DEPARTMENT OF ENERGY & CLIMATE CHANGE

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

Planning for new energy infrastructure

November 2009

Department of Energy and Climate Change

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

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1.1 Introduction

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 and cope with generation occurring in locations of greater diversity.

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: A Framework Document for Planning Decisions on Nationally Significant Energy Infrastructure' (EN-1), provides the primary basis for decisions by the Infrastructure Planning Commission (IPC) on applications it receives for the electricity networks infrastructure as defined at Section 1.7. Under the Planning Act 2008, the IPC also has to have regard to any local impact report submitted by a relevant local authority, any relevant matters prescribed in regulations and any other matters which the IPC thinks are both important and relevant to the decision.

1.2.2 The Planning Act also requires that the IPC must decide an application in accordance with relevant NPSs except to the extent it is satisfied that to do so would:

- lead to the UK being in breach of its international obligations;
- be in breach of any statutory duty that applies to the IPC;
- be unlawful;
- result in adverse impacts of the development outweighing the benefits; or
- be contrary to regulations about how its decisions are to be taken.

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

1.2.4 This NPS, and in particular the policy and guidance on generic impacts in Part 2, may be helpful to local planning authorities (LPAs) in preparing their local impact reports. In England and Wales this NPS may also be a material consideration in decision making on applications that fall under the Town and Country Planning Act (TCPA) 1990 (as amended). Where relevant, those making decisions on such applications in England should apply the policy and guidance in this NPS as far as practicable.

1.3 Relationship with EN-1

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

- the high level objectives, policy and regulatory framework for new energy infrastructure consistent with the objective of contributing to the achievement of sustainable development and the Government's policies on mitigating and adapting to climate change;
- the need and urgency for new energy infrastructure and the social and economic benefits of meeting the need;
- the need for specific technologies, including the infrastructure covered by this NPS;
- key principles to be followed in the consideration and examination of applications;
- the role of the Appraisal of Sustainability and its outcome 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 repeat the material set out in EN-1.

1.3.3 Further information on the relationship between NPSs and the town and country planning system, as well as background on the role of NPSs and the arrangements in the devolved administrations, will be issued by the Department for Communities and Local Government (CLG).

1.4 Geographical coverage

1.4.1 This NPS, together with EN-1, is the primary decision-making guidance document for the IPC on nationally significant electricity network infrastructure in England and Wales.

1.4.2 In Scotland the IPC will not examine applications for nationally significant electricity network infrastructure. 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.

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

1.5 Period of validity and review

1.5.1 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 for IPC decision making. Further information can be found in CLG's NPS Guidance.

1.6 Appraisal of Sustainability

1.6.1 This NPS has been subject to an Appraisal of Sustainability (AoS) incorporating the requirements for Strategic Environmental Assessment (SEA). The conclusions of the AoS for all the non-nuclear NPSs are summarised in Section 1.6 of EN-1.

1.7 Infrastructure covered by this NPS

1.7.1 This NPS covers the following types of nationally significant infrastructure:

- above ground electricity lines of 132kV and above; and
- other infrastructure for electricity networks that is associated with a Nationally Significant Infrastructure Project (NSIP).

1.7.2 This NPS does **not** cover lines below 132kV unless they are associated with a NSIP which will be determined by the IPC.

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

- transmission systems (the long distance transfer of electricity through 275kV and 400kV lines), and distribution systems (lower voltage lines from 240V to 132kV from transmission substations to the end-user) which can either be carried on towers/poles or undergrounded; and
- associated infrastructure e.g. sub-stations (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.

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 impacts and sets out policy on the assessment of generic energy impacts which are common across a range of energy technologies. 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. The guidance in this NPS is additional to that on generic impacts set out in EN-1 and does not replace it. The IPC should consider this NPS and EN-1 together. In particular, EN-1 sets out the Government's conclusion that there is a significant need for new major energy infrastructure (see summary and conclusion in Part 3 of EN-1). EN-1 includes assessments of the need for new major electricity networks infrastructure in Section 3.8. In the light of this, the IPC should start its assessment of applications for infrastructure covered in this NPS on the basis that need has been demonstrated.

2.1.2 Factors influencing site selection by developers for electricity networks infrastructure are set out below. They are included to provide the IPC with guidance on the criteria that applicants consider when choosing a site. But the specific criteria considered by applicants, and the weight they give to them, will vary from project to project. This is at the commercial risk of the applicant. Energy companies decide what applications to bring forward and the Government does not seek to direct applicants to particular sites or routes for electricity networks infrastructure. The crucial consideration for the IPC is whether the proposal is in line with EN-1 and this NPS (including the impact considerations they set out).

