DEPARTMENT OF ENERGY & CLIMATE CHANGE

Carbon Capture Readiness (CCR)

A guidance note for Section 36 Electricity Act 1989 consent applications

URN 09D/810

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Preface

Article 33 of the EU Directive on the Geological Storage of Carbon Dioxide[1] (Directive 2009/31/EC) requires that, prior to a new combustion plant, with a capacity at or over 300 MWe and of a type covered by the EU Large Combustion Plant Directive, receiving development consent, a number of assessments need to be carried out relating to the technical and economic feasibility of capturing, transporting and storing its emissions of CO_2. These assessments are designed to determine whether it is reasonable to expect that the proposed power station will be fitted with Carbon Capture and Storage (CCS) in the future. Depending on the outcome of those assessments, the Directive then requires space to be set aside to accommodate future carbon capture equipment, making the proposed plant in effect "carbon capture ready" (CCR).

Following a consultation[2], undertaken in 2008, the Government has determined that, in England and Wales, these assessments should be undertaken (and space be required to be set aside) as part of the process of granting development consent under Section 36 of the Electricity Act 1989. Government has made clear its intention that no new combustion plant covered by the threshold for CCR would be consented unless the application demonstrated it would be CCR when built.

This guidance is intended to give practical advice on the types of information applicants need to submit to the Secretary of State to demonstrate that a proposed new combustion plant can be built CCR.

It is the Government's intention to ensure this guidance on CCR is reviewed regularly to reflect both technical and regulatory developments as we move towards wider deployment of CCS. This learning will come from the process of reviewing applications for consent under Section 36 of the Electricity Act 1989, as well as from the regular reports that successful applicants will be required to produce.

It is likely that these updates to the guidance will not generally require any further consultation, but can be incorporated into the master text of the guidance which will remain available on the DECC website. Applicants are advised always to check the website for the latest version of the guidance and for the latest advisory checklist annexes on the different capture methodologies.

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[1] The Official Journal text of the Directive is available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF. Article 33 inserts a new Article 9a into the Large Combustion Plant Directive, 2001/80/EC. Strictly speaking, Article 9a is the operative provision, but for convenience, Article 33 is referred to in this guidance.

[2] The Government's response to the "Towards Carbon Capture and Storage" consultation is available on the DECC website at: http://decc.gov.uk/en/content/cms/consultations/towards_ccs/towards_ccs.aspx

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The Purpose and Applicability of the Guidance Document

The Government is committed under Article 6 of the Electricity Market Directive[3] to publishing the criteria against which applications to construct and operate generating stations are considered. This guidance has been produced to explain the implementation through Section 36 of the Electricity Act 1989 (hereinafter Section 36) of the Government's policy on CCR. It is intended to supplement the existing guidance on the full application process for consent under Section 36[4].

The CCR requirements (and therefore this guidance) apply to applications for power stations with an electrical generating capacity at or over 300 MW and of a type covered by the EU Large Combustion Plant Directive[5] (LCPD). This capacity threshold for CCR is based on the capacity of the new power station as a whole, rather than on the individual capacity of each of the units which make up the power station. However, where an application for a variety of generating unit types is received (for example combined cycle and open cycle gas turbines), the threshold is applied to the new units of the same type on the site.

This guidance applies to applicants:

(i) who submitted before 23 April 2009 an application for Section 36 consent for a new power station of the type described above but on which a decision has not yet been taken by the Secretary of State; and

(ii) submitting after 23 April 2009 an application for Section 36 consent for a new power station of the type described above.

Applicants should submit the required assessments demonstrating CCR as part of their initial Section 36 consent application with its supporting documentation. The assessments should not be considered supplementary information which can be submitted at a later stage. Together with the rest of the Section 36 application material, these assessments will be public documents.

This guidance also explains the level of information which applicants can reasonably be asked to submit in the demonstration of CCR when applying for Section 36 consent. Therefore it is intended to be useful to local planning authorities and other statutory and non-statutory bodies with a role to play in the development consent process (e.g. including the relevant nature, environment, countryside, aviation, heritage and health and safety bodies), in

[3] EU Directive 2003/54/EC on common rules for the internal market in electricity.

[4] Guidance for s. 36 EA applicants is available via http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/consents_planning/guidance/guidance.aspx

[5] Energy from waste plants are not covered by the LCPD.

explaining the type of information on CCR which can be submitted by applicants.

We expect the guidance to be of use primarily to prospective applicants, local planning authorities and other statutory and non-statutory bodies (e.g. including the relevant nature, environment, countryside, aviation, heritage and health and safety bodies), but it may also be of use to members of the public and other interested parties.

England and Wales

This guidance only covers the consenting process in England and Wales.

DECC's Planning Reform and Development Consents team handle applications for Section 36 consents for generating stations above 50 MW that fall to be determined by the Secretary of State for Energy and Climate Change. They receive representations on behalf of the Secretary of State and assess applications on his behalf. They also aim to make sure that the procedures are carried out fairly and transparently. A site visit may be carried out with the relevant planning authorities and applicant in attendance in order to familiarise the case officer with the development site and surrounding area (usually after the consultation period has closed).

However, neither the Secretary of State nor officials acting on his behalf can discuss the merits of individual cases or give an indication of what the Secretary of State's decision might be.

Any queries on the Section 36 process should be addressed to:

The Onshore Consents Team
Energy Markets and Infrastructure Group,
Department of Energy and Climate Change
Area 3A, 3 Whitehall Place
London SW1A 2AW
Tel: 0300 060 4000 (switchboard)

E-mail: Gareth.Leigh@decc.gsi.gov.uk

The information provided in this document is neither definitive nor exhaustive. It is up to applicants, in preparing their assessments, to decide which parts of this advice are relevant to the particular circumstances of their proposed new combustion plant.

This guidance should be read in conjunction with the legislation to which it refers and other legislative guidance or advice where available. All applications made under Section 36 or any other statutory regime will be considered on their merits and nothing in this guidance will prejudge the outcome of any such decision.

It is available in English and on request in Welsh.

Copies of this guidance are available to download via the DECC web site: http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/consents_planning/guidance/guidance.aspx

Relevance of this Guidance to Consent Applications made to the Infrastructure Planning Commission

The Infrastructure Planning Commission (IPC) will become responsible for accepting and examining applications for development consent in respect of new power stations upon commencement of s.15 of the Planning Act 2008 under s.104 of that Act. The IPC will then become responsible for consenting applications for new power stations following designation of the relevant national policy statements (NPS).

The IPC has been directed, in the Overarching Energy National Policy Statement that it should follow this CCR guidance, or any successor to it produced by the Department of Energy and Climate Change, when considering applications for combustion generating stations (which are at or over 300 MWe and of a type covered by the LCPD). Accordingly, references in the guidance to Section 36 consents and the Secretary of State should be taken to include references to development consent orders under the Planning Act 2008, and to the IPC, as appropriate. The IPC has also been directed to have regard to advice from Environment Agency as to the suitability of the space set aside on or near the site for carbon capture equipment and the technical feasibility of the retrofitting carbon capture equipment.

Introduction

1. The consultation "Towards carbon capture and storage"[6] launched on 30 June 2008 sought views in the light of the EU's then proposals on how CCR should be defined; how it could be assessed; and on how and whether any CCR policy might be implemented in respect of England and Wales. Following this consultation, Government determined[2] that, in England and Wales, CCR should be assessed during the consenting process for the construction and operation of new power stations under Section 36 and that no power station at or over 300 MWe and of a type covered by the LCPD would be consented unless it could demonstrate it would be CCR.

The EU's CCR Policy

2. Article 33 of the Directive requires that the technical and economic feasibility of retrofitting carbon capture equipment and of the transport of CO_2, together with the availability of CO_2 storage sites, should be assessed by the applicant and consenting body during the process of deciding whether to grant an operating or construction licence for any new power station with electrical outputs at or over 300 MWe and of type covered by the LCPD. If Member States' consenting authorities consider that it is technically and economically feasible for a power station to be retrofitted with CCS technology, they must require suitable space to be set aside for the future retrofit of carbon capture equipment. This guidance implements both Article 33 of the Directive and the Government's further requirement that if a proposed power station is subject to the Directive requirements, it will only be granted development consent if it is assessed positively against the Article 33 criteria.

3. In this guidance, the term "CCR", used in the context of an individual power station, refers to the fact that the consenting authority has concluded at the time the consent was granted that it will be technically and economically feasible (giving to those terms the meaning outlined below) to retrofit CCS to that power station in the future, and references to retrofitting CCS to a power station should be understood to include linking it by way of suitable means of transport to an offshore site of deep geological storage as well as the retrofitting of carbon capture (and CO_2 compression) equipment to the power station itself.

Implementing CCR Policy in the UK

4. CCR policy, which the Government sees as a preliminary step towards CCS, has been developed in the light of both the EU requirements and the responses to the "Towards carbon capture and storage"

[6] The original "Towards Carbon Capture and Storage" consultation document is available on at the DECC website via:
http://decc.gov.uk/en/content/cms/consultations/towards_ccs/towards_ccs.aspx

consultation. This new policy affecting Section 36 consents is set out in the Government's response to the "Towards Carbon Capture and Storage "consultation[2].

5. Many of the power stations consented and built from now on could still be operating for at least the next 30 years, possibly into the 2040s and indeed beyond[7]. Given the pressing challenge of the UK's 80% target for reduction of greenhouse gases by 2050 as compared to 1990 levels, it is reasonable to assume such plants will need to fit carbon abatement technology at some point in their lifetime. For this reason, the Government has decided that all new power stations with electrical outputs at or over 300 MWe and of a type covered by the LCPD should only be consented if they can be considered CCR.

6. Government intends to consider applicants' CCR assessments with a "no barriers" approach. Applicants are asked to demonstrate that there are no known technical or economic barriers which would prevent the installation and operation of their chosen CCS technologies. Government does not intend to prescribe the detail of how CCS technology is applied in individual cases, but does expect that applicants will follow best practice as far as this knowledge is available and provide a reasoned justification of their choices.

CCR Requirements

7. As part of their application for Section 36 consent applicants will be required to demonstrate:

- that sufficient space is available on or near the site to accommodate carbon capture equipment in the future;
- the technical feasibility of retrofitting their chosen carbon capture technology;
- that a suitable area of deep geological storage offshore exists for the storage of captured CO_2 from the proposed power station;
- the technical feasibility of transporting the captured CO_2 to the proposed storage area; and
- the likelihood that it will be economically feasible within the power station's lifetime, to link it to a full CCS chain, covering retrofitting of capture equipment, transport and storage.

Applicants must make clear in their CCR assessments which CCS retrofit, transport and storage technology options are considered the most suitable for their proposed development.

[7] This is in terms of the plant's possible operational lifetime, not the normal accounting depreciation period for the investment or what turns out to be the actual pay back period on the investment.

In addition, if applicants' proposals for operational CCS involve the use of hazardous substances, they may be required to apply for Hazardous Substances Consent (HSC). In such circumstances, they should do so at the same time as they apply for Section 36 consent (see paras 70 to 82).

8. If granted consent, operators of the power station will be required to:

- retain control over sufficient additional space on or near the site on which to install the for the carbon capture equipment, and the ability to do use it for that purpose;

- submit reports to the Secretary of State for DECC as to whether it remains technically feasible to retrofit CCS to the power station. These reports will be required within 3 months of the commercial operation date of the power station (so avoiding any burden on the operator with an unimplemented consent) and every **two** years thereafter until the plant moves to retrofit CCS.

Any applicant for Section 36 consent should expect that the consent will contain conditions which have the effect, if not the same wording, as the model conditions at Annex G.

Guidance on demonstrating CCR requirements

9. This guidance is intended to give practical advice on the type of information applicants need to submit to the Secretary of State to demonstrate that a proposed development can be built CCR. For clarity, the minimum suggested information is highlighted in text boxes.

10. Applicants are reminded that such assessments will be public documents as part of the Section 36 consenting process and, even if marked as commercially sensitive, may be released in response to a Freedom of Information or Environmental Information Regulations request if they are not subject to any absolute bars on disclosure and it is considered to be in the public interest to do so.

Allocation of space for carbon capture equipment

11. Applicants should be prepared to submit plans and supporting documents with their initial Section 36 application to demonstrate that sufficient space is available to accommodate carbon capture equipment, sized so as to be capable of processing emissions from the entire power station, in the future. Applicants should explain what percentage of these CO_2 emissions they consider will be captured by their proposed capture technology, in keeping with the principle of best practice explained in paragraph 6. These plans need to contain sufficient detail to allow the Secretary of State, taking appropriate advice from the Environment Agency, to be confident that the applicant is allowing

sufficient space overall on and/or nearby to the site - and in appropriate areas on site - to allow for the subsequent retrofitting of the declared type of CO_2 capture and compression plant.

