DEPARTMENT OF ENERGY & CLIMATE CHANGE

The Justification of Practices Involving Ionising Radiation Regulations 2004

The Secretary of State for Energy and Climate Change

New Nuclear Power Station Designs: Determinations on Class or Type of Practice

November 2009

Contents

1. Secretary of State's Determinations

The Secretary of State for Energy and Climate Change has determined that:

(a) the application by the Nuclear Industry Association for a Regulatory Justification decision in respect of new nuclear power station designs, submitted in November 2008, comprises an application for four classes or types of practice and that these classes or types of practice are as set out below:

(i) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, heavy water moderated thermal reactor currently known as the ACR-1000 designed by Atomic Energy of Canada Ltd;

(ii) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the AP1000 designed by Westinghouse Electric Company LLC;

(iii) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the EPR designed by AREVA NP; and

(iv) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the ESBWR designed by GE-Hitachi;

and

(b) each of the four classes or types of practice qualifies as a new class or type of practice for the purposes of the Justification of Practices Involving Ionising Radiation Regulations 2004.

2. Background

2.1 Regulatory Justification is a process required under the Justification of Practices Involving Ionising Radiation Regulations 2004 (referred to in this document as the Regulations),[1] where the Secretary of State for Energy and Climate Change, as Justifying Authority, must decide whether a new class or type of practice resulting in exposure to ionising radiation is justified by its economic, social or other benefits in relation to the health detriment it may cause.

2.2 In November 2008, the Government received a consolidated application (the Application)[2] from the Nuclear Industry Association (the Applicant) for a Regulatory Justification decision for the class or type of practice being: *"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in light water cooled, water moderated thermal reactors using evolutionary designs."*

2.3 Before the Secretary of State can decide whether or not the proposed class or type of practice is Justified under the Regulations, he must first determine what the class or type of practice described in the Application is, and whether it is capable of being considered as a new class or type of practice for the purposes of the Regulations.

2.4 These questions were the subject of a public consultation on the Application which was published in December 2008.[3] Having considered the responses to that consultation, the Secretary of State considers that the Application should be treated as an application for the Regulatory Justification of the four separate classes or types of practice set out on page 2 and that these are new classes or types of practice for the purposes of the Regulations. He has published his final determinations on these classes or types of practice at page 2. This document now sets out the reasons for these determinations.

1 The Justification of Practices Involving Ionising Radiation Regulations 2004, Statutory Instrument 2004 No. 1769 http://www.opsi.gov.uk/si/si2004/20041769.htm

2 The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations, Volumes 2 and 3 http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

3 The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

3. Defining a class or type of practice

Consideration of the Application

3.1 According to guidance published by the Department for Environment, Food and Rural Affairs (Defra) in August 2007,[4] if a Regulatory Justification decision is to apply to a class or type of practice, the benefits and detriments of the different practices that make up that class or type of practice are likely to be broadly similar.

3.2 In the consultation on the Application, the Government expressed its preliminary view that a class or type of practice is best defined by reference to a common set of technical characteristics in so far as they affect the benefits and detriments of that class or type of practice.

3.3 This preliminary view was based on analysis, described in the consultation on the Application and summarised below, of whether the class(es) or type(s) of practice to be assessed should be defined by reference to technical characteristics and/or non-technical attributes.

Technical characteristics and non-technical attributes

3.4 The class or type of practice proposed by the Applicant was based on technical characteristics, but was also based on the following three attributes:

- evolutionary design, by which is meant a design which has not at present been constructed or operated, but which could be achieved by small or moderate modifications to existing designs;
- minimum regulatory status, by which is meant a design currently available for assessment by UK regulators; and
- readiness for implementation, by which is meant a design commercially available in the UK.[5]

3.5 In its preliminary view set out in the consultation on the Application, the Government said that it did not believe that these attributes were technical characteristics.

