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ENERGY REVIEW - NUCLEAR RECOMMENDATIONS

Issue

Further to the updates on various elements of the nuclear workstream we have given you throughout the Review, this submission sets out a package of measures which form our recommendation on nuclear.

Recommendation

That you agree that the Energy Review should conclude that new nuclear should play a role in the UK's future generating mix, while recognising that that it will be for the private sector to make the investment decisions within the framework set by Government.

That you agree that a number of enabling measures are taken to remove the regulatory barriers for new nuclear build, and that further work is undertaken to ensure appropriate risk transfer to the private sector for waste and decommissioning liabilities.

That you note in particular that the appropriate regulators are in place to ensure that the nuclear security, safety and non-proliferation risks are managed effectively and that these issues do not present a barrier to a new programme of new build in the UK. However, we recommend meeting with these regulators, before the meeting with the PM and Secretaries of State on 20 June, to discuss these issues in further detail. We already in contact with your office about arranging this meeting.

That you note that we are also examining the case for a mechanism to support the carbon price, which would benefit nuclear and other low carbon technologies.

That you note that it is likely that the most attractive sites for new build are owned by British Energy (BE), although there are other sites owned by the NDA and at other locations that might present attractive sites for new build. Work is ongoing with HMT

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and Shareholder Executive on what the Review should say about the possibility of British Energy participation in new build.

That you note that a number of other nuclear issues have been considered in the context of the Energy Review, and have been found not to pose significant barriers to investment in new build.

That you agree that these proposals should form the basis of your advice to the Secretary of State and the Prime Minister.

Timing

It would be helpful to get a steer from you by Monday 12 June, so that we can prepare the necessary material for the next meeting of the PM's Ministerial Group on 20 June.

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Argument

Summary

The economics of nuclear depend critically on assumptions made about future gas and carbon prices, and nuclear costs. On some sets of assumptions, the nuclear case is positive; in others, negative, so a judgement has to be made about the relative weight to be given to the various scenarios. Our view is that, if we see a world of at least moderately positive carbon prices, and gas prices more likely to be in the upper half of our range, then the scenarios tending to favour nuclear deserve more weight.

A summary of the cost benefit analysis is at Annex 1. The main points from the analysis are:

- Gas fired generation has a narrow cost advantage over new nuclear generation in the central gas price scenario. This advantage becomes greater as the gas price falls and / or the nuclear cost increases. Nuclear generation has a cost advantage in a high gas price scenario.
- Nuclear new build would help us meet our longer-term emissions goals. For example, if 4 new stations with generating capacity approximately 6 GW were in place by 2025, this would cut emissions by just under 5 million tonnes of carbon, and take us up to 13 percentage points closer to the trajectory for our 2050 goal.
- Similarly, adding 6 GW of nuclear capacity would reduce the forecast level of total gas consumption in 2025 by around 7%.

These recommendations are based on analysis that has been reviewed by the Peer Review Group chaired by Vicky Pryce, Chief Economist, Department of Trade and Industry.

Nature of decision

If new nuclear build takes place, it would be initiated, funded, constructed and operated by the private sector, operating within the market framework. Discussions with industry suggest that there is a conditional appetite for investment in new build. Plausible scenarios include a consortium of two or three of the major European nuclear players, or one of these individual players acting alone.

We have assumed throughout a model in which the private sector would come forward with proposals for new build which the Government would consider under Section 36 of the Electricity Act. In the Energy Review conclusions, we would be announcing that, in principle, the Government would be prepared to approve such proposals provided the necessary conditions were met, because we judged that new build would be in the national interest (but note the section below on devolution).

It is important to note the previous commitment in the 2003 Energy White Paper on new nuclear build:

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“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 the proposals.”

Ministers' decision in the Review would not be about the number of nuclear plants to be built or the timing for their commissioning (although for illustrative purposes the Review announcement might well spell out the implications of, for example, broadly replacing the current capacity). We would be leaving the market to take a view on this, based on its assessment of commercial viability and within the framework the Government will have established.

The decision would not therefore guarantee new build. It would pave the way for it, and demonstrate Government support for it (and we would aim to ensure, as far as possible, through informal contacts with the industry, that the terms of the announcement would be broadly welcomed by them as providing a good basis for preparing new build proposals).

Facilitating measures

We have developed a range of facilitating measures within the market framework to reduce the regulatory barriers which disadvantage nuclear in relation to other technologies, and which currently disincentivise investment, as set out in Annex 2. The package of facilitating measures is set out below, and is explained in greater detail in Annexes 3 and 4.