12. Assessments of the appropriate space to be set aside for the subsequent retrofit of capture equipment will depend on:

    - the type of capture technology declared as likely to be chosen (the key variable);
    - the size/number of the power generating units;
    - the input fuel for the power units;
    - decisions about whether the necessary CO_2 processing would be on or off site;
    - ensuring the safe storage of chemicals;
    - avoiding congestion on site for safety both during construction and operation; and
    - future progress in developing the capture technologies which may reduce the space required for the related equipment.

13. Since capture technologies have not yet been demonstrated on a commercial scale, it is not appropriate for Government to impose prescriptive requirements on the amount of space which should be set aside. Applicants should make a reasoned justification for their proposed space allocation on the basis of their chosen capture technology. (It logically follows that the same technology should be covered in the retrofit feasibility study.) This is consistent with a no barriers approach through which the Government intends to consider applicants' assessments.

14. A recent International Energy Agency (IEA) report[8] gave indicative figures for the capture plant land footprint for different types of gas and pulverised coal plant (based on net plant capacities of around 500 MW), using either post-combustion capture or oxyfuel combustion. The Environment Agency, in offering their advice to the Secretary of State as the consenting authority, will use this IEA document together with other relevant information sources as a starting point in judging whether the amount of space allocated by applicants is appropriate.

[8] *CO_2 capture as a factor in power plant investment decisions*. 2006/8. IEA, Greenhouse Gas Report

Table 1: Approximate minimum land footprint for some types of CO_2 capture plant

	CCGT with post-combustion capture	CCGT with pre-combustion capture	CCGT with oxy-combustion	USCPF with post-combustion capture	IGCC with capture	USCPF with oxy-combustion
Site dimensions – generation equipment (m)	170 x 140	170 x 140	170 x 140	400 x 400	475 x 375	400 x 400
Site dimensions – CO2 capture equipment (m)	250 x 150	175 x 150	80 x 120	127 x 75		80 x 120
Total site footprint (m^2)	62,000	50,000	34,000	170,000	180,000	170,000

Acronyms: CCGT – combined cycle gas turbine; IGCC – integrated gasification combined cycle; USCPF – ultra-supercritical pulverised fuel

15. Applicants must be able to demonstrate suitably located land will be available for them to use for the capture element of the CCS chain at the point of retrofit. If an applicant intends to use any space off the core power station site subsequently for CCS, or if the applicant does not own the area of land in question as freehold or on a lease whose term matches or exceeds the expected lifetime of the power station, this needs to be made clear as part of their initial Section 36 application in the submitted plans and designs. If they do not already own or occupy this ancillary site, the applicant will need to satisfy the Secretary of State that they are in a position to ensure that they will be able to use the ancillary site when they move to installing CCS, and will be required, as a condition of obtaining Section 36 consent, to retain the ability to use the ancillary site for CCS purposes. Whether land over which the applicant only has an options will be considered sufficiently available will have to be determined on a case by case basis, by reference to the specific contractual arrangements in each case (relevant factors will include whether retrofitting is likely to occur after the latest date at which it is legally possible to provide for the option to be exercised[9]). The key consideration is that the ownership or use of the land before the applicant decides or is required to retrofit should not present any foreseeable obstacle to retrofitting at that time. Where it is proposed to use land that is not directly adjacent to the power station site, applicants will also need to provide assurances that they will be able to use corridors of land, as necessary, linking that land to the power station site.

16. Applicants may not suggest nor agree with any third party that land set aside for the purposes of CCR should be considered as environmental mitigation space to compensate for loss of habitat due to the power

[9] See the Perpetuities and Accumulations Act 1964,

station development. This is because the purpose of the land is as a site in the future for carbon capture equipment, therefore it would not be available for long term mitigation. It is also important that the site is not allowed to become a wildlife reserve through neglect or mismanagement such that it would not be available for retrofit in the future. The retained land should not be owned, occupied or used (either by the applicant or a third party) in any way which may prevent its being cleared and free to accommodate the carbon capture plant within two years of the capture equipment being required to be installed

17. The Government does not intend that land set aside for CCR should be categorised in the future for purposes other than industrial use on regional spatial plans of land use.

Space

Key Information

18. In order to demonstrate that the proposed space is suitable and that development can be considered CCR, operators should include outline site plans (drawings) in their application for Section 36 consent. The site plans, which will be public documents, will need to be more detailed than those submitted with Section 36 applications prior to the introduction of the CCR requirement, to enable the Environment Agency to advise Ministers that the proposed plant layout is suitable for subsequent CCS installation. The site plans should be sufficiently detailed to show:

    - the footprint of the combustion plant;
    - the location of the capture plant including any air separation units;
    - the location of the CO_2 compression equipment;
    - the location of any chemical storage facilities; and
    - the exit point for CO_2 pipelines from the site.

19. Conceptual diagrams and a description, demonstrating how the space will used, should also be submitted. Basic calculations using the known volumes of CO_2 which will have to be processed could usefully be included in the space description to justify the size and type of processing equipment chosen.

Assessment of the technical feasibility of retrofitting carbon capture equipment

20. The aim of this assessment is to demonstrate to the consenting authority that the plant has been designed in such a way as to enable the subsequent retrofit of carbon capture equipment to the entire capacity of the proposed power station. Applicants should also explain what percentage of these CO_2 emissions they consider will be captured by their proposed capture technology, in keeping with the principle of best practice explained in paragraph 6. In order for the Secretary of State to be confident that proposed power station is CCR, applicants must include in their CCR assessment a clear statement on what type of technology is considered most appropriate for their power station. Applicants may wish to include a discussion of other technology options to justify their choice, but must make clear which option is considered most appropriate for their power station. This option should then be the one assessed when considering the economic feasibility of retrofitting carbon capture equipment to the power station.

21. Applicants should provide an assessment of their proposed plant designs as part of their Section 36 application that is sufficiently detailed for the Environment Agency to advise the Secretary of State that there are no known technical barriers to a subsequent retrofit of the type of capture technology declared. Applicants are therefore not expected to submit designs in the sort of detail required for a Front End Engineering and Design (FEED) study.

22. The assessment of technological feasibility could be against either:

    - an appropriate reference document; or
    - by the provision of sufficient technical detail by the applicant in their submitted plans and discussions with the advisory body.

23. In terms of a reference document, the Government suggested, in its response to the "Towards Carbon Capture and Storage" consultation, a specific IEA document[10] as the one currently appropriate for post-combustion amine scrubbing and oxyfuel technologies.

24. Based in part on this, the Environment Agency have produced advisory checklists for applicants to guide them on the issues that need considering. **Annexes 1A-C** contain these checklists for:

    - post-combustion amine scrubbing on coal;
    - pre-combustion CO_2 capture from gas (or syngas) and hydrogen-rich fuel gas combustion; and

[10] *CO_2 Capture Ready Plants.* Executive Committee of the IEA Greenhouse Gas Programme. Technical Study. Report Number: 2007/4. Date May 2007. This IEA document, which has been peer reviewed in accordance with best scientific practice, can be found at www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1980

- post-combustion amine scrubbing on gas.

25. These checklists will be updated by the Department of Energy and Climate Change, working with the Environment Agency, as these capture technologies develop. We also expect that in time advisory checklists for other capture technologies will be added to this guidance document**.**

26. The Government does not intend to insist that an applicant, when in time they come to make a Section 36 consent application to install CCS (see para 96), must do so on the basis of the capture technology declared at this CCR stage. The Government recognises that CCS technology is still developing and does not wish to bind operators to a technology which may be less effective or less economic than that available to applicants at the stage of CCS retrofit.

27. As stated in paragraph 6, the Government intends to consider applicants' CCR assessments with a "no barriers" approach. Applicants are asked to demonstrate that there are no known technical or economic barriers which would prevent the installation and operation of their chosen CCS technologies. Government does not intend to prescribe the detail of how CCS technology is applied in individual cases, but does expect that applicants will follow best practice as far as this knowledge is available and provide a reasoned justification of their choices.

28. The concept of best practice, on the basis of current knowledge, is relevant to post-combustion capture. The process requires steam in order to regenerate the CO_2 saturated chemicals, providing clean chemicals which can be recycled back into the system and a high concentration stream of CO_2 ready for compression, transport and eventual storage. Standalone boilers are not considered as efficient a method of providing steam for regeneration of the chemicals as an integrated capture system in which steam is extracted from within the combined cycle gas turbine (CCGT) or coal power station itself. If applicants choose a standalone boiler as part of their proposals for the retrofit of carbon capture equipment, they must justify this choice and demonstrate that it could be considered comparable to an integrated system once carbon capture is operational. For example this could be by providing evidence that the standalone system for the provision of steam for post-combustion capture was as thermally efficient per unit of CO_2 as an integrated system once carbon capture is operational for their particular power station. By asking applicants to provide a justification of their choice rather than stating applications of this type will not be considered suitable, the Government has not ruled out the possibility that such options for standalone steam provision will be considered.

29. Applicants are only asked to compare the efficiencies of the power stations once capture is operational rather than before because there are not thought to be significant differences[11] in plant efficiencies prior to retrofit between modified (needed for integrated capture) and unmodified (for use with standalone steam provision capture) generating turbines.

Technical feasibility of retrofitting CCS

Key Information

30. Government envisages that the technical feasibility study for retrofitting CCS equipment will take the form of a written report and accompanying plant designs which:

- make clear which capture technology is currently considered most appropriate for retrofit in the future to the power station; and
- provide sufficient detail to enable the Environment Agency to advise the Secretary of State on whether the applicant has sufficiently demonstrated there are no currently known technical barriers to subsequent retrofit of the declared capture technology.

31. Applicants are directed to the IEA reference document[10] on capture technologies and to the advisory checklists (see **Annexes A-C)** when preparing their technical assessment of the feasibility of retrofitting carbon capture equipment.

Assessment of a suitable offshore area for CO_2 storage

32. An applicant's choice of proposed storage area as part of their application for a Section 36 consent, together with CO_2 transport considerations, will influence the viability of their proposed power station site. It is the responsibility of the applicant to make a short, reasoned, written justification of their proposed storage area, demonstrating that no known barriers exist to its use for CO_2 sequestration.

33. The Government has made clear in its response to the "Towards Carbon Capture and Storage" consultation[2] that in the UK only offshore storage areas are currently considered suitable by Government for CO_2 storage. Therefore applicants must identify an offshore CO_2 storage area in their CCR storage assessment.

[11] **Lucquiaud M., Patel P., Chalmers H. and Gibbins J.** Retrofitting CO2 capture ready fossil fuel plants with post combustion capture. Part 2: requirements for natural gas combined cycle plants using solvent-based flue gas scrubbing. *Proc. IMechE, Part A: J. Power and Energy,* 2009, **223**(A3), 227-238

34. At the present time, the Government suggests that the simplest and most appropriate means of demonstrating there are "no known barriers" to storage is by delineating on a map a suitable storage area in either the North Sea or Morecambe Bay. Applicants are advised to identify within the delineated area at least two fields or saline aquifers (with appropriate CO_2 storage capacity) listed in either the "valid/viable" (these two descriptors were used interchangeably for the uppermost storage classification within the DTI study) or the "realistic" categories in the DTI's 2006 study of UK storage capacity[12]. It would be for the applicant to state which field(s) are in his proposed storage area. The fields or aquifers involved could be in one or both of these two categories. This DTI study is considered to be the most comprehensive reference document currently available. If an applicant wishes to select any field or aquifer beyond those covered by the DTI study, it will be for him to demonstrate a comparable level of assurance to that in the DTI study that this field or aquifer would be suitable for CO_2 storage.

35. Applicants may use alternative data sources if they see fit[13], though an equivalent level of certainty needs to be demonstrated. For example, the Scottish Centre for Carbon Storage (SCCS), with the support of the Scottish Government, has quantified Scottish CO_2 sources and storage potential in offshore areas surrounding Scotland[14]. Further data sources can be expected to become available in future.

36. There is no requirement for applicants to obtain either an exploration or storage licence at the CCR stage. Government recognises that, as a greater amount of information becomes available on the nature and characteristics of the UK's storage capacity, operators will as a matter of course review and refine their initial assessments. We do not expect plans at the CCR stage that are so specific as to require appropriate commercial negotiations with other parties holding relevant rights or otherwise equipped to take forward a specific storage project. It would not be reasonable to require commitments on these matters at the CCR stage.

37. It should be noted that operators will be required to obtain a permit from DECC and a lease from the Crown Estate in order to store CO_2 offshore when CCS is operational. In common with the other CCR assessments, an applicant's choice of storage area at the CCR stage will not be binding. It therefore follows that an applicant's choice of storage area at the CCR stage will not confer priority on that applicant for use of that storage area when CCS is deployed on their power station.

