DEPARTMENT OF ENERGY & CLIMATE CHANGE

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National Policy Statement for Electricity Networks Infrastructure (EN-5)

Planning for new energy infrastructure

July 2011

Department of Energy and Climate Change

National Policy Statement for Electricity Networks Infrastructure (EN-5)

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Part 1 Introduction

1.1 Background

1.1.1 The new electricity generating infrastructure that the UK needs to move to a low carbon economy while maintaining security of supply will be heavily dependent on the availability of a fit for purpose and robust electricity network. That network will need to be able to support a more complex system of supply and demand than currently and cope with generation occurring in more diverse locations.

1.2 Role of this NPS in the planning system

1.2.1 This National Policy Statement (NPS), taken together with the Overarching National Policy Statement for Energy (EN-1), provides the primary basis for decisions taken by the Infrastructure Planning Commission (IPC) on applications it receives for electricity networks infrastructure (see Section 1.8 of this NPS). The way in which NPSs guide IPC decision making, and the matters which the IPC is required by the Planning Act 2008 to take into account in considering applications, are set out in Sections 1.1 and 4.1 of EN-1.

1.2.2 Applicants should ensure that their applications, and any accompanying supporting documents and information, are consistent with the instructions and guidance given to applicants in this NPS, EN-1 and any other NPSs that are relevant to the application in question.

1.2.3 This NPS may be helpful to local planning authorities (LPAs) in preparing their local impact reports. In England and Wales this NPS is likely to be a material consideration in decision making on relevant applications that fall under the Town and Country Planning Act 1990 (as amended). Whether, and to what extent this NPS is a material consideration will be judged on a case by case basis.

1.2.4 Further information on the relationship between NPSs and the town and country planning system, as well as information on the role of NPSs, is set out in paragraphs 13-19 of Annex A to the letter to Chief Planning Officers issued by the Department for Communities and Local Government (CLG) on 9 November 2009[1].

1.2.5 Paragraphs 1.2.2 and 4.1.6 of EN-1 provide details of how this NPS may be relevant to the decisions of the Marine Management Organisation (MMO) and how the Marine Policy Statement (MPS) and any applicable Marine Plan may be relevant to the IPC in its decision making.

1.3 Relationship with EN-1

1.3.1 This NPS is part of a suite of energy NPSs. It should be read in conjunction with EN-1 which covers:

1 http://www.communities.gov.uk/publications/planningandbuilding/letternpsconsultation

- the high level objectives, policy and regulatory framework for new nationally significant infrastructure projects that are covered by the suite of energy NPSs (referred to as energy NSIPs) and any associated development;
- the need and urgency for new energy infrastructure to be consented and built with the objective of contributing to a secure, diverse and affordable energy supply and supporting the Government's policies on sustainable development in particular by mitigating and adapting to climate change;
- the need for specific technologies, including the types of infrastructure covered by this NPS;
- key principles to be followed in the examination and determination of applications;
- the role of the Appraisals of Sustainability (AoS) (see Section 1.7 below) in relation to the suite of energy NPSs;
- policy on good design, climate change adaptation and other matters relevant to more than one technology-specific NPS; and
- the assessment and handling of generic impacts that are not specific to particular technologies.

1.3.2 This NPS does not seek to repeat the material set out in EN-1, which applies to all applications covered by this NPS unless stated otherwise. The reasons for policy that is specific to the energy infrastructure covered by this NPS are given, but where EN-1 sets out the reasons for general policy these are not repeated.

1.4 Future planning reform

1.4.1 Aside from cases where the Secretary of State intervenes, or where the application is not covered by a designated NPS, the Planning Act 2008, as in force at the date of designation of this NPS, provides for all applications for development consent to be both examined and determined by the IPC. However, the enactment and entry into force of the provisions of the Localism Bill (introduced into Parliament in December 2010) relating to the Planning Act would abolish the IPC. The function of examining applications would be taken on by a new Major Infrastructure Planning Unit ("MIPU") within the Planning Inspectorate, and the function of determining applications on infrastructure projects by the Secretary of State (who would receive a report and recommendation on each such application from MIPU). In the case of energy projects, this function would be carried out by the Secretary of State for Energy and Climate Change.

1.4.2 If the Localism Bill is enacted and these changes take effect, references in this NPS to the IPC should be read as follows from the date when the changes take effect. Any statement about the IPC in its capacity as an examining body should be taken to refer to MIPU. Any statement about the IPC in its capacity as a decision-maker determining applications should be taken to refer to the Secretary of State for Energy and Climate Change in his capacity as decision-maker; MIPU would have regard to such statements in framing its reports and recommendations to the Secretary of State.

1.5 Geographical coverage

1.5.1 This NPS, together with EN-1, is the primary decision-making guidance document for the IPC when considering development consent applications for NSIPs for electricity networks infrastructure in England and Wales as described in paragraph 1.8.1.

1.5.2 In Scotland, the IPC will not examine applications for electricity network NSIPs. However, energy policy is generally a matter reserved to UK Ministers and this NPS may therefore be a relevant consideration in planning decisions in Scotland.

1.5.3 In Northern Ireland, planning consents for energy infrastructure projects are devolved to the Northern Ireland Executive, so the IPC will not examine applications for energy infrastructure in Northern Ireland.

1.6 Period of validity and review

1.6.1 This NPS will remain in force in its entirety unless withdrawn or suspended in whole or in part by the Secretary of State. It will be subject to review by the Secretary of State in order to ensure that it remains appropriate. Information on the review process is set out in paragraphs 10-12 of Annex A to CLG's letter of 9 November 2009 (see paragraph 1.2.4 above).

1.7 Appraisal of Sustainability and Habitats Regulations Assessment[2]

1.7.1 All of the energy NPSs have been subject to an Appraisal of Sustainability (AoS)[3] incorporating the requirements of the regulations that implement the Strategic Environmental Assessment (SEA) Directive[4]. General information on the AoSs can be found in paragraph 1.7.1 of EN-1. Habitats Regulations Assessment was also done for all the energy NPSs. Paragraph 1.7.13 of EN-1 sets out the conclusions of the HRA.