2.2 Factors influencing site selection by developers

2.2.1 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.

2.2.2 Electricity companies will need either to own the land on, over or under which construction is to take place (or to hold sufficient rights on or interest in it), or to have permission to install their electric lines and associated equipment (for example, poles, pylons, transformers and cables). They will also require subsequently to have access to that land for the purposes of inspecting, maintaining, repairing, adjusting, altering, replacing or removing the line or equipment.

2.2.3 Agreements with landowners/occupiers are obtained by the electricity company through either a wayleave or permanent easement agreement. Many of these contracts will have been acquired by voluntary agreement and will have been concluded before the IPC receives the application. However, where the applicant wishes to install a new line or lines and agreement cannot be reached with the landowners, the applicant may apply for a "necessary" or compulsory wayleave as part of their application to the IPC. The applicant may also apply for the compulsory purchase of land. This would be unlikely to be sought where lines and cables are installed, but may occur where other electricity network infrastructure, such as a new substation, for example, is required. The above issues may be a relevant consideration in the electricity company's examination of various routes.

2.2.4 There will usually be some flexibility around the location of the associated substations and developers will give consideration to how they are placed in the local landscape taking account of local topography and the possibility of screening.

2.2.5 Under Schedule 9 to the Electricity Act 1989, all transmission and distribution licence holders have a duty in formulating proposals for new electricity networks infrastructure to "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 shall do what [it] 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."

2.2.6 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.

2.3 General assessment principles

2.3.1 The impacts of electricity network infrastructure applications should be set out by the applicant in a statement that should accompany each project application. The statement may be an Environmental Statement (ES) as required by the Environmental Impact Assessment (EIA) Directive and Regulations or, where the EIA Directive does not apply, the applicant should provide the IPC with environmental information in accordance with the guidance that follows, and proportionate to the project. In addition, where relevant, the applicant should provide such information as may reasonably be required to enable the IPC to undertake an Appropriate Assessment (AA) under the Habitats Regulations. References to an Environmental Statement in this NPS should be taken as including a statement that provides this information, even if the EIA Directive does not apply.

2.3.2 EN-1 also explains in Section 4.9 that the Planning Act aims to create a holistic planning regime so that the cumulative effects of the same project can be considered together. The Government envisages therefore that wherever reasonably possible, applications for new generation stations and related infrastructure should be contained in a single application to the IPC. 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 reinforcement 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 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[1]. Early engagement with the IPC is encouraged in such circumstances.

2.3.3 Where an individual electricity networks infrastructure project is submitted to the IPC, the IPC should use the following criteria to help decide whether it can reasonably be considered in isolation and in particular, that the contribution of the works to the need for energy infrastructure (as set out in Part 3 of EN-1) is demonstrated. This is likely to be the case if:

- 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. 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 network. An example of how this could be demonstrated is Round 3 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 In such cases the IPC may conclude no further evidence should be necessary. If it believes it needs to probe further then it may wish to consider 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 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, is required to bring forward the most efficient solution in terms of network design, taking into account current and reasonably anticipated future generation demand.

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.

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

2.4 Climate change adaptation

2.4.1 Paras 2.1.7 and 2.1.8 of EN-1 set out Government policy on adaptation, while Section 4.8 of EN-1 sets out the generic considerations that applicants and the IPC should take into account with regard to the potential impact of climate change on electricity networks infrastructure. EN-1 describes how projects should be designed to be resilient to such impacts. Climate change is likely to increase risks to the resilience of some infrastructure, from flooding for example, or in situations where it is located near the coast or an estuary or is underground. For electricity networks infrastructure applicants should in particular set out how the proposal would be resilient to:

- flooding, particularly for sub-stations 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
- earth movement or subsidence caused by flooding and drought for underground cables.

2.4.2 The IPC should expect that climate change resilience measures will form part of the relevant impact assessment in the ES accompanying an application. For example, future increased risk of flooding would be covered in any flood risk assessment.

2.5 Criteria for “good design” for energy infrastructure

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 Regarding proposals for electricity networks infrastructure, the IPC should in particular expect applicants to demonstrate good design in respect of landscape and visual amenity as set out in Section 2.7 below, and in the design of the project to mitigate impacts such as noise and electric and magnetic fields (EMFs) in Sections 2.8 and 2.9.

2.6 Impacts of electricity networks

2.6.1 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 sub-station. In this NPS, the terms “effects”, “impacts” or “benefits” should be understood to mean likely significant effects, impacts or benefits. This NPS sets out additional technology-specific considerations on the following generic impacts considered in EN-1:

- Landscape and Visual; and
- Noise and Vibration.

