UPDATE ON DEVELOPMENTS RELEVANT TO THE MANAGEMENT OF NEW BUILD WASTES

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This document does not present the views of the Committee on Radioactive Waste Management nor can it be taken to present the views of its author. It is a paper to inform Committee deliberations and both the author and the whole Committee may adopt different views and draw entirely different conclusions after further consideration and debate.

Introduction

1. This paper was originally produced to update CoRWM on developments relevant to the management of higher activity wastes from new nuclear power stations between the August 2010 plenary meeting, when CoRWM discussed its work on new build wastes for the second half of 2010-11 (CoRWM doc. 2845), and March 2011, when CoRWM was finalising its proposed work programme for 2011-12 (CoRWM doc. 2919). This version of the paper takes account of comments made by DECC, EDF and NDA on an earlier draft, of discussions at CoRWM's plenary meeting on 29-30 March 2011 (CoRWM doc. 2930) and of events since then.

Government Developments

National Policy Statement

2. The second consultation on the draft National Policy Statements (NPSs) for energy infrastructure (DECC, 2010a) closed on 24 January 2011. After discussion at the November 2010 plenary meeting (CoRWM doc. 2869), CoRWM did not respond directly to the consultation but sent the Department of Energy and Climate Change (DECC) a letter (CoRWM doc. 2878) about waste management issues arising from the Government response to the first NPS consultation (DECC, 2010b).

3. The DECC Business Plan (DECC, 2010c) stated that the final NPSs would be put before Parliament for ratification in May 2011. However, in March 2011 the DECC Secretary of State said that Government would consider the nuclear NPS in the light of the events at Fukushima before proceeding with the ratification process. Following the publication of the interim report from HM Chief Inspector for Nuclear Installations on the implications of the events at Fukushima for the UK nuclear industry (ONR, 2011), Government announced that it would bring forward the NPSs for ratification as soon as possible after it had considered the report in detail.

Justification

4. The Secretary of State's decisions, as Justifying Authority, that the UK EPR and AP1000 reactor designs have been shown to be "justified" were published in October 2010 and placed before Parliament. The decisions were given effect by Statutory Instruments, which were approved by Parliament in November 2010. This completed the justification process for the UK EPR and the AP1000 designs.

Funding Arrangements

5. Two parallel consultations on funding arrangements for decommissioning and waste management for new nuclear power stations began in December 2010 and ended on 8 March 2011. One of these consultations was about the Waste Transfer Pricing Methodology (DECC, 2010d). The other was about Funded Decommissioning

Programme Guidance (DECC, 2010e). These followed on from previous consultations (BERR, 2008a,b; DECC, 2010f), to which CoRWM did not respond[1].

6. The Waste Transfer Pricing Methodology and the Funded Decommissioning Programme Guidance are to be finalised before one of the potential new build operators, NNB GenCo[2], submits its Funded Decommissioning Programme (FDP) to Government. DECC plans that the FDP Guidance will be published later this year, at the same time as the Financing Order and Regulations come into force.

7. In addition, NNB GenCo has requested an indicative "Expected Price" as input to its FDP. At the time of approval of the FDP, Government will set the "Cap" for NNB GenCo's waste transfer price and will set the Expected Price that will apply until the first quinquennial review of the FDP.[3] The methods for establishing the Cap and the Expected Price will be given in the final Waste Transfer Pricing Methodology.

2050 Pathways Analysis

8. In July 2010, DECC published its 2050 Pathways Analysis report (DECC, 2010g), which examined how the UK could secure low carbon energy supplies to 2050, and requested feedback by 5 October 2010[4]. The section on nuclear power set out four illustrative "trajectories" for nuclear power generation:

    - Level 1 – no new build
    - Level 2 – installed nuclear capacity of 39 GW by 2050
    - Level 3 – installed nuclear capacity of 90 GW by 2050
    - Level 4 – installed nuclear capacity of 146 GW by 2050.

9. The text of the report indicated that the Level 1 and Level 4 trajectories were unlikely. The Level 2 trajectory implied a lower rate of building new power stations than in current plans (which would imply an installed capacity of 16 GW by 2025, paras 23-24). The Level 3 trajectory reflected current plans and assumed that the build rate in these plans would continue.

10. The report only mentioned the possible need for a second geological disposal facility (GDF) in the case of the Level 4 trajectory. It stated that participants at a nuclear industry workshop thought it unlikely that reprocessing of new build spent fuel would become an attractive or necessary option in the time to 2050. It also stated that workshop participants considered that a transition to other reactor technologies was unlikely over this time period.