1.7.2 Key points from the AoS for EN-5 are that:

- through supporting the transition to a low carbon economy, EN-5 is considered to have significant positive effects on the economy and skills AoS objective in the short term;
- effects on ecology are uncertain at this level of appraisal, as they depend on the sensitivity of the environment and the location and design of specific infrastructure;

2 Appraisal of Sustainability for the Revised Draft Electricity Networks available at: http://webarchive.nationalarchives.gov.uk/20110302182042/ https://www.energynpsconsultation.decc.gov.uk/home

3 As required by Section 5(3) of the Planning Act 2008

4 Directive 2001/42/EC of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.

- significant negative effects were identified for the landscape, townscape and visual AoS objective because of the prominent visual nature of electricity networks infrastructure covered in EN-5; and
- electricity networks infrastructure development has similar effects to other types of energy infrastructure, although because of the linear nature of electricity lines, effects are spread across a wider area; for the majority of the AoS objectives (excluding visual), the strategic effects of EN-5 are considered to be neutral.

1.7.3 As required by the SEA Directive, Part 2 of AoS-5 also includes an assessment of reasonable alternatives to the policies set out in EN-5 at a strategic level. The two alternatives assessed were:

(a) the Government would take a strategic view on locations where it is best to develop electricity network infrastructure and limit consenting to those areas; and

(b) the adoption of a presumption that electricity lines should be put underground (generally, or in particular locations, such as Areas of Outstanding Natural Beauty (AONBs)).

1.7.4 Assessment showed that alternative (a) is likely to have effects similar to those of EN-5 because the general location of electricity networks infrastructure is determined by existing network/power station locations and the anticipated location of new stations, and, therefore, the strategic choice of locations will be limited by those factors. However, the alternative is more likely to lead to planning blight, and adverse economic effects through restricting development and investment in the designated corridors. The EN-5 policies are therefore preferred.

1.7.5 Assessment showed that alternative (b) would have effects similar to those of EN-5 policies for climate change, but that it was likely to have negative effects on the security of supply and economic objectives. Effects on soil, water, ecology and archaeology are likely to be negative, at least in the short term, requiring significant mitigation, but there is uncertainty around long term effects depending on the specific location and the sensitivity of the receiving environment. However, long term effects on landscape, townscape and visual impacts will be positive. It would be possible to reduce the potential negative effects of alternative (b) by applying the presumption of undergrounding to particular types of designated landscape, but this would also reduce the perceived positive effect for those outside such areas. Because of the negative effects on security of supply and economic objectives, as well as the other negative effects listed above, it is considered preferable to adopt the policies in EN-5 because the range of factors to be taken into account means that decisions on undergrounding are best taken within a more flexible policy framework using case by case evaluation.

1.8 Infrastructure covered by this NPS

1.8.1 Infrastructure for electricity networks generally can be divided into two main elements:

- transmission systems (the long distance transfer of electricity through 400kV and 275kV lines), and distribution systems (lower voltage lines from 132kV to 230V from transmission substations to the end-user) which can either be carried on towers/poles or undergrounded; and
- associated infrastructure, e.g. substations (the essential link between generation, transmission, and the distribution systems that also allows circuits to be switched or voltage transformed to a useable level for the consumer) and converter stations to convert DC power to AC power and vice versa.

1.8.2 This NPS covers above ground electricity lines whose nominal voltage is expected to be 132kV or above. Any other kind of electricity infrastructure (including lower voltage overhead lines, underground or sub-sea cables at any voltage, and associated infrastructure as referred to above) will only be subject to the Planning Act 2008 – and so be covered by this NPS – if it is in England, and it constitutes associated development for which consent is sought along with an NSIP such as a generating station or relevant overhead line.

Part 2 Assessment and Technology-Specific Information

2.1 Introduction

2.1.1 Part 4 of EN-1 sets out the general principles that should be applied in the assessment of development consent applications across the range of energy technologies. Part 5 of EN-1 sets out policy on the assessment of impacts which are common across a range of these technologies (generic impacts). This NPS is concerned with impacts and other matters which are specific to electricity networks infrastructure or where, although the impact or issue is generic and covered in EN-1, there are further specific considerations arising from this technology.

2.1.2 The policies set out in this NPS are additional to those on generic impacts set out in EN-1 and do not replace them. The IPC should consider this NPS and EN-1 together when considering applications relating to electricity networks infrastructure. In particular, EN-1 sets out the Government's conclusion that there is a significant need for new major energy infrastructure generally (see Part 3 of EN-1). EN-1 includes information regarding the specific need for new major electricity networks infrastructure in Section 3.7. In the light of this, the IPC should act on the basis that the need for the infrastructure covered in this NPS has been demonstrated.

2.2 Factors influencing site selection by applicants

2.2.1 The sections below include references to factors influencing site/route selection by applicants for electricity networks NSIPs. These are not a statement of Government policy, but are included to provide the IPC and others with background information on the criteria that applicants consider when choosing a site or route. The specific criteria considered by applicants, and the weight they give to them, will vary from project to project. The choices which energy companies make in selecting sites reflect their assessment of the risk that the IPC, following the principles set out in paragraph 4.1.1 of EN-1, will not grant consent in any given case. In the market-based GB system, electricity network companies are regulated monopolies which must respond to demand from generators and consumers of electricity by developing and maintaining economical and efficient networks whilst having regard to various non-financial considerations[5]. It is for electricity network companies, responding to actual and anticipated changes in the patterns of supply and demand within the framework of

5 On the market-based system in general and the regulatory position of the transmission and distribution monopolies, see Chapter 2 of *Electricity Market reform: Consultation Document* at http://www.decc.gov.uk/assets/decc/Consultations/emr/1041-electricity-market-reform-condoc.pdf.

regulation of new investment administered by Ofgem, to decide what applications for new electricity networks infrastructure to bring forward and the Government does not seek to direct applicants to particular sites or routes for electricity networks infrastructure[6].

