whether you’d agree, over the last year to eighteen months the whole climate change
question has been much more in the public arena. I mean not just in the last month or so with
the G8 and Gleneagles and everything. But certainly there are times now if I’m travelling in the
day and I put the radio on there’s a phone in about, not necessarily about nuclear but it might be
about energy efficiency, it might be about wind turbines on your roof, whatever...

Well Sustainability’s a big driver to it. Do you think the nuclear industry would welcome that
debate?

Absolutely, yeah absolutely. We try very hard to make that debate happen but inevitably as
soon as you say you’re from the nuclear industry people know what you’re going to say. It’s a
bit like having the debate on the death penalty and having the guy from the electric chair
manufacturer’s stand up, you know what he’s going to say. So people will interpret us as
having, you know, a vested interest but we do encourage and are fairly active in not just
participating ourselves but encouraging people like academics who we know are very well
informed on the issues to participate as well. I mean it’s actually where I, I mentioned that, sort
of, public understanding of science aspect of what I do outside of [The Company] because that’s
not something I do, sort of, through [The Company] that’s where the two bit’s of my life come
together because a lot of it is about explaining risk and explaining, sort of, scientific issues and
factual issues to people who don’t necessarily think they’re interested.

Is the Governments position on nuclear power, because I know they’ve effectively stated that
we’re not going to build anymore nuclear power stations and the ones that we’ve currently got
are, most of them are due to end by 2020, is that still the current position?

No, well not quite, I mean that’s, the way you’ve put it is an interpretation of what they’ve said.
What they’ve consistently said is that they will keep the nuclear option open. So, they have
recognised the Carbon, you know, the environmental benefit’s of nuclear with respect to cutting
Carbon emissions and that was recognised in the white paper. But they felt at the time that it
was right to put their priorities on energy efficiency and Renewables as ways of meeting the
huge climate change challenge that we face. Our feeling is that increasingly Government are
realising that, you know, whilst both of those can make a contribution they're not going to solve the problem on their own. I mean if you, I'm not quite sure you've delved into the facts and figures the UK is set up the target of cutting CO\textsubscript{2} emissions by 20% by 2010 which we're going to miss, we'll probably hit 13-14% if we're lucky that's relative to 1990, the Kyoto baseline. We've said that we want 20% of our electricity to come from Renewables by 2020. Now that's hugely ambitious, I mean we've, we're about 3.5% Renewable at the moment but most of that is sort of Hydro that's been in Scotland for the last twenty years and we've used all the good sites for it. So that 1% at most of our power comes from new, what you call new, Renewables sort of wind farms, etc. We're already in 2005, we've got fifteen years to get that up to 20%. And that's of power generated not capacity because obviously you've got the, sort of, the fact that they're not always running, they're not always at full speed, so 20% of actually Kwhrs out of them all from Renewables is hugely ambitious. And people are doubting whether we've actually got the number of boats and cranes or whatever to just put up that many wind farms in that time. It's about two turbines a day between now and 2020.

But even if we did it, if we achieved all of that with all the Renewables obligations and subsidy payouts and everything else that would go with it, all we would do is replace the 20% Carbon free nuclear that's going to be closed by then, virtually closed by then by 20% of Carbon free Renewables and we'll have worked really hard and spent a load of money to add it by then. In Carbon emissions terms we'll have, sort of, just trodden water for fifteen years and we actually need and the Government has committed us to making a 60% cut again against 1990 levels by 2050. So if we spend the next fifteen years of that 45 year journey doing nothing effectively then we're not going to get there, we're really not. So we argue for Renewables, we argue for energy efficiency and we argue for nuclear as well add to the list, sort of Clean Coal and Carbon capture technologies as well, which again is coming out at the moment, not really proven on a lot scales yet. You, sort of, can't capture the principles, you know if that can be made to work, if that's cost effective that's got a great role to play as well.

What impact do you think the United State's unwillingness to sign up to Kyoto is having on those that have signed up to, to meet their own targets?

It's not, I mean the US approach isn't actually helping the Kyoto process because the fact that they haven't signed it has been a barrier to people taking it as seriously as people might have done I think. The fact that it's now actually been ratified by Russia signing it earlier this year has been helpful. And actually in many ways even though the US hasn't signed it, the US has been doing an awful lot to cut their own Carbon emissions. So to some extent George Bush has been portrayed as the, and this is you know a personal view now, not the [The Company] political opinion. You know, George Bush has been, sort of, portrayed as the man, sort of, pulling the rug from under the whole climate change debate by not signing up to Kyoto but in fact they've done an awful lot to develop things like Clean Coal technology to put, they put, you know billions of dollars into the Hydrogen economy which you know, may be the next stab at making that big step towards a 60% reduction by, you know, cutting out all the vehicle emissions. They've got the new energy bill which is in the process of going through at the moment which offers benefits to nuclear. In the form of effectively subsidies for the early plans and certain designs that you would build to help get those designs into the system. So they're doing lots of things to encourage Carbon free technology to come forward but they haven't actually signed up to Kyoto because actually making that commitment for them is a very big step given where they're economy is.

What is the United State's position in terms of building new plants?

New nuclear plants?

Yeah.

They have an initiative called nuclear power 2010 which was launched by the last energy secretary Spencer Abraham and George Bush. That was, sort of, when it started the 2010 was we want a nuclear power station on the books producing electricity by 2010. That's, sort of, shifted now to we'd like to be building it by 2010 but it's still helpful and they have, they've got,
sort of, consortia of utilities over there who together are looking at different reactor designs because one of the issues with nuclear is if you build a series of one plant of one design the first one is going to be, cost quite a bit more than the second one because there'll be a lot of sort of, first of a kind engineering that has to be done at a very detailed level, you know, even if the plant is well enough designed to get it's license approval. Just, you know, the design of the secondary buildings just needs doing. So once you build the first one the second is that much easier given all the, all the sort of glitches that have worked their way out in commissioning and testing and so on. So there's always been a reticence to build the first one and what they're now looking at is, you know, getting a group of different utilities together to say between us we'll buy four or five of these so that we'll share the cots of that first one so we can all equally share the cost of the second, the third and the fourth.

And that's something again that nuclear power 2010 initiative has been helpful in sort of moving towards. There are a couple of consortia at the moment, most of, the leading one is called Nustart, Nu as in for nuclear start, which is looking at a couple of technology options. And that's looking like it might go ahead. But they also have a very different licensing approach over there because they take the technology of the reactor and they look at that and say yes we will approve that reactor then they also take a site and say, you know, for that site without thinking about one specific reactor, they just think about having a nuclear station there and we'll look at, you know, there's an equivalent of a public enquiry where they'll look at the transportation issues and they'll look at the local environmental impact and, you know, jobs and what it might effect in terms of wildlife and everything else around the site and they'll say yes you can have it or no. But they'll say can you have a nuclear station on that site. So if you come along as a utility all you need is a, sort of, site permit and a reactor that's got a, sort of, tick in the approved box and you put the two together and off you go. So they have that and that approach makes it much more straightforward because the reactors, they've also already licensed designs like the Westinghouse design called the AP1000 which is one that's being considered in the UK as well, that's already been licensed in the States, even though nobody's come forward and said we want to build it yet, they've done the licensing of it up front. We consistently argue or try to persuade Government that might be something they could usefully do over here to help eat into that ten years, which doesn't apply a commitment to build anything it just means you've taken the first three years work out of the process. So from that point of view that's helpful, so they have got a model with the new energy bill and the steps that they've taken to sort of streamline the road to getting there, they've taken some very positive steps and I think the US will build new nuclear and I think they'll build it, take the decisions to build it before we do and hopefully that might encourage the UK and other countries to sort of follow suit.

What's the process in building new plants, I mean are there specific contractors that would be looked t or would it be just go to the market...

I think it would be, it would probably be go to the market but I suspect we'd have an idea of who the people that would come forward would be. It would more likely be people who were familiar with the industry and although we haven't built reactors we have built plants of one sort or another. You know, plants up at [Named Plant] and so on. So there are contractors who are experienced at working in the industry and understand the way it's regulated and understand some of the things that make it interesting and challenging sometimes to do construction projects in the nuclear industry compared to other organisations. And who have got, sort of, some of the big civil engineering or heavy engineering facilities that you would expect to have. So I think we've probably got a fair idea of who the likely candidates would be in the, sort of, the supply chain on the contractor side. To be fair I think a lot of them are very keen to make it happen as well, you know we've, you know there are little groups within the industry of players like the [The Company's] and so on and the trade association and the nuclear industries association and getting together with some of those supply chain participants and they're as keen as we are to get the debate moving forward.

Do you think it would be very much, I mean in the construction industry at the moment there is a lot of talk about partnering approaches where you make a commitment with a specific contractor or a specific set of contractors on the supply chain to build pretty much every project that you're
possibly, to be honest we're just trying to get our heads around actually the first one rather than twenty years after that a lot of the time. i don't think there would be a huge reluctance to getting into that kind of arrangement. i think it is that people would have to recognise, would recognise it is a very political industry to work in and so anybody whether it's on the, whichever side of the consortium you might be playing in people would want to make sure that they weren't going to suddenly find they'd made a huge investment of their own capital and then a political decision is taken and, you know, the rug gets pulled from under the whole project and you're not in any way indemnified from that. so getting that contractual model in place, which might i think inevitably whenever you look at nuclear projects you can't get away from some role of government in there even if it's just, you know, the, sort of, signed sealed and delivered letter from government that says we ain't going to interfere in this and were quite keen to see it happen. that in itself would be a hugely valuable role that government could play. at the moment you kind of get the feeling that governments saying well we're keeping the option open and we recognise it might be good but we're not really going to do anything to push it forward is being interpreted as well you can start a project if you like but we reserve the right to come and meddle in it and tell you we don't like it and, you know, allow the approvals processes to go on for a year and a day.

on a similar sort of theme do you think that the nuclear industry would be better off in, sort of, the way it is now, or do you think a move towards nationalisation would be beneficial?

i'm going to have to caveat that answer by saying it's a personal view rather than any [the company] policy. personal view is you can see the way in which government in the past has been this, sort of, owner and driver of the nuclear industry has made projects happen. you know, what we've now got is a deregulated market where government is saying it's waiting for the private sector to come forward but if the kind of project doesn't lend itself to the private sector taking that kind of risk unless government is prepared to put some constraints on the risk. so even if it's just government saying well we will indemnify you to the extent that we guarantee not to change the waste policy once you're halfway through running your reactor and tell you you've then got to put your waste on planet pluto instead of a whole in the ground in west cumbria or whatever it might be. you know, it might be government saying we're not going to, we undertake not to, you know if there is a nuclear accident somewhere else in the world, heaven forbid, but if there is a sort of chernobyl 22 in somewhere you've never heard of we undertake not to just shut down all your power stations the following morning on a knee jerk response rather than a reasoned technical argument even though we might feel that the same thing couldn't happen in the uk because that's the kind of thing that could happen because of the nature of the industry. so if government were saying that we will indemnify you as investors, private sector investors in this project that that's the sort of act of government control. that might be a, you know, a kind of thing that government would need to do. that sort of pushes you towards, well you've almost nationalised it anyway then haven't you because you've said government are, you know, it's only private sector so long as everything's chugging along perfectly fine if everybody wants it to. now that's not say that, you know, private sector doesn't bear commercial risk in terms of the price of electricity going up and down or cost of fuel going up and down and all the other things that you would expect, you know, a normal widget manufacturing company to have to cope with day in day out. but the widget manufacturer isn't going to be shut down on the monday morning because, you know, some plant on the far, other side of the world has gone boom on the sunday night whereas a nuclear industry organisation might.

how is [the company] working to improve the awareness and application of sustainability in your activities currently?

we've, we did, i mean, i don't know if you're aware of all the changes [the company's] going through at the moment. we're almost, sort of, breaking up the [the company] organisation as it used to be. we've put our reactor manufacturing arm, which we bought from, in america three or four, well five or six years ago now, [the manufacturing subsidiary] nuclear business that's up for sale as of earlier this year. we've formed a big subsidiary, so big that it's about 90% of
the people who work in [The Company] work in this subsidiary called [The Subsidiary] which is focused on the clean up and decommissioning side and serving the new Government body the nuclear decommissioning authority which looks after all the assets and the nuclear sites, several nuclear sites in the UK. So we’re now the managing contractor on sites like [Named Plant]. We don’t own [Named Plant] site anymore, but we manage it on behalf of Government, but that can be put out to tender and we could lose that tender at some point. So we work in a very different way from the way we used to. Up until a couple of years ago we had a sustainability, sustainable development team I think it was called as part of our corporate sector that was looking at getting the sustainability issues seen right across the company and they did some very good work on things like corporate social responsibility and sustainability issues in general. We actually picked up a guy from that team, it was only a little team of about three or four people, but when that team split up we picked up the guy who was doing all the climate change work and he now works for me in our energy policy unit. So we’re very pro-active in that respect and I suppose a lot of the other sustainability issues within the clean-up and decommissioning side are managed within that group now as, sort of, as a more normal business if you like. I mean nuclear clean-up is almost of itself contributing towards sustainability because it’s effectively cleaning up the mess of previous generations.

How long does it take to decommission a nuclear power station?

I only hesitate before I answer that question; I was actually asked that question in a slightly different way in a conference I was speaking at last week. What we tend to do with the stations that we’ve shut down already, we take all the fuel out, take all the major removable radioactive components out. Then we basically lock the door and say we’re going to come back in about 100 years, which sounds a bit dramatic. The only reason for doing that is unless you need that land for something else you’re far better leaving that building in a safely managed way for 100 years while the rest of the radioactivity largely decays away and then when you do want to go in and deal with that building, you know, decommissioning it and turning it into a green field site or whatever you’re actually dealing with something that is by then, sort of 80% less radioactive than it is today. So people think, oh it takes 100 years to do it, isn’t that hugely expensive? It doesn’t, I mean we could do it straight away, if there was a need for that land for some other specific purpose then we would. But in most cases we tend to sort of leave it, sort of, safe stored for fifty, a hundred years and then it’s not that difficult it’s about demolishing the building, taking away the waste and, and managing the, sort of, well either it’s concrete type waste or steel or reactor components.

Well have there been any power stations that have been decommissioned?