Regulatory Developments

Health and Safety Executive

11. Prior to the March 2011 events at Fukushima, the Health and Safety Executive (HSE) was on track to complete its Generic Design Assessment (GDA) of new nuclear power stations in June 2011 (HSE & EA, 2010a). However, it was expected that there would be GDA issues to resolve after that date.

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[1] CoRWM had only recently been reconstituted at the time of the 2008 consultation. The reasons for not responding to the 2010 consultation are in CoRWM doc. 2817.
[2] NNB GenCo is the operating company formed by EDF Energy and Centrica; see para 22 for further details.
[3] See Annex A for more on these concepts and the methodology for setting the prices.
[4] www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx.

12. In anticipation of this situation, HSE and the Environment Agency (EA) published guidance on the management of GDA outcomes (HSE & EA, 2010b). This document discussed the nature of the HSE's Design Acceptance Confirmation (DAC) and the EA's Statement of Design Acceptability (SoDA), and the resolution of GDA issues and assessment findings raised during GDA.

13. Requesting Parties (para 22) have the responsibility for resolving GDA issues. They are required to produce Resolution Plans and submit these to the regulators. All the GDA issues need to be cleared before regulators can provide their final DAC and SoDA. In spring 2011 there were expected to be relatively few GDA issues (HSE & EA, 2011a) and CoRWM was told that none of these were expected to relate to radioactive waste management (CoRWM doc. 2904).

14. However, there were expected to be a relatively large number of GDA "assessment findings". It would be for new build operators to take into account these assessment findings during the site-specific nuclear licensing and environmental permitting processes. There would be assessment findings for each reactor design, some of which would relate to radioactive waste management (CoRWM doc. 2904).

15. Requesting Parties are not required to specify exactly how radioactive wastes will be managed in their GDA submissions. They are required to provide regulators with credible plans that include a base case and other options, and that indicate when decisions will need to be taken on which options are to be implemented. It is for new build operators to take these decisions, in the light of site-specific and fleet-wide factors, and views expressed in the public consultations required by the regulatory and planning regimes.

16. In 2010, HSE and EA had some early discussions with DECC about the possibility of a second round of GDA for additional reactor designs (HSE & EA, 2010a). A GDA2 would have planning and resource implications for HSE and EA and would need to be carried out so that there were no adverse impacts on GDA1 or on site-specific licensing and permitting.

17. In April 2011, the Office for Nuclear Regulation (ONR) was created as an agency within HSE. ONR contains the Nuclear Installations Inspectorate, the Office for Civil Nuclear Regulation and the UK Safeguards Office. From 1 July 2011 it will also include the Department for Transport's Radioactive Materials Transport Team. When it is fully operational as a statutory corporation, ONR will be an autonomous organisation, legally separated from, but still supported by, HSE. From April 2011 onwards, GDA work has been carried out within ONR.

Environment Agency

18. The EA consultation on its GDA findings ended in October 2010. Summary reports of the responses were published in December 2010 (EA, 2010a, 2010b). Annex B gives some further details of points made in the responses.

GDA and Implications of Events at Fukushima

19. ONR and EA announced in April 2011 that they would not draw conclusions from GDA in June 2011 as had been planned (HSE & EA, 2011b). This was because they wished to take into account the findings of the interim and final reports of HM Chief Inspector for Nuclear Installations on the implications of the events at Fukushima for the UK nuclear industry. However, in July 2011 ONR and EA would publish the GDA issues that had been identified by that time, together with the Requesting Parties' Resolution Plans for those issues (HSE & EA, 2011c).

20. There would be a new GDA issue for each reactor design to cover any relevant recommendations from the Chief Inspector's reports. When the recommendations were known, the Requesting Parties would develop plans to address them. The timescales for issue of the final DACs and SoDAs would depend on the contents of these plans (HSE & EA, 2011c).

21. ONR and EA also stated that they would not publish their GDA Technical Assessment Reports in June 2011 as originally planned. The reports would be revised to take account of relevant recommendations from the Chief Inspector's reports and any safety case changes that the Requesting Parties wished to make as a result of their own assessments of events at Fukushima. The reports would be published as they became available (HSE & EA, 2011c).