3.6 From the point of view of defining a class or type of practice, it was the Government's preliminary view that the non-technical attributes

4 The Justification of Practices Involving Ionising Radiation Regulations 2004 (SI 2004 No 1769), Guidance on their application and administration, Version May 2008 http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

5 The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations, Volume 2, Chapter 1 (Proposed Practice, Technology Description, and Example Designs) http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

referred to in paragraph 3.4, while they might be weighed in the balance of benefits and detriments, should not be used as defining criteria in shaping a class or type of practice subject to a Regulatory Justification decision. Evolutionary design is not a technical criterion which implies a common set of characteristics but is instead a reference to the state of development of a design. Since evolutionary designs may vary considerably, it does not imply a common set of technical characteristics. Minimum regulatory status and readiness for implementation also refer to the state of development of a design, and do not imply a common set of technical characteristics.

Number and nature of the classes or types of practice

3.7 The Application states that: *"We recognise [...] that it is for the Justifying Authority to decide whether the proposed class or type of practice, and the four example designs, constitute a single new class or type of practice or a number of different classes of types of practice. If the Justifying Authority decides that the application comprises more than one class or type of practice we ask that this application be treated as an application for justification of each of such new classes or types of practice."*[6]

3.8 The Application states that were the Secretary of State minded to consider each of the four example designs as separate classes or types of practice, each of those practices could be summarised as follows:

"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in an evolutionary light water cooled, water moderated thermal reactor known as ACR-1000 designed by Atomic Energy of Canada Ltd."

"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in an evolutionary light water cooled, water moderated thermal reactor known as AP1000 designed by Westinghouse Electric Company LLC of the USA."

"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in an evolutionary light water cooled, water moderated thermal reactor known as EPR designed by AREVA NP of France and Germany."

"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in an evolutionary light water cooled, water moderated thermal reactor known as ESBWR designed by GE-Hitachi of the USA."[7]

6 The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations, Volume 2, paragraph 1.10 http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

7 The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations, Volume 2, paragraph 1.10 http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

3.9 In the consultation on the Application, the Government expressed its preliminary view that the Secretary of State should treat the Application as an application for a Regulatory Justification decision on the basis of four different classes or types of practice, each based on one of the reactor designs specified in the Application.

3.10 The Government's preliminary view was based on the following analysis of whether single or multiple class(es) or type(s) of practice should be the subject of a Regulatory Justification decision.

Consideration of a single class or type of practice

3.11 The Defra guidance on Regulatory Justification[8] notes that nuclear power generation represents a very broad generic class or type of practice, and that the benefits and detriments arising from the operation of different types of nuclear power generation could differ substantially. Where there are such substantial differences, it is unlikely that a single Regulatory Justification decision could be made. However, a single decision could be made in respect of similar designs having broadly similar benefits and detriments.

3.12 Further to the Government's preliminary conclusion that the non-technical attributes described in paragraph 3.4 should not be used as defining criteria in making a Regulatory Justification decision, the Government considered whether it should assess the Applicant's proposed single class or type of practice with the three non-technical attributes described in paragraph 3.4 removed. This would have given rise to the following class or type of practice:

"The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in light water cooled, water moderated thermal reactors".

3.13 Where a class or type of practice covers multiple designs, Regulatory Justification is of the class or type of practice, not of individual reactor designs. This means that, in the case of such a single class or type of practice, it was the Government's preliminary view that it would need to identify sufficient relevant information to ensure that it was aware of the benefits and detriments arising from all of the designs which fell within that class or type of practice.

3.14 Accordingly, if the class or type of practice was defined so that it encompassed designs other than the four designs identified in the Application, then it was the Government's preliminary view that it was likely that it would need to assess information in relation to designs other than those identified in the Application. Such a broad class or

8 The Justification of Practices Involving Ionising Radiation Regulations 2004 (SI 2004 No 1769), Guidance on their application and administration, Version May 2008 http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

type of practice could differ quite significantly from that contained in the Application and could require the Secretary of State to acquire significant further information. The Government's preliminary conclusion was that it would not be appropriate to assess such a broad class or type of practice.