2.2.2 The general location of electricity network projects is often determined by the location, or anticipated location, of a particular generating station and the existing network infrastructure taking electricity to centres of energy use. This gives a locationally specific beginning and end to a line. On other occasions the requirement for a line may not be directly associated with a specific power station but rather the result of the need for more strategic reinforcement of the network. In neither circumstance is it necessarily the case that the connection between the beginning and end points should be via the most direct route (indeed this may be practically impossible), as the applicant will need to take a number of factors, including engineering and environmental aspects, into account.

2.2.3 In order to be able lawfully to install, inspect, maintain, repair, adjust, alter, replace or remove an electric line (above or below ground) and any related equipment such as poles, pylons/transmission towers, transformers and cables, network companies need either to own the land on, over or under which construction is to take place or to hold sufficient rights over, or interest in that land (typically in the form of an easement), or to have permission from the current owner or occupier to install their electric lines and associated equipment and carry out related works (usually referred to as a "wayleave").

2.2.4 Where the network company does not own (or wish to own) the relevant land itself, it may reach a voluntary agreement that gives it either an easement over the land or at least a wayleave permission to use it during the tenure of the current owner or occupier. Where it does not succeed in reaching the agreement it wants, the company may, as part of its application to the IPC, seek to acquire rights compulsorily over the relevant land by means of a provision in the DCO. The applicant may also apply for the compulsory purchase of land: this is not normally sought where lines and cables are installed, but may occur where other electricity network infrastructure, such as a new substation, is required. The above issues may be relevant considerations when the electricity company is considering various potential routes.

2.2.5 There will usually be some flexibility around the location of the associated substations and applicants will give consideration to how they are placed in the local landscape taking account of such things as local topography and the possibility of screening. See Section 2.8 below and Section 5.9 in EN-1.

2.2.6 As well as having duties under section 9 of the Electricity Act 1989, (in relation to developing and maintaining an economical and efficient network), developers will be influenced by Schedule 9 to the Electricity Act 1989[7], which places a duty on all transmission and distribution licence holders, in formulating proposals for new electricity networks infrastructure, to

6 See paragraph 3.3.24 of EN-1

7 http://www.legislation.gov.uk/ukpga/1989/29/schedule/9

"have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and … do what [they] reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects." Depending on the location of the proposed development, statutory duties under section 85 of the Countryside and Rights of Way Act 2000 and section 11A of the National Parks and Access to the Countryside Act 1949 may be relevant.

2.2.7 Transmission and distribution licence holders are also required under Schedule 9 of the Act to produce and publish a statement setting out how they propose to perform this duty generally.

2.3 General assessment principles for electricity networks

2.3.1 EN-1 explains in Section 4.9 that the Planning Act aims to create a holistic planning regime so that the cumulative effects of different elements of the same project can be considered together. Therefore the Government envisages that, wherever reasonably possible, applications for new generating stations and related infrastructure should be contained in a single application to the IPC.

2.3.2 However, particularly for generating stations and the related electricity networks, this may not always be possible or represent the most efficient approach to the delivery of new infrastructure. This could be, for example, because of the differing lengths of time needed to prepare the applications for submission to the IPC, or because a network application relates to multiple generation projects or because the works involved are strategic reinforcements required for a number of reasons. It may also be relevant that the networks application and a related generating station application are likely to come from two different legal entities, or be subject to different commercial and regulatory frameworks. Case studies illustrating the different scenarios that may arise can be found in a report prepared by the Electricity Networks Strategy Group Planning Working Group[8]. Early engagement with the IPC is encouraged in such circumstances.

2.3.3 Where an electricity networks infrastructure project is submitted to the IPC without an accompanying application for a generating station, the IPC should have regard to the matters specified in paragraph 4.9.3 of EN-1, as well as the need for the proposed infrastructure (as set out in Part 3 of EN-1). Circumstances in which the IPC considers it appropriate to consider a networks application separately from related proposals may include where, although the proposed generating station has yet to be consented, there is clear evidence of demand in that:

- the project is wholly or substantially supported by connection agreements or contractual arrangements to provide connection; or
- the project is based on reasonably anticipated future requirements.

8 http://www.ensg.gov.uk/assets/demonstrating_the_need_for_electricity_infrastructure_-_june_2009.pdf

This might be because it is located in an area where there is likely to be either significant increased generation or a significant increase in load on the existing network. An example of how this could be demonstrated is Round 3[9] for offshore windfarms where site licensing arrangements will give a clear indication of the areas within which future applications for consent will be received.

2.3.4 If the IPC believes it needs to probe further then factors it may wish to consider include whether the project would make a significant contribution to the promotion of renewable energy, the achievement of climate change objectives, the maintenance of an appropriate level of security of electricity supply or whether it helps achieve other energy policy objectives.

2.3.5 The IPC should also take into account that National Grid, as the owner of the electricity transmission system in England and Wales, as well as Distribution Network Operators (DNOs), are required under section 9 of the Electricity Act 1989[10] to bring forward efficient and economical proposals in terms of network design, taking into account current and reasonably anticipated future generation demand. National Grid is also required to facilitate competition in the supply and generation of electricity and so has a statutory duty to provide a connection whenever or wherever one is required.

2.3.6 Given that electricity lines form part of a network, there may also be circumstances where a single application contains works in different geographical locations. Where it can be demonstrated that a series of works will reinforce the network as a whole and meet the need set out in EN-1, the IPC should be willing to accept an application that seeks development consent for the entire set of works. Applicants should discuss potential applications of this nature with the IPC in advance of submitting a formal application.

2.4 Climate change adaptation

2.4.1 Part 2 of EN-1 provides information regarding the Government's energy and climate change strategy including policies for mitigating climate change. Section 4.8 of EN-1 sets out the generic considerations that applicants and the IPC should take into account to help ensure that electricity networks infrastructure is resilient to climate change. As climate change is likely to increase risks to the resilience of some of this infrastructure, from flooding for example, or in situations where it is located near the coast or an estuary or is underground, applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it would be resilient to:

- flooding, particularly for substations that are vital for the electricity transmission and distribution network;
- effects of wind and storms on overhead lines;
- higher average temperatures leading to increased transmission losses; and

9 The Crown Estate's third round of offshore wind farm leasing

10 http://www.legislation.gov.uk/ukpga/1989/29/section/9

- earth movement or subsidence caused by flooding or drought (for underground cables).

