Development near overhead lines

Planning and amenity aspects of high voltage electricity transmission lines and substations

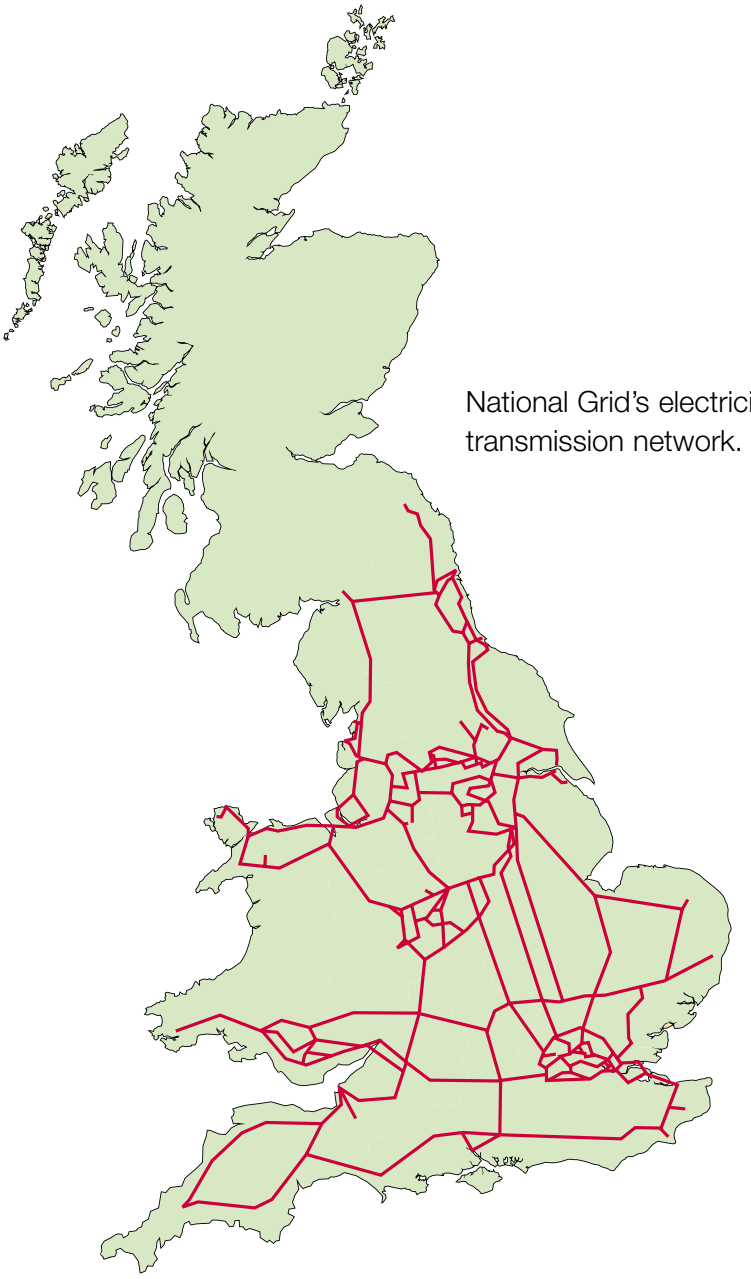
nationalgrid

Contents

This document provides information for planning authorities and developers on National Grid's electricity transmission lines and substations. It covers planning and amenity issues, both with regard to National Grid's approach to siting new equipment, and to development proposals near overhead lines and substations.

Who we are and what we do

Electricity is generated at power stations around the country. These power stations use a variety of fuels - principally coal, gas, oil, nuclear and wind - to generate electricity, and the stations are generally sited to be close to fuel and cooling water rather than to be near centres of demand.



National Grid's electricity transmission network.

Electricity is then transmitted from the power stations through a national network of electricity lines which operate at high voltage. National Grid owns the electricity transmission network in England and Wales and operates the electricity transmission system throughout Great Britain. Local distribution companies then supply electricity at progressively lower voltages to homes and businesses.