Consideration of multiple classes or types of practice

3.15 The Government therefore considered the alternative approach allowed for in the Application of separately considering the four individual reactor designs described in paragraph 3.8. Given the Government's preliminary view that evolutionary designs, and the other non-technical attributes, were not suitable characteristics to use in the definition of a class or type of practice, they were removed from the Applicant's suggested definitions. This left the following four classes or types of practice:

(a) *The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as ACR-1000 designed by Atomic Energy of Canada Ltd.*

(b) *The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as AP1000 designed by Westinghouse Electric Company LLC of the USA.*

(c) *The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as EPR designed by AREVA NP of France and Germany.*

(d) *The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as ESBWR designed by GE-Hitachi of the USA.*

3.16 While the Government was satisfied that the type of generic assessment needed in the Regulatory Justification process could be carried out on classes or types of practice containing a single reactor design, it acknowledged that this involved a more narrowly defined class or type of practice than is necessarily required for Regulatory Justification. It would in principle be legitimate to Justify a much broader class or type of practice under the Regulations. However, in this case, it was the Government's preliminary view that the narrow approach was more appropriate. Such an approach is also based entirely on technical characteristics and supported by evidence presented in the Application.

Summary of responses to the consultation on the Application

Class or type of practice

3.17 Question 1 of the consultation on the Application asked:

"Do you agree with the Government's preliminary view that, following the application submitted by the Nuclear Industry Association, the decisions by the Secretary of State and the Justifying Authority should be by reference to four classes or types of practice, based on:

(a) The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as ACR-1000 designed by Atomic Energy of Canada Ltd.

(b) The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as AP1000 designed by Westinghouse Electric Company LLC of the USA.

(c) The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as EPR designed by AREVA NP of France and Germany.

(d) The generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, water moderated thermal reactor known as ESBWR designed by GE-Hitachi of the USA,

and that these qualify as new classes or types of practice. If not, why not?"

3.18 The responses received to the consultation on the Application generally accepted the Government's preliminary view that the decisions by the Secretary of State should be by reference to the four classes or types of practice proposed in that consultation.

3.19 However, some respondents said that they preferred the single class or type of practice proposed by the Applicant, on the grounds that the benefits of new nuclear power stations are broadly independent of specific reactor designs and that the detriments are broadly similar between all four designs.

3.20 Some respondents said that the focus on individual reactor designs was too specific, and that the class or type of practice under consideration should be the much wider one of the generation of electricity by nuclear power. Others suggested that a class or type of practice should be classified by moderator type. Some respondents felt that evolutionary designs should be considered as a technical characteristic as it enables

assessment of a class or type of practice by reference to existing experience.

3.21 A number of respondents said that, in view of the similarity of the designs, the AP1000 and the EPR could be regarded as one class or type of practice.

3.22 Several respondents said that the ACR-1000 and the ESBWR should be withdrawn from the Regulatory Justification process on the grounds that they are not currently under consideration in the Generic Design Assessment (GDA) process. Some respondents expressed support for priority to be given to the AP1000 and the EPR in order to avoid delay to the Regulatory Justification process.

Accommodating developments in reactor designs

3.23 Under regulation 10 of the Regulations, a person may apply to the Secretary of State to review an existing class or type of practice if new and important evidence about its efficacy or consequences is acquired.

3.24 In the consultation on the Application, the Government expressed its preliminary view that a Regulatory Justification decision would apply to the individual reactor designs identified in the Application but would allow for the possibility of reasonable modifications to those designs which did not affect those benefits and detriments.

3.25 Question 5 of the consultation on the Application asked:

"Do you have any comments on how best the Government might accommodate changes or developments of the named reactors in its classes or types of practice?"

3.26 Several respondents said that they would not expect changes or developments in the design of the selected reactors to require a review of the Regulatory Justification decision, provided the designs continue to meet the key attributes described in the Application for each reactor type.

3.27 Further, several respondents said that the design of a reactor Justified under the Regulations would be improved in the light of increased technical knowledge and experience, and in response to more demanding regulatory requirements. They said that the nuclear regulatory framework is in place to regulate such changes once a high-level assessment of the class or type of practice has been completed, and that any difference arising from such changes could be expected to be in the form of a positive change in the balance of benefits and detriments.

3.28 However, a number of respondents thought that any future changes or developments to the specifications of the reactor designs should be presented for further Regulatory Justification.

Secretary of State's conclusions

3.29 **Defining class or type of practice** Consideration of the arguments presented by those responding to the consultation on the Application did not lead the Secretary of State to reconsider the preliminary view that a class or type of practice is best defined by reference to a common set of technical characteristics in so far as they affect the benefits and detriments of the class or type of practice.