2.4.2 Section 4.8 of EN-1 advises that the resilience of the project to climate change should be assessed in the Environmental Statement (ES) accompanying an application. For example, future increased risk of flooding would be covered in any flood risk assessment (see Section 5.7 in EN-1).

2.5 Consideration of good design

2.5.1 Section 4.5 of EN-1 sets out the principles for good design that should be applied to all energy infrastructure.

2.5.2 Proposals for electricity networks infrastructure should demonstrate good design in their approach to mitigating the potential adverse impacts which can be associated with overhead lines, particularly those set out in Sections 2.7 to 2.10 below.

2.6 Impacts of electricity networks

2.6.1 Part 5 of EN-1 contains policy for the IPC when assessing potential impacts of energy infrastructure projects (generic impacts). It also contains information to assist the interpretation of the impact sections of all the energy NPSs. When considering impacts for electricity networks infrastructure, all of the generic impacts covered in EN-1 are likely to be relevant, even if they only apply during one phase of the development (such as construction) or only apply to one part of the development (such as a substation). This NPS sets out additional technology-specific considerations on the following generic impacts considered in EN-1:

- Biodiversity and Geological Conservation;
- Landscape and Visual; and
- Noise and Vibration.

2.6.2 In addition, this NPS also sets out technology-specific considerations for the impact of EMFs, which is not an impact considered in EN-1.

2.6.3 The impacts identified in Part 5 of EN-1 and Part 2 of this NPS are not intended to be exhaustive. Applicants are required to assess all likely significant effects of their proposals (see Section 4.2 of EN-1) and the IPC should consider any impacts which it determines are relevant and important to its decision.

2.7 Biodiversity and Geological Conservation

Introduction

2.7.1 Generic biodiversity effects are covered in Section 5.3 of EN-1. However, large birds such as swans and geese may collide with overhead lines associated with power infrastructure, particularly in poor visibility. Large birds in particular may also be electrocuted when landing or taking off by completing an electric circuit between live and ground wires. Even perching birds can be killed as soon as their wings touch energised parts.

Applicant's Assessment

2.7.2 The applicant will need to consider whether the proposed line will cause such problems at any point along its length and take this into consideration in the preparation of the Environmental Impact Assessment (EIA) and ES (see Section 4.2 of EN-1). Particular consideration should be given to feeding and hunting grounds, migration corridors and breeding grounds.

IPC Decision Making

2.7.3 The IPC should ensure that this issue has been considered in the ES and that appropriate mitigation measures will be taken where necessary.

Mitigation

2.7.4 Careful siting of a line away from, or parallel to, but not across, known flight paths can reduce the numbers of birds colliding with overhead lines considerably.

2.7.5 Making lines more visible by methods such as the fitting of bird flappers and diverters to the earth wire, which swivel in the wind, glow in the dark and use fluorescent colours designed specifically for bird vision can also reduce the number of deaths. The design and colour of the diverters will be specific to the conditions – the line and pylon/transmission tower specifications and the species at risk.

2.7.6 Electrocution risks can be reduced through the design of crossarms, insulators and the construction of other parts of high voltage power lines so that birds find no opportunity to perch near energised power lines on which they might electrocute themselves.

2.8 Landscape and Visual

Introduction

2.8.1 Generic landscape and visual effects are covered in Section 5.9 of EN-1. In addition there are specific considerations which apply to electricity networks infrastructure as set out below.

2.8.2 Government does not believe that development of overhead lines is generally incompatible in principle with developers' statutory duty under section 9 of the Electricity Act to have regard to amenity and to mitigate impacts (see paragraph 2.2.6 above). In practice new above ground electricity lines, whether supported by lattice steel towers/pylons or wooden poles, can give rise to adverse landscape and visual impacts, dependent upon their scale, siting, degree of screening and the nature of the landscape and local environment through which they are routed. For the most part these impacts can be mitigated, however at particularly sensitive locations the potential adverse landscape and visual impacts of an overhead line proposal may make it unacceptable in planning terms, taking account of the specific local environment and context. New substations, sealing end compounds and other above ground installations that form connection, switching and voltage transformation points on the electricity networks can also give rise to landscape and visual impacts. Cumulative landscape and visual impacts can arise where new overhead lines are required along with other related developments such as substations, wind farms and/or other new sources of power generation.

2.8.3 Sometimes positive landscape and visual benefits can arise through the reconfiguration or rationalisation of existing electricity network infrastructure.

Applicant's Assessment

2.8.4 Where possible, applicants should follow the principles below in designing the route of their overhead line proposals and it will be for applicants to offer constructive proposals for additional mitigation of the proposed overhead line. While proposed underground lines do not require development consent under the Planning Act 2008, wherever the nature or proposed route of an overhead line proposal makes it likely that its visual impact will be particularly significant, the applicant should have given appropriate consideration to the potential costs and benefits of other feasible means of connection or reinforcement, including underground and sub-sea cables where appropriate. The ES should set out details of how consideration has been given to undergrounding or sub-sea cables as a way of mitigating such impacts, including, where these have not been adopted on grounds of additional cost, how the costs of mitigation have been calculated.

2.8.5 Guidelines for the routeing of new overhead lines, the Holford Rules[11], were originally set out in 1959 by Lord Holford, and are intended as a common sense approach to the routeing of new overhead lines. These guidelines were reviewed and updated by the industry in the 1990s and should be followed by developers when designing their proposals.