Developments by Requesting Parties and Potential Operators

22. The Requesting Parties are the companies that have asked for their reactor designs to be considered in GDA, namely EDF and AREVA for the UK EPR and Westinghouse for the AP1000. EDF Energy is also a potential operator. It has formed an operating company, NNB GenCo, with Centrica. The latter has an option to contribute up to 20% of NNB GenCo's investment in new nuclear power stations.[5]

23. Other potential operators are Horizon Nuclear Power (a consortium of E.ON UK and RWE npower) and NuGeneration Ltd (NuGen, a consortium of Iberdrola, GDF Suez and Scottish and Southern Energy). Vattenfall also has an interest in entering the UK market but as yet has not published any plans. The following table shows the plans of each operator.

Potential Operator	*Potential Sites*	*Reactor Type and Capacity*
NNB GenCo	Hinkley Point Sizewell	UK EPR, two reactors at each site, 6.4 GW(e) total
Horizon	Wylfa Oldbury	reactor type not chosen, about 6 GW(e) in all
NuGen	land north of NDA Sellafield site	reactor type not chosen, up to 3.6 GW(e)

24. The current plan is for the first EPR at Hinkley Point to start commercial operation in 2018. Horizon aims to start its first station in 2020 and NuGen's station may start in 2023.

25. The pre-planning application consultation on the proposals for Hinkley Point ended in October 2010. A further consultation on some aspects was held from 28 February to 25 March 2011. A planning application for site preliminary works has been submitted to West Somerset County Council. Separate applications for a temporary jetty have been made to the Marine Management Organisation and the Department for Transport. It has been reported that there are still some concerns about the appraisal of local impacts at Hinkley Point (NuLeAF, 2011). Stakeholder engagement at Sizewell is continuing (NuLeAF, 2011).

[5] Centrica owns 20% of British Energy's nuclear power stations and EDF Energy 80%. Both British Energy and NNB GenCo are part of EDF Energy, which operates the existing stations and will operate the new ones.

Nuclear Decommissioning Authority Work

26. In November 2010 NDA published a report on its work on management of new build spent fuel for potential new build operators (NDA, 2010). The work was commissioned via the Nuclear Industry Association (NIA). It explored potential options for the location of stores and packaging plants for new build spent fuel, storage systems, various types of disposal canisters and various geological disposal concepts. CoRWM met NDA, NIA and EDF on 31 January 2011 to discuss the report and possible future work (CoRWM doc. 2906).

27. NDA has carried out work for DECC on estimating the costs of geological disposal of new build spent fuel and intermediate level wastes (ILW). It used its Parametric Cost Model to provide input to the DECC consultation on a Fixed Unit Price for waste disposal (DECC, 2010f). It has calculated the cost of an illustrative scenario for geological disposal of new build spent fuel and ILW, as input to DECC's determination of an indicative Expected Price for NNB GenCo (para 7).

28. Points that arose in the 31 January 2011 meeting about NDA work for NIA and DECC on new build wastes included the following (CoRWM doc. 2906).

    i) There is little scope for further technical work on establishing regional or central storage facilities and packaging plants for new build spent fuel in the short term. Regional or central facilities may offer considerable advantages over constructing a spent fuel storage facility and packaging plant at each new build station (the base case for GDA and for FDPs). In order to establish regional or central facilities it would be necessary to identify suitable locations. There is an expectation that this would be done in a way that involves local communities, and takes into account potential locations of a GDF (or GDFs). There is no urgency to develop an appropriate approach (for example, a new build spent fuel packaging plant is unlikely to be required before about 2120).
    ii) Feedback from the Hinkley Point pre-planning application consultation indicated that people feel that 50 years[6] would be a long, but not an unacceptable, period to store spent fuel at a new reactor site after the end of electricity generation. Some respondents did not view a 50 year storage period very differently from, say, 100 years. In all cases they would need assurance that fuel could be kept safely and securely once reactors have been closed and decommissioned.
    iii) When considering options for reducing the heat output of spent fuel disposal canisters in the feasibility studies report (NDA, 2010), NDA did not assess the implications for the areal extent (footprint) of a GDF. NDA recognise that reducing the quantity of spent fuel in each canister, or reducing the burn-up of some or all of the fuel, could increase the GDF footprint significantly.
    iv) There are differences between the quantities of new build spent fuel:
        - in the NDA's "Upper Inventory" for a GDF in its generic Disposal System Safety Case (DSSC), which is based on 10 GW installed capacity
        - implied by the 16 GW capacity currently planned by new build operators (para 23) and used in NDA Expected Price work for DECC
        - implied by the 39 GW and 90 GW figures in scenarios in the Government's 2050 Pathways Analysis (para 8).
    v) With the NDA's baseline and upper inventories, the footprint of the part of a GDF that holds heat generating waste (vitrified high level waste and spent fuels) is