3.30 **Four classes or types of practice** The Secretary of State has concluded that he should make Regulatory Justification decisions based on four classes or types of practice. While recognising that some would prefer the single class or type of practice originally proposed by the Applicant, he noted that the Applicant allowed for the Secretary of State's preferred course of action in its Application.

3.31 The Annex to this document explains the different groups into which reactor designs can be classified. The reactor designs in the Application span three reactor groups, PWR, BWR and ACR. The Secretary of State has decided that the classes or types of practice should differentiate both between these reactor groups (and, in the case of the AP1000 and the EPR, between different designs in the PWR reactor group), and between the different groups by noting the use of different moderators, heavy and light water.

3.32 **Accommodating developments** A Regulatory Justification decision must be made in advance of a class or type of practice being first adopted or approved. Justification is the first step in the radiological protection regime recommended by the International Commission on Radiological Protection (the ICRP).[9] There are other ICRP principles (Optimisation and Limitation) relevant to the approval of nuclear power stations, which are applied separately and after the Regulatory Justification process.

3.33 Optimisation of protection is a requirement to keep all exposures as low as reasonably achievable, taking into account social and economic factors. Limitation is the principle that the total dose to any individual from regulated sources in planned exposure situations should not exceed the appropriate recommended limits.[10]

9 The ICRP is an independent international body of experts which provides guidance on a range of topics relating to the protection of man from the harmful effects of ionising radiation http://www.icrp.org/

10 Council Directive 96/29/EURATOM of 13 May 1996 (OJ L 159, 29.6.1996, p.1) http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf, ICRP Publication 60: 1990 Recommendations of the ICRP and ICRP Publication 103: 2007 Recommendations of the ICRP http://www.icrp.org/

3.34 The Secretary of State's view is that what is important in making a Regulatory Justification decision is the judgement he takes of the balance of benefits and detriments of a class or type of practice. Once that decision is made, a review of that decision should be necessary only if there are material changes which give rise to new and important evidence about the efficacy or consequences of the class or type of practice.

3.35 For example, the Secretary of State's view is that changes such as improvements to the design of safety or environmental features would be likely to fall within the Optimisation process, and should not require the Regulatory Justification decision to be revisited.

3.36 In making a positive Regulatory Justification decision, the Secretary of State would intend that the decision should apply to any subsequent modifications to the design which did not materially affect the balance of benefits and detriments. To ensure that any decision would continue to apply to the class or type of practice following any change which might occur in the name or owner of the proposed design, the Secretary of State added the word "currently" to the titles of the classes or types of practice and removed the reference to the country of origin of the owners of the proposed designs.

Secretary of State's determination

3.37 The classes or types of practice which are to be assessed by the Secretary of State as Justifying Authority are therefore:

(i) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, heavy water moderated thermal reactor currently known as the ACR-1000 designed by Atomic Energy of Canada Ltd;

(ii) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the AP1000 designed by Westinghouse Electric Company LLC;

(iii) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the EPR designed by AREVA NP; and

(iv) the generation of electricity from nuclear energy using oxide fuel of low enrichment in fissile content in a light water cooled, light water moderated thermal reactor currently known as the ESBWR designed by GE-Hitachi.

Prioritisation of Secretary of State's decisions

3.38 The Secretary of State has decided to consult on and make decisions on two of the four classes or types of practice, the AP1000 and the EPR initially. He will leave consulting on and making decisions on the ACR-1000 and the ESBWR until later. This is in order to concentrate attention on those reactor designs for which, in the Secretary of State's view, applications to build and operate in the UK are at present most likely to be made in the near future.

4. New or existing class or type of practice

Consideration of the Application

4.1 It is the responsibility of the Secretary of State to decide whether a class or type of practice is new or existing. If he determines that it is new then it is his responsibility, as Justifying Authority, to decide if it is Justified under the Regulations. If the class or type of practice is an existing class or type of practice then no Regulatory Justification decision is required.

4.2 A class or type practice is new for the purposes of the Regulations if no practice in that class or type was carried out in the United Kingdom before 13 May 2000 and if the class or type of practice has not previously been found to be Justified under the Regulations.

4.3 A class or type of practice is existing for the purposes of the Regulations if either:

(a) a practice in that class or type was carried out in the United Kingdom before 13 May 2000; or

(b) it has been found to be Justified under the terms of the Regulations;

or both.[11]

4.4 There are a number of existing nuclear power stations in the UK. These fall into three broad categories namely, Magnox reactors, Advanced Gas Cooled reactors and the PWR at Sizewell B.