2.8.6 In overview, the Holford Rules state[12] that developers should:

- avoid altogether, if possible, the major areas of highest amenity value, by so planning the general route of the line in the first place, even if total mileage is somewhat increased in consequence;
- avoid smaller areas of high amenity value or scientific interest by deviation, provided this can be done without using too many angle towers, i.e. the bigger structures which are used when lines change direction;
- other things being equal, choose the most direct line, with no sharp changes of direction and thus with fewer angle towers;
- choose tree and hill backgrounds in preference to sky backgrounds wherever possible. When a line has to cross a ridge, secure this opaque background as long as possible, cross obliquely when a dip in the ridge provides an opportunity. Where it does not, cross directly, preferably between belts of trees;
- prefer moderately open valleys with woods where the apparent height of towers will be reduced, and views of the line will be broken by trees;
- where country is flat and sparsely planted, keep the high voltage lines as far as possible independent of smaller lines, converging routes, distribution poles and other masts, wires and cables, so as to avoid a concentration of lines or “wirescape”; and
- approach urban areas through industrial zones, where they exist; and when pleasant residential and recreational land intervenes between the approach line and the substation, carefully assess the comparative costs of undergrounding.

11 The “Holford Rules” are a series of planning guidelines first developed in 1959 by Lord Holford, adviser to the then Central Electricity Generating Board on amenity issues. They were reviewed in the 1990s by National Grid . The rules are not published as a single work but they are referred to in a number of planning publications including *Visual Amenity Aspects of High Voltage Transmission* by George A. Goulty (1989) and Planning Overhead Power Line Routes by RJB Carruthers (1987) Research Studies Press Ltd, Letchworth.

12 Notes and explanations of the Holford Rules are available on the National Grid website http://www.nationalgrid.com/NR/rdonlyres/E9E1520A-EB09-4AD7-840B-A114A84677E7/41421/HolfordRules1.pdf

IPC Decision Making

2.8.7 The IPC should recognise that the Holford Rules, and any updates, form the basis for the approach to routeing new overhead lines and take them into account in any consideration of alternatives and in considering the need for any additional mitigation measures.

Undergrounding

2.8.8 Paragraph 3.7.10 of EN-1 sets out the need for new electricity lines of 132kV and above, including overhead lines. Although Government expects that fulfilling this need through the development of overhead lines will often be appropriate, it recognises that there will be cases where this is not so. Where there are serious concerns about the potential adverse landscape and visual effects of a proposed overhead line, the IPC will have to balance these against other relevant factors, including the need for the proposed infrastructure, the availability and cost of alternative sites and routes and methods of installation (including undergrounding)[13] .

2.8.9 The impacts and costs of both overhead and underground options vary considerably between individual projects (both in absolute and relative terms). Therefore, each project should be assessed individually on the basis of its specific circumstances and taking account of the fact that Government has not laid down any general rule about when an overhead line should be considered unacceptable. The IPC should, however only refuse consent for overhead line proposals in favour of an underground or sub-sea line if it is satisfied that the benefits from the non-overhead line alternative will clearly outweigh any extra economic, social and environmental impacts and the technical difficulties are surmountable. In this context it should consider:

- the landscape in which the proposed line will be set, (in particular, the impact on residential areas, and those of natural beauty or historic importance such as National Parks, AONBs and the Broads)[14];
- the additional cost of any undergrounding or sub-sea cabling (which experience shows is generally significantly more expensive than overhead lines, but varies considerably from project to project depending on a range of factors, including whether the line is buried directly in open agricultural land or whether more complex tunnelling and civil engineering through conurbations and major cities is required[15]. Repair impacts are also significantly higher than for overhead lines as are the costs associated with any later uprating.); and

13 Proposed underground cables do not require development consent under the Planning Act, but they may form part of a scheme of new infrastructure which is the subject of an application under the Act, and requirements or obligations regarding undergrounding may feature as a means of mitigating some of the adverse impacts of a proposal which does require and is granted development consent.

14 See Section 5.9 of EN-1

15 See Section 5.9 of EN-1

- the environmental and archaeological consequences (undergrounding a 400kV line may mean disturbing a swathe of ground up to 40 metres across[16], which can disturb sensitive habitats, have an impact on soils and geology, and damage heritage assets, in many cases more than an overhead line would).

Mitigation

2.8.10 In addition to following the principles set out in the Holford Rules and considering undergrounding, the main opportunities for mitigating potential adverse landscape and visual impacts of electricity networks infrastructure are:

- consideration of **network reinforcement** options (where alternatives exist) which may allow improvements to an existing line rather than the building of an entirely new line; and
- selection of the **most suitable type and design of support structure** (i.e. different lattice tower types, use of wooden poles etc) in order to minimise the overall visual impact on the landscape.

2.8.11 There are some more specific measures that might be taken, and which the IPC could require through requirements if appropriate, as follows:

- **Landscape schemes**, comprising off-site tree and hedgerow planting are sometimes used for larger new overhead line projects to mitigate potential landscape and visual impacts, softening the effect of a new above ground line whilst providing some screening from important visual receptors. These can only be implemented with the agreement of the relevant landowner(s) and advice from the relevant statutory advisor may also be needed; and
- **Screening**, comprising localised planting in the immediate vicinity of residential properties and principal viewpoints can also help to screen or soften the effect of the line, reducing the visual impact from a particular receptor.

16 The width of disturbed ground needed to match the performance of a proposed overhead line will depend on the desired transmission capacity and the types of suitable cable available.

2.9 Noise and Vibration

Introduction

2.9.1 Generic noise effects are covered in Section 5.11 of EN-1. In addition there are specific considerations which apply to electricity networks infrastructure as set out below.

2.9.2 All high voltage transmission lines have the potential to generate noise under certain conditions.

2.9.3 Line noise is generated when the conductor surface electric stress exceeds the inception level for corona discharge[17] activity which is released as acoustic energy and radiates into the air as sound. Transmission line conductors are designed to operate below this threshold. However, surface contamination on a conductor or accidental damage during transport or installation can cause local enhancement of electric stress and initiate discharge activity leading to the generation of noise.

2.9.4 The highest noise levels generated by a line generally occur during rain. Water droplets may collect on the surface of the conductor and initiate corona discharges with noise levels being dependent on the level of rainfall. Fog may also give rise to increased noise levels, although these levels are lower than those during rain.