The handling of decommissioning and waste costs will be important (though a relatively small proportion of total costs). The principle should be that owners/operators of nuclear plant should meet these liabilities. However, potential investors in new build would want to see waste liabilities capped; for example, investors would have no control over the costs of a waste repository, or any escalation in these costs caused by repository construction delays. Government's legal obligations to ensure that decommissioning and waste management are carried out safely mean that Government would be seen as ultimately responsible for ensuring that liabilities would be met.

It will not be possible to arrive at detailed arrangements for the Review conclusions; these will be matters to be settled with potential developers, and we would need to ensure that any arrangements were compatible with European State Aid rules. Further work is being done on how best to define this issue in the Review announcement, with a view to protecting the Government's future negotiating position. We are working with HMT to come to an agreed position; HMT's primary aims are to minimise any contingent liability which might fall to Government, and to state principles without defining any funding mechanism at this stage. We hope to agree draft text with HMT shortly, which we will then put to you for approval.

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Legislation

We would not need new powers to approve the building and operation of new nuclear plant. However, it is possible that some of the measures in this submission may require primary legislation to implement. This is particularly the case with decommissioning and waste costs, where the need for legislation will become clearer as arrangements are developed with potential developers following the Review announcement. The alternative is to rely entirely on contracts with developers.

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Recommended Options

Section A - Pre-construction

The pre-construction regulatory framework for new generating capacity creates delays, uncertainty and significant process costs for developers of nuclear power. The risks associated with this regulatory uncertainty increase the financing cost of nuclear, which compromises the investment decisions of potential developers. Industry has reported that without changes to the regulatory framework, nuclear will not come forward. These barriers are discussed further in Annex 2.

There are five enabling measures Government could take to reduce risk and uncertainty in the pre-construction phase (more detail is attached at Annexes 3 and 4):

- Clarifying the Government's position and establishing a national need for nuclear because of its contribution to a diverse low-carbon generating mix;
- Improving how planning inquiries are run, while maintaining the opportunity for public involvement, by adopting the best practice introduced in 2005 by ODPM for other large infrastructure projectsⁱ;
- Using existing statutory processes to give the public the opportunity to discuss national issues in advance of any planning inquiries. Then giving the Inspector more powers to focus planning inquiries on relevant local issues;
- Introducing a pre-licensing system to avoid regulators requiring unnecessary modifications to standardised, internationally recognised designs; and
- Ensuring that the necessary grid upgrades are seen as an intrinsic part of any new build and that where practicable, planning permission for them is considered at the same time as for the generating station.

We also recommend that Government keeps the option open for further (primary) legislative change to streamline the planning process, and considers this issue again once the recommendations from the Barker Review of Land Use Planning and the Eddington Study into the future of transport are known (after November 2006). This will help to ensure a consistent cross-Government approach.

ⁱ The Town and Country (Major Infrastructure Project Inquiries Procedure) Rules 2005

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Section B - Back-end and Contingent Liabilities

If Government is willing to reduce regulatory barriers which disadvantage nuclear in relation to other generating technologies, measures should also be put in place to transfer as much of the risk as practicable to the private sector, while recognising that Government will always be seen as ultimately responsible for nuclear liabilities, as was seen with the BE rescue and restructuring. This is particularly the case with the 'back-end' issues of waste and decommissioning, which are considered in more detail below and in Annex 6.

Decommissioning

Decommissioning raises questions of uncertain costs (particularly since no-one is likely to have practical experience of decommissioning the new designs of nuclear reactor for at least 50 years), and the risk that Government could face a contingent liability for meeting the costs of decommissioning if, for whatever reason, an operator fails to make adequate provision. Given this uncertainty, we recommend that the Review concludes that decommissioning costs should be provided by the operator, and that Government (with the NDA) will work with industry and independent experts to develop a framework which ensures costs are forecast accurately, adequate funding provision is made, and risks to the taxpayer are minimised. We are working with HMT to agree a process under which this framework could be developed, and aim to put text to you for approval shortly.

Waste

As with decommissioning, there are major uncertainties over the cost of managing waste from any new reactors. This uncertainty is compounded by the timing of any decision on CoRWM. (We will be submitting further advice separately on the CoRWM process and implementation shortly.) It is feasible to envisage a scenario where operators are obliged to manage all waste (including spent fuel) on site for the life of a plant, with Government taking responsibility (for a fee) for disposing of the waste when the plant closes. In due course, Government may need to provide a degree of certainty over the repository costs for which new build operators would be responsible. However, at this stage, we judge that it should be sufficient to set out principles such as new build operators should make payment to cover an appropriate share of the costs of final waste disposal, with a promise of follow up work (along the same lines as decommissioning) to develop a framework. As with decommissioning, we are working with HMT to agree a process.