This transmission system which operates at 400,000 and 275,000 volts (400kV and 275kV) is known as the "national grid" and covers some 4,500 route miles of overhead line, 420 route miles of underground cable and more than 335 substations. The system, which connects the electricity generators' power stations with the networks of the local distribution companies, also connects with some large industrial customers who, by reason of their size and technical characteristics or location, are directly connected to the transmission system.

Under the Electricity Act 1989 National Grid is the holder of a transmission licence. It is required in this capacity to develop and maintain an efficient, coordinated and economical system of electricity transmission and to facilitate competition in the supply and generation of electricity.

Unlike virtually all other commodities, electricity cannot be stored in bulk until it is needed; it has to be generated in the right quantities, at the time it is needed. The vast majority of generating capacity in England and Wales is connected by National Grid's transmission system. This enables the operation of power stations to be coordinated, offering potential benefits of reducing the amount of spare generating capacity and generating reserve needed, and the ability to select power generation to supply the needs of the moment.

The energy industry is currently going through a period of significant change resulting in a multi-billion pound investment programme. This will encompass small and large scale electricity generation and substantial investment in energy networks to replace and upgrade ageing assets, construct new infrastructure to connect and efficiently deliver new energy sources, as well as maintaining the levels of safety and reliability to which everyone has become accustomed.

This note describes National Grid's amenity responsibilities. It briefly sets out both the amenity aspects which National Grid takes into account in siting new electricity lines and substations, and the amenity aspects which are relevant to proposed development near National Grid's electricity transmission equipment. The note goes on to explain these considerations in more detail, which we believe developers and local planning authorities may wish to take into account.

Overhead lines and substations

An electricity line consists of either an overhead line or an underground cable, or both. A typical National Grid overhead line route uses three main types of lattice steel tower (or pylon). These are:

- suspension towers which support the conductors on straight stretches of line;
- deviation towers at points where the route changes direction; and
- terminal towers where lines terminate at substations or are connected to underground cables.

Appendix II illustrates these features.

National Grid's substations are necessary for the efficient operation of the transmission system, for the specific role of switching circuits or transforming voltage. They are normally sited between power stations and the transmission network, and between the transmission network and the local distribution companies' networks. They can be sizeable developments, and including connecting terminal towers, can occupy up to 20 hectares.

However, advances in technology means that the equipment located at substations is now more compact than that of the 1950s and 1960s when many of the existing substations were built. Hence new substations are considerably smaller in size, both in height and area covered, and in certain circumstances, can be sited inside a building which resembles an industrial unit. Substations are usually contained within steel palisade fencing to ensure public safety, and the structures, excluding towers, are not usually more than 15m in height. Road access is necessary for staff, and for the transport of equipment during construction, maintenance or repair. Very occasionally, transformers or other very large items of plant may need to be moved into or out of sites as abnormal indivisible loads.

Consent procedures

National Grid is a statutory undertaker under the Town and Country Planning (General Permitted Development) Order 1995. The Order grants planning permission for certain defined classes of development. National Grid therefore has certain rights to carry out development under the Order without the need for planning permission from the local planning authority. This permitted development relates primarily to development in existing substations, on operational land and to underground cables. New substations or major extensions to existing substations may require planning permission from local planning authorities.

To construct a new overhead line in either England or Wales, National Grid requires formal consent, under section 37 of the Electricity Act 1989, from the Secretary of State for Business, Enterprise and Regulatory Reform, unless the new line is across land owned and occupied by the company. The Electricity Act 1989 contains a formal procedure for consultation with local planning authorities within whose areas the new line is proposed. If they maintain an objection to an application for section 37 consent then the Secretary of State is required to convene a public inquiry. When granting section 37 consent, the Secretary of State will usually direct that planning permission for the development will be deemed to be granted under the Town and Country Planning Act 1990.