2.9.5 After a prolonged spell of dry weather without rain to wash the conductors, contamination may accumulate at sufficient levels to result in increased noise. After heavy rain, these discharge sources are washed away and the line will be quiet again. Surface grease on conductors can also give rise to audible noise effects as grease is able to move slowly under the influence of an electric field, tending to form points which then initiate discharge activity. Surface grease is likely to occur along the entire length of a conductor. Hence there may be many potential discharge sources and, consequently, a high noise level. This will only occur if substandard grease has been used during manufacture or if the conductor has been overheated by carrying excessive electrical load. This can be mitigated by conductor cleaning or replacement.

2.9.6 Transmission line audible noise is generally categorised as “crackle” or “hum”, according to its tonal content. Crackle may occur alone, but hum will usually occur only in conjunction with crackle. Hum is only likely to occur during rain when rates of rainfall exceed 1mm/hr. Crackle is a sound containing a random mixture of frequencies over a wide range, typically 1kHz to 10kHz. No individual pure tone can be identified for any significant duration. Crackle has a generally similar spectral content to the sound of rainfall. Hum is a sound consisting of a single pure tone or tones.

17 Corona discharge is an electrical discharge brought on by the ionization of a fluid surrounding a conductor, which occurs when the strength of the electric field exceeds a certain value, but conditions are insufficient to cause complete electrical breakdown or arcing.

2.9.7 Audible noise effects can also arise from substation equipment such as transformers, quadrature boosters and mechanically switched capacitors. Transformers are installed at many substations, and generate low frequency hum. Whether the noise can be heard outside a substation depends on a number of factors, including transformer type and the level of noise attenuation present (either engineered intentionally or provided by other structures). Noise may also arise from discharges on overhead line fittings such as spacers, insulators and clamps.

Applicant's Assessment

2.9.8 While standard methods of assessment and interpretation using the principles of the relevant British Standards[18] are satisfactory for dry weather conditions, they are not appropriate for assessing noise during rain, which is when overhead line noise mostly occurs, and when the background noise itself will vary according to the intensity of the rain.

2.9.9 Therefore an alternative noise assessment method to deal with rain-induced noise is needed, such as the one developed by National Grid as described in report TR(T)94,1993[19]. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991)[20] and in that respect is consistent with BS 4142:1997. The IPC is likely to be able to regard it as acceptable for the applicant to use this or another methodology that appropriately addresses these particular issues.

IPC Decision Making

2.9.10 The IPC should ensure that relevant assessment methodologies have been used in the evidence presented to them, and that the appropriate mitigation options have been considered and adopted. Where the applicant can demonstrate that appropriate mitigation measures will be put in place, the residual noise impacts are unlikely to be significant.

2.9.11 Consequently, noise from overhead lines is unlikely to lead to the IPC refusing an application, but it may need to consider the use of appropriate requirements to ensure noise is minimised as far as possible.

Mitigation

2.9.12 Applicants should have considered the following measures:

- the positioning of lines (see Section 2.8 (landscape/visual impact)) to help mitigate noise;
- ensuring that the appropriately sized conductor arrangement is used to minimise potential noise;

18 For example BS4142.

19 Technical Report No. TR(T)94, 1993. A Method for Assessing the Community Response to Overhead Line Noise, National Grid Technology & Science Laboratories.

20 ISO 1996: 1982 (BS7445:1991) Description and Measurement of Environmental Noise, International Standards Organisation (British Standards Institution).

- quality assurance through manufacturing and transportation to avoid damage to overhead line conductors which can increase potential noise effects; and
- ensuring that conductors are kept clean and free of surface contaminants during stringing/installation.

2.9.13 The ES should include information on planned maintenance arrangements. Where this is not the case, the IPC should consider including these by way of requirements attached to any grant of development consent.

2.10 Electric and Magnetic Fields (EMFs)

Introduction

2.10.1 Power frequency Electric and Magnetic Fields (EMFs) arise from generation, transmission, distribution and use of electricity and will occur around power lines and electric cables and around domestic, office or industrial equipment that uses electricity. EMFs comprise electric and magnetic fields. Electric fields are the result of voltages applied to electrical conductors and equipment. Fences, shrubs and buildings easily block electric fields. Magnetic fields are produced by the flow of electric current; however unlike electric fields, most materials do not readily block magnetic fields. The intensity of both electric fields and magnetic fields diminishes with increasing distance from the source.

2.10.2 All overhead power lines produce EMFs, and these tend to be highest directly under a line, and decrease to the sides at increasing distance. Although putting cables underground eliminates the electric field, they still produce magnetic fields, which are highest directly above the cable (see para 2.10.12). EMFs can have both direct and indirect effects on human health. The direct effects occur in terms of impacts on the central nervous system resulting in its normal functioning being affected. Indirect effects occur through electric charges building up on the surface of the body producing a microshock on contact with a grounded object, or vice versa, which, depending on the field strength and other exposure factors, can range from barely perceptible to being an annoyance or even painful.

2.10.3 To prevent these known effects, the International Commission on Non-Ionizing Radiation Protection (ICNIRP[21]) developed health protection guidelines in 1998 for both public and occupational exposure. These are expressed in terms of the induced current density in affected tissues of the body, “basic restrictions”, and in terms of measurable “reference levels” of electric field strength (for electric fields), and magnetic flux density (for magnetic fields). The relationship between the (measurable) electric field strength or magnetic flux density and induced current density in body tissues requires complex dosimetric modelling. The reference levels are such that compliance with them will ensure that the basic restrictions are not reached or exceeded. However, exceeding the reference levels does not necessarily mean that the basic restrictions will not be met; this would be a trigger for further investigation into the specific circumstances. For protecting against indirect effects, the ICNIRP 1998 guidelines give an electric field reference of 5kV m^{-1} for the general public, and keeping electric fields below this level would reduce the occurrence of adverse indirect effects for most individuals to acceptable levels. When this level is exceeded, there is a suite of measures that may be called upon in particular situations, including provision of information, earthing and screening, alongside limiting the field. In some situations there may be no reasonable way of eliminating indirect effects.