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[12] Industrial carbon dioxide emissions and carbon dioxide storage potential in the UK. Report No. COAL R308, DTI/Pub URN 06/2027, October 2006. Available at: www.berr.gov.uk/files/file35684.pdf

[13] Some examples of alternative resources are detailed in Annex 1E(i)

[14] The Scottish Centre for Carbon Storage report "Opportunities for CO_2 Storage around Scotland" is available via: http://www.geos.ed.ac.uk/sccs

38. If applicants wish to apply for the storage permit and lease at the CCR stage to ensure that a storage area will be available for their use once CCS is operational, that will be a commercial decision for them.

39. Applicants should include information on the amount of CO_2 that would be produced and stored as part of their CCR storage assessment. This data will be used to determine whether the proposed storage area has sufficient capacity for the uses proposed to date, taking account of any earlier applications which may have identified the same fields or aquifers for the same purpose. Any applicant, who identifies fields or aquifers which do not appear to have enough capacity, when account is taken of earlier applications, will be asked to propose an alternative storage area.

40. In time, a storage market may develop in which combustion plant operators may enter commercial agreements with specialist CO_2 storage operators. However, applicants for Section 36 consent may not, at the CCR stage, avoid the requirement to specify a storage area by making the assumption that they will be able to outsource such arrangements at the time of CCS deployment. This applies even if applicants are proposing to enter into joint transport arrangements (see para. 49). If there is evidence on which to base an outsourcing proposal it should be included either in the storage assessment done with the Section 36 application or in one of the subsequent written reviews to demonstrate continuing CCR.

41. Once a storage market has developed, if an applicant at the CCR stage chooses to refer to a co-operative storage arrangement, they would need to demonstrate that the proposed storage site has sufficient capacity for their CO_2 in addition to any others already contractually committed to that site.

Storage

Key Information

42. Demonstration of the storage component of CCR should involve:

- identification of a possible storage area, including delineating the geographical extent of that area, and identification within that area of at least two oil or gas/gas condensate fields (or saline aquifers) listed in the range of geological formations identified as "viable " or "realistic" for CO_2 storage;
- the data source relied on for identification of the suitability of these areas and fields/aquifers should be the 2006 DTI study or other similarly authoritative source(s);
- a short summary including an estimate of the total volume of CO_2 likely to be captured and stored by the power station and an estimate of the CO_2 storage potential of the area identified by the applicant. The purpose of this summary will be to demonstrate whether the proposed storage area has sufficient capacity for the proposed plant's captured emissions, when account is taken of earlier applications which have relied on the same fields or aquifers for this purpose.

Assessment of the technical feasibility of CO_2 transport

43. The viability of a proposed site for a new power station will be influenced by the availability of CO_2 transport routes to the proposed storage area. The onshore transport of CO_2 is expected to be by pipeline, given the large volumes which will be captured at a power station of the size covered by the CCR requirement. Transport offshore to the storage site may be by pipeline or ship.

Onshore Transport by Pipelines

44. Applicants must demonstrate that a feasible route exists from the site to the storage area. In particular, it is important that applicants for Section 36 consent demonstrate that a feasible "way-out" exists from the power station site for the CO_2 pipeline. In order to do this, for the first 10km surrounding the power station applicants are asked to identify a favoured route for their pipeline, within a 1km wide corridor, and in addition are asked to identify major pre-existing obstacles (arising because of safety or environmental concerns) within a 10km radius of the station. Applicants are asked to do this in order that the degree of flexibility that may exist over the eventual pipeline route (if, for example, it turns out at a later stage that subsequent development has made the

originally favoured route impracticable) can be ascertained. In addition, some applicants may apply for HSC for the power station site (see paras 70-82), which, if granted, would impose a consultation distance around the site in which the local authority must consult the Health and Safety Executive (HSE) before consenting to any further development. This may assist the preservation of at least part of a feasible way-out from the plant.

45. Applicants are directed to the consultation, due for publication shortly, by the HSE on the classification of CO_2 pipelines under the Pipeline Safety Regulations 1996, to the interim safety advice on CO_2 pipelines available on the HSE website and to the Planning Advice for Development near Hazardous Installations (PADHI) software planning tool[15], when identifying major pre-existing safety obstacles (for example hospitals or schools).

46. After the first 10km from the power station, because of the greater availability of alternative routes, applicants are asked to identify a 10km wide corridor to the point(s) on the coast where they envisage either a pipeline going offshore or CO_2 going onboard ship.

47. The corridor widths are not the degree of clearance which must exist between the pipeline and other forms of development, rather they delineate the area in which the applicant thinks it feasible for the pipeline to be routed.

48. We recognise that some part of the proposed corridor, especially nearer to the site where the options may be more limited, may unavoidably impinge on a designated site e.g. a Natura 2000 site or Site of Special Scientific Interest. If so, and recognising that means already exist to mitigate the impacts of current infrastructure, including gas pipelines, on these types of site, e.g. through sophisticated boring techniques, applicants should suggest how such impacts could be minimised. At the CCR stage, given the inevitable uncertainty about the precise route and what might by the CCS stage in the future be the safety and environmental requirements, we do not envisage any formal environmental impact assessment (EIA) being undertaken. This will however need to be done when an operator wishes to fit CCS to the plant. In order to retrofit CCS, Government has made clear that a further Section 36 application[16] will be required, in addition to the separate consents and licences necessary for CO_2 transport and storage. At this point an EIA covering the impacts arising from CCS at the power station will be conducted and an Environmental Statement (ES) included in the application requirements. If consent for the transport method, for example a CO_2 pipeline, is included in the application to retrofit carbon capture to the plant, the ES would also need to cover its impacts. If the transport method is not included in the

[15] Further details on the PADHI planning tool is available from the HSE website.
[16] or its successor under the Planning Act 2008.

Section 36 application, then the impacts of CO_2 transport will be assessed as part of a separate consent application.

Transport Networks

49. Initially at least, such transport plans are likely to be point to point routes for an individual combustion site application. However, it is clear from work already underway jointly between the public and private sectors that in time it may be more cost effective for there to be a network of CO_2 pipelines onshore to which an individual combustion site could be linked up. For this reason amongst others, it is not the Government's intention to require an operator, when they apply to move to CCS, to use any of the routes explored at the CCR stage if there is a more feasible alternative.

50. If applicants choose to enter into joint transport arrangements with other companies, the same level of detail will be required as for individual plans, including, but not limited to:

- demonstration that a feasible way-out for the pipeline from the proposed site exists and identification of major pre-existing obstacles (either because of safety or environmental concerns), within a 10km radius of the station;
- demonstration that the pipeline could connect to the transport network; and
- demonstration that the main transport route which would carry the CO_2 to the co-operative storage area was viable.

51. Applicants may not, when applying for an initial Section 36 consent, assume, at the CCR stage, that they will be able to outsource such onshore transport arrangements at the time of future CCS deployment.

Offshore transport by ship and pipeline

52. A key consideration in any transport route is the point at which the CO_2 goes offshore, whether by pipeline or by ship. The applicant will need to demonstrate in their assessment report that a feasible route from land to sea exists. This is of particular importance as much of the coastline surrounding England and Wales is protected. Applicants should acknowledge potential barriers to the transport of CO_2 offshore and suggest how these factors might be mitigated.

53. CO_2 transport by ship for use in industrial processes and in the food industry is currently on a much smaller scale than that envisaged for CCS. There are, however, significant numbers of liquefied petroleum gas carriers which do transport dangerous fluids and the design of which may be suitable for transporting large volumes of CO_2[17]. It would be for

[17] Aspelund A., Mølnvik M.J. and De Koeijer G. 2006. Ship Transport of CO2 Technical Solutions and Analysis of Costs, Energy Utilization, Exergy Efficiency and CO2 Emissions. Chemical Engineering Research and Design, Vol 84, Issue 9, 847-855.

an applicant planning to use these or any other ships to make a case for the safe transport of CO_2 by these means.

54. Experience in the UK with offshore gas pipelines is considerable. Sophisticated boring and drilling methods may mitigate impact on coastline. An applicant's assessment should contain a similar degree of detail for the offshore pipeline with the rest of the onshore route although it is recognised that it will only be possible to identify broad route corridors in which applicants expect the pipeline route will lie with identification of any major unavoidable environmental obstacles and provide suggestions on how the impact could be mitigated.

Interim guidance on safety and CO_2 pipelines and shipping

55. The large volumes of CO_2 which will be involved in CCS mean that it is likely to be transported in a compressed form[18]. The HSE are currently undertaking research to develop a better understanding of the hazards of and standards for the conveyance of liquid, dense phase and supercritical CO_2 in pipelines. Such high pressure CO_2 pipelines are currently operational in enhanced oil recovery projects (EOR) in the USA[19].

56. This work will inform the HSE's decision on whether certain physical states of CO_2 (e.g. dense phase), together with consideration of the quantities involved in CCS process, merit classification as 'dangerous fluids' for the purpose of the Pipelines Safety Regulations 1996 (PSR)[20] and/or 'dangerous substances' for the purpose of the Control of Major Accident Hazards Regulations 1999 (as amended) (COMAH)[21].

57. The Government understands that the HSE intend to consult on the classification of dense phase CO_2 pipelines under the PSR, this may assist applicants in the future in determining a suitable corridor for onshore CO_2 pipelines.

58. Operators need to understand the mechanisms, hazards, consequences and probabilities of pipeline failures in pipelines conveying CO_2 in order to ensure safe design, commissioning and operation. A precautionary approach will need to be taken by developers at the CCR stage, given the developing regulatory regime, to ensure that no known barriers exist

[18] "Pipeline Design and Construction" Pipeline Design & Construction: A Practical Approach" by Mo Mohitpour, Hossein Golshan, Matthew Alan Murray (ASME press 2003) gives in chapter 12 some details of the US's relatively extensive experience with CO_2 pipelines.
[19] CO_2 from the Dakota gasification plant is piped for use in EOR near Weyburn, Saskatchewan, Canada. The project has received sponsorship from the IEA. Further details are available at www.dakotagas.com.
[20] Provisions for the treatment of dangerous fluids in the PSR can be found in regulation 18 and references there-in and are available at www.opsi.gov.uk/si/si1996/Uksi_19960825_en_1.htm
[21] These regulations came into force on 1 April 1999 and are amended by the Control of Major Accident Hazards (Amendment) Regulations 2005 from 30 June 2005. They implement Council Directive 96/82/EC known as the Seveso II Directive, as amended by Directive 2003/105/EC.

along the proposed route. HSE have published interim guidance on the conveyance of CO_2[22] applying a precautionary principle that classifies CO_2 as if it were a "Dangerous Fluid" under the PSR when considering CO_2 pipeline design.

59. Therefore applicants should treat CO_2 as a "Dangerous Fluid" under the PSR when considering CO_2 pipeline design and route at the CCR stage. Applicants are advised to check with HSE for updates to this guidance.

60. If the applicant plans to move CO_2 by ship from a port or jetty to their storage area, they will need to consider and demonstrate there are no barriers to their complying with all the relevant safety factors involved in loading a dangerous fluid onto a ship. The Marine and Coastguard Agency are responsible for the safety regulation on ships[23] and their regulations should be consulted. Harbour orders are likely to be required for the construction of facilities to load CO_2 onboard ships. Applicants are advised to contact the Department of Transport for further advice[24].

[22] Interim guidance from HSE on the conveyance of CO_2 in pipelines is available at: www.hse.gov.uk/pipelines/co2conveying.htm

[23] Further information on safety regulations concerning shipping can be obtained from the Maritime and Coastguard Agency http://www.mcga.gov.uk/c4mca/mcga07-home/shipsandcargoes.htm

[24] A guide on Harbour Orders can downloaded from the DfT website via: http://www.dft.gov.uk/pgr/shippingports/ports/harbourorders/

Transport Technical Feasibility Study

Key Information

61. The transport feasibility study should include a marked up map at a scale sufficiently large for the proposed route corridors to be clear and a written report with sufficient detail to identify the preferred form and route or routes for transport from the exit point from the site to the point where the CO_2 goes offshore. The route plan can be in an up to 1 km wide corridor for the first 10 km off the site (where options to alter the route will be more limited). Along this portion of the route, applicants must have demonstrated that a feasible way-out for the pipeline from the proposed site exists and identify major pre-existing obstacles (either because of safety or environmental concerns). Thereafter, applicants should identify an up to 10 km broad corridor for the pipeline route to the chosen point(s) for the pipeline going offshore or for the CO_2 going on board ship. Applicants should also:

    - consider the offshore transport route from the transit point offshore to the storage area and demonstrate there are no barriers to the transport of the CO_2 by the declared preferred method into any of the fields/aquifers in this storage area;
    - confirm that no unavoidable safety obstacles exist within the identified route corridor, on the basis of current knowledge about the hazards posed by CO_2 transport;
    - suggest methods by which the environmental impacts on an unavoidable designated site within the route corridor could be mitigated on the basis of current knowledge at the time of the feasibility study.