[6] The original NDA work for the Requesting Parties on disposability of new build spent fuel indicated that storage for over 100 years would be needed prior to disposal. The November 2010 report (NDA, 2010) indicated that the storage period could be reduced to about 50 years.

much larger than that of the ILW part. The quantity of heat generating waste is thus likely to be a major factor in GDF siting.

vi) CoRWM noted that NDA appears to continue to focus on the KBS-3 concept for disposal of spent fuel (and vitrified HLW). This is the only concept for spent fuel and HLW for which there is any quantitative post-closure safety assessment in the DSSC[7]. It is the only concept considered in any detail in the Letter of Compliance (LoC) process. It is also the basis for NDA's Parametric Cost Model[8] (DECC, 2009a) and is the reference case for NDA's cost calculations for DECC for its determination of an Expected Price (see Annex A).

vii) In early engagement on developing the specification for the generic DSSC, EA made the point to NDA that, for optimisation purposes, it would be better to consider a range of concepts for geological disposal on an equal footing; engagement with EA has continued on this topic.

viii) NDA noted that the LoC process requires an element of quantified assessment and to be consistent with past practices assessments against the KBS-3 concept have been maintained. However, packaging specifications are to be updated considering the totality of the DSSC.

Issues for CoRWM's Future Work on New Build Wastes

Optimisation of the Management of New Build Wastes

29. It is evident that DECC has two potentially competing objectives with respect to the management, including the geological disposal, of new build spent fuel and ILW:

    - to establish the price it will charge to new build operators for geological disposal in such a way as to minimise the risk that there is any residual liability for the Government (and hence tax payers)
    - to minimise the actual costs of geological disposal of new build wastes (in order to minimise costs to Government and hence tax payers).

30. New build operators and NDA are required by regulators to optimise all their waste management activities, including geological disposal of new build wastes. The Government's prices for geological disposal may not be fixed until 30 years after the start of commercial generation at new build reactors (perhaps 2048 for Hinkley Point). Until they are fixed, there is no obvious financial incentive for NDA, as Government's delivery organisation, to optimise geological disposal of new build wastes.

31. At present, new build operators also have limited financial incentive to work with NDA on optimisation of geological disposal. This is because the prices they expect to be charged by Government are heavily influenced by factors such as the financing charge for fixed costs, the allowance for an optimism bias and the risk premium, all of which are to be added to the NDA's best estimates of costs (see Annex A).

Consideration of New Build Wastes in the MRWS Process

32. When the 2008 MRWS White Paper was published, the focus was on legacy wastes. Although it was recognised that new build wastes would have to be considered and accommodated if they arose, the baseline inventory for a GDF did not include new build wastes (Defra et al., 2008).

[7] Illustrative GDF designs for two other types of geological settings are considered in the DSSC. The safety cases for these are qualitative.

[8] The Parametric Cost Model can deal with various rock types, GDF depths, waste inventories etc. but its starting point for spent fuel and vitrified HLW is the KBS-3 concept in "strong rock" (DECC, 2009a).

33. The situation now is somewhat different. Although they have yet to take final investment decisions, new build operators have announced plans to construct reactors with a total capacity of 16 GW by 2025. DECC has considered scenarios involving 39-90 GW installed nuclear capacity by 2050 (DECC, 2010g). The Committee on Climate Change examined a scenario in which about 40% of the UK's power is generated by nuclear stations by 2030 (CCC, 2011). In such scenarios, the quantities of spent fuel produced by new reactors could well be the dominant factor in determining the size of a single GDF, or could necessitate the construction of more than one GDF.

34. It therefore seems anomalous that NDA is only considering new build spent fuel from reactors with a 10 GW capacity in its implementation planning and its DSSC, and is doing so in less detail than for the baseline inventory, which does not include any new build wastes. A more comprehensive and flexible approach would seem to be required, which takes into account the timescales on which decisions will be taken about whether new nuclear power stations will be built and how their spent fuel will be managed.