21 http://www.icnirp.de/

2.10.4 The levels of EMFs produced by power lines in normal operation are usually considerably lower than the ICNIRP 1998 reference levels. For electricity substations, the EMFs close to the sites tend to be dictated by the overhead lines and cables entering the installation, not the equipment within the site. The Stakeholder Advisory Group on extremely low frequency electric and magnetic fields (ELF EMFs) (SAGE) was set up to provide advice to Government on possible precautionary measures that might be needed to limit public exposure to electric and magnetic fields associated with electricity supply. The Government response to recommendations made in SAGE's first interim assessment sets out those measures that will be taken as a result of the recommendations[22].

2.10.5 The Health Protection Agency's (HPA) Centre for Radiation, Chemical and Environmental Hazards (CRCE) provides advice on standards of protection for exposure to non-ionizing radiation, including the ELF EMFs arising from the transmission and use of electricity. In March 2004, the National Radiological Protection Board (NRPB) (now part of HPA CRCE), published advice on limiting public exposure to electromagnetic fields. The advice recommended the adoption in the UK of the EMF exposure guidelines published by ICNIRP in 1998. These guidelines also form the basis of a 1999 EU Recommendation on public exposure and a Directive on occupational exposure. Resulting from these recommendations, Government policy is that exposure of the public should comply with the ICNIRP (1998) guidelines in terms of the EU Recommendation. The electricity industry has agreed to follow this policy. Applications should show evidence of this compliance as specified in 2.10.9 below.

2.10.6 The balance of scientific evidence over several decades of research has not proven a causal link between EMFs and cancer or any other disease. The HPA CRCE keeps under review emerging scientific research and/or studies that may link EMF exposure with various health problems and provides advice to the Department of Health on the possible need for introducing further precautionary measures.

2.10.7 The Department of Health's Medicines and Healthcare Products Regulatory Agency (MHRA) does not consider that transmission line EMFs constitute a significant hazard to the operation of pacemakers.

2.10.8 There is little evidence that exposure of crops, farm animals or natural ecosystems to transmission line EMFs has any agriculturally significant consequences.

IPC Decision Making

2.10.9 This NPS does not repeat the detail of the ICNIRP 1998 guidelines on restrictions or reference levels nor the 1999 EU Recommendation. Government has developed with the electricity industry a Code of Practice, "Power Lines: Demonstrating compliance with EMF public exposure

22 http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_107123.pdf

guidelines – a voluntary Code of Practice"[23], published in February 2011 that specifies the evidence acceptable to show compliance with ICNIRP (1998) in terms of the EU Recommendation. Before granting consent to an overhead line application, the IPC should satisfy itself that the proposal is in accordance with the guidelines, considering the evidence provided by the applicant and any other relevant evidence. It may also need to take expert advice from the Department of Health.

2.10.10 There is no direct statutory provision in the planning system relating to protection from EMFs and the construction of new overhead power lines near residential or other occupied buildings. However, the Electricity Safety, Quality and Continuity Regulations 2002[24] set out the minimum height, position, insulation and protection specifications at which conductors can be strung between towers to ensure safe clearance of objects. The effect of these requirements should be that power lines at or below 132kV will comply with the ICNIRP 1998 basic restrictions, although the IPC should be satisfied that this is the case on the basis of the evidence produced as specified in the Code of Practice.

2.10.11 Industry currently applies optimal phasing[25] to 275kV and 400kV overhead lines voluntarily wherever operationally possible, which helps to minimise the effects of EMF. The Government has developed with industry a voluntary Code of Practice, "Optimum Phasing of high voltage double-circuit Power Lines – A Voluntary Code of Practice"[26], published in February 2011 that defines the circumstances where industry can and will optimally phase lines with a voltage of 132kV and above. Where the applicant cannot demonstrate that the line will be compliant with the Electricity Safety, Quality and Continuity Regulations 2002, with the exposure guidelines as specified in the Code of Practice on compliance, and with the policy on phasing as specified in the Code of Practice on optimal phasing then the IPC should not grant consent.

2.10.12 Undergrounding of a line would reduce the level of EMFs experienced, but high magnetic field levels may still occur immediately above the cable. It is not the Government's policy that power lines should be undergrounded solely for the purpose of reducing exposure to EMFs. Although there may be circumstances where the costs of undergrounding are justified for a particular development, this is unlikely to be on the basis of EMF

23 http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/development%20consents%20and%20planning%20reform/1256-code-practice-emf-public-exp-guidelines.pdf

24 http://www.legislation.gov.uk/uksi/2002/2665/contents/made

25 Many overhead power lines have two circuits, each consisting of three conductor bundles or "phases" carried on the same pylons. Each circuit produces an electro-magnetic field, and the cumulative field depends on the relative order of the three phases of each circuit. This is referred to as "phasing" and the lowest magnetic fields to the sides of the line are produced by an arrangement called "transposed phasing".

26 http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/development%20consents%20and%20planning%20reform/1255-code-practice-optimum-phasing-power-lines.pdf

exposure alone, for which there are likely to be more cost-efficient mitigation measures. Undergrounding is covered in more detail in paragraphs 2.8.8 – 2.8.9 (landscape and visual).

2.10.13 In order to avoid unacceptable adverse impacts of EMFs from electricity network infrastructure on aviation, the IPC should take account of statutory technical safeguarding zones defined in accordance with Planning Circular 01/03[27], or any successor when considering applications. More detail on this issue can be found in Section 5.4 of EN-1. Where a statutory consultee on the safeguarding of technical facilities identifies a risk that the EMF effect of electricity network infrastructure would compromise the effective and safe operation of such facilities, the potential impact and siting and design alternatives will need to have been fully considered as part of the application.

2.10.14 The diagram at the end of this section shows a basic decision tree for dealing with EMFs from overhead power lines to which the IPC can refer.