Assessment of the economic feasibility of CCS

62. Our legally binding 2050 greenhouse gas emissions reduction target of 80% compared to 1990 levels will require decarbonisation of the electricity sector. Part of this process will be the widespread deployment of CCS technology on fossil fuel power stations. At present, it is unclear when such widespread deployment will occur, but, given the long life times of power stations built now, it would be inappropriate to permit the construction of a fossil fuel generating plant in respect of which there was no reasonable prospect that it would at some point become technically and economically feasible to retrofit CCS to it. This, in conjunction with the requirements of Directive 2009/31/EC has driven Government policy regarding CCR. Accordingly, in its response to the "Towards Carbon Capture and Storage" consultation[2] Government made clear that it intended to interpret the EU requirements on CCR in a way that supported its commitment to new power stations at or over 300 MWe (and of a type covered by the LCPD) being built CCR, whilst ensuring unnecessary burdens are not placed on operators.

63. Directive 2009/31/EC requires applicants to carry out an assessment of the economic feasibility of retrofitting and transport. Recital 47 states that *"The economic feasibility of the transport and retrofitting should be assessed taking into account the anticipated costs of avoided CO_2 for the particular local conditions in the case of retrofitting and the anticipated costs of CO_2 allowances in the Community. The projections should be based on the latest evidence; a review of technical options and an analysis of uncertainties in the assessment processes should also be undertaken."*

64. Following consultation on a draft version of this guidance, the Government has determined that applicants should conduct a single economic assessment which encompasses retrofitting of capture equipment, CO_2 transport and the storage of CO_2. The Government considers that this ensures that the assessments are a meaningful part of the CCR process. The assessments will allow applicants to demonstrate the full range of costs and benefits associated with the deployment of CCS to any given plant, thereby fulfilling one of the underlying aims of the Government's CCR policy (identifying, and not granting development consent to, those plants where it is unlikely that there will ever be a reasonable business case for CCS) in a manner which takes full account of all relevant technical and economic factors and is not inconsistent with EU policy as represented in Directive 2009/31/EC.

65. Applicants should provide evidence of reasonable scenarios, taking into account the cost of the capture technology and transport option chosen for the technical CCR assessments and the estimated costs of CO_2 storage, which make operational CCS economically feasible for the proposed development. As mentioned previously, Government will not consent any power station whose developers cannot envisage any reasonable scenarios under which operational CCS would be economically feasible.

66. The preparation of such economic assessments will involve a wide range of assumptions on each of a number of factors, and Government recognises the inherent uncertainties about each of these factors. There can be no guarantee that an assessment which is carried out now will predict with complete accuracy either in what circumstances it will be feasible to fit CCS to a proposed power station nor when those circumstances will arise, but it can indicate the circumstances which would need to be the case to allow operational CCS to be economically feasible during the lifetime of the proposed new station.

67. While an applicant is likely to already have access to models of many of the factors required for these assessments in order to make a judgement on the viability of any capital investment in the plant, some recent published information sources that might be of assistance are listed in **Annex E(ii)**.

68. A model assessment structure is suggested below on which applicants may chose to base their economic assessments. However, this is not the only way in which the assessment could be addressed and it is the responsibility of applicants to justify the capture, transport and storage options chosen for their proposed development.

Outline

The assessment should be based on the same assumptions as have been made in the preceding technical assessments.

Range of parameters taken into account

The parameters of the model should be described, as should the base case against which the reasonable scenarios will be compared.

Applicants are likely to find it useful to include at least some of the following parameters:

Assumed £/€ exchange rate
Hurdle rate/Internal Rate of Return
Fuel price
Carbon Price
Power output with/without CCS
Lifetime load factor
CO_2 emitted with/without CCS
Cost of transport (construction and operation)
Cost of retrofitting capture equipment (construction and operation)
Cost of storage (permitting and operation)
Reasonable estimates of the costs when needed should be considered, once the technology is proven and the equipment is available from supply industry.

Methodology

Applicants should describe the principles in use within the model and may wish to assess the economic feasibility of operational CCS by comparing:

a) the cost of producing electricity without CCS, but having to buy EU allowances for 100% of CO_2 emitted; with

b) the cost of producing electricity with CCS, assuming EU allowances do not have to be bought for the amount of CO_2 stored (in a world where an operator would otherwise have to buy EU allowances for 100% of this CO_2 if it was emitted to the atmosphere).

Applicants could then vary the range of the individual parameters within the model (for example fuel price or capital costs) to determine the range of carbon prices for which operational CCS is economically feasible – this would give a measure of the uncertainty within the model.

Scenarios

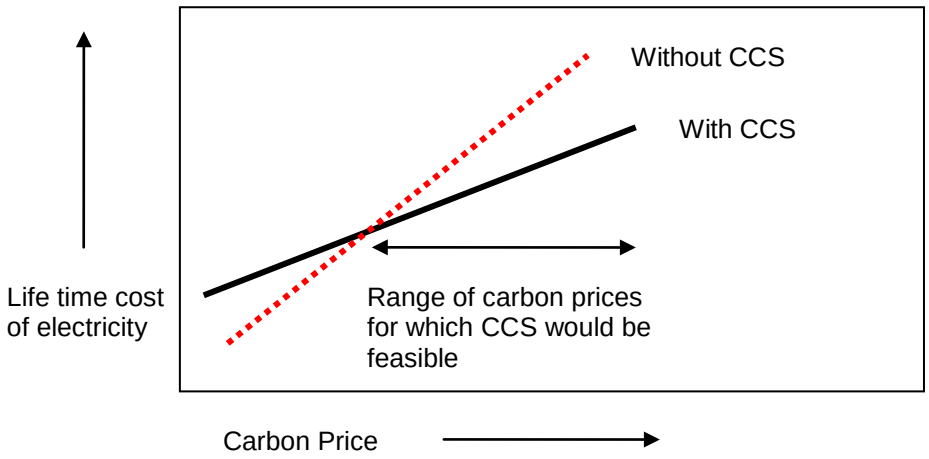
Applicants may also wish to consider a range of reasonable scenarios under which operational CCS would be economically feasible, for example comparison of:

- new dedicated and purpose built transport and offshore facilities; with
- reuse of existing offshore facilities for CO_2 injection.

Although each development must demonstrate that there are no foreseeable barriers to its independent capability to retrofit CCS equipment, Government recognises that in time a market in shared facilities may develop – therefore applicants may also wish to consider this type of scenario for comparison.

Determining feasibility

One method of demonstrating the feasibility of operational CCS on the plant could be to calculate the lifetime price of electricity using the above scenarios and to plot this against a range of carbon prices, as outlined below. Depending on the results of the modelling, above a certain carbon price the price for electricity produced with CCS will be lower than the price for electricity without it. Applicants would then need to justify whether they considered such a carbon price would occur within the lifetime of the proposed power station.



Conclusions

Applicants could then produce a clear summary of their results and state under which reasonable scenarios and parameter ranges operational CCS would be economically feasible.

69. It is possible, if not likely, that some of the assumptions on which the economic assessment rests will need to be revisited over time in order to determine whether or not it has or will become economically feasible to fit CCS when the assessment predicted that it would be feasible. However, it would not be appropriate for the Government to require that the economic assessment be reviewed and possibly updated as part of the ongoing reporting requirements on CCR. This is partly because most, if not all, of the parameters which will determine economic feasibility are not in any way controlled by developers, and partly because information on matters such as exchange rates and predictions of future carbon prices as readily available to Government, if it wishes to consider the impact which changes in them may have on the feasibility of fitting CCS to particular power stations.

Hazardous Substance Consent and Section 36 consent

70. Operational CCS is likely to bring onto combustion plant sites chemicals and gases which are not currently present (or not present in such quantities) on such sites. Depending on the hazard classification of these substances and the quantity present, sites with operational CCS could become subject to the Council Directive 96/82/EC, as amended by Directive 2003/105/EC, known as the Seveso II Directive. The aim of the Directive is to prevent major accidents which involve dangerous substances and to limit their consequences for man and the environment. One particular requirement of the Directive is that Member States must ensure that these objectives are taken into account in their land use planning policies. The Directive is implemented in the UK by the Planning (Hazardous Substances) Act 1990 and Regulations made under the Act which include the Planning (Hazardous Substances) Regulations 1992[25]. This regulatory framework (which is the responsibility of the Department of Communities and Local Government) controls the location of new major hazard installations through a consent process and also controls the development around sites where Hazardous Substance Consent (HSC) has been granted.

71. One of the consequences of operating a site at which hazardous substances (currently classified as such under the Planning (Hazardous Substances) Regulations 1992[25]) are present is the need to obtain HSC.

72. If HSC is determined to be necessary and granted, HSE notifies the local planning authority (LPA) of a consultation distance around the site. LPAs are then required to consult HSE, using the Planning Advice for Development near Hazardous Installations (PADHI) software system, when they receive an application for planning permission within this Consultation Distance. This is designed to prevent major accidents and mitigate their consequences by limiting the type and density of new development at varying distances from the major hazard site.

[25] These regulations came into force on 11th March 1992 and were amended in 1999 and 2009

73. Because of the impact this could have on the LPAs plans for the area, operators are encouraged to discuss their plans with the LPA at an early stage of the project.

74. If HSC is found to be necessary, because of the nature of the substances proposed for use during operational CCS, the Government considers that the application for HSC, referred to above, should be determined in parallel with the initial Section 36 application. Otherwise it is possible that there could be a conflict between the LPAs wish for future developments in the area immediately adjacent to the combustion station and the applicant's subsequent introduction of hazardous substances required for the carbon capture process.

75. Therefore the Government requires that the applicant should apply to the Secretary of State[26] for a direction that Hazardous Substances Consent (HSC)[27] be deemed to be granted at the same time as applying for Section 36 consent if the applicant's CCR proposals for operational CCS involve the storage or use on site of hazardous substances currently classified as such under the Planning (Hazardous Substances) Regulations 1992[25].

76. If HSC is granted, the consultation distance set by HSE will depend on the type and quantity of hazardous substances (classified as such under the Planning (Hazardous Substances) Regulations 1992[25]) proposed for use in operational CCS. These substances could include the following for the various capture processes:

- **Post-combustion capture using chemical scrubbing:** The nature (toxic or non toxic) and quantity of the chemicals proposed for use during capture will affect whether HSC is necessary and, if necessary, the size of the associated consultation distance;
- **Oxyfuel combustion:** The amount of oxygen estimated to be present on the site will affect the consultation distance ;
- **Pre-combustion gasification and capture:** The amount of hydrogen estimated to be produced during gasification and the type and amount of amines proposed for use during capture will affect the consultation distance.

77. Although compressed forms of CO_2 are not currently classified as hazardous it is now recognised that an accidental release of large quantities of CO_2 could result in a major accident. There is extensive

[26] Under section 12 (2) of the Planning (Hazardous Substances) Act 1990 it is possible for the Secretary of State to direct that HSC be deemed to be granted at the same time as considering an application for Section 36 consent. Schedule 2 (para. 45) to the Planning Act amends the Planning (Hazardous Substances) Act 1990 so that the IPC can grant deemed hazardous substances consent in parallel with their planning consent for a combustion station once the IPC takes over planning consents for such stations.

[27] The legislative framework for Hazardous Substances Consent is set out in the Planning (Hazardous Substances) Act 1990 and The Planning (Hazardous Substances) Regulations 1992, as amended in 1999 and 2005.

ongoing research into the hazard potential of dense phase CO_2[28] and the result of this work will inform future decisions as to whether and to what extent CO_2 should be defined as a dangerous substance under the Seveso II Directive and the relevant UK legislation. On a precautionary basis HSE is recommending that early adopters of operational CCS can best meet their general duties under the Health and Safety at Work Act by applying the principles of COMAH when designing, constructing and operating their capture and compression installations.

78. If the results of this research determine that dense phase CO_2 is hazardous, then developers for new combustion power stations will be advised to apply for HSC covering this substance (in addition to any other hazardous substances proposed for use during operational CCS) at the same time as applying for Section 36 consent. Existing holders of Section 36 consent, who had demonstrated CCR in their initial consent application, would also be encouraged to discuss with their local Hazardous Substances Authority (often the LPA) whether this change in classification of compressed forms of CO_2 would necessitate an application for HSC or amendment of an existing HSC.

79. Applicants are advised to discuss with their LPA the fact that CCR plant may result in compressed forms of CO_2 being on site in the future, which would then require HSC. Operators and planning authorities are advised to consider the implications of this in the LPAs' long term development plans for the area in question.

80. The 2 yearly reviews of CCR status will provide an opportunity for operators to assess the need for HSC or the remit of an existing HSC, especially if compressed forms of CO_2 have been classified in the interim.