Not down to completely green field, there’s been one in Spain that was decommissioned to effectively a concrete block, well a concrete foundation block I should say, sort of, one block of building in the middle of it, which was fairly impressive. I forget exactly where that is. We have decommissioned research reactors, so university research reactors down to green field site in this country. I think overseas they have done the same, even to the extent of having the site used for some common agricultural use. But those are research reactors rather than full scale commercial reactors. The main reason we haven’t is just timing that, you know, the earliest nuclear station, commercial nuclear station in the world was Caulderhaul in Cumbria and that closed about three or four years ago so we just haven’t yet had the time to be doing that. And as I say unless there is a commercial driver to do it, the actual best practice health and safety in practice would be to defer a lot of that activity until, you know, some considerable time later on. And particularly, a lot of them are on existing, operating nuclear sites anyway so it’s not really a question turning it into, sort of you know, pasture land or kids playground. You know, Caulderhaul is on the edge of the Sellafield site within the nuclear licensed site boundary so, you know, what are you going to do with that land anyway.

More of a personal opinion type question for you, if there were proposals put forward to build a new nuclear power station, or new nuclear power stations within a five or a ten mile radius of where you actually live what would your reaction be?

I’d think great I might get a job there. I genuinely wouldn’t mind.
What do you think the overall opinion in the area would be?

I’ll answer the question but then I’ll say something else after you’ve said that. I suspect that, I mean I live in North Manchester which is quite heavily populated. I suspect there’d be a lot of opposition to it by people who hadn’t really thought about it before and if they stopped and said do I want a nuclear station or not then not would probably come out highest. I suspect a lot of people would object without really being sure what they were objecting to, but the thing I wanted to say was in all the policy work that we’ve done and all the campaigning that the industry has done for new nuclear in this country one of the things that we have been absolutely consistent on is what we are looking for is for new nuclear stations to be built on existing licensed sites so that’s on or adjacent to the existing power stations for a whole number of reasons. I mean the three really good ones are, you know, these are nuclear licensed sites and getting a nuclear site license is not a very easy thing to do, as you can imagine. Getting one in North Manchester where I live would be impossible I’m sure because it’s so heavily populated and you’d have to have some hugely strategic national importance..

They do have them in the States next to heavily populated areas though don’t they, in New York City...

They do as in relatively near so in the UK they tend to be about as far away from population centres as you can get them. But then when you look at UK geography compared to US geography that still not so far as you can’t, you know, have people who work there and travel into work, you know and then you can’t transmit the electricity from where you’ve generated it to where you want to use it over 100, 200 miles. Manageable type of distance, if you looked at the US and the whole geography there and the whole big empty spaces in the middle where there’s absolutely nothing putting power stations all in the most empty part of the US would be just madness because you’d have huge infrastructure bills, you know, 1000 miles of transmission line to get it to where people are. So they are relatively close to places like New York and some of the other...

The reason I ask the question is because I’m not entirely, I mean I don’t much about the nuclear industry in the US but there was an article that I did read that said there is, there are five or six nuclear power stations in New York State...

New York State is not just Manhattan.

No, there is actually one, I can’t remember what is was called, one nuclear power station that was within twenty. I think twenty to forty miles of 20,000,000 a city of 20,000,000 people, so that was where the question came from.

And that’s closer than there is one to London for instance, Sizewell’s probably, well Sizewell, Dungeness, Bradwell I think none of them are more than 100 miles or so from London. I mean we’ve got a slightly different history, we’ve tended to put them on what might have been military sites or other sites in any case around the UK, there’s other issues. Historically we’ve not actually made a new siting [sic] decision, I can’t remember what we last made a siting [sic] decision about taking a brand new patch of land and that wasn’t a nuclear licensed site and putting, you know, putting a power station on it, it would be interesting to go and find that out. But no I was going to mention three reasons, one is that getting the nuclear license question if you don’t want to start with, you know, a fresh piece of farmer’s field to do that, you’re better off looking at the existing site and then extending the boundary of an existing nuclear license that you might have. Secondly the populations around those sites are, are almost, you know, are almost entirely supportive of nuclear. Again for a number of reasons, there’s obviously the, sort of, selfish reason that a lot of people are employed by them, but also because they tend to live there they tend to find out a bit more about what a nuclear station involves and a little bit about pros and cons and the safety records and so on. And when they do that in general they are reassured rather than more worried so it works in that way. So there’s, sort of, the existing licenses, the public support and there’s actually the question of the infrastructure. That we’ve got the nuclear fleet at the moment that’s due to close so when those power stations close you’ll
have all the transmission line that goes up to the site and you'll have no power generation capacity on the end of it. So if you're looking to build a new station, where better to build it that where you can plug it straight into an existing wire than go 100 miles up the coast.

Would that not increase the cost of building the station though, if you built it on a Brownfield existing site, it would be more expensive than building it on a Greenfield site, would that be a correct thing to say?

I wouldn't necessarily think so, no. I mean you'd have a lot of service facilities on the site already. So things like, you know, canteen buildings, the infrastructure on the site. A lot of it would be there to serve you know the workforce that worked in the nuclear power station, the workforce for decommissioning or particularly if you put a station into the safe store mode it's... I mean in simple terms it's obviously like a night watchman with a torch, you know, it doesn't need a lot of manpower to deal with it. So you've got the facilities still there on the site to deal with you know a few hundred people which you could perhaps extend to deal with a construction workforce or any operational workforce when that comes about. So you probably are better starting with the, you know, from a site point of view, certainly when you aggregated up and think well I've got all the power lines there as well, you know, using an existing site to just replace one station with another effectively. You've got the sub-station there which again might very well have been in full working order, so there's lots of stuff, that, you know, you could reuse, you might have to strengthen it and upgrade it for some of the transmission line if you were building a much bigger station than the one you were closing for instance. But, even on just a purely, just one example on a purely practical level, getting planning permission to build, you know, a string of pylons across the countryside to a new site is, would be a lot bigger issue than saying we want to leave the pylons we've already got that people are accustomed to. I don't wish to imagine how it would play out with the people who would be, you know, most affected by a nuclear, the people in the streets, or you know, the fields or whatever, save our views, you know, in the same way that they do with wind farms actually when you want to build those. You know, save our views, save our countryside, save our natural environment, you know, I don't want a pylon through the back of my conservatory or whatever. Whereas at the moment those that are already there at least are largely accepted by the people who are affected by them. So it makes sense rather than have a site that's empty or not functioning a set of power lines that run to it that you've got to take down to work on the existing sites. The industry’s policy I should say just to round it off, the industry’s policy has always been we would use the existing nuclear sites and build on or adjacent to those. And there are enough of those to accommodate a new fleet of nuclear stations that would, you know, get our capacity or our contribution back up to, sort of, 25%, 30% of, you know, UK demand which is what is was or historically what it has been for the last several years. Now obviously if you wanted to do a France and go to 80% then obviously you haven't got enough sites but I don't think that's the discussion we're having at the moment.

Ok, moving on to a slightly different area what are the current concerns regarding safety. I mean what's different today than it was in 1950 when we started building nuclear?

Right yeah, I mean there's, one of the things is that, I mean reactor safety has always evolved as the industry has progressed and particularly as the industry has become more international. I mean a reactor like Chernobyl, I hesitate to go straight into to talk about Chernobyl, but a reactor like Chernobyl would not have been licensed in the west anyway, it simply couldn't have been because of the way it was designed. Now worldwide we've got much more consistent safety standards now that mean that reactors like that are no longer operating. And that isn't obviously a guarantee that something somewhere won't happen through a different cause but certainly the very obvious safety flaws in that reactor would have been, you know, nipped in the bud in any western country.

We've also now with the kind of designs that people are looking at for deploying in the UK moving to what's called either passive safety or something very close to it, which means you don't rely on having three or four different electrical safety systems or three of four different sort of intervention systems to the reactor if something doesn't appear to be working. What you have is you rely on things like gravity, natural thermal circulation to automatically bring the
reactor back to a safe condition should something start to look as if, you know it's going in a way that it shouldn't be. So reactors now are sort of failsafe features in, you know, a sort of, a dead man's handle on the train if you're familiar with that, you know, the guy holding it as soon as anything happens to the driver, he has a heart attack and stops holding the handle the train comes to a halt, sort of, pushing against a spring. So we have safety systems which are actively preventative of coming into operation by the rest of the plant is working safely. And something like the AP1000 for instance, that I mentioned before, I mean that is a fully passively safe reactor, so anything that could happen in that reactor to, sort of, look like an abnormal event which shut the reactor down by things like natural thermal circulation and gravity of control rods which are the things that you, sort of, extract out of the reactor to encourage the reaction to proceed. You know, there held up again by systems that rely on the reactor working appropriately. So as soon as that stops to happen the things will fall in and shut down the neutrons in the reactor.

So that's a big safety plus and actually it's been very helpful economically as well because in the past when we've had safety systems you have to have at least, if it's an important safety critical system, you've got to have at least three completely independent ways of sensing the same parameter in the middle of a reactor. You know, sensing things in a middle of a reactor is not easy at the best of times but you obviously can't do it with one because if that fails you don't know what's happening. If you've got two as soon as they tell you something different you don't know which one to believe, so you need at least three and in most cases we go with four completely independent systems. I mean they've all got to be wired in separately; they've all got to be power in separately because they can't all come off the same plug or whatever else. They've got to work in different ways and that means huge amounts of control and instrumentation in a reactor. Now certainly making things passively safe you don't actually need all that sensing to drive you're safety systems I should say you've then got three or four different ways of intervening and putting something right, sort of, mechanically or electrically or whatever. Again to make sure you can always operate it. As soon as you rely on passive safety then you take out a lot of that, sort of, redundant sensing, cabling, piping, valves, motors and everything else. So if you look at the parts list of a modern reactor compared to, sort of the ones that are operating today it's only about half the number of valves about a third of the amount of pipe work and cabling and so on.

So that's a huge economic saving and it's a huge saving on commissioning because you don't have to go and test all those independent systems because there just not all there anymore. You know, just to test gravity every morning, technically gravities still working, you take that for granted. So the construction time is much shorter, the simplicity of the reactor is much or the reactor design is much simpler and that makes the thing much more economic, as well as being even safer than the ones we've got operating today. Now that's not saying that the ones we've got operating today are not safe, they meet all the standards and everything else but they do it in a rather sort of belt and braces, I'm not going to say belt and braces, in an over-engineered way sometimes and because you've got a lot of systems in there, you know are never going to use.

Do you think competition will have a, or if the market was further deregulated to encourage competition within the electricity sector, do you think that would have a negative impact on safety?

I don't actually in the nuclear sector because we have an independent safety regulator the Nuclear Installations Inspectorate which is a branch of Government which is, you know, there solely to insist on the highest possible standards of nuclear safety. And whilst 99% of the time mentioning the Nil within [The Company] or anybody in the nuclear industry is likely to cause a sort of cursing and grinding of teeth, but that's for all the right reasons because of they give us a really hard time that's what they're there to do. They have no interest, no vested interest in relaxing safety standards, they are there to be the nuclear industries watchdog on behalf of the Government and to insist on a very high standard of everything and, you know, I can't imagine that that would change in a, you know, if the market was to be more deregulated.

Ok.
I mean, it might mean that, I don’t know, if it were to, if more deregulation meant sort of breaking the industry up into smaller or the supply of electricity industry up into smaller and smaller companies and increasing competition, that might just make it harder for anybody to invest at all in nuclear it, you know, it depends on how it would, sort of, implement itself I suppose but you do need us to use the term critical mass of investment capability and so forth to be able to make nuclear part of your generating portfolio. You have to be able to, you know, you have to be ready and able and willing to wait for that ten years while you invest in a project and see it through to completion and then a further ten, twenty, thirty, forty, you know, maybe sixty years of operating the asset so it doesn’t, you know, anything that moves the market towards, sort of you know, fly by night, here today, gone tomorrow operators, the, sort of, dot com type model isn’t going to help nuclear at all, and you do need that.

Moving on to a kind of related issue to safety in sort of today’s kind of political world is terrorism. How is the nuclear industry deal with terrorists and terrorist threats?

Well again we’ve got the regulator whose sole job is to make sure we are up to scratch on safety and physical security issues.

I’m kind of thinking more of things that are slightly out of your control, I mean, for instance, what would be the process if say a plane was hijacked and was heading towards a nuclear site, what’s the…?

There has actually been as you might expect a bit of work done in recent years to study just that. The electric power research institute in the States did some good modelling work on that. Inevitably I’m going to be talking about modelling work now because it’s not the kind of thing you can sort of run a couple of experiments on, although there have been experiments. There was an experiment in the States before 9/11 two or three years ago where they ran a fully laden Phantom jet fighter into a concrete wall in the middle of the Nevada desert I think it was to see how this wall would respond to it, it basically wrote off the plane and made about a six inch dent in the wall, which is, and it was a reactor grade wall. I know that’s a Phantom jet not a 747 or whatever else But one of the things, the interesting things that came out of the IPRE study was...

Firstly the conclusion was that nuclear stations were pretty robust and would withstand an aircraft impact without, sort of, major release of radioactivity. Two reasons, one is that they’re built to be strong and robust anyway because they’re have reason to keep the stuff on the inside in rather than to keep the stuff on the outside out but it obviously works both ways. But actually when you look specifically at a plane crash and you look at something like a 747, a nuclear station, you know, the heart of a reactor building itself is so small that you’ve got to make a decision do you want in your worse case scenario this thing to be hit by the nose of the plane in which case the engines which is where most of the weight is may miss it, you know, one goes wither side, or do you want to hit it with an engine in which case the other engine and the nose of the plane miss it. So as planes actually get bigger you don’t actually get a bigger and bigger, sort of, risk of a bigger and bigger consequence of an impact, it just means you’re hitting it with, you know, whatever choose, part of the plane you choose to hit it with you’re very limited by, in terms of consequence. So, and they found in the modelling work that they did that it would withstand an impact now, you know, again this is not, sort of, a [The Company] policy comment but, sort of, if I’m off the record... [edited for confidentiality]. Some countries have already said they have, sort of, anti-aircraft facilities around their nuclear stations. France have said that they’ve installed anti-aircraft facilities around their nuclear stations. In the UK we don’t talk about what measures we’ve taken or what we do take we just say we have methods in place and then the Office of Civil Nuclear Security reassure themselves that those measures are adequate. But we take the view that if you tell everybody what your, sort of, defence steps are it makes it a bit easier for them to work they’re way round it.

So you’ve got the fact that it’s small and hard to hit. You’ve got the fact that you know it’s well protected and you’ve got the fact that even if you did hit it you wouldn’t be guaranteed to achieve a result necessarily other than some sort of political point scoring of having, you know,
crashed a plane into a nuclear power station. If you think of all the other targets you've got and I don't need to list them because I'm sure you can, sort of, think of them as well. Things like other major industry that deals with difficult materials you know pipelines that are long and thin and therefore much harder to protect than small single point structures. You know, places where large amounts of flammable materials like oil and gas are stored and processed. Places where you get tens of thousands of people gathering, you know, in the same place at the same time which are much, sort of, softer targets and potentially easier to hit and much less well protected, certainly much less robust. You can't help thinking that whilst it might look like an attractive target, in terms of consequence and likelihood of realising that consequence it's by no means, you know, a done deal that, you know, the worst would happen.