Section C – Sites

Any future nuclear build would be dependent on the availability of suitable sites. Given the controversial nature of the projects and various technical requirements, such as seismology and access to (seawater) cooling there are a limited number of appropriate sites. As such, industry report that the preference is for development of land adjacent to existing nuclear installations because of the local support for the industry which affects planning risk, availability of skilled labour and the necessary site characteristics.

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At existing sites in England we expect that it would be possible to install an additional 12.8GW (our current capacity is 12GW) without major controversial grid upgrades. There is further capacity for 4.8GW in Wales and Scotland, although devolution issues would make new build here more complicated. These new stations could be build on land adjacent to the existing stations.

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Section D – When does Government need to take action on nuclear?

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Discussions with industry suggest that detailed questions on decommissioning and waste would not need to be resolved immediately. However, it is likely that we would need to give some indication this summer of the timetable over which these issues would be resolved. Work needs to continue during the pre-construction period to develop arrangements that would be finalised before construction commences, and probably before a planning application is submitted. This view is based on initial discussions with potential developers and on the fact that the planning stage is the point at which developers start to commit significant amounts of capital.

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ANNEX 1: SUMMARY OF NUCLEAR COST BENEFIT ANALYSIS

Introduction

1. The cost benefit analysis for nuclear power generation assesses the following:
 - The full cost of new nuclear generation, including pre development, construction, infrastructure investment, Operating and Maintenance, fuel, waste management and decommissioning.
 - The benefits of new nuclear generation as regards carbon emissions reduction, and security of supply.
2. Costs and benefits are compared to a do nothing scenario, where it is likely that investment in new power generation capacity would be based on gas fired technology. In theory, if the benefits exceed costs, it would be a good idea for the Government to enable (if not necessarily directly support) new nuclear build. If the costs exceed the benefits, then such a policy would, in theory, not be justified.
3. The main messages from the analysis are:
 - Gas fired generation has a narrow cost advantage over new nuclear generation in the central gas price scenario. This advantage becomes greater as the gas price falls and / or the nuclear cost increases. Nuclear generation has a cost advantage in a high gas price scenario and in a low nuclear cost scenario.

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- Nuclear new build would help to close the gap between current and target emissions in the medium / long term. Under an assumption that the first plant in a new programme is added in 2021, with 3 additional plants added by 2025, making around 6GW in total, this would reduce the forecast 2025 carbon gap by up to 13%.
- Adding 6 GW of nuclear capacity by 2025 would reduce the forecast level of total gas consumption by around 7%.
- New nuclear generation can be justified in some – but not all – states of the world considered in the analysis.

Gas fired generation has a cost advantage over new nuclear generation in the central gas price scenario

4. The central gas price scenario assumes a gas price of 36 pence / therm and a gas fired generation cost of £33.50 per megawatt hour (MWh). It is assumed that the cost of new nuclear generation is £37.50 / MWh. (These are “levelised” costs i.e. total capital and other costs are spread equally over the assumed lifetimes of the plant.)
5. The nuclear cost figure adds a premium to figures from various studies and industry feedback, and construction cost data from the project currently underway to add a new nuclear plant in Finland, in order to allow for *appraisal optimism*. Waste management costs are estimated under the assumption that future waste would be disposed of geologically together with legacy waste. The underlying assumption on decommissioning costs is conservative relative to estimates provided by vendors.
6. The cost advantage of gas fired plant in the central case is around £30 million / GW annually, with NPV of around £700 million / GW over forty years.

Cost penalties in pessimistic scenarios for nuclear are small relative to total system costs

7. The cost-benefit analysis includes pessimistic scenarios for nuclear investment: a gas price of 21 pence / therm; a nuclear levelised cost of £43.80 / MWh. The aggregate annual cost penalty, resulting from a combination of the two pessimistic scenarios, is of the order 1.25% of total power system costs for each GW of nuclear capacity. In present value terms, cost penalties in these pessimistic scenarios sum to just over £4 billion / GW.

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Security of supply benefits are a smaller order of magnitude than environmental benefits

8. Investment in new nuclear capacity would reduce the level of total gas consumption and gas imports in 2025. A programme to add 6 GW of new nuclear

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capacity by 2025 would reduce total forecast gas consumption in 2025 by around 7%.