Advice on the procedure for consulting local planning authorities is given in a Circular issued jointly by the then Department of the Environment (Circular 14/90 of that office) and the then Welsh Office (Circular 20/90).

Under its duty in the Electricity Act 1989 to facilitate competition in the supply and generation of electricity, National Grid must offer connection facilities to any new or proposed power station or plant, including offering connections to a local distribution company or major industry that requires a high voltage electricity supply. Therefore proposals for a new electricity generation project may also involve transmission works away from the power station site, such as new overhead lines, modifications to existing lines or new development at substations. These transmission works may be the responsibility of National Grid, the distribution companies or the generator itself depending upon the particular circumstances of each case.

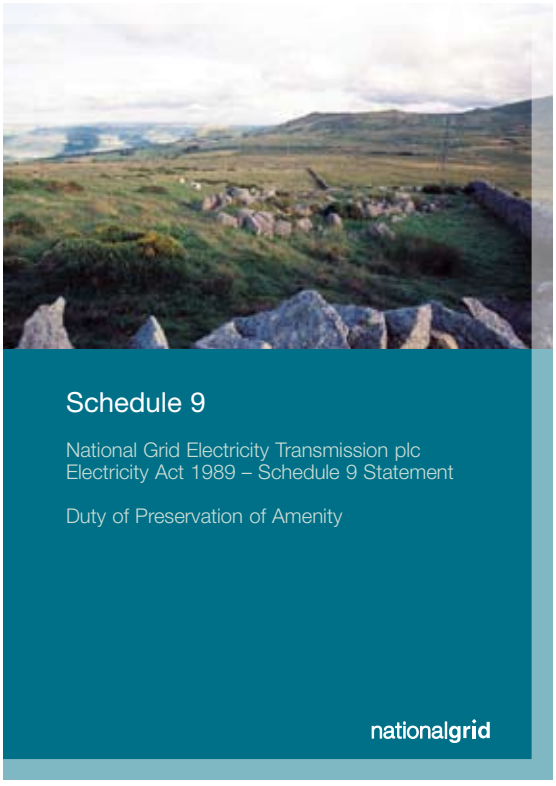
A generator promoting a new power station of over 50 megawatts generation capacity would seek consent under section 36 of the Electricity Act 1989. Although such an application would be separate from any associated transmission works, discussions between the generator and National Grid normally take place at an early stage. Indeed, National Grid would encourage prospective generators to consult it in advance of the consent process so that transmission and consent implications of the project can be fully considered.

Amenity responsibilities

Schedule 9 Statement

Under section 38 of the Electricity Act 1989, National Grid has a duty in formulating proposals for new development 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."

National Grid is also required under schedule 9 of the Act to produce and publish a statement setting out how it proposes to meet this obligation. The company's Schedule 9 Statement is available as a separate document. http://www.nationalgrid.com/uk/LandandDevelopment/SC/Responsibilities/



Environmental Impact Assessment

Overhead lines with a voltage of 220kV or more and a length of more than 15km which require consent under section 37 of the Electricity Act 1989 are included in schedule 1 of The Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000 (as amended). These regulations implement European Directive 85/337/EEC as amended by Directive 91/11/EC which set out procedures for the assessment of the effects of certain projects on the environment. For all development listed in schedule 1 of the regulations, the preparation of an environmental statement is mandatory. As such National Grid will always undertake an environmental impact assessment of all new high voltage overhead line routes of more than 15km in length and submit an environmental statement.

A separate list of developments is covered in schedule 2 of the regulations. A schedule 2 development project need only be subject to environmental assessment if it is likely to have a significant effect on the environment because of its size, nature or location. The regulations state that where proposals include a high voltage overhead line or an overhead line installed in a sensitive area, the need for an environmental impact assessment will be determined on a case-by-case basis. National Grid will therefore carry out environmental impact assessments for some overhead line developments which fall into schedule 2, dependent on consultation with the relevant local planning authorities and the outcome of the screening process.