Now that isn't an argument, it's not a rigorous safety argument that says it wouldn't, you know, but that sits I think alongside the modelling work that people have done. If that were to happen then the consequences would be, you know, wouldn't be catastrophic. Now there is also, having said all of that, there is still the public perception that these things might be a terrorist target even if it weren't to be a, even if it were ultimately to be unsuccessful and that is an issue that we have to look at. And I think again would mean, in the current climate, you wouldn't probably want to build one of these things near a centre of population because it might be seen as a, sort of you know, double whammy almost of, you know, if you have one in the middle of New York City then even if you don't damage the reactor you probably got some sort of major impact on the surrounding population. I mean, I think the bottom line, just to round it off, we are increasingly recognising in a world where it's difficult to guarantee the safety of anything you whether it's public infrastructure services, you know, buildings whatever and whilst, you know, whilst it's you don't want to, sort of, take decisions that might be governed by terrorist forces elsewhere, you have to do what you can to protect yourself but I think we recognise it increasingly that 100% safety anywhere is just no longer something that we can take for granted.

Moving on to a slightly different area, what is the current, well that's not the way I want to phrase it actually. I'm going to throw two words out and just kind of base a discussion on that, the two words are nuclear fusion.

Oh right.

What's the current position and what's the future viability of nuclear fusion?

Right, I mean the first thing to say is [The Company] as a company has, doesn't have any interest in fusion, we're not developing fusion technology, we're not a partner in JET or any other fusion projects, so it's a, sort of, this is a detached view rather than a fusion industry view because the fusion industry and the fission industry are relatively disconnected. Having said that we do work with them sometimes on research projects on advanced materials and such like, things that might be mutually beneficial and there are some connections through other third parties but I think our view is that fusion looks very attractive, it's looked very attractive for about the last forty or fifty years which is how long people have been working on it and it's one of those technologies that always seems to have been some decades away, at the moment it is some decades away in terms of commercial deployment.

How many, how long, I mean...

I think we're talking about thirty or forty years realistically for anything to happen. What people have said and David King the Government Chief Scientist has said and I don't think it's an unreasonable view to hold today is He sees nuclear fission as being, if you like the next generation of nuclear fission as being the bridge to nuclear fusion coming along. And I'd be very comfortable with a world view of the future where that's how it pans out. You know, we build one more fleet of fission stations and then if the fusion technology is there and it's commercially viable and everything else falls into place then fusion may well be the thing that takes over. I think if that happens then we'll have done our job, you know, collectively in terms of Carbon emission and sustaining a sustainable future. It might actually be some completely different technology, it might be Clean Coal with Carbon Capture, and it might be, you know,
Renewables technology that takes some sort of step change forward in terms of, you know, its economic attractiveness or whatever else it could be sub-sea marine devices or whatever, there's a lot of potential things out there which are at their fairly early stages of development that clearly aren't going to contribute for the next fifteen to twenty years but might contribute in thirty or forty.

Would I be correct in saying that there is only, that there are currently no full-scale fusion reactors but there are plans to, I think there are plans to build one in France aren't there?

Yeah, I mean the next phase. I mean there is the JET reactor at Culham which I'm not quite sure where that's up to in terms of sort of trying to achieve, you know, more energy out than it gets in. The next stage I think the ITER reactor which they've finally decided is going to be built in France rather than Japan, I think the aim of that one is to get it to sort of more commercial operation of actually being able to make more energy than it consumes. But again, you know, that's, just achieving that isn't an end in itself, you've then got a whole load of commercial considerations about how viable is it to build a whole fleet of these things and where are you going to put them and what grid infrastructure do you need to get power in and the power out to operate and so on. So I think it does have a lot of potential its for something to maybe replace the next fleet of fission stations that we would build rather than as an excuse for not building fission reactors.

Part Three: The PFI

Ok, I'm just going to have a look because the next section of questions I have got is about PFI. I don't think there's anything actually.

Part Four: Modelling

What I'm trying to sort of identify is there anything that, sort of, is there anything that a) will, sort of, merge nuclear and PFI is there anything that stimulates the coming together of the two but more probably importantly in this research is there anything that conflicts between the nuclear industry and the point of the PFI. Now from what I have done with my research is I've come up with two, basically two tables, which I can't find the stimulants table, its here somewhere, ok. Basically a table of stimulants and a table of impediments to applying the PFI to nuclear power. Now what I'd like to do is just is have a look a first of all the stimulants and cast your eye through the table, if I just give you a brief overview, this is split into four levels, the external environment level which is basically Government, anything external to the industry, industry wide a general sort of level. And there is an organisational level itself with stimulants at a kind of business level and there is the specific project level, so a specific station or new station and there is the job role level, the people that actually work in there, which is, which is less relevant to this research but its included to, sort of, have an overall view of everything. So this is basically trying to identify stimulants to PFI in nuclear power. So if there is anything that you think shouldn't be there or anything that has been omitted.

So these are things that, sort of, help nuclear to look attractive?

Yeah, things that would drive new nuclear power stations.

Yes, reduced capital expenditure, I guess that means in terms of reducing the amount they have to spend on other things, if the other alternatives like Renewables are more expensive.

This is also from a PFI point of view, the Government wouldn't actually have to stump up...

Oh right, ok, because Government aren't footing out for this are they. I've got you. Increase the Government's ability to meet Kyoto targets, yeah, I mean Kyoto and other environmental I would say because Kyoto is fairly, I mean Kyoto really only runs to 2012 at the moment, how Kyoto or its successors evolve in terms of, sort of, setting longer term targets is going to be quite
important particularly those nations that find themselves, sort of, committed to it because as I think I said to you before new nuclear in this country is not going to do anything on 2010 targets that we’ve set ourselves or 2012 Kyoto targets other than maybe give us a vehicle to maybe catch up if we fall behind them. So environmental benefits from improved air quality, yeah. Improved public knowledge and awareness to improve levels of public perception.

*I think that’s more of as a result of the public debate that would have to be gone through.*

Ok, so that’s a consequence which whether that’s attractive to Government I suppose having an educated public is a two edged sword but lets move on from that. Reduced reliance on external primary power sources.

*As in fuels.*

Yeah, so you mean things like imported gas with that, then yeah. I mean the Governments, the first energy review the thing that proceeded the white paper by a year was done by the Cabinet Office actually concluded that we could regard Uranium as an indigenous fuel because it was so secure. So effectively, I mean when we say self-sufficiency I’m always a bit wary because we don’t mine our own Uranium but, you know, if the Government say that its that reliable that we can treat it as indigenous then that’s good enough for me, its not often I say that about things Government say. Social service needs met?

Yeah, this is a PFI, sort of, derived benefit. In this case the social need is to obviously have a reliable, to maintain supply all the time.

So that’s reliability of supply in my language then yeah. Comparison with public sector comparator.

*That’s a PFI based one as well, where basically with a PFI project you have to go through and show that procuring your power station via PFI, the PFI procurement route would be more than, would provide better value for money than if it was procured through a traditional means and the PSC is basically a model which shows if you build through traditional means this is how much it would cost and this is the value for money and PFI is better than that. Although it’s somewhat smoke and mirrors because the Government is going to work, we are going to use it, so if you, so basically they, I think the best way to put it is they try and help you round, if you have a project that’s not necessarily showing value for money they will show you how to make it so it does. Basically they get their top spin team on it. Yes, I’m sure that would feature somewhere. Social environment improvement, I mean I guess does that link to, sort of affordable electricity in a reliable supply, you know, and not cutting off hospitals when they’re in the middle of an operation, that kind of thing.*

Yeah, that kind of thing. I mean its basically that’s an overall of the social benefits from it.

I mean, I guess the affordability of energy, particularly when you get to, sort of, the heating and lighting and winter and, sort of, fuel poverty and Government call it consideration which in the end is very much linked to their policy target. The last ones interesting, I would have said, I mean it’s a difficult one, we, you know, there are jobs in nuclear but actually with jobs, as the number of jobs in a supply sector industry like electricity generation goes up so the economics, you know, work against you. So, you know, somebody said to me if you really want to remedy unemployment we should have, sort of, men on treadmills making electricity and that would be hugely capital, hugely labour intensive, you know, one of the arguments against the Renewable industry to some extent is there is so much man effort involved in the manufacture of wind turbines and their operation and maintenance that it actually makes them not as free to run as people sometimes think they are. So there is employment but I wouldn’t, if you could add to that something about, you know, high value employment, you know, with technologies and skills that are deemed to be valuable, you know, you’ve got engineers, you’ve got technologists, you’ve got a lot of professional staff, what are seen by Government as high value jobs.
One of the things that’s just occurred to me actually as we’ve been talking is the fact that if we did have new nuclear power stations they would be in the most part replacing the old ones, and the fact that those new stations are a far simplified design in the future would mean that there would actually be less employment. Could it lead to a decrease in jobs?

Potentially, yeah. I mean the aim of the industry is to get you know bigger station which require less, you know, smaller teams of operators to run them but whether that’s maintenance, whether its routine operation whatever. So that, as in every industry you would expect, you know, the utility the operator to be cutting its cost base as far as is, sort of, practical and safe to do so.

So that’s probably one that needs a little bit more research.

So I would certainly say there is a jobs angle to it, in terms of, if you look at nuclear versus, you know, coal or gas or Renewables we would say that the employment that we bring is of the high value technical professional jobs and its worth knowing that the trade unions are very supportive of nuclear, for two reasons. One because of the members that work in the sector but also because of some of these other social benefits that, you know, feed into, sort of, economic, you know, there’s nothing explicit there about economic competitiveness and I think when you, when we’ve, if you look at and maybe link it back to self sufficiency of external power sources and fuels but there’s two angles to that, the reliability of supply angle but there is also the fact that if we, I mean if we, for the sake of argument, lets compare ourselves with our nearest major commercial competitor which is France, they’ve got 80% nuclear and most of the rest is sort of hydro and whatever, very little fossil. If we’re 80% gas and the world gas price is going up, all of our, you know, the oil and gas price tend to go up together, so the bulk of our economy is then driven by oil and gas used directly in industry, gas used to generate electricity in industry, whichever way you look at it we’re screwed frankly. So, I mean that’s not a problem if all your other competitors have got the same mix that you’ve got, but if you’ve got people out there with a much more balanced portfolio and, you know, you’ve got all your eggs in one basket and that turns out to be the wrong one then it isn’t just the electricity prices go up for the likes of you and me paying our electricity bills, its for all our industry, you know, particularly, virtually all the heavy engineering users or heavy energy users are supportive of a balanced mix that includes nuclear for that reason. And the CBI are very supportive the Major Energy Users Council I think its called are very pro-nuclear. Energy Intensive Users, there’s all these things but they’re all, Jeremy Nicholson who runs that is supportive of nuclear as part of a balanced mix because they’re worry is if you put all your eggs in one basket and then that egg turns out to be the wrong one the you’ve, sort of, sold the economy down the river almost. So right that’s the top, top level. From an organisational, so this is now the utility that’s running the power station, so that’s organisation which probably isn’t [The Company] but I’ll put my utility hat on. Yeah you obviously, protection from Carbon tax or other Carbon measures like a trading scheme or whatever. New technology patents?

I’m thinking because this is very much driven form an innovation point of view and because its such a high level technical industry that to remain competitive...

There might be something there in the very, sort of, small, sort of, add on bits of technology but the point I was trying to make before we would want to take a technology that was in the global shop window and just build it unchanged in this country so we wouldn’t be looking to tweak new I mean there might be jobs in the, sort of, service sector obviously patents in the technology developments in the service sector of the guys who come to maintain it, do the necessary things about radiation protection and all the rest of it to do with managing, you know, the station and the fact that we have a nuclear industry that needs serving in all sorts of ways by a whole, sort of, supply chain. But in terms of reactor technology I think we’d be looking to take what was there in the shop window and build it so its, you know, I always tend to use my motor car analogy but, you know, its all very well to have a whole load of guys who thought they were better than Henry Ford at designing cars but what we’re going to do is go out and buy, you know, Mondeo’s and...
Its still a, there must be a substantial Research and Development aspect to the nuclear industry though?

There is, I mean quite a lot of the research and development is more focused on the clean-up and decommissioning side but also, I mean its fair to say that there is an awful lot of development and work that goes on in the instrumentation side so again it's a bit like if you think of your car analogy the car itself might be a completely standard product but its going to develop add on, you know, a new bit of technology that fits in the car but your going to have, you know, garages and services centres where they do the car maintenance and whatever and plugging all this complicated engine analysis and tuning equipment into the dashboard to tell you what the state of your engine is. You know, there is technology there, there’s technology in the sort of control room systems and all the rest of it for the reactors and the regulation monitoring technology and so forth that has to fit around the actual reactor piece itself but that’s perhaps not quite as high up as, or maybe there not meant, I won’t assume they are in order...

No there’s no specific order there...

It might be a bit peripheral that one. Yeah, base load generation providing constant demand, for a utility under the current market conditions that’s very important. I mean one of the, you’re probably aware of it if you’ve looked into it, one of the drawbacks of Renewables is the market rewards people for saying what they’re going to deliver and when and then doing it. Which is great if you know when the winds going to blow, you know, two hours ahead but people very often don’t. So, you know, if you over shoot you get peanuts for the extra that you produce and if you under shoot then you have to pay a fortune to make up to what you said you were going to deliver. So being able to say I’m going to do, you know, 96% of capacity and hitting 96%, you know, is very valuable. Yeah low primary fuel costs, absolutely. I guess implicit in that is the fact that if it does change then it doesn’t affect your overall costs because its low controllable costs in general. Efficiency through increased competition as a benefit to the organisation?

This is because competition usually encourages a company to streamline its, streamline as much as it can its efficiency and productivity because obviously if it doesn’t its going to get...

Is that a particular benefit of nuclear though or is that, would an organisation strive to do that anyway?

It’s a benefit derived through the PFI, because...

Ok, sorry right, ok right...

Which would apply to nuclear power...

When I was looking at it I had my nuclear benefits hat on, but you’re right if this is PFI and nuclear as a combination and that’s a PFI derived benefit. Open and transparent cost management, I guess that’s equally PFI.

Yes and no, I think one of the things that, that is a benefit of nuclear power and definitely from the research I’ve done is that the research into nuclear economics unlike other energy generation facilities is quite robust and it takes a look from actually construction of a power station to the decommissioning of that power station. It takes the whole, whereas other industries...