9. In a world where gas fired plant is added to the power system rather than nuclear plant, this increases vulnerability in the event of a gas supply interruption. Given this vulnerability, the economic option would be to back up gas fired plants with oil distillate switching capability. In the event of a gas supply interruption, gas fired plants would then be able to continue operating for a period up to one winter in duration.
10. If nuclear plant is added rather than gas fired plant, there is no longer the need to maintain back up capability. The benefit of nuclear generation can then be seen as avoided cost of oil distillate back up, estimated to be of the order £100 million / GW.

Welfare balance is positive in central / high gas price, central / low nuclear cost worlds, and negative in low gas price / high nuclear cost worlds

11. The welfare balance associated with nuclear new build relative to a do nothing scenario where gas fired plant is added to the power system is the sum of security of supply and environmental benefits net of any nuclear cost penalties. Welfare balances under alternative scenarios are presented in Table 1 below.
12. The table shows that the net benefit of nuclear generation is negative at low gas prices even at the high end of assumed carbon prices, and more so if nuclear costs are high. In a low gas price scenario, a carbon price of £40 / tonne is required to justify new nuclear generation. In a high nuclear cost scenario, a carbon price of £27 / tonne is required in order that the net benefit of new nuclear generation is positive.
13. Welfare balance is positive in the central gas price world for a carbon price above £10 / tonne, and in high gas price / low nuclear cost worlds across the range of carbon prices (including a zero carbon price).

Table 1: nuclear generation welfare balance under alternative gas price, carbon price and nuclear cost scenarios, £ / GW

	Low gas price	Central gas, high nuclear	Central gas price	Central gas, low nuclear	High gas price
Carbon price = £0/tCO ₂	-2600	-1700	-600	700	1100
Carbon price = £10/CO ₂	-1900	-1100	0	1300	1700
Carbon price = £17/CO ₂	-1500	-600	500	1800	2200
Carbon price =	-1000	-100	1000	2300	2600

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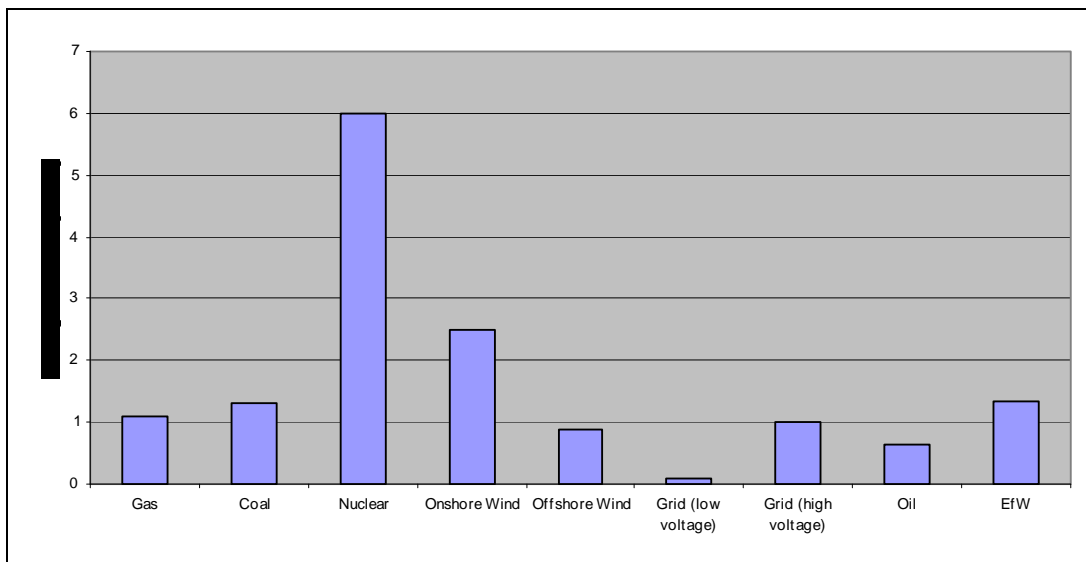
£25/CO2					
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Nuclear generation is likely to be justified in a world where there is continued international commitment to carbon emissions reduction and gas prices are at or above 36 pence / therm