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

2.6.3 The list of generic impacts in Part 4 of EN-1 and technology-specific considerations in this NPS is not exhaustive (see para 4.16.2 in EN-1). The applicant should identify the impacts of their proposal in the ES both in terms of those covered in this guidance and any others identified.

2.7 Landscape and Visual

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

Introduction

2.7.2 New above ground electricity lines, whether constructed using lattice steel towers or wood poles, can give rise to adverse landscape and visual impacts, dependent upon their scale, siting, degree of screening and the nature of the landscape/local environment through which they are routed. 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. Sometimes positive landscape and visual benefits can arise through the reconfiguration or rationalisation of existing electricity network infrastructure.

IPC Decision Making

2.7.3 Guidelines for the routeing of new overhead lines, the Holford Rules[2], were originally set out in 1959 by Lord Holford, and the IPC should recognise that, while they have been reviewed and supplemented, they still form the basis for the approach to routeing new overhead lines.

2.7.4 In overview, the Holford Rules state[3]:

- 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;

2 The "Holford Rules" are a series of planning guidelines first developed in 1959 by Lord Holford, adviser to the then Central Electricity Generating Board (CEGB) on amenity issues. They were reviewed in the 1990s by National Grid (NG). 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.

3 Notes and explanations of the Holford Rules are available on the eurelectric website http://www2.eurelectric.org/docsharenoframe/common/openfile.asp

- 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, for lines other than those of the highest voltage.

2.7.5 These are the principles that the IPC should expect the applicant to have followed where possible in its overhead line proposals and the IPC should take them into account in any consideration of alternatives and in considering the need for any additional mitigation measures.

Undergrounding

2.7.6 In considering whether lines should be placed underground to obtain the benefits of reductions in landscape and/or visual impacts, the IPC will need to balance those reductions in visual intrusion against the costs (economic, environmental and social) and technical challenges of undergrounding.

2.7.7 The IPC should take into account that the cost of undergrounding electricity cables is between ten and twenty times as much per unit length as for an overhead line, depending on whether the line is buried directly in open agricultural land and the higher figure where more complex tunnelling and civil engineering through conurbations and major cities is required[4].

2.7.8 Maintenance and repair costs are also significantly higher than for overhead lines as are the costs associated with any later uprating. With an overhead line this can be achieved by using different conductors which may or may not require additional tower works (strengthening), whereas uprating an underground cable installed as part of a route can only be achieved at considerable expense by new excavations and installation of larger or additional cables.

4 Source: www.nationalgrid.com/uk/LandandDevelopment/DDC/Undergrounding

2.7.9 There are, in addition, costs which are environmental and social. To match overhead line performance for a 400kV double circuit as many as twelve separate cables in four separate trenches may be needed resulting in a cable swathe of up to 40 metres. This can disturb sensitive habitats and damage heritage assets, in many cases more than an overhead line would. Access for maintenance and repair is required for the duration of the system's life (about 60 years). And when faults occur 400kV underground cables are on average out of service for a period 25 times longer (between two and six weeks) than a comparable overhead line, mainly due to the longer time taken to locate, excavate and undertake technically involved repairs. During this time excavations may result in road closures and traffic management measures with consequent traffic disruption.

2.7.10 The IPC should not refuse consent for overhead line proposals on the basis that undergrounding is preferable unless it is satisfied that the benefits from undergrounding outweigh the extra economic, social and environmental costs and the technical difficulties are surmountable.

2.7.11 The previous paragraphs will also be relevant in terms of consideration of undergrounding to mitigate or avoid other impacts beyond landscape and visual.

Mitigation

2.7.12 In addition to following the principles set out in the Holford Rules and considering the undergrounding option, the main opportunities for mitigating potential adverse landscape and visual impacts of electricity networks infrastructure that the IPC will expect the applicant to have considered lie in the:

- 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;
- 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; and/or
- selection of an **appropriate corridor/detailed route alignment**.

2.7.13 There are some more specific measures that might be taken, and which the IPC could require through conditions 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 and advice from the relevant statutory advisor may also be needed; and
- **Screening**. 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.

2.8 Noise

2.8.1 Generic noise effects are covered in Section 4.26 of EN-1. In addition there are specific considerations which apply to electricity networks infrastructure as set out below.

Introduction

2.8.2 All high voltage transmission lines have some potential to generate noise under certain conditions.

2.8.3 Line noise is generated when the conductor surface electric stress exceeds the inception level for corona discharge 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 and installation can cause local enhancement of electric stress and possibly initiate discharge activity.

2.8.4 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.