81. Schedule 2 of the Planning (Hazardous Substances) Regulations 1992 contains Form 1 (available at http://www.opsi.gov.uk/si/si1992/Uksi_19920656_en_1.htm) which applicants should use to apply for HSC. The hazardous substances that are subject to controls and the amounts at or above which a hazardous substances consent is required (known as the controlled quantities) are set out in Schedule 1 to the Planning (Hazardous Substances)1992 Regulations, as amended by the Planning (Hazardous Substances) (Amendment) (England) Regulations 2009 (amendments to the regulations in Wales will be available in November 2009). The up to date list of such substances and quantities is available at http://www.opsi.gov.uk/si/si2009/uksi_20091901_en_1 .

82. Applicants must detail in Form 1 the nature and amount of any hazardous substances (either named in Part A of Schedule 1 or covered

[28] An overview of the general hazards of CO_2 is available on the HSE website at http://www.hse.gov.uk/carboncapture/carbondioxide.htm

by Parts B or C) which they propose will be present on the site when the capture plant is operational, together with information on the associated vessels and processes. Guidance on filling in this form, given the uncertainties which may exist over the exact nature of the vessels and processes which may be involved in operational CCS, is available from HSE. Additional guidance is also available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/hazardoussubstancesguide.pdf

CCR review reports and Section 36 CCR conditions

83. CCR is an interim measure, designed to widen the pool of power stations to which in time CCS may be retrofitted. Given the evolving state both of CCS technologies and of relevant safety regulation in particular, the Government considers it prudent to require, as part of any CCR consent condition, that successful applicants for Section 36 consents submit reports periodically about whether it remains technically feasible to retrofit CCS to the power station. Applicants will also be required through an additional Section 36 condition to retain an appropriate degree of control over the ownership and use of the additional space on or near to site set aside for the carbon capture equipment, so as to ensure that they continue to present no foreseeable barrier to retrofitting (as required by Article 33 of Directive 2009/31), and to report in the reviews on their ongoing compliance with this condition.

84. If applicants fail to ensure that sufficient suitably located land remains available for the carbon capture equipment, they will be considered in breach of their original Section 36 consent and may be subject to legal action as a result.

85. The Government considers that the purpose of review of a consented power station's CCR assessments should be to let Government know whether circumstances have changed such that there is any technical reason why an applicant's original proposals cannot now be implemented. It will be a condition of an applicant's Section 36 consent that this information is supplied but, (except as regards the maintenance of control over the space set aside for carbon capture equipment) the outcome of the review will not lead to an applicant being considered to be in breach of their Section 36 consent. The information gathered in such reviews will inform Government policy making, for example on the possible need for protected routes for CO_2 pipelines in the future[29].

86. The information gathered in the reviews will also be used to:

- inform future updated versions of the CCR guidance document to the benefit of all operators of CCR plants;

[29] If appropriate, these policy changes will also be reflected in the National Policy Statements used by the Infrastructure Planning Commission.

- inform the UK's input to the EU's mandatory regular reviews of the Directive.

Review of proposals for the retrofit of carbon capture equipment

87. Where the technical annexes to this guidance on retrofitting of CCS technologies have been updated, applicants will only be expected to take account of material changes which would present a barrier to the original proposals. The review of this CCR element should comprise a short report confirming that no technical barriers exist or if identified, how these could be overcome. Applicants will have space set aside on site and will have identified one feasible method of retrofit in their original Section 36 application, therefore the Government considers that it will, generally, be possible to retrofit a form of carbon capture equipment to the plant in the future. Applicants may, if they wish, use the review to justify, with reference to the latest CCS technological advances, why less space would now be required to be retained for possible future CCS plant. The Secretary of State will consider such justifications and may allow appropriate modifications to the amount of land retained.

Review of proposals for CO_2 transport and storage

88. The Government recognises that CCR at the Section 36 consent stage does not provide assurances over an applicant's right to use the particular CO_2 transport route or CO_2 storage area identified in their initial Section 36 application. However the Government considers that it would still be valuable for the review to cover the transport and storage options chosen by the applicant. The purpose of the review will be to inform Government of the position in respect of possible barriers to the applicant's proposals for transport and storage. If any such barriers are identified, applicants should suggest how these barriers would be overcome. For example this may be by providing details of an alternative transport route or storage area.

89. The DTI study (see paragraph 34) placed a conservative estimate of realistic UK storage capacity offshore of between 7.5 – 22.3 Gt of CO_2, (this estimate does not included the theoretical capacity of saline aquifers in the Northern and Central North Sea Basins) therefore the Government considers that applicants will be able to identify an alternative storage option if their original proposals are no longer available. However in respect of CO_2 transport, there may be exceptional circumstances, for example as a result of subsequent development by third parties along what an applicant had identified as the preferred CO_2 transport route from the power station, where it becomes impossible for an applicant to identify a currently available and feasible CO_2 transport route close (within the first 10km) to the power station. (Since there are likely to be a greater number of available alternative routes with increasing distance from the power station, it is unlikely that development further away from the plant will have the effect of making it impossible to construct a transport route from it). The

frequency of these losses of a CO_2 transport route will inform Government policy as to whether CO_2 transport routes need to be protected in the future. It is important that applicants inform the local planning authorities in the areas surrounding the power station of the likelihood that a CO_2 pipeline will be needed in the future to ensure this is taken into account in local planning decisions.

Review mechanism

90. The CCR reviews required following receipt of a Section 36 consent will commence within 3 months of the commercial operation date of the power station and will be required every two years thereafter. These reports will need to continue only until such time as the operator retrofits CCS to the full capacity of their plant.

91. It is possible, if not likely, that some of the assumptions on which the economic assessment rests will need to be revisited over time in order to determine whether or not it has or will become economically feasible to fit CCS. However, it would not be appropriate for the Government to require that the economic assessment be reviewed and possibly updated as part of the ongoing reporting requirements on CCR. This is partly because most, if not all, of the parameters which will determine economic feasibility are not in any way controlled by developers, and partly because information on matters such as exchange rates and predictions of future carbon prices as readily available to Government, if it wishes to consider the impact which changes in them may have on the feasibility of fitting CCS to particular power stations.

92. Operators should explain at each review stage their position in relation to the need for HSC for their proposals for operational CCS. This will be particularly important if dense phase CO_2 becomes classified as a hazardous substance. In such cases, operators would also be encouraged to discuss with their local Hazardous Substances Authority (often the Local Planning Authority) whether this change in classification of dense phase CO_2 would necessitate an application for HSC or amendment of an existing HSC.

93. The reports will need to be submitted to the Department responsible for energy policy, currently the Department of Energy and Climate Change.

Assessment of CCR in Section 36 applications

94. In considering an application for Section 36 consent the Secretary of State will be drawing on advice from a range of bodies with specialist skills in assessing whether there are no technical barriers to CCR and whether the economic assessments make CCS feasible in the lifetime of the station. We plan for these to be primarily:

- **the Environment Agency** who will consider the technical assessments in respect of space and the feasibility of retrofitting the declared preferred type of capture plant and advise the Secretary of

State as to whether or not they comply with a "no barriers" approach to any later CCS retro fit;

- **the Onshore Consents Team in DECC** who will consider the technical assessments of the CO_2 transport and the storage component of CCR with additional advice from those bodies within government with relevant expertise to offer including the proposed Marine Management Organisation (MMO), the HSE and the British Geological Survey (BGS) if required;

- **the Health and Safety Executive** may assist the Onshore Consents Team in DECC on the assessment of the transport component of CCR. They are currently carrying out research to inform the safety guidelines on the transport of dense phase CO_2 pipelines and have provided interim guidance on safety and possible CO_2 pipelines (see paragraph 54). HSE also have a role in advising the Secretary of State on applications for Hazardous Substances Consent and in setting the appropriate consultation distance around the site (see paragraphs 70-82); and

- **the economists within DECC** who will consider the soundness of the assessment on the economic feasibility of CCS.

95. In addition all the statutory advisors and other bodies who normally consider Section 36 applications[30] will be able to comment on the CCR assessments submitted.

Deployment of CCS

96. CCR status does not equate to consent for CCS. Deployment of CCS will involve major infrastructure changes on site and will therefore necessitate another Section 36 consent or in due course consent by the Infrastructure Planning Commission under the Planning Act 2008. In order to retrofit CCS, Government has made clear that a further Section 36 application will be required, in addition to the separate consents and licences necessary for CO_2 transport and storage. At this point an EIA covering the impacts arising from CCS at the power station will be conducted and an Environmental Statement (ES) included in the application. If consent for the transport method, for example a CO_2 pipeline, is included in the application to retrofit carbon capture to the plant, the ES would also need to cover its impacts: if not, then the impacts of CO_2 transport will be assessed as part of a separate consent application. The detailed arrangements surrounding the licensing of

[30] Statutory and non-statutory consultees for Section 36 applications include: the relevant local planning authorities, the Environment Agency (or the Environment Agency Wales), Natural England (or the Countryside Council for Wales), the Civil Aviation Authority, National Air Traffic Services, the Health and Safety Executive, the Ministry of Defence, the Welsh Assembly Government (if applicable), the Greater London Authority (if applicable) and other Government Departments and the relevant Government Office.

CO_2 storage are currently under consultation[31] but will include a full environmental assessment of the impacts of storage as required by the Directive. A further assessment would be required in relation to the offshore transport proposals, although in practice it is likely that this would be combined with the storage assessment.

97. The reasons why an EIA for CCS is not needed at the CCR stage are explained in para 48.

Hydrogen combustion plant

98. It is possible that some applicants for new power stations at or over 300 MWe may believe they are unlikely in the future to move to CCS because they would plan to switch to using hydrogen as a fuel (thereby reducing CO_2 emissions to zero and obviating the need for any carbon capture).

99. However, Directive 2009/31/EC requires as a minimum that the specified technical and economic CCR assessments on storage, transport and retrofitting should be done. Also, given the uncertainties about whether the volumes of hydrogen needed would be commercially available at the unknown point when it might be required, the Government will still require such applications to demonstrate CCR by completing these assessments and by ensuring suitable space is left available on site to retrofit CCS equipment.

Model CCR development consent conditions

100. In order to illustrate how it is expected that the principles outlined in this guidance (particularly as regards the setting aside of space for capture equipment and the review of technical feasibility of CCS retrofit), Annex G contains model conditions of the kind which applicants should expect to see included in consents under Section 36 or development consent orders made under the Planning Act 2008. While it may not be appropriate to follow every detail of the wording of the model conditions in any given case, they do indicate the points to be addressed in applying the policy set out above to individual power station proposals and the level of assurance which should be achieved in imposing CCR obligations on applicants.

[31] The consultation on the proposed offshore carbon dioxide storage licensing regime is available on the DECC website via:
http://decc.gov.uk/en/content/cms/consultations/co2_storage/co2_storage.aspx

Annexes

Annex A: Environment Agency verification of CCS Readiness New Pulverised Coal Fired Power Station Using Post-Combustion Solvent Scrubbing

Annex B: Environment Agency Verification of CCS Readiness New Natural Gas Combined Cycle Power Station Using Pre-Combustion CO_2 Capture (including coal gasification) and Hydrogen-Rich Fuel Gas Combustion

Annex C: Environment Agency verification of CCS Readiness New Natural Gas Combined Cycle Power Station Using Post-Combustion Solvent Scrubbing

Annex D: Storage options drawn from “Industrial carbon dioxide emissions and carbon dioxide storage potential in the UK”

Annex E: Some information resources to assist with the preparation of the assessments

Annex F: Glossary

Annex G: Model CCR development consent conditions

Annex A

Environment Agency verification of CCS Readiness New Pulverised Coal Fired Power Station Using Post-Combustion Solvent Scrubbing

Capture Ready Features

IEA GHG Technical Report 2007/4 "CO_2 Capture Ready Plants" is used as a reference document. In the following sections the titles and relevant text from report 2007/4 is shown in italics. Notes on evidence expected to be provided are shown in bold normal font. Where it is not possible or not considered necessary to provide the evidence this should be justified.

A1 Design, Planning Permissions and Approvals

Note A1: A pre-feasibility-level conceptual capture retrofit study should be supplied for assessment, showing how the proposed CCR features would make adding post-combustion capture technically feasible, together with an outline level plot plan for the plant retrofitted with capture.

A2 Power Plant Location

Note A2a: The work undertaken on CO_2 transport and storage should be referenced. The exit point of gases from the curtilage of the plant and how this affects the configuration of the capture equipment is the important aspect for the Environment Agency.

Note A2b: Health and Safety items in this section are outside the Environment Agency remit.

A3 Space Requirements

Space will be required for the following:

a) *CO_2 capture equipment* [including for CO_2 drying and compression].
b) *Boiler island additions and modifications.*
c) *Steam turbine island additions and modifications.*
d) *Extension and addition of balance of plant systems to cater for the additional requirements of the capture equipment* [including for upgrade of other pollutant control systems that may be required by the solvent technology chosen].
e) *Additional vehicle movement (amine transport etc.).*
f) *Space allocation for storage and handling of amines and handling of CO_2.*[including space for infrastructure to transport CO_2 to the plant boundary].