4.5 The UK's existing nuclear power stations are "existing practices" for the purposes of the Regulations and are listed in the register of existing practices maintained by the Government.[12]

11 The Justification of Practices Involving Ionising Radiation Regulations 2004, Regulations 4 and 5 http:www.opsi.gov.uk/si/si2004/20041769.htm

12 http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/government/legislation/justification/justification.aspx

4.6 In the consultation on the Application, the Government expressed its preliminary view that the four classes or types of practice it had proposed qualified as new classes or types of practice. This preliminary view was on the basis that it is arguable that there are material differences between each of the proposed classes or types of practice and the existing practices, and that the decision in relation to Sizewell B was made under a previous version of European Council Directive 96/29/Euratom of 13 May 1996.[13]

Summary of responses to the consultation on the Application

4.7 The comments received during the consultation on the Application generally accepted the preliminary view that the four classes or types of practice proposed by the Government qualified as new classes or types of practice.

4.8 Some respondents felt that the proposed classes or types of practice were existing because nuclear fission has been used to generate electricity in the UK for over fifty years. Others felt that the EPR was not a new class or type of practice because it differs little from the existing PWR at Sizewell B. Some respondents argued that, although the proposed classes or types of practice might not be entirely new, a fresh Regulatory Justification decision was advisable in view of the time which had passed since the previous Justification decisions on nuclear power stations.

Secretary of State's conclusion and determination

4.9 The Secretary of State, having considered the responses to the consultation on the Application, concluded that each of the four classes or types of practice listed in paragraph 3.37 is a new class or type of practice and therefore requires a Regulatory Justification decision by the Secretary of State as Justifying Authority.

Office for Nuclear Development
DECC
9 November 2009

13 Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation (OJ L 159, 29.6.1996, p.1) http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf

5. Annex: Note on the classification of nuclear reactors

5.1 There are several different groups into which nuclear reactors can be divided, based on their technical features, and different individual designs within each group. The diagram below sets out in summary form one possible classification of thermal nuclear reactor designs into groups. This information is set out in greater detail in advice the Government has received from its technical advisers.[14]

5.2 All the reactor designs in the Application relate to light water cooled, water moderated thermal reactors. Water can include "light water" and "heavy water". "Light water" means H_2O, or water as generally understood. "Heavy water" is D_2O where D is deuterium, an isotope of hydrogen with a neutron added to the nucleus.