Use of a Geological Disposal Reference Case

35. NDA makes extensive use of a reference case for geological disposal, which consists of one GDF in hard rock, made up of the KBS-3V concept for HLW and spent fuel and the Nirex phased repository concept for ILW. The reference case is the one that is:

    - considered in most detail in implementation planning
    - the subject of some quantitative post-closure safety assessment in the DSSC
    - used as the main basis for LoC work
    - used in NDA calculations for DECC of Expected Prices for geological disposal of new build spent fuel and ILW
    - forms the basis for the NDA Parametric Cost Model, which will be used in setting the Caps on prices for geological disposal of new build spent fuel and ILW.

36. It is clear that NDA needs to use a reference case, or a small number of reference cases. It would be impractical to consider a large number of combinations of geological disposal concept and geological setting for all the above purposes. It is equally clear that over-emphasis on a reference case is incompatible with the optimisation requirement and could waste time and money.

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ANNEX A

DECC Consultations on Funded Decommissioning Programme Guidance and an Updated Waste Transfer Pricing Methodology

Scope of and Background to the Consultations

A1. The funding arrangements for new build decommissioning and waste management are set out in the Energy Act 2008. New build operators must, before construction starts, have a Funded Decommissioning Programme (FDP), approved by the DECC Secretary of State. The Nuclear Liabilities Financing Assurance Board (NLFAB) has been set up to advise the Secretary of State on the adequacy of the proposed FDPs submitted to him. FDPs are then to be reviewed every five years.

A2. Operators must publish their FDPs, annual reports on these FDPs and reports on the quinquennial reviews. The initial FDP, any major proposed modifications, the annual reports and the quinquennial reports must be accompanied by verification reports. The Verifier will usually be commissioned by the operator but must be independent of the operator.

A3. An FDP will consist of a Decommissioning and Waste Management Programme (DWMP), which sets out what is to be done, and a Funding Arrangements Plan (FAP), which sets out how the operator will set up and maintain a Fund to cover decommissioning, waste management[9] and waste disposal costs. There was a consultation on Statutory Guidance on FDPs in 2008 (BERR, 2008a,b). Since then DECC has held discussions with potential new build operators and, partly as a result, has made changes to the Guidance. While these changes are not considered to be very significant, DECC thought it desirable to seek further views. The current consultation document contains revised Guidance and an explanation of the changes (DECC, 2010e).

A4. The consultation on the updated Waste Transfer Pricing Methodology (DECC, 2010d) was preceded by a consultation on determining the Fixed Unit Price (FUP) for waste disposal and cost estimates for decommissioning, waste management and waste disposal (DECC, 2010f). Prior to this, three pre-consultation discussion papers were issued for comment (DECC, 2008; DECC, 2009a, b). The current consultation document (DECC, 2010d) contains the Government response to the FUP consultation and seeks views on an updated methodology.

Funded Decommissioning Programme Guidance

The Base Case in an FDP

A5. In an FDP an operator must show that there are realistic, clearly defined and achievable plans for decommissioning, waste management and waste disposal, and that the operator has made robust cost estimates for these plans, taking account of risks and uncertainties. The Base Case given in the proposed FDP Guidance is intended to assist the operator to make cost estimates and is used by Government in making its benchmark cost estimates, for use in judging whether FDPs are adequate. The operator can put forward alternative approaches but must justify them.

A6. The proposed FDP Guidance (DECC, 2010e) states that the Base Case may differ from regulatory requirements related to safety, security or protection of the environment. This

[9] DECC uses the term “waste management” to mean all activities except disposal. CoRWM uses it to mean all the activities involved in dealing with waste, from controlling its generation through to and including its disposal.

is because the Base Case is to be used for the purpose of making prudent financial provisions, not for meeting regulatory needs.

Working Assumptions for the Base Case

A7. The proposed FDP Guidance lists the Base Case assumptions. These include:

- a 40 year station operating life
- the regulatory regime that is in force throughout the station's operation and decommissioning is that in force when the FDP is submitted
- storage of ILW will occur at power station sites and will be followed by geological disposal, in "the same geological disposal facilities to be used for the disposal of ILW from existing nuclear facilities"
- ILW must meet the GDF operator's conditions for acceptance at the date scheduled for its disposal
- new nuclear power stations will use uranium or uranium oxide fuel
- spent fuel will not be reprocessed[10]
- spent fuel will be stored at each power station site, packaged at that site, then transported to and disposed of in "a GDF".