14. The economic case against nuclear arises if the probability of low gas prices / high nuclear costs is significantly higher than the probability attached to other scenarios, and / or the carbon price is significantly less than the £25/ tonne assumed in the analysis.
15. In the central gas price scenario, nuclear generation is economically justified unless international commitment to emissions reduction falls away, in which case the relevant carbon price is zero. As far as some commitment remains, environmental benefits of nuclear investment accrue and net benefits associated with this option are positive.
16. This continues to be true as nuclear costs increase beyond the range given in the various studies of nuclear generation. In the central gas price scenario, and valuing environmental benefits at a carbon price of £25 / tonne, the economics of nuclear generation remain robust for a nuclear generation cost up to £43 / MWh. This is well above the forecast cost of power generated from the Finnish nuclear project currently under construction, by a margin that far exceeds any historical cost overruns associated with nuclear projects (e.g. Sizewell B).

Annex 2 - Barriers to Nuclear New Build

1. The pre-construction regulatory framework for new generating capacity creates delays, uncertainty and significant process costs for developers. These are especially acute for nuclear power stations, where there are eight consents required from five different regulators. Figure 3 shows the extent of the these delays compared to other generating types:



Source: Electricity Development Consents Directorate, DTI

Figure 3: Time taken to secure planning permission in England and Wales for power stations >50MW under Electricity Act 1990

NB – Nuclear based on Sizewell B, most recently constructed (although consented under previous regime). Hinkley Point subsequently secured consent in 3 years but was not constructed

2. For Sizewell B, the direct planning inquiry costs alone were £30m and the process took more than six years (of which less than ten percent of time was devoted to local issues). Furthermore, a two-year delay between the submission of the inspector's report and the decision by the Secretary of State cost the developer £98m in increased financing costsⁱⁱ. During this time, the Nuclear Installations Inspectorate (NII) was considering the application for a site licence; during this process the developer invested £180m in abortive design changesⁱⁱⁱ as design modifications were proposed.
3. These costs, and the risks associated with regulatory uncertainty, increase the financing cost of nuclear, which compromises the investment decisions of potential developers. Industry has reported that without changes to the regulatory framework, nuclear will not come forward. Although there are many factors influencing the investment decisions of potential developers, the uncertainty and potential for delays in the pre-construction process of nuclear further slant the playing field in favour of more straightforward technologies like gas.

ⁱⁱ Information supplied by British Energy

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Annex 3 – Detail on Facilitating Measures

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Costs of Facilitating Measures

Action	Cost to Government	Cost to Business
White Paper	Administrative	£0
Justification	Administrative	£0
Primary Legislation	Administrative	£0
Inquiry Rules	Administrative	£0
Pre-Licensing	Administrative	£15m
Strategic Environment Assessment	£2-5m	
White Paper	Administrative	£0
Decommissioning Arrangements	£0m Contingent Liability of c£636m per reactor (if EPR)	c£636m per reactor (if EPR)
Waste Arrangements	Cost of repository for legacy waste (£11.2bn) ^{iv} Contingent Liability c£159m per reactor (if EPR)	O&M costs of £64m per reactor (if EPR) c£159m per reactor (if EPR)

^{iv} A repository will be required, regardless of a decision for new build or not.

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ANNEX 6 - DECOMMISSIONING AND WASTE COSTS

Decommissioning

1. Any private sector player building and operating a new nuclear reactor would be required to meet the full costs of its subsequent decommissioning, irrespective of the costs of doing so.
2. However, there are uncertainties over what these costs could be, for a number of reasons: they are unlikely to occur for at least 50 years, there has been no experience of decommissioning the new generation of power stations and because Government, through controlling the regulatory environment under which decommissioning takes place, has the power to significantly influence the costs and timescales of clean up. These uncertainties mean that an operator could suddenly face a significant increase in decommissioning costs towards the end of the asset cash generating life, due to changes that are outside operator control.
3. Given these uncertainties, and given the particular features of the nuclear industry, there is a risk that an owner/operator may experience circumstances in which it is unable to meet the costs of decommissioning the nuclear plant, particularly as the cash outflows involved occur decades after the end of the revenue generating life of the asset itself.
4. In these circumstances, Government would come under pressure to meet the unfunded costs of decommissioning if no alternative means of funding were available to the owner/operator. Government is ultimately responsible for ensuring that decommissioning is carried out safely.
5. This risk will always rest with Government. However, in order to mitigate the contingent liabilities and costs to the taxpayer associated with this risk, Government would need to establish robust and transparent arrangements with industry to ensure that the liability is adequately funded. If a decision is taken to enable new nuclear build, Government (particularly the NDA) would need to work closely with industry over the coming year to develop these arrangements.
6. One aspect of these arrangements might involve a cap on operator liability in the event of regulatory change; further discussions with industry are necessary to determine if this would be essential to enable investment. At this stage we judge the need for a cap on decommissioning liabilities to be very slim, but we cannot rule it out completely. We would also need to ensure that any arrangements were compatible with the State Aid rules.