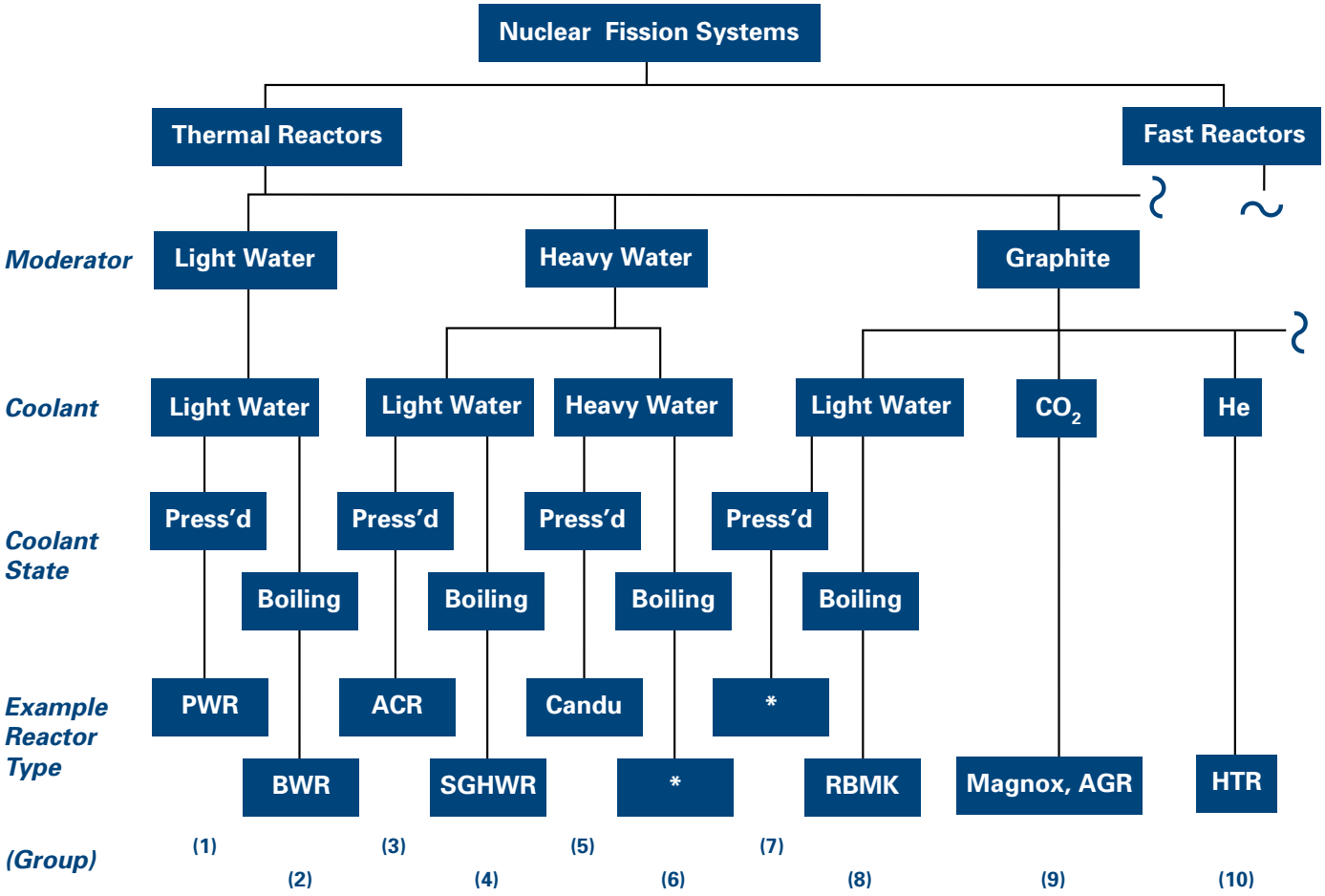
5.3 The nuclear reactor designs in the Application all function by bombarding Uranium-235 with neutrons so that the atom splits ('fission'), producing fission products, extra neutrons and heat. This process is most likely to occur if the neutrons are moving in a particular speed range, when they are referred to as "thermal neutrons". The extra neutrons produced by fission are moving at much higher speeds and are slowed to 'thermal' speeds by using a "moderator" (for example: light water, heavy water, graphite), thus making further fission of U235 atoms more likely. The heat given off when Uranium-235 atoms splits heats the "coolant" (the liquid circulating through the core of the reactor so as to transfer the heat from it) which is, through various means, turned to steam which then drives turbines which generate electricity.

5.4 Of the four reactors in the Application, two, the AP1000 and the EPR, are Pressurised Water Reactors (PWRs). PWRs are shown in the diagram as Group 1. This is the most common type of nuclear reactor. It uses light water as both coolant and moderator. The design is distinguished by having a primary cooling circuit which carries water through the core of the reactor under very high pressure so that it cannot boil. Heat is then transferred to a secondary circuit in which steam is generated to drive the turbine.

5.5 One of the reactors in the Application, the ESBWR, is a Boiling Water Reactor (BWR). BWRs are shown in the diagram as Group 2. This is similar to the PWR, but there is only a single circuit. The coolant turns to steam which drives the turbines, and the turbines are part of the reactor circuit.

14 Advice on the influence of reactor technology on the definition of classes or types of practice for new build justification, Authors: Gregg Butler, Grace McGlynn (IDM) with input from Andrew Worrall and Kevin Hesketh (National Nuclear Laboratory) http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

5.6 One of the reactors, the ACR-1000, is an Advanced CANDU Reactor (ACR). The ACR is shown in the diagram as Group 3. This uses light water as a coolant and heavy water as a moderator.



*Power reactors have not yet been developed in Group 6 (heavy water moderated, boiling heavy water cooled) and Group 7 (graphite moderated, pressurised light water cooled)

Department of Energy and Climate Change. www.decc.gov.uk
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