Its interesting that you say that because we often get challenged on the fact that, on our economics but I think that your actually right but its interesting for me to hear you, sort of, make that point. Yes I guess you could say if you’re looking at life-cycle cost management rather than, sort of, day to day management of the facility then you, yes I guess that is a benefit compared to, sort of, our competitors.

Standard of service is a PFI defined service because you have to define the standard of service you expect because Government...
Encourages future investment, I mean is that because you know that the nuclear stations are going to be around for fifty years, so you’ve got...

Well, yeah basically if you’re putting money into a technology and then the Government are actually putting their weight behind it then it guarantees future investment because its effectively going to be a new wide industry open sector with which there is going to be future investment...

No that’s fair enough then. Client ability to apply penalties for non-performance.

Yeah, this is a PFI one, if you don’t meet the standard of service you’ve contracted to...

Sort of, a service level agreement type...

Yeah, you don’t pay for it...

I mean you’re right about the last one, there is an opportunity for innovation and creativity I think provided its, sort of, properly focused, I mean there isn’t, I wouldn’t have said there is a lot scope for, sort of, somebody turning up for at the gate of the power station and saying I’ve developed a great big bit of technology that I’ve got in the back of the van and if you can just take the lid of your reactor over there I’ll stick it in for you.

I think I’ve covered that in the impediments which we’ll come on to...

But I mean it links back top the discussion we had about patents doesn’t it, there’s plenty of, sort of, second order or secondary service side where you’ve got scope for that and equally you’ve got, it probably links top that one about increased employment and having high technical and professional, you know, and skilled people working in the industry, if gives you the opportunity to stimulate innovation and creativity through the workforce you’ve got. When you get to the project level are we now more looking at the PFI type ones than...

Yeah, yeah we’re also thinking as well if we’re going to continue to develop new nuclear powers stations, not necessarily the next few that are built the few after that are not necessarily going to be based on the current designs now they’re going to be the current designs in twenty years. So the potential for improvement between now and then is kind of what I’m looking at here, but innovation...

I guess there is potential for all of those to improve...

Innovation and programme, productivity and value for money these are all PFI, because obviously the quicker, if you’re a private company and you’re putting capital expenditure into getting a nuclear power station built the quicker you get that thing built, producing electricity the quicker you’re seeing a return on your income. So obviously there is an incentive for all this to be achieved. Risk allocation at the bottom there is a very important concept in PFI with the Government. They don’t necessarily want to get rid of all the risk onto a private sector person all they want to see is that the risk is shared effectively and managed effectively...

So everybody is driving in the same direction basically...

Basically whoever is in the best position to manage the risk best whoever that person is should bear that risk, therefore say if the Client is in a better position to bear the risk than a contractor then the Client should bear that risk then he doesn’t have to pay for it.

Which is the exact opposite of the way the nuclear industry used to work. We used to have what we called cost plus contracts, I don’t know if you’re familiar with those but it was a basis of; you know, you can. What you can charge the customer for doing something is what is costs you plus fifteen percent or whatever. So if it costs you a lot or if you can show it costs you a lot to do it you get a better profit because you get fifteen percent of a big number not fifteen percent of a small number and if you actually deliver it really quick and cheap, sort of, two days after
they ask for it and it took a bloke half an hour to do you'll make 35p profit on the job, it wasn't really helpful. Didn't stop it lasting a long time but it wasn't very helpful in driving the industry into a commercial world. Was there anything specific you wanted to pick up at project level I think in general terms I'd agree with you there, the potential for all of those is there but...

And at the job role level we've really looked at just talking about the high level skills that you've got, driving it and obviously the higher level of skilled people you've got the more they cost.

Yeah, I mean there might be one other, which probably belongs right at the top there that I'm just thinking about this jobs and skills thing that, you know, the Government I think recognise that nuclear skills is a, sort of, strategic area of importance and what they have said was even when they were looking at what they just called keeping the option open, one of the things that they were most keen to do was to make sure that we didn't allow the UK nuclear skill base to dwindle away in case we did need it again in the future. And I think they recognised that, you know, it would be quite difficult for any Government to completely close off the nuclear option. I mean they might say that we're not, we as Government are going to make the commitment not to invest in nuclear stations or to take any measures to support nuclear stations or even to allow them to be built in the next ten years. They could conceivably do that I can't see why they would want to but conceivably they could. I think they recognise that there is a skill base there that they might need to draw on at some point in the future if wind, you know, gas prices were going up through the roof or there was political instability in all those sensitive parts of the world...

There's is a similar problem in the Construction Industry with the skills base. You can't get plumbers or bricklayers or any of the trades because people have left it because it was such a crap job in the last twenty years that they all gone their separate ways and now there is nobody that can do it so there is a big problem there...

And without in any way wishing to belittle plumbers or bricklayers or plasterers or anybody else in the civil engineering industry it probably takes longer to learn to train to be a nuclear safety inspector or reactor operator or some of those key jobs than it does to build up from scratch, so there's skills in the...

But if you lost that base it would take you much longer to replace it...

Exactly and one of the things that we've been conscious of in the industry is you know the heyday of the industry was, sort of, the sixties and the early seventies, you know, perhaps into the early eighties and people who were joining the industry then and in senior positions then are now close to retirement, so we've got quite a hump of people in terms of numbers who are all getting quite close to retirement and in ten, fifteen years when they've gone if we've not taken the opportunity for them to pass on those skills to, you know, a similar number of people or young people coming into the industry, so we're keeping that skills conveyor belt going then we really run the risk of not being able to switch it...

But I suppose that's highly difficult due to the uncertainty to the future of the industry.

Yeah it is and, you know, whilst when I joined the industry and when people who joined maybe ten years ago thought they were joining an industry that was, sort of, an industry of the future, that was, there might very well be new reactors built as these current ones start to close down, you know, as, I won't say becomes less unlikely because with my optimistic hat on it looks more unlikely that in the next energy review at the end of the year we will conclude that we need to take some steps to do this but if we don't then, you know, we're, sort of, last chance saloon really, and the nuclear industry starts to look like, you know, an industry in decline and an industry that's just there to clean up after itself and then pack up and go home. That doesn't attract, you know, high calibre talent that has the choice of joining, you know, the oil industry, the pharmaceutical industry, the xyz. you know, IT based industry and all the rest of it are, you know, not going to see nuclear as first resort its going to be last resort. I mean you don't get the best people unless you're prepared to pay disproportionate rates and what that's likely to mean is that we get less good intake of human capital than we would otherwise have. So I think
keeping that, you know, whether its through research and development activities and what we have just got is, you know, we've got Government support to invest in some, to participate in some international reactor development programmes partly to help bring in new people into the universities and then into companies to provide those skills to be a repository for those skills and experience that's leaving. So there is a, there is an argument there at a macro skills level rather than just the, the, sort of, you know, the power plant electricity creation level.

Ok, moving on slightly to the opposite, the barriers, the impediments. It's the same kind of thing PFI and nuclear combination, basically the same thing really.

Current levels of public knowledge and opinion, awareness and acceptance...

Just the lack of knowledge really...

Yeah, I mean I would, sort of, link that back to that comment I made earlier on about you know peoples perception of public perception. It's like opinion formers or decision makers' perception of public perception is a very real barrier, perhaps more than the actual public acceptance itself. I think acceptance is the right word there. Support is not something that we actually need but acceptance, you know, lack of opposition is the key thing.

Nuclear waste, yeah, and again we talked about that. I mean one thing I didn't say when we talked about waste was just to give you the, sort of facts and figures as we talked about the, sort of, policy side of it, but there's an important issue which is we already have a nuclear waste inventory in this country from the historic operation through the, sort of, forties, fifties, sixties, seventies. No decision we take about new nuclear stations affects the fact that we've got to manage that and we are managing all that safely and effectively, whatever. If we were to build a new fleet of say ten reactors which would, sort of, push our level up to about 25-30% again and operate for the next sixty years, which would be the design life of those stations, so that's longer than the industry has operated so far, but if we were to do that we would add just 10% to the amount of waste we've already got. So we're not talking about, sort of, doubling or tripling the existing problem, we're talking about adding a, you know, a thin volume layer of up to one tenth to the size of the challenge we've already got. And so we're not talking about, sort of, doubling or tripling the existing problem, we're talking about adding a, you know, a thin volume layer of up to one tenth to the size of the challenge we've already got and actually all the technical difficulties would still be in the old stuff because nowadays people design reactors thinking about waste management and so forth.

So its actually, its, its...

So, I mean there is a philosophical argument that says if you haven't sorted out completely your current problem you shouldn't be adding to it but there's perhaps a more pragmatic argument that says look if I've got to sort all that stuff out anyway its not actually a big deal to say...

The problems already existing isn't it, you're not really adding...

Absolutely, and its not really a technical problem, you know, we've discussed before it's a political problem in terms of Government just not saying what people have to do with it. Once they say what people have to do with it then we can get on and do it. And certainly waste management of fuel, spent fuel and wastes from new designed reactors is just not, it's a no-brainer, quite frankly, it's very straightforward technically provided that the policy's in place. So there a lot of perception issues I think around nuclear waste.

Proliferation of nuclear material, cor blimey, that's another perception one, well they all are, aren't they, terrorism, lets do them all together. Proliferation, again if you take the pragmatic view, you know, if one were running a hostile nation or group and wanted to get hold of nuclear materials and weaponry and all the technology and everything to go into that, my personal view is whether the UK has built power stations under all the right safeguards and regimes or not isn't going to affect your ability to do that because you're probably not going to come to the UK to do it anyway. You're going to go to other parts of the world where that technology and potentially those materials are more available to you. The technology genie is out of the bottle effectively, you can't put it back in, the clear separation now between civil material and military material is
sort of overseen by the International Atomic Energy Agency very rigorously, you know, we have their inspectors full-time on sites like [Named Plant] making sure that everything goes where it needs to go and so forth. So, but there is a perception that the two are linked, for some people that perception goes back decades in some cases to when, sort of, civil nuclear and military nuclear were, sort of, two-sides of a national security interest, you know, the same coin almost. It is still a barrier to some people but practically I don't think it makes a difference. I mean there is an issue there about whether we should be developing technologies that we, you know, as far as the global community, are not prepared to share with every other country in the world and there are certainly countries in the world that we would say yes we've got nuclear energy as a way of dealing with our, sort of, energy policy objectives, but we're not prepared to share it with you at the moment, you know, for political reasons. I don't think that's a barrier to us doing is ostensibly the right thing just because there's, you know, a small fraction of the countries in the world you can't, you would have to prevent from having the same option available to. In some ways it makes it more important because if you're condemning them to burning coal and oil we should be doing even more to make sure that we're not. Terrorism I think we talked about before. I mean there is a big perception slant to all four of those top four. New legislation and regulation, well yeah, I mean we've talked about that, sorry?

Licensing?

Yeah, licensing and all of that and the need for a, what I always call a streamlined but not shortcut approach to approvals and regulation, planning.

Public sector comparators, that's a PFI one...

Yeah, is that effectively saying the public sector would be able to do it...

The problem is most public, a lot of public sector comparators especially in the early nineties when a lot of PFI came on stream a lot of the public sector comparators were just not very realistic in terms of in how there models were created and how they, they didn't give a realistic view of the construction industry. So it's just a potential barrier to PFI. The next one public service ethos, PFI kind of tends to perpetuate the belief that the public sector is inefficient in what it does because one of the benefits of PFI tends to be increased efficiency through private sector management. So that itself was perpetuated or it originated from the Trade Unions...

Right I was going to, I couldn't quite see how that was a barrier to the PFI but I suppose if its seen as a kick in the teeth for the public sector every time then...

The Trade Unions, especially...they're very negative towards PFI they see it as a danger to workers and they're very against it which is, sort of, one of the reasons the Government has problems with the use of it.

I've found out to my cost, I was speaking to, it wasn't, was it TU's, it was TU representatives in Glasgow, some of the leaders of the Scottish Trade Union Movement I was doing an evening dinner talk do on a Friday night in Glasgow and with it being a Friday night in Glasgow there was a fair bit of networking at the bar before I got to speak to them and I was doing my, sort of, fifteen, twenty minute slot and said something about the market and deregulation and private sector finance, nothing wrong with that and when it got to the end they were queuing up to jump me, did I say that, oh yeah, well have it either way but however you want to do it really. And that was the thing they were all wanting to, eh you said...And long term public financial commitment.

That's just for PFI I mean the thing with PFI's are the Government are committed to spend so much money over twenty-five to forty years. With nuclear power I can see it extending that to fifty or sixty years. So it's a long term commitment that they've got to fund.

But in what way are the, I mean the public sector aren't funding it are they?

No this is directly a public, Government position because the Government basically pay for the service, its that service payment that's got to be met every year for sixty years.
But if the, I mean I suppose if you had a PFI that didn't involve Government on either side of the fence. If you have a PFI that was effectively, you know, private sector builds it and sells it to you and me directly and ten million other people directly on our electricity bill via some middle man somewhere then there wouldn't have to be a public financial commitment. If it was health service I could see it would because Government aren't going to say go ahead private sector build a hospital but we might build one over here as well and we might not come to you.

At the moment its only the Government that are acting as Client in PFI's but if...

So I guess if its pure PFI as configured according to the current model then that does imply some...right organisation, nuclear waste, yeah we've talked a little bit about that before I mean that's, I mean there might be a perception issue with that more than a reality one again I suspect. I mean, you know, if you run the station then you will have to either store or pay for somebody else to deal with the nuclear waste you produce which is a different type of, you know, cost stream than if you run a different kind of power station but I mean its worth just bearing in mind, perhaps the higher level picture again nuclear is one of the few forms of power generation that does actually, you know, manage its own waste production. You know, if you see CO₂ as a waste or an environmental, an environmentally damaging product then gas and coal fired stations just spew it out into the atmosphere and may or may not pay, you know, a cost according to how much of it they spew out, but that isn't necessarily the full cost of, you know, either sweeping back up or the, sort of, societal cost of the environmental impact by any means and so they pay a bit of a fine but they don't actually pay the full cost of cleaning the mess up whereas the nuclear industry does pay all the cost of its waste management. So you can argue from a, sort of, environmental acceptability point of view that nuclear is the only one that is, sort of, sweeping up after itself properly.

The economics one is just basically there's obviously going to be significant. I mean the capital cost, the decommissioning cost and the safety costs are just going to be higher.

Yeah I mean those are all, I mean capital and the financing cost of capital are two of the biggest contributors to the overall cost. Decommissioning is not actually a big component, its only about a couple of percent of the total life-cycle generating cost.