Waste

7. As with decommissioning, there is a presumption that owner/operators should meet the costs of managing and disposing of waste created by new build. However, (and again, as with decommissioning), Government would come under

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pressure to guarantee that these costs would be met, given Government's responsibility to ensure that waste is managed safely.

8. It is feasible to envisage a scenario where operators are obliged to manage all waste (including spent fuel) on site for the life of a plant, with Government taking responsibility (for a fee) for disposing of the waste when the plant closes.
9. CoRWM presents additional uncertainty to the costs of final waste disposal. Discussions with industry players suggest they are comfortable with managing ongoing waste during the operational stage of a plant's life (for example, on-site storage, and managing these costs within operation and maintenance expenditure). The major area of uncertainty lies around final disposal. Operators will want certainty over the quantum of any contribution to the fixed costs of final disposal. They are clear that there is a great deal of uncertainty over the costs of the solution for final disposal. They also point out that they have no scope to influence the scale of the costs, or reduce the risk of any cost overruns.
10. To minimise the risk of unfunded contingent liabilities, Government could ensure that operator payments reflect the potential costs of final disposal in a repository, with an additional margin to cover interim storage in the event that a repository is not ready to take the waste when plants close. This should help avoid situations like that in the US, where operators are pursuing cases against the US Government for failure to deliver the Yucca Mountain repository in time to take waste for which levies had been paid.
11. Industry argues that any increase in costs of waste management caused by changes in regulation should be borne by Government. There is a case for Government not taking the full regulatory cost risk, given that other sectors of the economy (e.g. oil or water companies) face similar risks. However, as with decommissioning, there may be a case for Government taking part of the risk by, for example, entering into risk sharing agreements where any increase in regulatory cost to an operator is capped. Further work and discussion with industry is necessary to establish whether such a risk sharing arrangement would be essential to enable investment. We would also need to ensure that any arrangements were compatible with the State Aid rules.

Annex 7 – Related Nuclear Issues

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Whilst the price of uranium ore has risen in recent years, future increases, even with increasing global demand, are expected to be modest. Prices are expected to remain substantially below historically high levels of the 1970s. It is also important to note that a doubling of uranium prices would have a minor impact on final fuel costs and overall generation costs.

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Grid implications for possible new nuclear build

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The question of physical grid connection for new build is an important issue, experience has shown that securing timely consent for major grid reinforcements can be a lengthy and expensive process.

Replacing current nuclear power stations with modern designs is not a simple matter of reconnecting to the grid. Several old nuclear power stations were 300-500MW and connected at the 132kV distribution network. Modern designs could be in excess of 1600MW. This will require major line reinforcement that in turn will need to go through the planning application process via Section 37 of the Electricity Act. However, it is important to note that any applications under section 37 for consent will also benefit from the improved approach to planning outlined in Annex 3.

Another problem is timing of phasing out old sites, or if several reactors are required to be built on the same site. Total capacity of a single transmission line in Great Britain cannot exceed 1320MW. At a site with a single transmission line, where one AGR and one Magnox exist and the latter is replaced, this capacity would be breached and another transmission line would be required.

A further issue is the assumed growth of off-shore wind. It is likely to connect into a sub-station located at nuclear power stations due to their location on the coast. This is something with which new build would need to contend, although any necessary upgrades during the life of the nuclear plant required because of an expansion in off-shore wind would have to be considered as part of the later (wind) project.

As part of the Review, an analysis was undertaken by industry experts with considerable input from National Grid and Ofgem, to determine what likely investments would be required to accommodate new nuclear power stations at existing sites. The experts concluded that, although it would probably be necessary for new grid infrastructure at all existing sites in order to accommodate new build, that it did not present an insurmountable barrier at enough sites to sustain at least a programme to replace our current nuclear capacity.

The focus of this analysis was not on the potential grid reinforcements that may be needed as the result of new build, because the cost of these reinforcements would be spread across all users of the grid, through the Transmission Charge (TNUoS), and not the individual developer. For example, building a nuclear power station in the far north of Scotland would place major strain on north south flows that a station in the south east of England would not. Further work should be undertaken on this as part of any future White Paper.