Note A3: It is expected that all of the provisions in a-f above will be implemented, including the provision of space and access to carry out the necessary works at the time of retrofitting without excessive

interruptions to normal plant operation. A statement describing how the space allocations were determined and how they will be met is required. Further details are requested in the following sections as appropriate.

A4 ASC PF Boiler and Auxiliaries

Note A4: A statement describing the proposed flue gas system modifications and how they will be implemented is required.

A5 DeNOx Equipment

Note A5: A statement is required of the predicted performance of the DeNOx equipment and its compatibility with the relevant solvent mixtures for capture retrofit.

A6 Particulate Removal Unit (ESP/ Bag Filter)

Note A6: A statement describing the expected configuration and anticipated performance of the particulate removal equipment (to maintain effective amine scrubber operation) is required.

A7 Flue Gas Desulphurisation Unit (FGD)

Note A7: A statement describing the expected configuration and anticipated performance of the DeSOx equipment after capture retrofit (to maintain effective amine scrubber operation) is required.

A8 Steam Turbine Generator and Auxiliaries

Note A8: A statement is required giving the steam pressure at the steam turbine IP/LP crossover (or other steam extraction point), together with a description of any post-retrofit equipment modifications/additions. It should be demonstrated that the turbine could be operated with capture using solvent systems with a range of steam requirements. The energy penalty involved in such steam extraction should be estimated and compared to theoretical minimum values (i.e. for extraction from a similar turbine that has been purpose-built for such steam extraction).

A9 Water - Steam - Condensate Cycle

Note A9: A statement is required describing the arrangements made to facilitate low grade heat recovered from the capture and compression equipment being used in the water-steam-condensate cycle. Where potentially-useful options have not been facilitated this should be justified.

A10 Cooling Water System

The amine scrubber, flue gas cooler and CO_2 compression plant introduced for CO_2 capture increase the overall power plant cooling duty.

Note A10: A statement is required of estimated cooling water demands (flows and temperatures) with capture and how these will be met. It is

expected that necessary space and tie-ins for cooling water supplies to post-combustion capture equipment will be provided and a description of these should be included.

A11 Compressed Air System

The capture equipment addition will call for additional compressed air (both service air and instrument air) requirements.

Note A11: A statement is required of estimated additional compressed air requirements together with a description of how these will be accommodated.

A12 Raw Water Pre-treatment Plant

Space shall be considered in the raw water pre-treatment plant area to add additional raw water pre-treatment streams, as required.

Note A12: A statement is required of estimated treated raw water requirements together with a description of how these will be accommodated.

A13 Demineralisation I Desalination Plant

No essential capture-ready requirements are foreseen, as the demineralised water requirement is not expected to increase after CO_2 capture retrofit.

A14 Waste Water Treatment Plant

Amine scrubbing plant along with flue gas coolers and FGD Polishing unit (if appropriate) provided for post combustion CO_2 capture will result in generation of additional effluents.

Note A14: A statement is required giving estimated additional waste water treatment needs and stating how the necessary space and any other provisions will be provided to meet expected demands.

A15 Electrical

The introduction of amine scrubber plant along with flue gas coolers, FGD polisher (if appropriate), booster fans (if required), and CO_2 compression plant will lead to a number of additional electrical loads (e.g. pumps, compressors).

Note A15: A statement is required listing the estimated additional electrical requirements and describing space allocation in suitable locations for items such as additional transformers, switching gear and cabling.

A16 Chemical Dosing Systems and Steam Water Analysis System

Modifications in these areas are not foreseen as an essential requirement.

A17 Plant Pipe Racks

Installation of additional pipework after retrofit with capture will be required due to the use of a large quantity of LP steam in the amine scrubbing plant reboiler, return of condensate into the water-steam-condensate cycle and

process integration of capture equipment with the water-steam-condensate cycle [and possibly other plant modifications].

Note A17: It is expected that provision will be made for space for routing new pipework at the appropriate locations. A statement identifying anticipated significant additional pipework and describing space allocations to accommodate these is required.

A18 Control and Instrumentation

Note A18: It is expected that space and provisions for additional control equipment and cabling will be implemented. A statement identifying anticipated additional control equipment and describing space and other provisions to accommodate these is required.

A19 Plant Infrastructure

Space at appropriate zones to widen roads and add new roads (to handle increased movement of transport vehicles), space to extend office buildings (to accommodate additional plant personnel after capture retrofit) and space to extend stores buildings are known. Consideration should also be given to how, during a retrofit, vehicles or cranes will access the areas where new equipment will need to be erected.

Note A19: It is expected that the provisions above will be implemented. A statement identifying anticipated requirements and describing how they will be met is required.

Other technologies for post-combustion capture

A20 'Essential' Capture-Ready Requirements: Post Combustion Amine Scrubbing Technology based CO_2 Capture

The capture-ready requirements discussed in this section are the 'essential' requirements which aim to ease the capture retrofit of PF Bituminous Power Plants with post combustion amine scrubbing technology based CO_2 capture

Note A20: The provisions covered in Notes A1-A19 can be adapted to include other liquid solvent mixtures for CO_2 capture that can be shown to have a reasonable expectation of being commercially available at the time of retrofit and for which reliable performance estimates are already available. A statement on where the requirements for capture readiness for such solvents differ from those for amine capture with respect to A1-A19 is required, together with any additional CCR features or other actions proposed, to be added as addenda to the responses to Notes A1-A19. If making the plant capture ready for other solvents conflicts with the CCR requirements for amine scrubbing then the impact on retrofitting amine scrubbing should be estimated and stated and the reasons for giving the other solvent priority should be justified.

Annex B

Environment Agency Verification of CCS Readiness New Natural Gas Combined Cycle Power Station Using Pre-Combustion CO_2 Capture (including coal gasification) and Hydrogen-Rich Fuel Gas Combustion

Capture Ready Features

See IEA GHG Technical Reports 2007/4 "CO_2 Capture Ready Plants" and 2005/1 'Retrofit of CO_2 Capture to Natural Gas Combined Cycle Power Plants' as background to this document.

Notes on evidence expected to be provided are shown in bold normal font. Where it is not possible or not considered necessary to provide the evidence this should be justified.

Pre-combustion (on site, gas and/or coal fuel)

The expectation is that it would be sufficient for a new natural gas combined cycle power plant to be capture-ready for post-combustion capture. The plant developer might alternatively choose to make the plant capture-ready for pre-combustion capture on-site, but would need to show that there is a reasonable expectation that this would offer an equally effective option for retrofitting capture in the future.

Pre-combustion capture involves the conversion of natural gas or coal to a hydrogen-rich fuel gas with the capture of the CO_2 produced during this process (or conversion of other fuels such as petroleum coke, petroleum residues, natural bitumens etc that can beneficially be upgraded through gasification; where "coal" is written in this checklist it can be extended to include such fuels). The hydrogen-rich fuel gas is then burnt in the gas turbine, replacing natural gas.

The general procedure is conversion of the fuel to a syngas consisting mainly of CO and H_2 by reforming (probably autothermal reforming for natural gas) or gasification (for other fuels), followed by a shift process in which the CO in the syngas is reacted with H_2O to form CO_2 and more H_2. The CO_2 is then removed for compression (including drying and, possibly, some removal of impurities) followed by transport to storage or use. Either air or oxygen (plus some steam) could be used for the autothermal reforming and the gasification stages, but based on current experience it is more likely that air would be used for the former and oxygen for the latter.

B1 Design, Planning Permissions and Approvals

Note B1: A pre-feasibility-level conceptual capture retrofit study should be supplied for assessment, showing how the proposed CCR features would make adding pre-combustion capture technically feasible,

together with an outline level plot plan for the plant retrofitted with capture. If the plant is not also going to be capture-ready for post-combustion capture then the justification for this should be provided.

B2 Power Plant Location

Note B2a: The work undertaken on CO_2 transport and storage should be referenced; the exit point of gases from the curtilage of the plant and how this affects the configuration of the capture equipment is the important aspect for the Environment Agency.

Note B2b: Health and Safety items in this section are outside the Environment Agency remit.

B3 Space Requirements

Space will be required for the following:

a) *If appropriate, coal delivery and storage facilities (and additional evidence will be provided to show that coal transport to the site is feasible);*
b) *Hydrogen fuel gas production facilities, including fuel reforming or gasification equipment, shift reactor, CO_2 separation and compression equipment and all other gas purification (including sulphur removal) or other pre-treatment facilities.*
c) *If appropriate, an air separation unit for oxygen production (plus possibly space for oxygen storage), with necessary separations from other equipment and space for the necessary oxygen pipelines.*
d) *Space for piping hydrogen-rich fuel gas to the gas turbine, and for gas compression equipment if required.*
e) *Steam turbine island additions and modifications (e.g. space in the steam turbine building for supplying and receiving steam to/from the hydrogen production facilities).*
f) *Extension and addition of balance of plant systems to cater for the additional requirements of the capture equipment, including CO_2 pipeline (and/or other facilities for CO_2 transport).*
g) *Additional vehicle movements.*
h) *Space allocation considering storage and handling of hydrogen, oxygen if appropriate and of CO_2.*

Note B3: It is expected that all of the provisions in a-h above will be implemented, including the provision of space and access to carry out the necessary works at the time of retrofitting without excessive interruptions to normal plant operation. A statement describing how the space allocations were determined and how they will be met is required. Further details are requested in the following sections as appropriate.

B4 Gas Turbine Combined Cycle unit operation with hydrogen-rich fuel gas

The gas turbine must be able to be modified to operate with the proposed hydrogen-rich fuel gas (including achieving any likely environmental

restrictions on the emissions of NOx, possibly with the addition of selective catalytic reduction equipment - SCR).

Note B4: A statement is required confirming that it will be possible to modify the gas turbine to accommodate firing on hydrogen-rich fuel gas in the future and estimating the future performance.

B5 Heat recovery steam generator, HRSG, and plant steam cycle

The heat recovery steam generator must be designed to accommodate the changed flue gas composition and temperatures after pre-combustion capture retrofit. The steam cycle as a whole must also be designed to accommodate the needs of the hydrogen production facility, both for providing any additional steam supplies to that facility and for the use of any additional steam production in the hydrogen production facility, to allow reasonable thermal integration and hence overall plant efficiency after retrofit.

Note B5: A statement is required describing changes in the requirements for the HRSG and steam cycle after retrofit and how they will be modified to accommodate this.

B6 Waste Separation and Disposal Facilities

Gasification of certain fuels such as coal or petroleum coke will give rise to by-product residue streams such as sulphur and/or solid ash that do not occur on natural gas plants. Provision for handling such streams on-site and for their satisfactory disposal from the site must be identified.

Note B6: A statement is required identifying any additional by-product streams from the plant after pre-combustion capture is retrofitted and describing the appropriate handling and disposal provisions that would be implemented.

B7 Cooling Water System

Pre-combustion CO_2 capture will increase the overall power plant cooling duty.

Note B7: A statement is required of estimated cooling water requirements (flows and temperatures) and how these will be met. It is expected that necessary space and tie-ins for additional cooling water supplies to the plant after retrofitting pre-combustion capture will be provided and a description of these is required.

B8 Compressed Air System

The capture equipment addition will call for additional compressed air (both service air and instrument air) requirements.

Note B8: A statement is required of estimated additional compressed air requirements together with a description of how these will be accommodated.

B9 Raw Water Pre-treatment Plant

Space shall be considered in the raw water pre-treatment plant area to add additional raw water pre-treatment streams, as required.

Note B9: A statement is required of estimated treated raw water requirements together with a description of how these will be accommodated.

B10 Demineralisation / Desalination Plant

Additional supplies of demineralised water are likely to be required after retrofitting e.g. for process steam used in the hydrogen production facility and possibly in the gas turbine NOx control system. Estimates of any such water requirements should be made and space allocated for the necessary treatment plant (and an additional water source be identified if necessary).

Note B10: A statement is required saying which of the above are needed and in what quantity and also describing how the necessary provisions will be implemented.

B11 Waste Water Treatment Plant

Fuel processing for pre-combustion CO_2 capture is expected to result in generation of additional waste water effluents.

Note B11: A statement is required giving estimated additional waste water treatment needs and describing how the necessary space and any other provisions will be provided to meet expected demands.

B12 Electrical

The introduction of the hydrogen production facility with pre-combustion capture will lead to a number of additional electrical loads (e.g. pumps, compressors).

Note B12: A statement is required listing the estimated additional electrical requirements and describing space allocation in suitable locations for items such as additional transformers, switching gear and cabling.

B13 Plant Pipe Racks

Installation of additional pipework after retrofit with capture will be required, e.g. for gas and steam transport and additional cooling water piping and possibly other plant modifications.

Note B13: It is expected that provision will be made for space for routing new pipework at the appropriate locations. A statement identifying anticipated significant additional pipework and describing space allocations to accommodate these is required.