I suppose it's more from a time perspective.

From a time perspective its, you know, it means you always have a long-term commitment to pay the decommissioning and when you get into the nest one of high risk, you know, that decommissioning bill is the same whether you've operated it for two days or sixty years so, you know, there is that risk if you finish early you may not have filled up your decommissioning fund to the level it needs to be in order to pay for the cost of decommissioning. So there's a, sort of, break even point I guess somewhere, where if you stop operating early, you then take the lid off your money box and see how much you've got there to pay for this decommissioning that you were putting in at, sort of, a, you know, a tenth of a penny a Kwhr or something all the way through, you've got, you know, 25p in there instead of whatever you need.

The high risk one actually I think I'm going to, I mean when I put it down it came from a perception point of view but I think the risk is actually, from what we've discussed more from the uncertainty currently with...

There is the waste, you know, there is the political nature of the industry which does always leave you with that, you know, are the Government going to implement some policy about nuclear that, you know, is damaging to an investor or operator. So I think that if you look at it as, sort of, operational revenue and financial risk, I mean I'm not assuming it as meaning safety risk, as what you've written but that's how I would interpret it, I think we had the discussion about that before.

The two-tier workforce is a PFI derived one because in PFI there are regulations which state any employees that are taken, if you build a new PFI hospital and you close and old one then all
the staff from the old one are then, the majority of the staff, at low level are moved into the
private sector and they're ran by the private company. Now there are regulations which say that
their wages, their salary, whatever has to remain the same, it's all protected. However new staff
that are employed post that transfer occurring are not protected by those regulations, so
effectively if you've got somebody that's been there ten years doing the same job as somebody
that's been their two weeks the person that's been there ten years could very well be on a hell
of a lot more money than the person that's just been employed just because of that.

Doing the same job?

Yeah, doing the same job, which is a risk that has been highlighted by the Trade Unions just
because of the way the regulations have been set up.

But that applies, so does that only apply if you shut down one facility and build a new one and
transfer the staff?

Yeah, pretty much it's the regulations, I think it's the Transfer of, it's the TUPE regulations.

Yeah TUPE, yeah we've had similar, with company reorganisation we've had the same issues
cropping up so I understand the issue with it. I'm not quite whether you would, in the energy
sector, whether you would always see one power station as the replacement for another one, in
some cases...

It might be a...

I mean in some cases the market is just saying we need more electricity generation, you know,
and it might be, it might be gas fired power station that's closing a nuclear one being built.

So actually that could be a redundant barrier.

I think it might crop up in some very specific circumstances, for instance if you were to say 'I
want to build a new reactor at a certain site, I won't name a site with your tape on, but

Its all going to be edited...

But if your target was, you know, we want to get it built so that it can come online on Monday
the 1st January because the existing station is scheduled to close on, you know, Sunday 31st
December and we want, you know, direct, you know continuation. We're going to switch one to
the grid as soon as the other one comes off and that's the reason why we're doing it on that site
on that day then I can see you might say well we were going to switch the staff across and there
might be those issues. In a lot of other cases it just like well we need some more capacity and
that capacity that comes off could be if anything it could be coal, you know, there's a lot of coal
stations coming off, you know, in the timescales that we're looking at. It might not even be that,
you know, the capacity level just, sort of, bobs up and down, sort of you know, random
histogram time, so you know it doesn't have to be always at the same level.

The next one is...

Difficulty for SME's, well it's difficult for SME's to become the operator of the station.

It's just that it's a very high capital area to operate in so smaller...

But having said that, yeah at certain levels it is high capital but when you get into the, sort of,
service side, you know, instrumentation, safety systems, you know, there are a lot of SME's that
are set up specifically for these services to meet certain needs either at one station or, you
know, at a number of throughout the industry in certain, sort of specialised areas.

I think from actual construction of a power station point of view...
Yeah, it's hard for SME's to be involved in the actual delivery of the project, in that sense your right.

And obviously the last one is a purely PFI one, it just costs more for the private sector to borrow money than Government.

True.

I think we've already talked about these in the project.

Yeah I think so, I mean there are, there are issues around the perception of nuclear but actually it's one of those things the closer you get to it the more, the more people are reassured I think by having increased knowledge. Yeah I guess the ones about legal costs and unreliable risk transfer are more to do with the PFI and the fact that you've got a lot of risk in different places rather than all in one place.

It's one of the big things with PFI and all the legal costs in actually setting up an agreement are phenomenal compared to traditional methods.

Yes and add the nuclear dimension into that and you've got a real, a lawyer's paradise.

And at the job role level I think it's just things we've discussed because there's obviously...

What's the top one? Is that linked to safety concerns?

It probably would have been when I wrote it, yeah.

Yeah, I mean you'd expect me to say this but I'll say it anyway. I mean the nuclear industry has got one of the best safety records of any sector. We've just done a bit of work pulling stats together from the nuclear industry and comparing them with sort of published safety statistics from other Government sectors and, you know, we're far better than things like the rest of the construction industry and we're better than, sort of, the oil and gas industry, we're better than the health service, they're all, I can remember off the top of my head but I think we're there or thereabouts with, sort of, retail and financial services and, sort of, the things that you really wouldn't worry about.

I suppose it's a perception thing...

I suppose it's about, you know, people at Sellafield with three heads and radioactive...

I mean the analogy I'd look at is that you're much more likely to be involved in a car accident than you are in a plane accident...

I say exactly the same thing but there is actually a, and its been documented somewhere, a thing called the healthy worker effect in the nuclear industry and which is one of those, sort of, counter intuitive things. But the thinking behind it is because we work in the industry that we do, and virtually everyone in this building gets an annual medical, whatever they do, you know, we've got a medical department here that spends all of its time giving people a, sort of, forty-five minute annual medical. People who work in radioactive environments get sort of the health check much more frequently. If you carry a little dose meter or whatever then they all get taken away and analysed. But just in terms of peoples general health, you know, I don't think in a lot of industries, either the general health service or retail or financial service or whatever, the employer isn't going to give you a medical every year...

It's interesting about the medical that it's one of the things that the construction industry is working very hard to bring in, but because of the, sort of, transient nature of the workforce in the construction industry it's very hard to do it, but its something they really do want to bring in.
I mean we don’t have that barrier and it has worked very well in our industry and certainly and, you know, when I occasionally mention it to people, you know, socially, people, you say you had your medical, people say, ‘your medical well you only work in office don’t you, you’re not in the middle of the, sort of, radioactive plants or anything’ you know, it’s not an active site here, there’s no activity on the site, you know, mines an office job, sort of, repetitive strain injury, driving off the side of the road, falling asleep in meetings and being beaten up for it are probably the biggest risks to my general health but, you know, I still get the medical so.

And the other thing, I think we’ve actually covered you know an individual working in a power plant is not going to have, there’s not going to be the room therefore for innovation just because...

Yeah, I mean there are parts of the industry that are very highly regulated in terms of what people can do. There are other parts of the industry, if you look at, you know, the sort of associated supply chain and some of the positives on there about, you know, the technology and innovation that’s stimulated by having a highly skilled workforce and looking at, sort of, new technologies and new ways to do, to serve that very regulated plant there might very well be a lot of opportunity for creative freedom in the right part of the supply chain...

But in the reactor its, sort of...

Working in the reactor, no it’s not like that. Oh lets just see what happens if we turn that up a bit...

Yeah, that where that’s coming from...

Sorry I was reading the lack of freedom one but I guess its linked to the third one as well, so is the lack of freedom saying the same thing in a more blunt way?

Yeah, that’s what it, there’s less...

Because we don’t lock them up, you know.

Its just a way of saying, its not like, to use a personal analogy I used to work for a chartered quantity surveyors in London and if you could come up with a way of doing your monthly valuation or something that was not necessarily... but was more efficient then you’d do it and you wouldn’t necessarily seek approval for that, unless it was something really major, if it just, I mean you tend to, with different projects you tend to agree different ways of working on an ad-hoc basis with the people you’re working with but I don’t think that’s something that could...

No, I mean the closer you get to, sort of, reactor operation you’re quite right that wouldn’t apply, you know, as you get further an further away into the sort of second and third stages of the supply chain then I think its probably less of an issue but there would be certainly sections of the industry where that wouldn’t apply. That’s probably just as true if your operating a gas-fired power station or a, you know, things like chemical plants and other sectors as well.

I think that pretty much covers it.

Good job we started early.

No, I mean I think we’ve covered everything, I don’t have anything else.

No further questions, M’lud

No, thank you for your time

No problem, no problem, happy to help.
Appendix Two

Research Interview Two ~ Interview Agenda - The PFI

Local Authority

Part One: Background

The first question is generally about you for record purposes. What is your position here?

My official job title is PFI Programme Manager.

How long have you been doing that?

By way of background, the start of the process which led to that job title and that role was because I was and technically still am the project manager for the schools project and at that time I was the group schools PFI project manager. That role I have been undertaking now on a full time basis since 2002. It must have been about, I guess, 18 months ago that, because we've got other PFI projects on the go apart from the schools one, the job was renamed PFI programme manager to distinguish between the exclusive role I had on the schools and the role that I now have.

What other projects are you involved in, apart from the schools?

Well, we've got a street lighting PFI project in [the City] which I'm not the designated Project Manager for but because it's a PFI project it therefore comes within the PFI programme. I've got a kind of oversight really of that and sort of support and offer guidance and advice to the project manager and the Project Team and the project board but its not one that I have sort of daily, Karen probably has more involvement with that, than I do and Rachel. So that's kind of oversight role in that one. We've also got, in its fairly early stages, a housing PFI project and I am the designated Project Manager for that. We have another massive project which is only just beginning really, which is not at the moment PFI and that's a project to try and identify new accommodation for the Council which could mean possibly vacating this building and going elsewhere and moving out to other city centre offices but at the moment that's not a PFI project.

What is your background with regard to before you got involved in PFI? Do you have a construction background for example?

No, not construction background at all. My background has been in Education and before I became the fulltime Project Manager for the schools project I was an Assistant Director within the education services in [the City] but because I was responsible in that role for things like capital programmes and resources generally I got involved in writing the, what's called the expression of interest which you basically write for whichever Government department is responsible. In this case it was the DFES for the schools project, because I wrote the expression of interest, and when that was approved and when I recovered from the shock of it being approved we knew we were going to have to have a designated fulltime project manager because it was a very big and very complex project and it was something I wanted to do I had a few battles with the Director of Education, not acrimonious ones, but I said I want to do this and I'm going to have to be full time the Council's Director of Finance wanted me to be based over here so I actually formerly left Education and became part of Corporate Finance which is currently where I still am, but my back ground has been in education and project management managing fairly major projects within an education services environment.
Part Two: PFI

I am going to move it on to talk about PFI, we've talked about projects, why do you think the projects we've talked about and why is the Council house refurbishment going to use that route?

There are different answers to that question in a sense. Certainly at the time that we were considering the schools project and the housing project and to a lesser extent the street lighting project PFI was probably the only way in which Local Authorities could put together the amount of capital that is needed. Now since then quite recently we've seen, or Local Authorities have seen, emerge this thing called Prudential Borrowing, don't ask me to go in to the in's and out's of Prudential Borrowing because I would have to ring the accountant. There have always been some quite difficult constraints on Local Authorities in terms of what we can borrow, for what, when, how its repaid. Stuff like that, to the extent that projects like the schools project for example, you just couldn't have done it with existing Council borrowing regimes. The Prudential Borrowing regimes that are now in place have freed up that quite considerably so now we could have gone for Prudential Borrowing to do the schools project, the street lighting project or the housing project. But at the time PFI was the only way really you could get yours hands on that kind of money.

Have the projects with the schools been successful through PFI, I know they're not finished yet, but so far?

Yeah, I mean it's been, we've got... there are two sides to the schools project really. One is, I mean this is simplifying what is by far from a simple scenario, but there are essentially two elements. I mean the schools are designed and built by a Contractor usually known as the Council's preferred bidder, and its a competitive bidding scenario that your into, so the schools are designed and built and then significantly they're also responsible, although its not the same part of the consortium, they are also responsible for maintaining those schools for 25 years to certain standards and specifications stipulated by the Council. There are financial penalties in the, in what's called the payment mechanism so if they don't perform they lose money its as simple as that. So far it has been, the construction side in particular has been incredibly successful I mean they have been blessed with good weather which of course is always important, but you have to bear in mind that we signed the project agreement on the 23rd December last year [2004] we then have the Christmas break which of course in the construction industry is traditionally down time and on the 10th of January this year [2005] they actually started on four of the five sites and they are ahead of schedule by a significant amount of time now on two of those four and your talking, when I say ahead of schedule, you're talking between four and six weeks ahead of schedule. The fifth site was always due to start next month in August and that's absolutely on target so the build and construction has been...

What's the quality been like?

Well I mean it's too early to tell isn't it? I mean the quality of the school as with any building I guess is only something that you can be really satisfied with in the fullness of time. Its worth saying that usually with PFI projects the Council and the Contractor appoint on a jointly agreed basis somebody called an Independent Certifier and that's somebody that's not part of the Contractor, not part of the Council, a third party effectively and they are responsible for effectively signing off various elements and stages of the project. Having been completed, you know, satisfactorily as far as the Council and the Contractor is concerned and until that signing off process is complete, you know, effectively the Contractor doesn't get paid for what they've done so its in their interests to make sure they get it right and we won't release chunks of money until we get that certificate saying yes this has been done as it should have been done and that goes on all the way through the building part of the project.

Out of the projects you have been involved in do you think PFI is more suited to a specific sector such as education or housing or health?

I means it's used, its used in any sector really where there is major capital investment. So for instance I know, its not happening in [the City], thank god, but [another City] are considering at
the moment a huge highways PFI I mean really massive, but I don’t know the details. I presume it’s something to do with either replacing or maintaining or remodelling their highway infrastructure but the value of that is you know telephone numbers, it’s massive. So that’s another section that, you know, you didn’t mention that it is being used and I think probably I mean social services have used it for instance. I mean, if you were considering doing it in [the City] we’ve currently got two homes for the elderly, two separate 60 bed homes they want to make the operation more cost effective. So they, what their thinking of doing, is closing the two currently separate homes and through PFI building a new 120 bed residential care home. So it’s, you know, its popped up in virtually every sector you can think of but its more, I mean in education its becoming common place and I can’t remember what the latest figure is now but many, many, many Councils have now got into PFI.

Do you still go through the process of comparing against a public sector comparator?