A8. It is recognised in the proposed FDP Guidance that all the reactor designs in the GDA have a planned operational life of 60 years. It is stated that it will be open to operators to propose and justify an operational life longer than 40 years. However, operators must then ensure that their funding provisions are robust against the risk that the station has to be decommissioned earlier than planned.

A9. The Guidance notes that use of regional or central spent fuel storage facilities or packaging plants would entail lower costs.

Costs to be met from the Operator's Fund

A10. The costs of conditioning and packaging of operational ILW and the costs of operation of spent fuel ponds during the life of the station are to be met from operational expenditure. Other ILW and spent fuel management costs are to be met from the operator's Fund.

A11. Thus the Fund must cover the costs of:

- construction and maintenance of ILW stores (other than those built when the station is constructed)
- conditioning and packaging of decommissioning ILW
- transport of all ILW to a GDF
- disposal of ILW
- operation of fuel ponds after the station has ceased generating electricity
- construction and maintenance of interim stores for spent fuel
- encapsulation of spent fuel for disposal
- transport of spent fuel for disposal
- disposal of spent fuel.

[10] The draft FDP Guidance actually says (p45): "there will be no reprocessing of uranium fuel". Presumably this is a typo, since the assumption is clearly that there will be no reprocessing of oxide fuel either.

Waste Transfer Pricing Methodology

A12. The Waste Transfer Price is the price that Government will charge the operator of a new nuclear power station when it takes title to and liability for waste. The Waste Transfer price must cover the costs of geological disposal of the waste. It is expected that Government will take title to and liability for waste after a power station has been decommissioned but before a GDF (or GDFs) are ready to take the waste. In the case of such "Early Transfer", the operator will pay Government a lump sum to cover pre-disposal costs, in addition to the Waste Transfer Price.

A13. The methodology deals with the setting of:

- the Expected Prices of geological disposal of spent fuel and ILW (*i.e.* the prices to be assumed by operators for provision of funding, up until the time that the Final Prices are set; these are reviewed every five years)
- the Caps on waste transfer prices
- the Final Price.

A14. The consultation document (DECC, 2010d) states that the methodology is largely consistent with that in the FUP consultation (DECC, 2010f). However, the FUP consultation did not deal separately with Expected Prices, Caps or Final Prices.

Expected Price

A15. In the proposed methodology, an Expected Price has four components:

- the Estimated Costs of geological disposal of new build ILW or spent fuel
- the Optimism Bias Adjustment
- the projected Risk Premium
- the projected Risk Fee.

Estimated Costs of Geological Disposal

A16. The Estimated Costs of geological disposal are derived from NDA's current best estimates for its reference case. The Estimated Costs include:

- full variable costs (*e.g.* of the construction of tunnels and vaults to take new build wastes, of emplacement of new build wastes)
- a contribution to fixed costs (*e.g.* construction of surface facilities and the access shaft and drift).

A17. The contribution to fixed costs is calculated in proportion to the new build waste share of the total variable costs of geological disposal. The calculation contains assumptions about the inventories of existing and committed wastes and new build wastes in a GDF.

A18. A financing charge is added to the fixed cost contribution. This is to cover the situation in which a GDF has to be constructed to a timetable driven by new build operators. For example, if new build spent fuel would not be ready for emplacement in a GDF when emplacement of existing and committed wastes would have been completed, construction of the parts of the GDF to hold new build spent fuel would be delayed and the surface facilities and access shaft and drift would stand idle. In the worked examples given in the consultation document (DECC, 2010d), the financing charge adds 38% to the fixed cost contribution for spent fuel.

Optimism Bias Adjustment

A19. The Optimism Bias Adjustment allows for uncertainties in calculating the costs of any specific disposal scenario. Such uncertainties are mainly those about the scope, timing and duration of disposal activities. The methodology uses the HM Treasury "Green Book" guidance to derive the adjustment. The consultation document states that the appropriate range for the Optimism Bias Adjustment is 6-66% and uses 66% in the worked examples (DECC, 2010d).

Risk Premium

A20. The Risk Premium is to compensate the tax payer for accepting the risk of cost escalation after Government has taken title to and assumed liability for the waste. In the Expected Price a projected value of the Risk Premium is used. There is a worked example in the consultation document (DECC, 2010d) of how a Risk Premium would be calculated. This is based on NDA's cost estimating guidance PCP09 and gives a Risk Premium for spent fuel of 15.5%.

Risk Fee

A21. The Risk Fee is to compensate the Government for accepting the small risk that the actual disposal cost will exceed the Cap. In the worked examples in the consultation document it is £2k/tU for spent fuel.