B14 Control and Instrumentation

Note B14: It is expected that space and provisions for additional control equipment and cabling will be implemented. A statement identifying anticipated additional control equipment and describing space and other provisions to accommodate these is required.

B15 Plant Infrastructure

Space at appropriate zones to widen roads and add new roads (to handle increased movement of transport vehicles), space to extend office buildings (to accommodate additional plant personnel after capture retrofit) and space to extend stores building are foreseeable. Consideration should also be given to how, during a retrofit, vehicles or cranes will access the areas where new equipment will need to be erected.

Note B15: It is expected that the provisions above will be implemented. A statement identifying anticipated requirements and describing how they will be met is required.

Annex C

Environment Agency verification of CCS Readiness New Natural Gas Combined Cycle Power Station Using Post-Combustion Solvent Scrubbing

Capture Ready Features

Relevant text from IEA GHG Technical Report 2007/4 "CO_2 Capture Ready Plants" is used as a basis for the requirements in this list. See also IEA GHG report 2005/1 'Retrofit of CO_2 Capture to Natural Gas Combined Cycle Power Plants'.

Notes on evidence expected to be provided are shown in bold normal font. Where it is not possible or not considered necessary to provide the evidence this should be justified.

Post-combustion (amine scrubbing)

C1 Design, Planning Permissions and Approvals

Note C1: A pre-feasibility-level conceptual capture retrofit study should be supplied for assessment, showing how the proposed CCR features would make adding post-combustion capture technically feasible, together with an outline level plot plan for the plant retrofitted with capture.

C2 Power Plant Location

Note C2a: The work undertaken on CO_2 transport and storage should be referenced; the exit point of gases from the curtilage of the plant and how this affects the configuration of the capture equipment is the important aspect for the Environment Agency.

Note C2b: Health and Safety items in this section are outside the Environment Agency remit.

C3 Space Requirements

Space will be required for the following:

a) *CO_2 capture equipment, including any flue gas pretreatment and CO_2 drying and compression.*
b) *Space for routing flue gas duct to the CO_2 capture equipment.*
c) *Steam turbine island additions and modifications (e.g. space in steam turbine building for routing large low pressure steam pipe to amine scrubber unit).*
d) *Extension and addition of balance of plant systems to cater for the additional requirements of the capture equipment.*
e) *Additional vehicle movement (amine transport etc).*

f) *Space allocation for storage and handling of amines and handling of CO_2 including space for infrastructure to transport CO_2 to the plant boundary.*

Note C3: It is expected that all of the provisions in a-f above will be implemented, including the provision of space and access to carry out the necessary works at the time of retrofitting without excessive interruptions to normal plant operation. A statement describing how the space allocations were determined and how they will be met is required. Further details are requested in the following sections as appropriate. The space for capture equipment might be significantly reduced if flue gas recycling through the gas turbine is used to concentrate the CO_2, but to validate this option suitable demonstrations of its feasibility by the gas turbine supplier would be required.

C4 Gas Turbine Operation with Increased Exhaust Pressure

The gas turbine (and upstream ducting and heat recovery steam generator, HRSG) must be able to operate with the increased back pressure imposed by the capture equipment, or alternatively space must be provided for a booster fan.

Note C4: A statement is required giving the expected pressure drop required for current commercial capture equipment together with a manufacturer's confirmation that the gas turbine can accommodate this and any effects on the performance, or alternatively describing booster fan specification together with space and other installation requirements.

C5 Flue Gas System

Space should be available for installing new duct work to enable interconnection of the existing flue gas system with the amine scrubbing plant and provisions in the duct work for tie-ins and addition of items such as bypass dampers and isolation dampers will be required as a minimum. If selective catalytic reduction (SCR) or other flue gas treatment is likely to be added at the time of retrofit then space for this should also be provided.

Note C5: A statement is required describing the space and required flue gas system configuration for retrofit requirements and how they will be implemented.

C6 Steam Cycle

Note C6: A statement is required giving the steam pressure at the steam turbine IP/LP crossover (or other steam extraction point), together with a description of any post-retrofit equipment modifications/additions. It should be demonstrated that the steam cycle could be operated with capture using solvent systems with a range of steam requirements. The energy penalty involved in such steam extraction should be estimated and compared to theoretical minimum values (i.e. for extraction from a similar steam cycle that has been purpose-built for such steam extraction).

C7 Cooling Water System

The amine scrubber, flue gas cooler and CO_2 compression plant introduced for CO_2 capture increases the overall power plant cooling duty.

Note C7: A statement is required of estimated cooling water demands (flows and temperatures) with capture and how these will be met. It is expected that necessary space and tie-ins for cooling water supplies to post-combustion capture equipment will be provided and a description of these should be included.

C8 Compressed Air System

The capture equipment addition will call for additional compressed air (both service air and instrument air) requirements.

Note C8: A statement is required of estimated additional compressed air requirements together with a description of how these will be accommodated.

C9 Raw Water Pre-treatment Plant

Space shall be considered in the raw water pre-treatment plant area to add additional raw water pre-treatment streams, as required.

Note C9: A statement is required of estimated treated raw water requirements together with a description of how these will be accommodated.

C10 Demineralisation I Desalination Plant

A supply of reasonably pure water may be required to make up evaporative losses from the flue gas cooler and/or scrubber. Estimates of this water requirement should be made and space allocated for the necessary treatment plant (and an additional water source be identified if necessary).
Note C10: A statement is required saying which of the above are needed and in what quantity and also describing how the necessary provisions will be implemented

C11 Waste Water Treatment Plant

Amine scrubbing plant along with flue gas coolers (if appropriate) provided for post combustion CO_2 capture will result in generation of additional effluents.

Note C11: A statement is required giving estimated additional waste water treatment needs and describing how the necessary space and any other provisions will be provided to meet expected demands.

C12 Electrical

The introduction of amine scrubber plant along with flue gas coolers, booster fans (if required), and CO_2 compression plant will lead to a number of additional electrical loads (e.g. pumps, compressors).

Note C12: A statement is required listing the estimated additional electrical requirements and describing space allocation in suitable

locations for items such as additional transformers, switching gear and cabling.

C13 Plant Pipe Racks

Installation of additional pipework after retrofit with capture will be required due to the use of a large quantity of LP steam in the amine scrubbing plant reboiler, return of condensate into the water-steam-condensate cycle, additional cooling water piping and possibly other plant modifications.

Note C13: It is expected that provision will be made for space for routing new pipework at the appropriate locations. A statement identifying anticipated significant additional pipework and describing space allocations to accommodate these is required.

C14 Control and Instrumentation

Note C14: It is expected that space and provisions for additional control equipment and cabling will be implemented. A statement identifying anticipated additional control equipment and describing space and other provisions to accommodate these is required.

C15 Plant Infrastructure

Space at appropriate zones to widen roads and add new roads (to handle increased movement of transport vehicles), space to extend office buildings (to accommodate additional plant personnel after capture retrofit) and space to extend stores building are foreseeable. Consideration should also be given to how, during a retrofit, vehicles or cranes will access the areas where new equipment will need to be erected.

Note C15: It is expected that the provisions above will be implemented. A statement identifying anticipated requirements and describing how they will be met is required.

Other technologies for post-combustion capture

C16 'Essential' Capture-Ready Requirements: Post Combustion Amine Scrubbing Technology based CO_2 Capture

The capture-ready requirements discussed in this section are the 'essential' requirements which aim to ease the capture retrofit of Natural Gas Combined Cycle power plants with post combustion amine scrubbing technology based CO_2 capture.

Note C16: The provisions covered in Notes C1-C15 can be adapted to include other liquid solvent mixtures for CO_2 capture that can be shown to have a reasonable expectation of being commercially available at the time of retrofit and for which reliable performance estimates are already available. A statement on where the requirements for capture readiness for such solvents differ from those for amine capture with respect to all of the relevant sections C1- C15 above is required, together with any additional CCR features or other actions proposed, to be added as addenda to the responses to Notes C1-C15. If making the plant capture ready for other solvents conflicts with the CCR requirements for amine

scrubbing then the impact on retrofitting amine scrubbing should be estimated and stated and the reasons for giving the other solvent priority should be listed and justified.

Annex D

Tables of "Realistic and "Viable" Fields for CO2 storage

Storage options drawn from "Industrial carbon dioxide emissions and carbon dioxide storage potential in the UK"

Report No. COAL R308, DTI/Pub URN 06/2027, October 2006.
(Available at: http://www.berr.gov.uk/files/file35684.pdf)

The two tables below represent the judged "realistic" capacity for storing CO_2, in gas and condensate fields, to which must be added the capacity in two saline aquifers - the Bunter sandstone in the southern North Sea basin up to 14.25 Gt and the Ormskirk Sandstone formation, up to 0.63Gt (see p.39)

Individual capacity estimates for oil fields are not in the public domain, but the total viable capacity has been estimated at 1.175 Gt of CO_2 and the total theoretical capacity has been estimated at 3.5 Gt of CO_2[32].

[32] Pages 9-11 of the "Industrial carbon dioxide emissions and carbon dioxide storage potential in the UK". Report No. COAL R308, DTI/Pub URN 06/2027, October 2006. Available at: www.berr.gov.uk/files/file35684.pdf

Table 4.1 Estimated CO_2 storage capacity of UK gas fields

Field name	Area	GIIP bcm	URR bcm	GEF	P bar	T °C	CO_2 density kgm^{-3}	Drive mech	Drive factor	CO^2 storage capacity (10^6 tonnes)
Frigg (UK)	C/NNS	92.07	72.48	197	198	61	714	W	0.65	170.76
Brechin	C/NNS								0.65	
Farragon	C/NNS								0.65	
Nuggets	C/NNS		10.4	128	114	31.4	786.6		0.65	41.7
Tullich	C/NNS								0.65	
Bains	EISB		1.4	128	114	31.4	786.6	U	0.65	5.43
Dalton	EISB		2.9	128	114	31.4	786.6	U	0.65	11.46
Darwen	EISB							U	0.65	
Hamilton	EISB	17.76	14.33	108	96.8	30	763.7	W	0.65	65.87
Hamilton North	EISB	6.51	5.34	120	105.8	30	784.1	W	0.65	22.68
Hamilton East	EISB							U	0.65	
Millom	EISB		6.1	128	114	31.4	786.6	U	0.65	24.25
Morecambe North	EISB	36.5	28.8	143	124	33	791.7	D	0.9	143.51
Morecambe South	EISB	155.8	149.1	146	128	32.7	800.9	D	0.9	736.08
Ormonde South	EISB							U	0.65	
Rivers Complex	EISB		8.5	128	114	31.4	786.6	U	0.65	33.95
Amethyst	SNS	31.0	23.9	235	283	88	692	D	0.9	63
Anglia	SNS	9.1	6.9	222	267	83	694	U	0.9	19
Ann	SNS	3.3	2.5	222	267	83	694	U	0.9	7
Audrey	SNS	25.0	18.9	222	267	83	694	U	0.9	53
Baird	SNS	3.4	2.5	222	267	83	694	U	0.9	7
Barque	SNS	85.5	38.7	228	264	79	710	D	0.9	108
Beaufort	SNS	1.1	0.9	228	276	91	669	D	0.9	2
Bell	SNS	5.7	4.3	222	267	83	694	U	0.9	12
Bessemer	SNS	3.7	2.8	228	278	91	672	D	0.9	8
Big Dotty	SNS	8.4	6.3	185	182	66	648	W	0.65	14
Boulton	SNS	5.8	4.0	295	447	116	741	D	0.9	9
Brown	SNS	1.0	0.7	223	274	89	675	D	0.9	2
Caister	SNS	10.3	7.5	288	428	114	732	U	0.65	12
Caister B	SNS									
Callisto	SNS	2.9	2.2	222	267	83	694	U	0.9	6
Camelot	SNS	7.9	7.1	192	193	60	712	MW	0.65	17
Cleeton	SNS	10.1	7.9	244	286	79	735	W	0.65	16
Clipper	SNS	33.2	21.3	228	265	79	712	D	0.9	60
Corvette	SNS	6.7	6.0	232	281	86	699	D	0.9	16
Davy	SNS	5.7	5.0	206	246	88	639	D	0.9	14
Dawn	SNS	0.7	0.5	164	162	64	609	D	0.9	2
Deborah	SNS	11.6	9.9	186	190	63	686	U	0.9	33
Delilah	SNS	1.3	0.7	182	196	66	677	U	0.9	2
Della	SNS	4.0	3.0	187	193	62	699	U	0.9	10
Esmond	SNS	10.8	9.7	158	157	57	656	W	0.65	26