Oh yes, you have to, in your outline business case which is called the OBC. The contents of the OBC and the parameters that you have to address are effectively dictated by Government and in particular the Treasury and it’s a requirement of the OBC that you demonstrate that PFI represents value for money and the way you do that is by comparing it against the PSC, you know, what cost would you incur if you were to build five new schools in a more traditional way and you have to be able to demonstrate that PFI effectively is cheaper. I mean there is a lot of smoke and mirrors in that and its sometimes the thing which can really make moving these projects forward difficult. Sort of behind the PSC comparator issue you’ve got the sort of unwritten expectation within Government that PFI will be seen to work although it was the brainchild of the Conservatives, one of the first things Labour did when they were re-elected was to say by the way PFI is going to continue to be the flavour of the day. So its, politically they have a vested interest in making it work. So what that can mean is that in discussion with Government departments about the PSC for instance they will sometimes, they won’t turn a blind eye to problems, but they will find a way of helping you round what the numbers appear to be saying so that they can say yes this appears to be value for money. It’s a big debate in PFI about whether PFI is value for money. It is an expensive way of doing things particularly for a Local Authority and for business.

In what way is it expensive?

Well for a Council the most significant element of expenditure is appointing external advisors and I don’t know of a Council involved in a significant PFI project which hasn’t had to appoint external advisors and very often they fall into one or all of three categories financial, legal and technical. Particularly legal costs are absolutely astronomical, the things that lawyers charge is... well I’m in the wrong business. That really does, that really does ratchet up the cost of the exercise and if you’re doing it, if you were trying to build five new schools in a more traditional way by enlarge you would find that you’d got the expertise and capacity in house, so you wouldn’t be spending these huge amounts of money on these external people and added to that is that its quite a long drawn out process so not only are you spending quite a lot of money on external advice its over quite a long period of time as well. Its often one of the criticisms that’s levelled against PFI that its just too expensive it may represent value for money at its core but actually delivering the project brings with it a whole load of expenditure.

Is the timescale, compared to more traditional methods, is it longer pre-contract, post-contract or about the same?

Its probably about the same pre-contract, maybe slightly longer but not significantly but post, well I need to go back a stage really its about the same up to the point at which the Local Authority decides who its preferred bidder is and from that point onwards you’re into what can be called negotiations and there are different kinds of PFI. We’re using, there are different kinds of public procurement approaches and one of the elements, the one we’ve used, is negotiation and that really was where I nearly gave up the will to live through last summer and autumn as we were approaching contract signature and it’s the negotiations with the bidder that really are much longer than you would get usually in a more traditional procurement route.

173
What stimulants do you believe there are to the PFI, what do you think, why do people do it, apart from the value for money and the perceived advantages from programme, construction programme are there any other advantages?

Well to some extent if you hark back to what I said earlier, to it still being to some extent the only show in town. If you want to do something badly enough, as we did with the schools project, you know, if you've got schools that are falling down and that is not an exaggeration in some cases. It is attractive to have a potential source of a solution and that to some extent is still the case with PFI. If you want to build new affordable rented homes, which is what lies at the heart of the housing project there's no other way of doing it other than to embrace the PFI process. So it's attractive in the sense that it offers potentially a solution to meet your needs.

And that's due to the capital expenditure aspect of it?

Yeah, I mean the other thing that PFI often has, not always but usually, is the, it has, schools is a good example and I said to you that not only is it about building these things but it's about providing the facilities management with it for 25 years. Now that can be quite attractive to a Local Authority or a school because the responsibility for doing that and making sure it's done well is effectively passed onto to somebody else now the Council pays for that but it's the risk in a sense which is being transferred from the Council to the private sector and it's a price that has to be paid. But nevertheless if you speak to head teachers these days and say what is it about running the school that you really find frustrating and excessively time consuming they'll say its looking after the buildings and maintaining the grounds. Under PFI, in theory, that's the responsibility of the private sector contractor and the Head and the Governors don't really need to worry about it.

Are there any barriers that you perceive with PFI, anything that you think would stop you using it, or would stop it expanding?

Well I suppose in a sense I hinted at some of them, I mean it is, its not a cheap process, you know, its potentially expensive. And although the ability to negotiate something with bidders is potentially valuable to the Council because the Council could come out with a better set of proposals than it went in with to the negotiation process it's the negotiation bit that can drag on and on and on. People could think we can't cope with that, it could be a disincentive. It's also not suitable for, it tends to be more suitable for fairly significant, significantly sized contracts. So if you've got a medium, I mean there are some exceptions to this but by-enlarge whatever sector your talking about whether its education, health, street lights, you know, if your looking at a project or an estimated total contract value of anything less than about £20m PFI is not usually going to be cost effective and you'd dismiss it on those grounds. I mean there not set, these thresholds and figures are not set in tablets of stone by the Government but experience has shown if you were to approach the Department of Transport about street lights for example and say we want to replace a quarter of [the City's] street lights, you know, its going to about £10m they'd say its not worth doing and they would not be prepared to support that. Its about size as well, that can be a disincentive.

If you were a private consultant would you advocate the PFI route to a prospective Client?

Yes. I mean yeah if it was, I mean PFI is suitable to some projects and not others so I wouldn't go in with both guns blazing regardless, and say yeah PFI, PFI, PFI you know its right for some things and not for others. I wouldn't make judgements about that until I knew a bit about the project that the Client wanted.

But it would definitely be an alternative?

Oh yeah, it would definitely be on the shopping list, oh yeah, absolutely.

What alternatives are there to the PFI approach?
Well I mentioned one, the Prudential Borrowing regime. I mean in a sense there aren’t any. There aren’t any.

*Just due to the capital expenditure?*

Yeah, I mean well there is an alternative I suppose, you know, maybe in one way or another [the City] could have rebuilt five schools over ten years, fifteen years, what have you. With all the grief and, you know, mess that that would bring with it and it would do that by trying to identify each financial year whether it has the capital to do that. So that is an alternative but it’s not really a very satisfactory one for all sorts of reasons. I suppose another alternative is of course that, you know, it’s a bit of a negative thing but you don’t do anything, you know, you say yeah we need five new schools, you know, for whatever reason were not going to do PFI we can’t do anything else we’ll just keep the status quo, but of course that’s not an option really.

*So the five schools that you chose on this particular project, why were they chosen over, because I imagine there are more than five schools in the area that need attention?*

Oh yeah we could have a series of PFI projects and still have schools left in [the City] which are not fit for the 21st century really. Well the first thing to say is that we, we originally, gosh it seems a lifetime ago now, we originally invited every school in [the City] to one or two sort of exploratory meetings with us when we were first scoping the project. Then we said you know were thinking of doing this. If your interested in your school being a part of it let us know and we told them a bit about the PFI process what was likely to be involved so on and so forth. The next stage was having had some responses from schools we then looked at what’s called the Asset Management Database which the Education Service maintain on each of its schools and that records things like conditions, suitability, sufficiency under those sorts of headings and basically describes the condition the school is in and its ranked effectively so you can look at a reasonably objective database and say ok, well, which are the worst schools in [the City], which are the worst twenty, fifteen, ten, five and that’s how we did it. You have to prove to the DFES in the early stages of the project that your intelligence or the database that you’re using the results that you’re putting forward is reliable and indeed the DFES keep the database as well so they can easily check. The other issue, I mean the thing that drove the schools project is, and you can lose sight of this quite easily, but it was about improving the pupil attainment and achievement because you can’t do that easily if your working in crap buildings. You need a decent environment to do that that’s what drove it. It wasn’t about, the building itself wasn’t the end. The end was about improving the performance of kids in all sorts of ways not just in exams and in that sense having identified through the Asset Management Database the schools with the most significant condition issues we then looked at the OFSTED reports for those schools to see if there were performance issues and so on and whilst that wasn’t the case for all five schools it was for three of them. So it was about putting together different perspectives of a school really and we came up with the five, now but you could just keep going and keep going.

*Part Three: Nuclear Power*

Ok, I’m going to move on from PFI, now my research, the research that I’m doing is to use PFI in another industry sector. Basically expanding it and its to do with providing power, electricity to various... because obviously with the loss of the North Sea oil in the next few years and the moth-balling of the nuclear, current nuclear power plants in the country its going to be a real problem. We’re going to have to import a lot of oil to provide energy for the UK’s needs. What I’m looking at is can we utilise PFI to help in an aspect of that, specifically I’m looking at nuclear power, whether nuclear power stations can be built, one of the main reasons I’m looking at PFI is because of the capital expenditure and also the costs over the lifetime and also the decommissioning of nuclear power stations. So I have a few questions about nuclear power, just general questions, I don’t suppose you have had any experience in the nuclear industry?

No, I hope you don’t want any detailed answers about nuclear power?
No, it’s more about trying to gage what opinion there is among people who are involved in construction and who are involved in PFI as well. What is your opinion on the use of nuclear power for the production of electricity generally?

I don’t think I’ve got one to be honest Dan, I’m quite neutral, I mean, do you mean personally or in terms of a PFI project?

Well, first personally, then we’ll come on to PFI...

I’m not, I’m not particularly, I’m not anti-nuclear power I’m not pro it either really. I mean, it’s a solution to a particular problem and its like any solution it will have its strengths and its weaknesses and its positive aspects and its negative aspects. So you know if that was a cost effective and I suppose a reasonably environmentally friendly way of providing energy it wouldn’t cause me any sleepless nights. A pragmatic view really.

From a PFI point of view do you think nuclear power would fit the scope?

I think it probably would actually. I mean I’ve never thought about it, you know, until you’ve asked me the question but I mean that kind of major infrastructure project is likely to be very, very attractive to certain elements of the bidding market. What you find in PFI is that you get firms who over the years kind of become known, not specialists particularly, but they get involved in particular sectors more than others do and they acquire an expertise and familiarity with that. I don’t know if there have been any PFI’s in the nuclear power industry, there may have been...

Not that I’m aware of, there may have been in sort of isolated areas like nuclear waste disposal things like that.

Well PFI and waste disposal, waste management, I mean that’s not uncommon. But whether that extends to nuclear waste management I don’t know. But, you know, you can think of some of the really enormous construction outfits, I mean the one that we ended up with [the Contractor], I mean they’re a [foreign] owned construction company, but if you open up their website you’d think they own the world. I mean it’s a huge, an enormous outfit it really is. I mean [the subsidiary of the Contractor] is a small part of it and you sort of see what they’re, they’re just huge. They operate for instance the toll road system in France and most of the auto-routes in France that build them. They do it, I’m trying to think of an English company, I mean it would probably be someone like Balfour Beatty, Costain or McAlpine maybe, civil engineering in particular rather than house-builders and I could see, I could see a number of firms being interested in any type of proposals for a PFI project with nuclear although there would be a lot of issues wouldn’t there about you know health and safety and absolute certainty that the Contractor was capable of looking after the buildings, it would be a highly technical.

Do you think it was a good idea when the Government privatised the nuclear industry or do you think it would be better as a nationalised industry?

I don’t think I know enough about it to be honest Dan. I mean I tend to, I mean I’m no disciple of PFI in that sense I tend to think that very often not always but very often operations that remain in the public sector particularly those that appear to be working reasonably probably continue, probably would be best if they continued to be in the public sector. I mean the railways are a classic example of something that has gone really pear-shaped since it was taken out of the public sector and put into the private sector. I’m not saying the private sector is incapable of making that better but you have to ask questions about the logic of privatising the rail network and the problems that have appeared since then I know it wasn’t perfect when it was publicly owned but its certainly not perfect now. And you could, you know, there are one or two other examples as well, there are some examples in the health sector where things that used to be in the public domain and are no longer and they’re experiencing significant difficulties. My gut feeling I suppose for a whole variety of reasons is that unless you can prove at the outset that private sector ownership, control is going to be better then I don’t think you should do it and that would probably be a very significant issue with the nuclear power industry.
What issues are you aware of in relation to nuclear power? I'm thinking of a broad sort of, nuclear waste for example is an issue, on the positive side there are no carbon emissions from nuclear power are there any that just spring to mind from general knowledge?

There is actually, only one highly specific element. I mean I don't live in [the City] I live in [another city] and in [the other city] for some peculiar reason there is a railway line that runs right the way through the town centre virtually which carries periodically nuclear waste and because well because of the nature of [the other city] and where this railway line is, I think its coming from what'sit in Cumbria.

Sellafield?

Yes, Sellafield that's right, it brings the waste from there I don't know where it takes it. That's a big issue for lots of people in [the other city], it's not for me personally but you know, you see these terribly decrepit looking trains, I've actually seen one with these sealed waste containers on with the radioactive signs and you think god there going to fall apart what happens to [the other city] if they disintegrate. So I suppose that's an issue I'm aware of, actually physically moving the waste.

So if there was going to be a new nuclear power station procured through PFI and it was going to be on the outskirts of [the other city] what would your opinion on that be?

Well in a sense my, I don't know. I think my attitude to it, my, whatever reservations I may have about it would not be about PFI as the procurement process, it would be about the power station really. I mean my better half hates PFI and we have frequent arguments about it. She thinks its disgraceful because she just doesn't believe in it or agree with it. So if we had a proposal to build a nuclear power station near [the other city] she would be saying bloody PFI again you know. I would be saying hang on it's about the power station not about how you get it. I mean I don't have sufficiently, I have got a pragmatic view to nuclear energy, to the creation of energy but provided I felt satisfied that you know everything that could have been done to secure the safety of local people had been done I wouldn't kick up a fuss about it. And you know if I felt that PFI was the most appropriate procurement route then, you know, so be it.

Do you think there is enough knowledge in the public arena about nuclear power for the general public?

In my opinion there probably isn't. I mean it's probably there to be got so maybe it's about people having the incentive to dig it out but it's not something you see. You know, you get little flurries in the media about nuclear power but it's not something that's there on a regular consistent basis.

Overall, generally what do you think the public's perception towards nuclear power is, from your point of view?

I should think it's probably negative

Why do you say negative?

Because I think it's the association with nuclear. You know with it's association with radioactivity and bombs and god knows what else. And some of the benefits of it, one of which you've alluded to sort of lack of emissions into the atmosphere is not often, that's not at the forefront of peoples thinking. I'm sure if the word nuclear was used it triggers images in people's minds and associations which may be complete rubbish but I think it's probably negative.

Do you think nuclear power stations would be, I'm trying to think of a way to phrase this, would be a target for terrorism, do you think there would be an increased threat if we had an increased number of stations?
Yeah, I mean they’re classic installations to take out aren’t they? It would be like you know, it would be like multiplying the opportunities that we’ve seen recently say in London, I mean if you, if we were suddenly to create six new London’s you know we’d probably see significant increase in terrorist activity on those six new London’s we’ve created. So if you build more potentially vulnerable installations you’re bound to, I think you’re bound to.