2.8.5 After a prolonged spell of dry weather without rain to wash the conductors, contamination may accumulate sufficiently to result in increased noise. After heavy rain, these discharge sources are washed away and the line is again quiet. Surface grease in 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.

2.8.6 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.

2.8.7 Audible noise effects can 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

2.8.8 While standard methods of assessment and interpretation using BS4142:97 "Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas"[5] 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.

2.8.9 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[6]. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991)[7] 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 similar methodology that appropriately addresses the particular problems.

IPC Decision Making

2.8.10 The IPC should ensure that the 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 mitigation measures can be successfully applied, it should be possible for the IPC to give limited weight to residual noise impacts.

2.8.11 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 conditions to ensure noise is minimised as far as possible as discussed below.

5 BS4142:1997 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas, British Standards Institution.

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

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

Mitigation

2.8.12 The IPC should expect the applicant to have considered the following measures:

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

2.8.13 The IPC should expect ESs to include information on planned maintenance arrangements and if not consider requiring these by conditions attached to any grant of development consent.

2.9 Electric and Magnetic Fields (EMFs)

Introduction

2.9.1 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.

2.9.2 All overhead power lines produce EMFs, and these tend to be highest directly under a line, and decrease to the sides at increasing distance. EMFs produced by power lines in normal operation are usually considerably lower than the International Commission on Non-Ionising Radiation Protection (ICNIRP) exposure levels. For electricity substations, the EMFs close to the sites will be dictated by the overhead lines and cables entering the installation, not the equipment within the site.

2.9.3 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 which, depending on the field strength and other exposure factors, can range from barely perceptible to being an annoyance or even painful.

2.9.4 To prevent these known effects, ICNIRP has developed health protection guidelines 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 *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.

2.9.5 The Health Protection Agency's Radiation Protection Division (HPA RPD) provides advice on standards of protection for exposure to non-ionising radiation, including the extremely low frequency (ELF) EMFs arising from the transmission and use of electricity. In March 2004, the National Radiological Protection Board (NRPB), (now the HPA RPD), published new advice on limiting public exposure to electromagnetic fields[8]. The advice recommended the adoption in the UK of the EMF exposure guidelines published by ICNIRP. These guidelines also form the basis of an EU Recommendation on public exposure and a Directive on occupational exposure. The electricity industry voluntarily complies with ICNIRP guidelines and the IPC should expect this compliance to be evidenced in applications.

8 http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733817602

2.9.6 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 Health Protection Agency (HPA) keeps under review emerging scientific research and/or studies that may link EMF exposure with various health problems and will consider the possible need for introducing further precautionary measures.

2.9.7 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.

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

IPC Decision Making

2.9.9 This NPS does not repeat the detail of the ICNIRP guidance on restrictions or reference levels. To satisfy itself that an overhead line application is in accordance with the guidelines the IPC will need to consider the evidence provided by the applicant and any other relevant evidence. It may also need to refer to the guidelines and take expert advice from the HPA.

2.9.10 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 set out the minimum height, position, insulation and protection specifications at which conductors can be strung between towers to ensure clearance of objects. The effect of these requirements is that power lines at or below 132kV will comply with the ICNIRP basic restrictions although the IPC will need to be satisfied that this is the case.

2.9.11 Where applications for new 275kV and 400kV overhead lines or underground cables are involved, the IPC will need to be satisfied that the ICNIRP basic restrictions for public exposure will not be reached or exceeded for any residential accommodation along the route of the line.

2.9.12 Industry currently applies optimal phasing[9] to 275-400kV overhead lines voluntarily and wherever operationally possible, which helps minimise the effects of EMF. Where the applicant cannot demonstrate that the line will be compliant with the Electricity Safety, Quality and Continuity Regulations 2002 and that the ICNIRP basic restriction for public exposure will not be reached or exceeded for any residential accommodation the IPC should refuse consent.

9 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".

2.9.13 Undergrounding of a line would reduce the level of EMF experienced but high magnetic field levels may still occur immediately above the cable. It is not Government 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 exposure alone, as there are likely to be more cost-efficient mitigation measures for EMF exposure alone. Undergrounding is covered in more detail in paras 2.7.6 – 2.7.11 (landscape & visual).

2.9.14 The IPC should take account of statutory technical safeguarding zones defined in accordance with Planning Circular 01/03 Safeguarding Aerodromes, Technical Sites and Military Explosive Storage Areas when considering applications. 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 these facilities, the potential impact and siting and design alternatives will need to have been fully considered.

2.9.15 The table at Annex A shows a basic decision tree for dealing with EMFs from overhead power lines to which the IPC can refer.