Europa	SNS	3.8	2.9	222	267	83	694	U	0.9	8
Excalibur	SNS	9.8	7.4	222	267	83	694	U	0.9	21
Forbes	SNS	3.0	2.2	179	193	63	692	W	0.65	6
Galahad	SNS	5.7	4.3	222	267	83	694	U	0.9	12
Galleon	SNS		49.2	223			690	U	0.9	137
Ganymede	SNS	10.6	8.0	222	267	83	694	U	0.9	23
Gawain	SNS	7.8	6.1	227	284	80	729	U	0.9	18
Gordon	SNS	5.2	3.1	165	181	61	682	W	0.65	8
Guinevere	SNS	2.8	2.6	230	276	92	665	D	0.9	7
Hewett L Bunter	SNS	59.5	57.7	140	137	52	640	D	0.9	237
Hewett U Bunter	SNS	38.4	37.2	97	94	42	490	W	0.65	122
Hewett Zechstein	SNS	11.9	6.0	148	147	54	655	D?	0.9	24
Hunter	SNS							U	0.65	
Hyde	SNS	6.1	4.3	244	298	87	713	D	0.9	11
Indefatigable	SNS	158.6	133.1	228	284	91	680	D	0.9	357
Johnston	SNS	10.8	7.3	240	326	108	662	D	0.9	18
Ketch	SNS	15.8	11.5	288		114	732	U	0.65	19
Lancelot	SNS	8.8	6.6	222	267	83	694	U	0.9	19
Leman	SNS	397.0	360.0	211	208	52	783	D	0.9	1203
Little Dotty	SNS	7.1	5.3	185	189	63	685	W	0.65	13
Little Dotty	SNS	2.8	2.1	111	115	47	605	U	0.65	8
Malory	SNS	2.8	2.1	234	293	93	683	D	0.9	6
Markham	SNS	9.0	6.6	288		114	732	U	0.65	11
Mercury	SNS	3.5	2.3	228	297	96	674	W	0.65	4
Mordred	SNS	0.5	0.4	222	267	83	694	U	0.9	1
Murdoch	SNS	13.5	9.9	283	423	113	733	U	0.9	23
Neptune	SNS	9.7	8.1	253	302	80	748	W	0.65	16
Newsham	SNS	0.7	0.5	222	267	83	694	U	0.9	1
Orwell	SNS	9.8	8.1	144	146	54	650	U	0.65	24
Phoenix	SNS	23.9	14.4	243	304	85	729	U	0.9	39
Pickerill	SNS	25.5	14.2	222	275	96	646	U	0.9	37
Ravenspurn North	SNS	59.8	36.8	236	313	104	662	D	0.9	93
Ravenspurn South	SNS	34.0	19.8	240	310	93	701	D	0.9	52
Rough	SNS	13.8	10.4	256	313	92	709	D	0.9	26
Schooner	SNS	30.0	17.3	287	446	110	758	D	0.9	41
Sean East	SNS	4.0	3.6	220	267	97	630	D	0.9	9
Sean North	SNS	7.4	6.6	218	272	94	651	D	0.9	18
Sean South	SNS	17.3	13.8	225	274	89	676	W	0.65	27
Sinope	SNS	2.2	1.7	222	267	83	694	U	0.9	5
Skiff	SNS							U	0.9	
Thames	SNS	9.9	6.8	218	256	83	679	D	0.9	19
Trent	SNS	3.1	2.6	288	379	112	700	U	0.65	4
Tristan	SNS	1.5	1.1	222	267	83	694	U	0.9	3
Tyne N	SNS	4.6	2.3	288	424	116	724	U	0.65	4
Tyne S	SNS	4.2	3.0	288	437	117	731	U	0.65	5
Tyne W	SNS	1.7	1.5	288	441	117	734	U	0.65	3

V Fields	SNS	73.4	45.3	220	239	61	770	D	0.9	143
Victor	SNS	30.1	26.0	230	279	89	683	D	0.9	70
Viking	SNS	84.7	82.0	243	304	85	729	D	0.9	221
Vixen	SNS	5.5	4.1	222	267	83	694	U	0.9	12
Waveney	SNS	3.0	2.4	227	252	84	669	D	0.9	6
Welland	SNS	10.1	7.7	222	267	83	694	U	0.9	22
West Sole	SNS	72.0	53.0	239	294	85	718	D	0.9	143
Windermere	SNS	2.8	2.3	254	398	113	713	U	0.9	6
TOTAL										**5138**

Figures in blue are averages derived from full datasets with the same geological reservior.

GIIP = Gas initially in place, URR - Ultimately recoverable reserves, GEF = Gas explansion factor, Drive mech = reservoir drive mechanism, D = depletion drive, W = water drive, U = unknown drive mechanism. Where drive mechanism is not recorded, the following assumptions have been made: Leman Sst fields have depletion drive, Bunter Sst reservoirs have water drive, Carboniferous reservoirs have water drive, other reservoirs have water drive.

Table 4.2. Estimated CO_2 storage capacity of UK gas/condensate fields

Field Name	Water Depth	URR 10^9 m^3	GEF	P bar	T °C	Drive mechanism	CO_2 density kgm^{-3}	CO_2 storage capacity (10^6 tonnes)
Alwyn North	126	17.2	275	499	120	D	763	43
Beinn	99	7	276.1	517	131		745	17
Brae East	116	43.3	268	514	124		761	111
Brae North	99	22	276	476	127		729	53
Britannia	136	85	276.1	413	137	D	654	181
Bruce	122	80.9	276.1	386	100		746	197
Drake	89	9.3	200	426	125	D	699	29
Elgin	93	25.9	276.1	517	131		745	64
Ellon	135	3.8	325	565	117	D	807	8
Erskine	100	9.36	318	961	171	D	845	23
Everest	89	19.78	276.1	517	131		745	48
Fleming	89	21.54	244	282	145	D	480	38
Franklin	93	25.65	276.1	517	131		745	62
Gannet B	95	7.41	276.1	517	131		745	18
Grant	139	4.59	314	586	118	D	814	11
Hawkins	89	3.29	245	382	136	D	629	8
Jade	79	11.22	276.1	517	131		745	27
Joanne	75	15.22	276.1	517	131		745	37
Judy	75	11.3	276.1	517	131		745	27
Kingfisher	105	7.93	295	602	128	D	798	19
Lomond	89	19.95	276.1	517	131		745	48
Marnock	93	16.85	276.1	629	149		763	42
Shearwater	90	27.29	276.1	517	131		745	66
Skene	120	16.11	276.1	517	131		745	39
TOTAL								**1216**

Figures in blue are averages of actual data. Column headings abbreviations as per Table 4.1.

All fields are in the Northern and Central North Sea Basin

Annex E

Some information resources to assist with the preparation of the assessments

(i) Technical

CO_2 Capture Ready Plants. Executive Committee of the IEA Greenhouse Gas Programme. Technical Study. Report Number: 2007/4. May 2007. See: http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1980

"*Capture Ready Study*". Andrew Minchener (July 2007) from the UK Institution of Chemical Engineers is linked to the IEA study, but looks more generally at various combinations of plant and capture technology types, though not in sufficient detail to enable it to be used as a reference text. It is available at: http://www.icheme.org/captureready.pdf

Pipeline Design & Construction: A Practical Approach, Chapter 12 on Carbon Dioxide Transmission. By Mo Mohitpour, Hossein Golshan & Matthew Alan Murray. Edition: 2, illustrated, published by ASME Press, 2003, ISBN 0791802027, 9780791802021

Consenting process

The Consenting Process for Onshore Generating Stations above 50MW in England and Wales: A guidance note on Section 36 of the Electricity Act 1989. October 2007. Available at : http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/consents_planning/guidance/guidance.aspx

Guidance on background information to accompany Notifications under Section 14(1) of the Energy Act 1976 and Applications under Section 36 of the Electricity Act 1989. December 2006 Available at: http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/consents_planning/guidance/guidance.aspx

"Good Quality" CHP meets the standards set in the Cogeneration Directive 2004/08 i.e. one that in practice delivers a CO_2 emissions reduction of over 30%. The Directive is available at: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:052:0050:0060:EN:PDF 25

Storage

British Geological Survey: http://www.bgs.ac.uk/

Industrial carbon dioxide emissions and carbon dioxide storage potential in the UK. Report No. COAL R308, DTI/Pub URN 06/2027, October 2006. Available at: http://www.berr.gov.uk/files/file35684.pdf

Development of a CO2 transport and storage network in the North Sea: Report to the North Sea Basin Task Force, Pub URN 07/1494, November 2007. Available at: http://www.berr.gov.uk/files/file42476.pdf

(ii) Economic

The Energy section of DECC website is a source of information on energy markets, policy and energy statistics. http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/markets.aspx

Energy Markets Outlook, available at: http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/outlook/outlook.aspx

Carbon Capture and Storage: Assessing the economics. McKinsey&Company 2008 and references therein. Available at http://www.mckinsey.com/clientservice/ccsi/pdf/CCS_Assessing_the_Economics.pdf

Stern Review, available at: http://www.hm-treasury.gov.uk/sternreview_index.htm

Annex F

Glossary

BAT	Best Available Technique
BGS	British Geological Survey
BIS	Department for Business, Innovation & Skills
CCGT	Combined Cycle Gas Turbine
CCR	Carbon Capture Readiness
CCS	Carbon Capture and Storage.
CHP	combined heat and power
CO_2	Carbon Dioxide
COMAH	Control of Major Accident Hazards
DECC	Department of Energy and Climate Change
DPA	Data Protection Act 1998
DTI	Department of Trade and Industry (now known as BIS)
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEED	Front End Engineering Design
FOIA	Freedom of Information Act 2000
GHG	Greenhouse gas.
HSA	Hazardous Substances Authority
HSE	Health and Safety Executive
HSC	Hazardous Substances Consent
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IPPCD	Integrated Pollution Prevention and Control Directive
LCPD	Large Combustion Plant Directive
LHV	Lower Heating Value
LPA	Local Planning Authority
MCZ	Marine Conservation Zones
MMO	Marine Management Organisation
MW	Megawatt
MWe	Megawatt electrical
NPS	National Policy Statement
PSR	Pipeline Safety Regulations 1999

SECTION 36 Section 36 of the Electricity Act 1989
SCCS Scottish Centre for Carbon Storage
SSSI Site of Special Scientific Interest

Annex G

CCR: model conditions for s. 36 consents or development consent orders under the Planning Act 2008

A. CCR: definitions

The following definitions apply for the purposes of Conditions A, B and C:

(a) "capture equipment" means the plant and equipment required to capture the target carbon dioxide and identified as such in the current CCS proposal;

(b) "CCS proposal" means a proposal for the capture, transport and storage of the target carbon dioxide, which identifies the proposed capture technology, transport route and storage location;

(c) "current CCS proposal" means:

(i) the CCS proposal set out in the Feasibility Study and assessed as technically feasible by the [Secretary of State / IPC];

(ii) if a revised CCS proposal has been identified under Condition C(5), the proposal which has been most recently so identified;

(d) "designated site" means the land identified in [the Feasibility Study] as the area where the Company proposes to locate the capture equipment;

(e) "Feasibility Study" means the document entitled [*X Generating Station CCR Feasibility Study*] and dated [*date*];

(f) "target carbon dioxide" means as much of the carbon dioxide emitted by the Development when it is operating at full capacity as it is reasonably practicable to capture for the purposes of permanent storage, having regard to the state of the art in carbon capture and storage technology.

B. CCR: compliance with EU law requirements

Until such time as the Development is decommissioned, the Company shall not, without the written consent of the [Secretary of State / IPC]:

(a) dispose of any interest in land which includes the designated site; or

(b) do any other thing, or allow any other thing to be done or to occur, which may reasonably be expected to diminish the Company's ability, within two years of such act or occurrence, to install and operate the capture equipment on the designated site.

C. CCR: monitoring of compliance with EU law and technical review

(1) The Company shall make a report to the Secretary of State:

(a) on or before the date on which three months have passed from the commissioning of the Development;

(b) within one month of the second anniversary, and each subsequent even-numbered anniversary, of that date.

(2) The report shall provide evidence that the Company has complied with Condition B:

(a) in the case of the first report, since this [consent was granted / order was made];

(b) in the case of any subsequent report, since the making of the previous report,

and explain how it expects to continue to comply with Condition B over the next two years.

(3) The report shall state whether the Company considers that some or all of the technology referred to in the current CCS proposals will not work, and explain the reasons for any such conclusion.

(4) The report shall identify any other impediment of which the Company is aware, as a result of which it considers that any aspect of what is proposed in the current CCS proposals is likely or certain not to be technically feasible.

(5) Reports which identify such an impediment shall state, with reasons, whether the Company considers it technically feasible to overcome the impediment by adopting revised CCS proposals, and, if so, include such proposals.

(6) The report shall state, with reasons, whether the Company has decided to seek any additional regulatory clearances, or to modify any existing regulatory clearances, in respect of its current CCS proposals in the period referred to in Condition C(2)(a) or (b) as appropriate.

(7) This Condition shall cease to have effect if the capture equipment is installed or the Development is decommissioned.

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