A quick technical question do you know the difference between nuclear fission and nuclear fusion?

No.

I am trying to discover…the essential difference is that nuclear fission is the current way of generating nuclear power by splitting the atom and it creates a whole load of crap at the end of it as well as the energy. Fusion is a way that we fuse two atoms together, which is the same reaction that occurs within the sun and it creates energy but there is no waste at the end of it. The only waste that is produced is every 20 years or so the equipment that is used to fuse the atoms together becomes highly radioactive and has to be disposed of, but there is no actual nuclear waste per se. Unfortunately it is about 100 years behind becoming viable as a normal method of power production. I mean the first facility, fusion power station is going to be built in France they have just won a contract to do it, I mean I don’t think its going to be procured by PFI…

It’s probably [the Contractor] that are going to do it…

It’s a £6bn power station to create a new nuclear fusion reactor on a mass production scale they have done it on sort of educational, technical scales but at the moment it takes far more energy to be put in than is actually created and comes out and they’re trying to get a better balance. The problem that nuclear fusion faces is that its coming on the back of nuclear fission and all the negativity surrounding that, its going to be tard with the same brush effectively, so that’s one area that needs looking at.

Part Four: Modelling

Right I am going to move on to a model that, this is basically a theoretical model of stimulants and impediments to applying PFI to nuclear power. I’ll let you have a look at the stimulants first. It’s split into four levels, basically the External Environment level which is a general level, and then an organisational level from a firm’s point of view, then a specific project level and then a job role level which is less important in this research but I’ve included it so that it’s a complete overhaul of the whole sort of area. Is there anything in this table that you think shouldn’t be there or is there anything that you think has been omitted that is glaringly obvious?

Lets have a look, these are stimulants yeah?

Yeah.

What do ‘social service needs met’ mean, Dan?

If there’s a need in the social community, say a need for extra schools or a service need is there then PFI provides a way to meet that need. Say, for example, if [the City] was suffering from brown-outs or black-outs a new nuclear power station would provide for that additional demand.

Right, I’m with you. No I think that’s fine, I can’t see anything that either should not be there or that’s been missed.

One question that has just occurred to me from looking at that. Do you think PFI increases the opportunity for innovation and creativity in projects?
Yeah it does, it does because, now why do I say that? Because it's a competitive process and bidders are obviously continually looking for ways to win bids but at the same time to safeguard their profits margins. So it's a very fine balance you've got. One of the ways that they do that is by looking for innovation in what they do and how they do it and I don't just mean cutting corners which then undermines quality. I'm trying to think of an example with the schools. Yeah, when we were talking to the Architect about one of the designs for the schools we were talking wall finishes and we were making some comparisons between traditional plaster and paint, stuff like that, which is notoriously difficult to maintain, it always needs cleaning and periodically needs repainting, plaster cracks and chips off, blah, blah, blah. In the process of our discussions with them at one point they came back and said how about a form of plastic sheeting, I can't even begin to talk about the technical side of all this, that was claimed to have a number of, you know, benefits, easier to clean, lower maintenance costs and it was cheaper as well, which surprised me but it was and they were, they were coming at it from... It's probably money that drives innovation but that, you know, we live in the real world don't we, so be it, if it results in something which is beneficial to the Client it is something which should be supported. So yes I think it does, I think it does.

On a similar aspect do you think PFI drives the private Contractor to look at methods to save money over time?

Oh absolutely, absolutely. I mean don't forget the, well in, certainly in our schools project I mean, [the Contractor] are responsible for maintaining those building for 25 years. It is therefore in their interest, if no-one else's, to make sure the design and construction of that building is as effective and efficient as it can be because, well it's not [the subsidiary of the Contractor], but [the Contractor] will have to provide the wherewithal to look after that for 25 years and if they don't they get clobbered so there is an incentive right at the outset to get the design solutions right and to get them capable of being maintained over that length of time because they're storing up problems for themselves if they don't.

Would they necessarily, spend additional money on the capital cost of the building to recoup savings in later years?

I think they probably would, yeah I mean the way in which the allocation between capital and revenue in PFI works is very, very complex but we know again from the schools project that they have some up with design solutions that, [the Village] Primary actually, which originally they weren't considering because of the cost they have taken a long hard look at the projected revenue and expenditure of that building over 25 years and decided that by spending more now with some adjustment to corridors or whatever they are going to save themselves some money further down the line. As importantly it was the solution that the school wanted anyway, but bidders are different. They're all different, I mean I'm sure you've heard of [a Contractor], who were on our shortlist at one time along with [the Contractor] and [a further Contractor] they were all on the Councils short list. And the way bidders approach Councils, PFI, projects generally is completely different I mean [a Contractor] had a very different approach to [the Contractor] and [a further Contractor] had a different approach again. Some of them tried to pretend and this is particularly true of PFI I think, some of them try to pretend that everything will be hunky-dory, won't be a problem we'll do anything you ask [the City} Council and that was [a Contractor's] approach, you know, and you think well we've heard this before. [the Contractor] came in at the outset and said well this is going to be difficult, that's going to be difficult, we need to get this sorted out, what about this? What about that? What about the other? [A further Contractor] were somewhere in between those. I'd much prefer the bidder to be realistic and quite candid with us right from the outset than someone who thinks its going to be plain sailing because PFI is never, ever plain sailing because its, you know, it's a very complex partnership.

Ok, we've looked at the stimulants...

Yeah.

This one is basically the opposite, the impediments. Same sort of thing really, is there anything there that shouldn't be or is there anything that should be there that isn't?
What do you mean here Dan, when you say unreliable risk transfer, at the project level?

This is something that has come out of the research on various PFI projects. That if a project, that if a PFI project is put together hastily and risks are transferred arbitrarily rather than going through and producing a risk register and seeing who is best to cope with that risk, either the Client or the Contractor, and it’s just a case of the Client who wants to get rid of all risk regardless, basically unreliable risk transfer doesn’t help, it’s not the most efficient way of a project going ahead.

I mean, as I’m sure you know, I mean the concept of risk transfer is absolutely fundamental to PFI. But the associated difficulty that goes with it is where the Contractor takes the risk they price it.

I mean the unreliable side is basically if there is a risk that would have been better borne by the Client, but the Client doesn’t want any risk at all and gives it to the Contractor, the Contractor is going to charge him for that and that is an inefficient way because there is no way the Contractor can do anything about it there’s no point him taking the risk.

No, that’s right. No again I don’t think there is anything you have missed there.

Are there any aspects of PFI which could possibly conflict with nuclear power?

Not really no. I mean there are two, there are two key drivers to the PFI philosophy and PFI process. One is as we’ve just mentioned it’s about allocating risk to the party best able to manage it. There is certainly nothing inherent in the nuclear power industry which would mean that that couldn’t be achieved. The second driver and this is what lay behind it when the Tories dreamt it up, it takes public sector borrowing out of the PSBR equation. Because, you know, the cost of the transaction doesn’t show up directly on the Government’s books and that’s you know that’s a fact I mean the cynics use it as something to beat PFI over the head with continually but it is a fact it doesn’t show up on the PSBR because on its not on the Councils books directly, its not on the Government’s books. With our schools projects it’s with [the Contractor]. Again there is nothing in a nuclear power proposal which would be difficult to secure from that point of view as well.

Isn’t there a danger that we are, kind of, procuring services today and putting the burden on future generations to pay from them?

Well they are all long term PFI, usually 25-30 years is the common for major projects. The schools one is 25 years, the housing one is 30 and the street lighting one is 25 years. Well I mean I suppose in a sense it’s not a danger it’s a reality. I mean the minute you sign that project agreement you are committing the Council to pay X-millions of pounds over 25 years to a private sector partner and in some way, some how that money has to be found. It doesn’t all come from central Government in terms of PFI credits. I mean the way the finances work in PFI is very, very complex but you’ll of heard of PFI credits I’m quite sure but that’s not the whole, I’ll give you an example. On the schools project we got from the DFES PFI credits of about £48m, the actual contract value to [the Contractor] is somewhere just under £60m. Now that £12m gap has to be made up in one way or another by the Council and that has implications for community charge and Council tax payers in [the City]. So inevitably its not a risk that your committing people to its an actuality you are making that commitment. On the other hand you would be doing that through, in one way or another you would be doing that through any procurement process because you’d be paying for it wouldn’t you and future generations would be paying for that in one way or another. So I’m not sure that, the length of time may be slightly different because they are long concession periods usually. You might find that you can pay off a debt earlier than 30 years or 25 years but nevertheless, however Councils raise money in one way or another it will get transferred to local council tax payers so I think it might be a bit of a red herring that, I mean I understand the question.
General Questions

OK, two kind of final general questions, what, and this is more of a personal opinion question, is the most fundamental issue globally regarding the environment at the current time?

I suppose it would have to be, globally, because you can think of different areas and zones globally where they're experiencing different pressures and so on. I suppose it would have to be climate change because that brings with it a whole host of sub-issues. Global warming, the correct technical term.

Secondly, what do you think is the most fundamental environmental issue for the Council when it's involved in construction? Is there any specific issue, do you ever sit down and talk specifically about the environment.

I mean generally, if you wanted a general word that concerns the Council its Sustainability. Within that or underneath that there is a whole raft of things sitting really, in terms of selection and construction of materials, energy efficiency obviously.

What's driving that? Is it purely cost savings or is it Government agenda?

It's a combination of things. I mean clearly the Council wants and try's, not always successfully, to make savings where it can. So part of it is financial. Part of it is a genuine concern within the Council, particularly among many Councillors, to do as much as they can to protect the local environment of [the City], as a local take on it and increasingly Local Authorities have to take account of and abide by national regulations about energy efficiency and stuff like that. I think it's probably those three elements, I don't think its any one more than any other. I'll give you an example, the early work that were doing now on the housing PFI project, the houses that we will have to have built will have to be to certain Government standards on energy efficiency and stuff like that, so there is that national thing that you cannot really argue with you've got to do it. Then you've got the where there are particular issues of importance to local Councils which are reflected in any project being undertaken on behalf of the Council, so it's a mixture of things really. We work in a political environment the Liberal Democrat's have always been more environmentally concerned than the Conservatives or Labour. Since we've just had a change again back to Labour we have had a Liberal Democrat/Conservative alliance, as I'm sure you know, we've noticed that there has been more far more discussion about environmental issues so it's a party political thing there is no doubt about that.

Well that concludes my questions, so thank you for your time.

No problem, Thank you.
Appendix Three

Interview Contact Pack

This Appendix includes the information pack issued to the interview participants following completion of the research interviews.
Dear Name

Master of Research – Innovation & Improvement in Property & Construction

I write further to my ................... regarding the research interview for incorporation into my thesis conducted as part fulfilment of the requirements for the award of the above.

This pack contains the following:

- Contact details;
- A brief outline of my research;
- A copy of the basic questions and theoretical model designed for the purpose of the interview and
- A copy of my current Curriculum Vitae.

If you have any further questions or clarifications following the interview please feel free to contact me. Should you require a copy of my final thesis an e-copy can be provided, following successful award of the MRes degree, upon request.

May I take this opportunity to thank you for the time and effort you have given in participating in my research.

Yours Sincerely

D M Cadman BSc (Hons) MRICS
Postgraduate
University of Salford

d.m.cadman@student.salford.ac.uk
What Stimulants & Impediments Exist in the Application of the Private Finance Initiative to Provide Better Value for Money in Nuclear Energy Generation in the United Kingdom?

In February 2003 the Government issued a White Paper reviewing its energy policies. Diminishing indigenous natural supplies, the loss of the majority of the United Kingdom's nuclear energy generation capacity by 2020 and an increase in both local and global demand for energy are leading toward an energy crisis. Additionally the Government must reduce CO₂ emissions by 12.5% of their 1990 levels by 2010; this means generating the required additional energy capacity should not be achieved by burning further fossil fuels. Renewable sources of energy are not sufficiently technologically advanced to account for the approaching shortfall. New nuclear energy generation facilities could successfully generate the required energy without increasing CO₂ emissions. Current nuclear energy generation is however uneconomically viable. An innovative new solution to create economically viable nuclear energy generation is required. The Private Finance Initiative is a procurement model aimed at increasing the provision of public services whilst keeping a restraint upon public expenditure. It is also founded upon providing value for money to and transferring risk from the public sector.

This research will be carried out with the use of an extensive literature review and semi-structured interviews to determine what stimulants and impediments exist in the application of the Private Finance Initiative to provide better value for money in nuclear energy generation. The research is needed to understand current issues and promote further research within this area in order to influence Government opinion and policy in order to prevent the impending energy crisis through the construction of new nuclear energy generation facilities utilising the Private Finance Initiative procurement model.

18 July 2005
Interview Agenda – Nuclear Power

Preliminaries

Switch on tape recorder
Thank Interviewee for agreeing to be interviewed
State Name, Company & Date for the recording

Part 1: Background

1. What is your position within the company and how long have you held that position?
2. What is your background? – Engineer, QS, etc.
3. What types of projects have you been involved in and are what are you currently involved in?
4. Are you a member of any professional bodies?

Part 2: Nuclear Power

5. Why do you believe nuclear power should be used in electricity generation?
6. What issues are you aware of in relation to nuclear power and in what order of importance would you rank them? Discuss Issues as portrayed in model.
7. What do you believe are the main stimulants/drivers to nuclear power?
8. What do you believe are the main impediments/barriers to nuclear power?
9. Do you believe the UK would benefit from an expansion of its current nuclear power generation facilities?
10. Do you believe the UK Government’s current position on Nuclear Power is the correct position?
11. What, in your opinion, is the most fundamental issue globally regarding the environment, at this current time?
12. What is the most fundamental environmental issue with respect to the construction industry?
13. Does the failure of the USA to sign up to the Kyoto Protocol regarding Carbon emission effectively render it useless?
14. How is your company working to improve awareness and application of sustainability and sustainable design into your activities?
15. Do you think the Government should introduce a Carbon Emissions tax?
16. Do you think the nuclear industry should be Nationalised?
17. If proposals were put forward to build a nuclear power station in your area (county) what would be your reaction?
18. Sweden generates 45% of its electricity requirements through nuclear power, France generates over 75% of its requirements, the UK currently generates just over 20% which is set to fall substantially over the next 15 years, combined with the exhaustion of North Sea oil what alternatives to nuclear power do you believe are viable to meet the UK's increasing requirement for electricity?

19. Do you know the difference between nuclear fission and nuclear fusion?

Give a brief outline of nuc. fusion and its main differences and then ask:

20. Would you be in favour of constructing a series of nuclear fusion reactors in the UK?

Part 3: PFI

21. What is your understanding of the Private Finance Initiative?

If their understanding is limited give a brief outline and move on.