Environmental statements are not required under the legislation for new substation proposals, however National Grid has given a commitment in its' Schedule 9 Statement to undertake relevant environmental investigations and report on these in any application for consent for new works.

Routeing of overhead lines

Guidelines for the routeing of new overhead lines were originally formulated by the Central Electricity Generating Board (CEGB), a predecessor to National Grid. These guidelines have subsequently been reviewed and supplemented by National Grid and are used as the basis of the company's approach to routeing new overhead lines.

The guidelines set out the principles to be applied in the routeing of new overhead lines. They cannot be expected to cover every possible situation and each case must be considered separately and on its own merits.

The selection of any new electricity line route will be a balance of all the various factors or constraints which have to be taken into account. Any overhead line will be a visual intrusion into the landscape through which it passes, and it is the dominant scale of towers which makes them difficult to absorb into the landscape.

In selecting a route National Grid seeks to reduce the visual effect of the line in terms of the number of people affected and the degree to which they are affected. The nature and topography of the landscape is considered and any statutory protection afforded to an area is also taken into account.

The selected route will typically seek to avoid crossing the highest contours, where towers would generally be the most prominent and will take account of the quality of the landscape and its ability to accommodate an overhead line. In other words an overhead line should 'fit' into the landscape as much as that landscape permits. The extent to which opportunities exist to screen the line will depend on existing vegetation, buildings and topographic features. When viewed from principal viewpoints, an overhead line should ideally be viewed against a background of existing landscape or other development rather than against the sky.

There may be a number of potential conflicts of interest in establishing a new overhead line route. Sometimes, for example, the best route through a landscape will be to follow a river valley rather than to cross the adjacent higher land. The valley, however, is likely to be more intensively populated and also may contain the major transport routes in the area as well as the better quality agricultural land. A new line so routed could have a greater effect on a larger number of people even though its effect outside the valley may be minimal. Conversely for example, upland areas, whilst having relatively little development, are likely to have protective designations and an overhead line across such areas may be visible over a much wider area.

These are all general routeing principles. In practice, the selection of a route will very much depend on the circumstances applicable to each case.

Siting of substations

The general location of a substation is initially determined by transmission requirements and line routeing. The substation may be required to increase the supply of electricity from a power station into the national grid system for transmission; or near an urban area, it may be required as a grid supply point to reduce the voltage to lower levels for the local distribution companies. Its general location is defined by these factors.
With regard to the precise location of a substation, National Grid has guidelines to assist in siting and designing substations to mitigate their environmental effects. The substation guidelines complement National Grid's line routeing guidelines and, where appropriate, are used in conjunction with them.

Proposals for new or significant extensions to substations, do not require environmental impact assessment under Government regulations or advice. However, National Grid normally undertakes relevant environmental investigations on such proposals, and would report on these investigations in submitting any planning application to the local planning authority.

This image shows an aerial view of St. John's Wood 400kV substation in north London. Amongst other factors, design of this GIS (gas insulated switchgear) substation had to take into account land constraints in this urban area.

Development near overhead lines and substations

National Grid owns the land occupied by its substations, but only exceptionally does it own the land which is crossed by its electricity lines. The line is retained by means of either wayleave agreements or permanent easements with the landowner. National Grid has the power to maintain and renew the electricity line and to gain access for these purposes.

National Grid seeks voluntary agreements with landowners. However, when these are not forthcoming National Grid has compulsory powers and can apply to the Secretary of State for a 'necessary wayleave' for the overhead line route, or compulsory purchase of the land occupied by the cable route. In such cases a hearing will take place which provides the opportunity for all issues to be discussed. Since it does not own the land, it cannot prevent development close to or under overhead lines (although, of course, safe electrical clearances must be maintained).

It has sometimes been suggested that minimum distances between properties and overhead lines should be prescribed. National Grid does not consider this appropriate since each instance must be dealt with on its merits. However, it has always sought to route new lines away from residential property on grounds of general amenity. Since the only limitation on new development has been the statutory safety clearances (Appendix III), a large amount of residential and other development has been carried out subsequently beneath and adjacent to overhead lines.