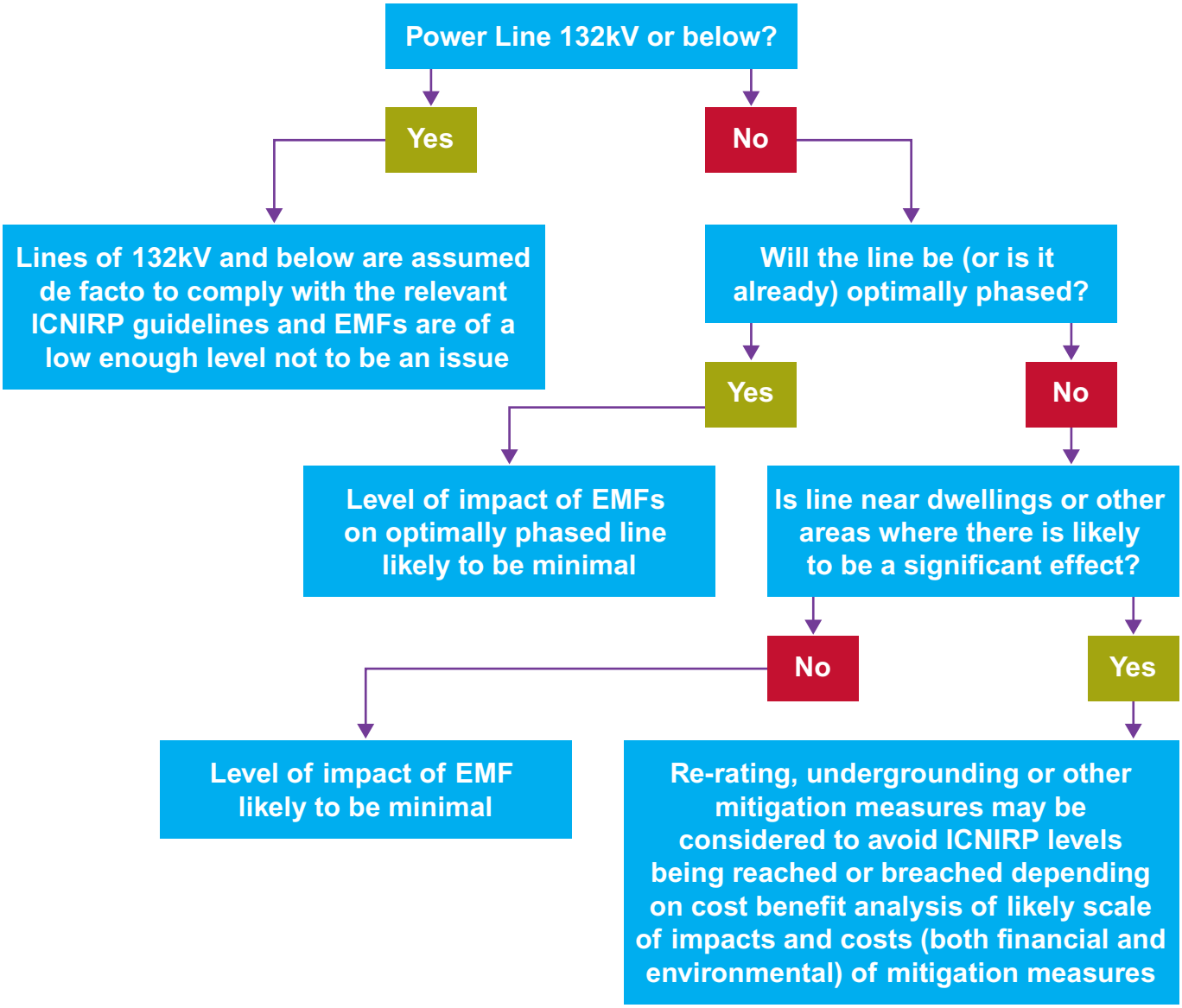
Mitigation

2.9.16 The applicant should have considered the following measures:

- consideration of height, position, insulation and protection measures subject to ensuring compliance with the Electricity Safety, Quality and Continuity Regulations 2002;
- consideration of any new advice emerging from the HPA HRD relating to ELF/EMFs; and
- applying optimal phasing to overhead power lines wherever possible and practicable to minimise effects of EMFs.

2.9.17 Where EMF exposure is within the ICNIRP reference levels, re-routing a proposed overhead line purely on the basis of EMF exposure is unlikely to be proportionate mitigation. Where EMF exposure is within the ICNIRP reference levels undergrounding of a line solely to further reduce the level of EMF exposure is also unlikely to be proportionate mitigation.

Annex A: Simplified Route Map for dealing with EMFs



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