Mitigation

2.10.15 The applicant should have considered the following factors:

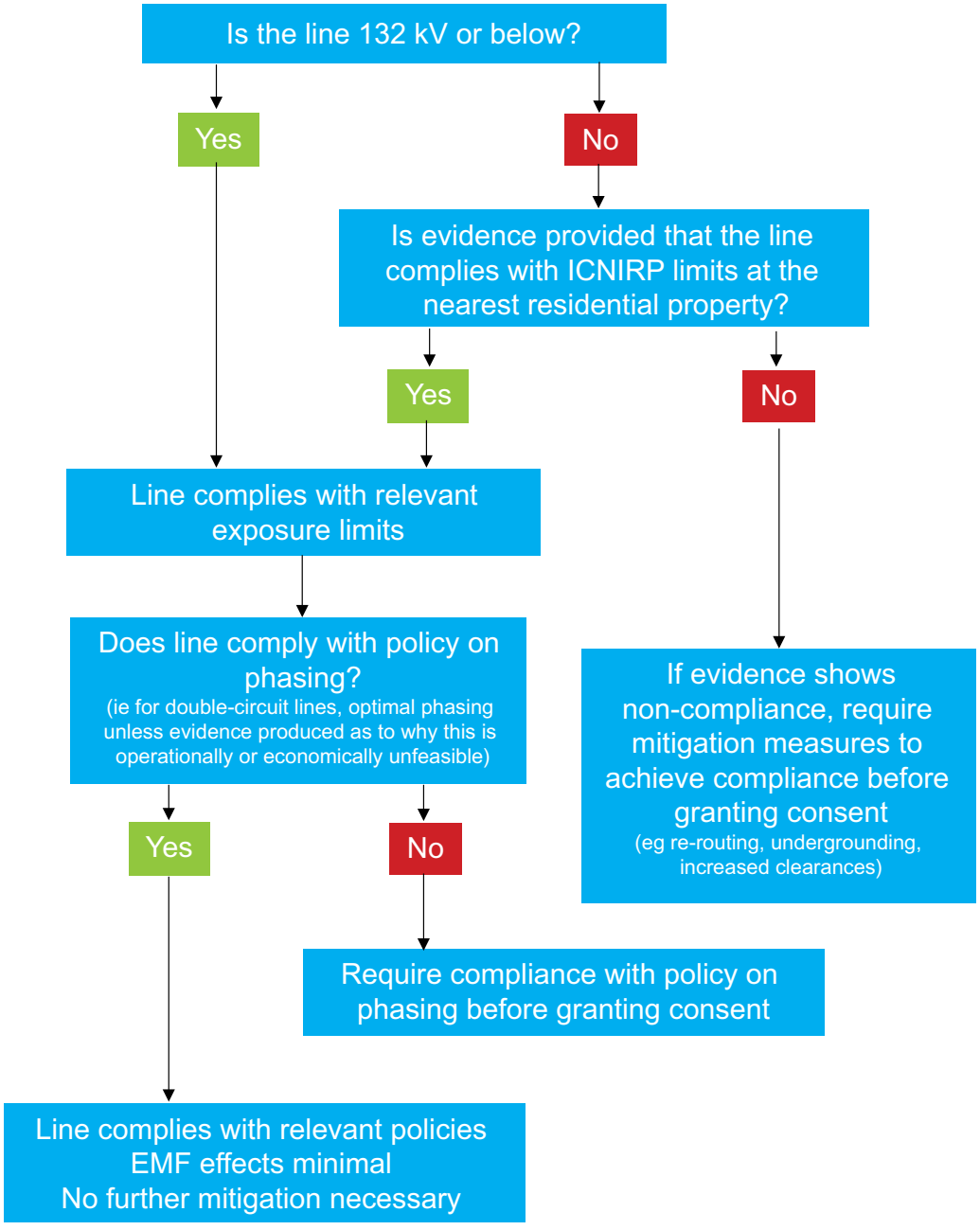
- height, position, insulation and protection (electrical or mechanical as appropriate) measures subject to ensuring compliance with the Electricity Safety, Quality and Continuity Regulations 2002;
- that optimal phasing of high voltage overhead power lines is introduced wherever possible and practicable in accordance with the Code of Practice to minimise effects of EMFs; and
- any new advice emerging from the Department of Health relating to Government policy for EMF exposure guidelines.

However, where it can be shown that the line will comply with the current public exposure guidelines and the policy on phasing, no further mitigation should be necessary.

2.10.16 Where EMF exposure is within the relevant public exposure guidelines, re-routeing a proposed overhead line purely on the basis of EMF exposure, or undergrounding a line solely to further reduce the level of EMF exposure are unlikely to be proportionate mitigation measures.

27 Safeguarding Aerodromes, Technical Sites and Military Explosive Storage Areas

Simplified Route Map for dealing with EMFs



Glossary of key terms[28]

DECC	Department of Energy and Climate Change
NPS	National Policy Statement
EN-1	Overarching NPS for Energy
IPC	Infrastructure Planning Commission
CLG	Department for Communities and Local Government
NSIP	Nationally significant infrastructure project
SEA	Strategic Environmental Assessment (under the Directive of the same name)
AoS	Appraisal of Sustainability
OHL	Overhead line carried on poles or pylons/transmission towers
Substation	An assembly of equipment in an electric power system through which electric energy is passed for transmission, transformation, distribution, or switching
kV	Kilovolts – 1000 volts
DC	Direct current
AC	Alternating current
EIA	Environmental Impact Assessment
ES	Environmental Statement
associated infrastructure	Development associated with the NSIP as defined in Section 115 of the Planning Act
network reinforcement	Uprating/upgrading and improving or replacement of existing lines
Habitats Directive	The European Directive (92/43/EEC) on the Conservation of Natural Habitats and Wild Flora and Fauna
AONB	Area of Outstanding Natural Beauty
HRA	Habitats Regulations Assessment
generic impacts	Potential impacts of any energy infrastructure projects, the general policy for consideration of which is set out in Part 5 of EN-1
DCO	Development Consent Order
EMFs	Electric and magnetic fields
ICNIRP	The International Commission on Non-Ionizing Radiation Protection
ELF EMFs	Extremely low frequency electric and magnetic fields

28 This glossary sets out the most frequently used terms in this NPS. There is a glossary in each of the energy NPSs. The glossary set out in EN-1 may also be useful when reading this NPS.

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