22. Have you been involved in projects that have utilised the PFI?
23. Why, in your opinion, were those projects procured via this route?
24. Were those projects successful?
25. What type of project or industry sector (i.e. health, education, residential, commercial, etc.) do you believe the PFI is best suited to?
26. What do you believe is the main purpose or driver behind the use of PFI?
27. What do you believe are the main stimulants to PFI?
28. What do you believe are the main impediments to PFI?
29. Do you believe PFI to be a successful method of procurement?
30. Do you believe PFI could or should be expanded to other sectors of the industry?
31. Would you advocate a PFI route to a prospective Client?
32. What alternatives are there to a PFI approach?

Part 4: Modelling

Give them the PFI/Nuclear model and ask if they agree with it. Is there anything that should not be there or are there any glaring omissions?

33. Do you think the PFI could be utilised to provide new nuclear power generation facilities in the UK? Give reasons.
34. To your mind are there any aspects of the PFI and its philosophy that conflict with the nuclear power industry?
35. Do you think your industry, and at a lower operational level, your firm would welcome the introduction of PFI to nuclear energy generation facility construction?

36. Is there anything else you would like to add to this discussion?

Thank them for their time
Give them the contact sheet and appendices.
Interview Agenda - PFI

Preliminaries

Switch on tape recorder
Thank Interviewee for agreeing to be interviewed
State Name, Company & Date for the recording

Part 1: Background

1. What is your position within the company and how long have you held that position?
2. What is your background? – Engineer, QS, etc.
3. What types of projects have you been involved in and are what are you currently involved in?
4. Are you a member of any professional bodies?

Part 2: PFI

5. What is your understanding of the Private Finance Initiative?
6. Have you been involved in projects that have utilised the PFI?
7. Why, in your opinion, were those projects procured via this route?
8. Were those projects successful?
9. What type of project or industry sector (i.e. health, education, residential, commercial, etc.) do you believe the PFI is best suited to?
10. What do you believe is the main purpose or driver behind the use of PFI?
11. What do you believe are the main stimulants to PFI?
12. What do you believe are the main impediments to PFI?
13. Do you believe PFI to be a successful method of procurement?
14. Do you believe PFI could or should be expanded to other sectors of the industry?
15. Would you advocate a PFI route to a prospective Client?
16. What alternatives are there to a PFI approach?

Part 3: Nuclear Power

17. Have you had any experience in either the nuclear industry or the construction of nuclear power stations?
18. What is your personal opinion regarding the use of nuclear power in electricity generation?
19. What issues are you aware of in relation to nuclear power and in what order of importance would you rank them? Discuss issues as portrayed in model.
20. What do you believe are the main stimulants/drivers to nuclear power?
21. What do you believe are the main impediments/barriers to nuclear power?
22. Do you believe the UK would benefit from an expansion of its current nuclear power generation facilities?
23. Do you know the difference between nuclear fission and nuclear fusion?

Give a brief outline of nuc. fusion and its main differences and then ask:

24. Would you be in favour of constructing a series of nuclear fusion reactors in the UK?

Part 4: Modelling

Give them the PFI/Nuclear model and ask them if they agree with it. Is there anything that should not be there or are there any glaring omissions?

25. Do you think the PFI could be utilised to provide new nuclear power generation facilities in the UK? Give reasons
26. To your mind are there any aspects of the PFI and its philosophy that conflict with the nuclear power industry?
27. Do you think your industry, and at a lower operational level, your firm would welcome the introduction of PFI to nuclear energy generation facility construction?
28. Is there anything else you would like to add to this discussion?

Thank them for their time
Give them the contact sheet and appendices.
Interview Agenda – Back-up Questions

Ask questions randomly and do not ask those which you feel are unnecessary.

**Part 1: Related Issues**

1. Do you believe the UK Government’s current position on Nuclear Power is the correct position?
2. What, in your opinion, is the most fundamental issue globally regarding the environment, at this current time?
3. What is the most fundamental environmental issue with respect to the construction industry?
4. Does the failure of the USA to sign up to the Kyoto Protocol regarding Carbon emission effectively render it useless?
5. How is your company working to improve awareness and application of sustainability and sustainable design into your activities?
6. Do you think the Government should introduce a Carbon Emissions tax?
7. Do you think the nuclear industry should be Nationalised?
8. If proposals were put forward to build a nuclear power station in your area (county) what would be your reaction?
9. Sweden generates 45% of its electricity requirements through nuclear power, France generates over 75% of its requirements, the UK currently generates just over 20% which is set to fall substantially over the next 15 years, combined with the exhaustion of North Sea oil what alternatives to nuclear power do you believe are viable to meet the UK’s increasing requirement for electricity?

Thank them for their time

Give them the contact sheet and appendices.
PFI/Nuclear Power Stimulants: Theoretical Model

External Environment Level:
- Reduced Government capital expenditure;
- Increase ability of Government to meet Kyoto targets;
- Environmental benefits from improved air quality;
- Improved public knowledge and awareness leading to improved levels of public acceptance of nuclear power;
- Reduced reliance on external primary power sources, UK retains self-sufficiency;
- Social service needs met;
- Comparison with Public-Sector Comparator;
- Social environment improvement;
- Increased employment.

Organisation Level:
- Protection from potential Carbon emissions tax;
- Benefits from new technology patents;
- 'Base-load' generation providing constant demand;
- Low primary fuel costs;
- Efficiency through increased competition;
- Open and transparent cost management;
- Standard of service defined;
- Encourages future investment;
- Client ability to apply penalties for non-performance;
- Opportunity for innovation and creativity.

Project Level:
- Sustainable design benefits;
- Technological innovations;
- Improved construction programme;
- Improved efficiency and productivity;
- Value for money;
- Cost reductions;
- Improved quality;
- Efficient risk allocation;
- Increased management expertise.

Job Role Level:
- High level technological research and development opportunities;
- High remuneration due to high level of expertise required.

Figure 4.3 PFI/Nuclear Power Stimulants: Theoretical Model
PFI/Nuclear Power Impediments: Theoretical Model

External Environment Level:
- Current levels of public knowledge, awareness, opinion and acceptance;
- Nuclear waste;
- Proliferation of nuclear materials and weaponry;
- Terrorism;
- New legislation and regulation required;
- Inefficiencies in public-sector comparators;
- Reduction of public service ethos and perpetuates belief of public-sector inefficiency;
- Long-term public financial commitment.

Organisation Level:
- Potential for decrease in safety levels due to competition;
- Storage of nuclear waste produced;
- Economics, safety, capital cost and decommissioning;
- High risk projects;
- Creation of 'two-tier' workforce;
- Market difficult to enter for SME's;
- High private sector borrowing rates.

Project Level:
- General safety concerns;
- Production of nuclear waste;
- High pre-contract and legal costs;
- Unreliable risk transfer.

Job Role Level:
- High risk work environment;
- Lack of freedom;
- Decreased opportunity for individual initiative and innovation;
- Strict rules and procedures.

Figure 4.4 PFI/Nuclear Power Impediments: Theoretical Model
Curriculum Vitae

Personal
Name: Daniel Martyn Cadman BSc (Hons) MRICS
Address: 29 Grasmere Crescent
          Sinfin
          Derby
          Derbyshire
          DE24 9HS
Date of Birth: 28 June 1980
Mobile: 07939 047891
Email: d.m.cadman@student.salford.ac.uk
Nationality: British
Driving Licence: Full British Car License

Qualifications
2004-Present: University of Salford, Salford, Greater Manchester
               MRes Innovation & Improvement in Property & Construction
2001-2003: Royal Institution of Chartered Surveyors
           Assessment of Professional Competence MRICS
1998-2002: University of Salford, Salford, Greater Manchester
           BSc (Hons) Quantity Surveying First Class
           University of Salford prize for best performance in the final year.
           J R Knowles prize for best performance in Construction Law.
A Level:
Business Studies ............................................................... B
General Studies ................................................................. C
Design & Technology .......................................................... C
Chemistry .............................................................................. D
GCSE:
Information Technology ................. A  English ......................... A
Mathematics ........................................ B  Science (Double Award) .... BB
Business Studies ................................. B  Design & Technology ... B
Drama ................................................. B  French ......................... B
English Literature ............................. C  History ......................... C
Employment

Oct 2004 - Present:
Position: CIRIA – Construction Productivity Network, Classic House, 174-180 Old Street, London EC1V 9BP
Details: CPD Seminar Reporter

Details:
Attend CPD seminars and produce report for issue to delegates.

Jul 2002 - Jul 2004:
Position: Gardiner & Theobald LLP, 32 Bedford Square, London WC1B 3JT
Details: Project Surveyor.

Details:
Project Surveyor on the following:
- £4m landscaping and infrastructure project, Paddington, London.
- Three £0.5m pedestrian bridge projects, Paddington, London.
- £0.5m domestic house refurbishment project, Central London.
- £0.1m retail refurbishment in a live shopping centre environment, Burgess Hill, West Sussex.

Assistant Surveyor on the following:
- £20m retail/residential project, Central London.
- £3.5m school refurbishment, Highgate, London.
- £80m residential project, Chelsea, London.
- Two £50m office projects, Paddington London.

Aug 2000 - Sep 2001:
Position: Ballast Pic, Harbour Buildings, The Waterfront, Brierley Hill, West Midlands DY5 1LN
Details: Junior Surveyor.

Details:
Junior Surveyor on the following:
- £14m retail extension to existing shopping centre, Redditch, West Midlands.
- £7m retail refurbishment in a live shopping centre environment, Redditch, West Midlands.
- £3m refurbishment of football stadium, Telford, West Midlands.

Jun 1999 - Sep 1999:
Position: BT/Securicor
Details: Call Advisor.

Mar 1996 - Sep 1999:
Position: Grasmere Building & Landscape Services
Details: Groundskeeper.

Jul/Aug 97 & Jul 95:
Position: Richard Wood Associates
Details: Work Experience Student.
Details: Architectural Technician.

Interests

Sunday league football, literature, music, theatre, outdoor pursuits.

References

Professional:
Mr Martin Harling MRICS
Partner
Gardiner & Theobald LLP
32 Bedford Square
London WC1B 3JT

Academic:
Dr David Eaton BSc MSc PhD MRICS
Senior Lecturer
University Of Salford
School of Construction & Property Management
Bridgewater Building
Salford
Greater Manchester M7 1NU
Glossary
# Glossary & Abreviations

<table>
<thead>
<tr>
<th>Bates Review</th>
<th>The review of PFI conducted by Sir Malcom Bates.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Emissions</td>
<td>Generic term used to describe Greenhouse Gas emissions including Carbon Dioxide emissions.</td>
</tr>
<tr>
<td>Contractor</td>
<td>The company engaged to construct and/or manage the project.</td>
</tr>
<tr>
<td>EPRI</td>
<td>Electric Power Research Institute.</td>
</tr>
<tr>
<td>Government</td>
<td>The United Kingdom Government.</td>
</tr>
<tr>
<td>Impediment</td>
<td>A situation or event that makes it difficult or impossible for someone or something to succeed or make progress.</td>
</tr>
<tr>
<td>Innovation &amp; Creativity</td>
<td>Definitions of innovation and creativity are discussed in section 1.1 of the research.</td>
</tr>
<tr>
<td>LA</td>
<td>Local Authority. The public sector body procuring a service through PFI.</td>
</tr>
<tr>
<td>Nuclear Energy</td>
<td>The creation of energy through the process of either nuclear fission or nuclear fusion.</td>
</tr>
<tr>
<td>Nuclear Fission</td>
<td>Nuclear fission involves splitting heavy atoms to generate heat which can be used to generate electricity.</td>
</tr>
<tr>
<td>Nuclear Fusion</td>
<td>Nuclear fusion is a process that seeks to fuse light atoms together in the same way in which the energy within a star is created.</td>
</tr>
<tr>
<td>ODPM</td>
<td>The Office of the Deputy Prime Minister.</td>
</tr>
<tr>
<td>Output Specification</td>
<td>The specification upon which the PFI tenderers are invited to bid which identifies the LA's requirements. The responsibility for meeting those requirements is entirely a matter for the SPV.</td>
</tr>
<tr>
<td>PESTLE</td>
<td>Political, Economic, Social, Technological, Legal and Environmental. Areas for research analysis.</td>
</tr>
<tr>
<td>PFI</td>
<td>The UK Government's Private Finance Initiative.</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private Partnership. A general term covering all projects involving the public and private sectors. PFI is a stream within PPP.</td>
</tr>
<tr>
<td>PSC or Public Sector Comparator</td>
<td>The benchmark used to assess the value for money of tenders. It is a notional cost estimate of a project procured traditionally by a LA.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Renewable energy sources rely on natural energy flows within the environment; they are continually replenished and are therefore sustainable.</td>
</tr>
<tr>
<td>Service Level</td>
<td>The specification which details the standard of service which must be delivered by the SPV.</td>
</tr>
<tr>
<td>Specification</td>
<td></td>
</tr>
<tr>
<td>SPV</td>
<td>Special Purpose Vehicle. The project company established for the delivery of a PFI project.</td>
</tr>
<tr>
<td>Stimulant</td>
<td>Something that encourages more of a particular activity.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>The ability to meet the needs of present generations, without compromising the ability of future generations to meet their own needs.</td>
</tr>
<tr>
<td>TUPE</td>
<td>The Transfer of Undertakings (Protection of Employment) Regulations 1981.</td>
</tr>
<tr>
<td>Unavailability</td>
<td>The test for determining deductions from the unitary payment for unsatisfactory performance by the SPV.</td>
</tr>
<tr>
<td>Unitary Payment</td>
<td>The payment made by the LA to the SPV for provision of the services specified in the Service Level Specification.</td>
</tr>
</tbody>
</table>
References
List of References


http://money.telegraph.co.uk/core/Content/display/Printable.ihtml Viewed 25 January 2005.


BBC (2002) *Al-Qaeda Plotted ‘Nuclear Attacks.’*


http://www.hm-treasury.gov.uk/documents/public_private_partnerships/ppp_pfi_stats.cfm
Viewed 15 May 2005


Applied Energy. 64 (1-4) Pp 31-53.


London: Spon Press.

Refocus. 6 (1) Pp 50-53.

Washington DC, USA: National Science Foundation.

PPP Forum Conference on 1st July 2004 held at Birmingham.

http://www.armscontrol.org/act/2003_12/MillerandScheinman.asp Viewed 1
June 2005.

University Press.


PPP Forum (2005d) *Project Interviews*. 