Results of Example Calculation of Expected Price for Disposal of Spent Fuel

A22. The results of the example calculation are as follows.

Components	*Price*
NDA best estimate, plus financing charge for fixed costs	£312k/tU (£642k per canister)
plus Optimism Bias	£517k/tU
plus projected Risk Premium	£598k/tU
plus Risk Fee	£600k/tU (£1236k per canister)

Cap

A23. In the proposed methodology, the Cap on the Final Price has three components:

- the Estimated Costs of geological disposal of new build ILW or spent fuel
- the Optimism Bias Adjustment
- the Contingency Allowance.

A24. The Optimism Bias Adjustment is derived in the same way as for the Expected Price (para A19). The other two components are derived as follows.

Estimated Costs of Geological Disposal

A25. The Estimated Costs of geological disposal are calculated using NDA's Parametric Cost Model. A Monte Carlo method is used to obtain a distribution of costs over a range of geological disposal scenarios (including inventory, depth and GDF layout). A financing charge is added to the fixed costs (para A18).

Contingency Allowance

A26. The Contingency Allowance is for wider uncertainties than those covered in the Estimated Costs and Optimism Bias Adjustment. The methodology includes two types of uncertainties (DECC, 2010f):

- incorrect basic assumptions in the Parametric Cost Model, *e.g.*
  - a very different geological disposal concept is used (*e.g.* not KBS-3 for spent fuel in hard rock)
  - co-disposal in a single GDF of vitrified HLW, spent fuel and ILW proves not to be technically possible
  - a GDF is not closed immediately after the end of waste emplacement
- incorrect assumptions about new build waste in the Parametric Cost Model, *e.g.*
  - additional fixed costs for new build wastes (*e.g.* a second GDF is needed to hold some or all new build wastes)
  - a delay in the start of emplacement of new build wastes
  - less spent fuel per canister.

A27. The Contingency Allowance is also calculated as a distribution, using Monte Carlo methods. The Contingency Allowance distribution is then combined with the Estimated Costs distribution, increased by the Optimism Bias (DECC, 2010d). The Cap is set at the 99th percentile of the resulting distribution.

Results of Example Calculation of the Cap on the Price for Disposal of Spent Fuel

A28. The results of the example calculation are as follows.

Components	*Price (£k/tU)*		
	minimum of distribution	*50th percentile*	*maximum of distribution*
NDA Parametric Cost Model estimate, plus financing charge for fixed costs	326	346	455
plus Optimism Bias	541	574	755
plus Contingency Allowance	497	641	1093

A29. In this example the Cap on the price for the disposal of spent fuel is £978k/tU (£2,015k per canister). This is compared in the consultation document (DECC, 2010d) to the current NDA best estimate cost of £312k/tU and the example Expected Price of £600k/tU.

Final Price

A30. The operator can choose the time at which the Final Price for disposal is set and this can be any time up to 30 years after the start of electricity generation at the power station in question. Government states that it expects the Final Price to be set after the first emplacement of legacy waste in a GDF. For example, if a GDF is open by 2040, this would be 22 years after the planned start of generation at the new station at Hinkley Point (2018). In such a case the Final Price would be derived using a Site Specific Cost Estimate, incorporating actual cost data. A Pricing Cost Estimate would be derived as the 95th percentile of the Site Specific Cost Estimate distribution and a Risk Premium added, together with a Risk Fee. The Risk Premium in this case would be smaller than that used for Expected Prices.

A31. The proposed methodology also has provisions for setting the Final Price after site selection for a GDF but before the first waste emplacement, and for setting the Final Price prior to GDF site selection. In the former case the procedure is similar to that for after the first waste emplacement but with a larger Risk Premium. In the latter case a Default Pricing Mechanism would be used, in which the Final Price is at the discretion of the Secretary of State, having regard to cost modelling available at the time. It is stated that a Final Price set using the Default Pricing Mechanism would probably be close to the Cap.

Discounting

A32. When Government sets the Final Price it will provide the operator with an Assumed Disposal Date. This is expected to be after the Transfer Date. The costs paid by the operator for disposal will be calculated using an appropriate discount rate and a discount period that is the difference between the Assumed Disposal Date and the Transfer Date. The consultation document gives an example of how this could affect waste disposal costs for a power station. This example is as follows.

	Current best estimate	*Final Price = Expected Price*	*Final Price = Cap*
Estimated waste disposal liability at Assumed Disposal Date (2130)	£350m	£670m	£1104m
Discounted value at Transfer Date (2080)	£118m	£226m	£372m

ANNEX B

Points from Responses to Environment Agency Consultation on its Generic Design Assessment Findings

In December 2010 EA published summary reports of the responses to its consultation on its findings from its assessment of the AP1000 and UK EPR reactor designs (EA, 2010a,b)[11]. This annex summarises the main points from the responses that are of interest to CoRWM.

EA received 65 responses to its consultation on its GDA findings for the AP1000, of which 18 were from individual members of the public. For the EPR findings it received 78 responses, of which 25 were from individual members of the public.

Geological Disposal

- Some respondents thought that EA was too optimistic about the implementation of geological disposal in the UK. Points made included:
  - only one area has so far expressed an interest in hosting a GDF
  - communities in that area might oppose placing new build spent fuel in that GDF
  - any site chosen for a GDF might not be technically suitable for a facility to hold both new build and legacy wastes[12]
  - the whole of West Cumbria is unsuitable for a GDF.
- It was suggested that the confidence of communities local to sites proposed for new nuclear power stations would be enhanced if there were clear contingency plans for dealing with delays in implementing geological disposal.
- One respondent expressed the view that the KBS concept for spent fuel disposal has been severely scientifically criticised and may not obtain a licence in Sweden.
- One view expressed by several respondents was that new build should not proceed until a GDF is available and to do otherwise would be irresponsible.

Storage of Spent Fuel

- Several respondents felt that the uncertainties about how, where and for how long spent fuel would be stored prior to geological disposal were not acceptable to communities near sites proposed for new nuclear power stations.
- Some respondents thought indefinite storage of spent fuel was a real possibility.
- Concerns were expressed about the safety of spent fuel storage. Issues mentioned included flooding, terrorist attacks and aircraft crash.
- Most respondents were in favour of investigating centralised storage of spent fuel. However, there was some opposition to transport of spent fuel from local storage sites to a central store. There were also concerns as to whether communities would be sufficiently involved in siting decisions for a central store.
- It was pointed out that there were inconsistencies between the spent fuel storage assumptions in the GDA and those in the first Government consultation on the NPS for nuclear. (The EA consultation closed before the second NPS consultation started.)
- EA was criticised for leaving it to EDF to describe the various possibilities for spent fuel storage.

[11] https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda

[12] This point was made qualitatively and quantitatively. In the latter case it was stated that NDA calculations showed that the GDF post-closure risks from new build spent fuel would be over half of the 10^{-6} guidance level, and this was without taking into account issues raised by Nuclear Waste Advisory Associates (NWAA).

Management of Intermediate Level Wastes

- Several respondents expressed serious concerns about the possible incineration of some ILW.
- There was a view that uncertainty about how ILW would be treated, packaged and stored was unacceptable to communities near proposed new build sites.
- It was suggested that EA was too optimistic about the capacity of the LLWR and the ease with which a replacement could be established if necessary. This would be relevant to ILW that was stored until it had decayed to low level waste (LLW).

GDA Process

- One respondent suggested that the regulators should publish the Resolution Plans for GDA issues that remain after step 4 has been completed in June 2011.
- Another respondent felt that it was not clear how GDA fits with other Government and regulatory processes for new build, including Planning processes.
- There was a suggestion from a prospective new build operator that as many issues as possible should be settled during GDA, when designers are in the lead. This is because designers of new nuclear stations are best placed to address many mitigation measures required by regulators. The view was that leaving too many issues to the site specific licensing stage, when operators lead, would place too large a burden on operators.
- Another new build operator expressed the view that it was not appropriate, for GDA purposes, to seek further commitments from NDA about spent fuel management and disposal. Outstanding issues were stated to be operator and site specific.

The Consultation

- One respondent expressed the view that the consultation was not truly "public", because the documents contained much technical detail that was not accessible to many people and over-burdened most readers.
- Another respondent felt that the consultation was too "desk-bound", with too few opportunities for discussion with EA and others[13].
- Another view was that the consultation was held too early, when there were considerable uncertainties about plans for the management of ILW and spent fuel.
- There was a suggestion that EA should answer in full all the points made in the responses to the consultation. It was stated that Government had not done this for other new build related consultations.

[13] There was one seminar on the consultation, in July 2010. The report of the seminar is at www.hse.gov.uk/newreactors/seminar-060710.pdf.