Where development takes place and how it is designed are principally matters for the landowner, developer and the local planning authority to determine. National Grid should be consulted at an early stage on proposals for development near lines and substations, when it is more likely that National Grid's advice and guidance on development near to electricity lines issues can be taken into account.

National Grid believes that the amenity considerations which are applied in routeing overhead lines and siting substations, should be considered in respect of development proposed in the vicinity of overhead lines and substations. Such amenity and other considerations are set out below. In addition National Grid has published comprehensive site layout, design and landscaping guidelines to provide advice and pragmatic solutions for anyone involved in the planning, design and development of sites near high voltage overhead electricity lines.
Visit the Sense of Place website at:
www.nationalgrid.com/uk/senseofplace

Safety aspects

Contact by people or objects with high voltage equipment must be avoided. At substations the high voltage compound is protected by the provision of high security fencing and all of National Grid's towers have anti-climbing guards. For overhead lines a statutory minimum safety clearance must be maintained between conductors and the ground: the higher the voltage of the line, the greater the clearance which is required. Appendix III gives information on statutory safety clearances and on where further information and advice can be obtained.

Safe clearances must be maintained from buildings constructed under or adjacent to overhead lines. Safe clearances must also be maintained for trees, structures such as street lighting, new roads, and ground levels where these will be altered by civil engineering operations.

Underground cables give rise to particular safety requirements. Requirements are dependent upon cable installation methods but generally the area above cables, and a distance on either side, must be kept clear of structures and trees. Access is required for maintenance and repair. It is essential that the cables and material surrounding them should not be disturbed. Further information on cables is available on our website.

Maintenance

From time to time access is required onto land to inspect, maintain and refurbish overhead lines and underground cables. National Grid's rights of access to undertake such works are contained within the wayleave agreement or permanent easement with the landowner.

Overhead lines are inspected on a routine basis both by foot and helicopter. Climbing inspections of towers also take place. Less frequently, overhead lines are refurbished; and conductors, insulators and associated fittings may be replaced, or towers painted. Occasionally towers and their foundations may also be refurbished.

For major refurbishment, such as replacing conductors, safety scaffolding may need to be erected over underlying properties, roads and other development. Certain maintenance techniques also involve the use of helicopters.

National Grid needs quick and easy access to carry out maintenance to its equipment, to ensure that it can be returned quickly to service and be available as part of the transmission system. Such access can be difficult to obtain without inconveniencing and disturbing occupiers and residents, particularly where development is in close proximity to overhead lines.

National Grid recognises that maintenance and refurbishment activities can cause disruption and adversely affect the general amenity of those occupying buildings beneath or adjacent to overhead lines and near to cable routes. Where possible, National Grid seeks to minimise the effects of such disruption. Developers should take into account the requirement of National Grid to maintain access to its equipment.

Visual impact

Since towers are such large and dominant structures, the opportunity to mitigate their effect on new development adjacent to an existing line is restricted. Nevertheless the layout of residential and other types of development, the orientation of main views out of a building, and the location of structural site planning by the developer can assist in reducing the visual impact on residents.

For further information please visit the Sense of Place website at: www.nationalgrid.com/uk/senseofplace

The siting, design and landscape treatment of new substations takes account of existing development. Landscaping, both through the modification of ground form and by planting, can help to mitigate the visual impact of a substation. Where new development is proposed in the vicinity of existing substations, the layout and design of the development can be planned to keep the adverse visual impact of the substation to a minimum.

Noise

High voltage overhead lines and substations can generate noise, the level of which depends mainly on the voltage of the overhead line or substation.

Noise from energised overhead lines is produced by a phenomenon known as “corona discharge” (a limited electrical breakdown of the air). While conductors are designed and constructed to minimise corona discharge, surface irregularities caused by damage, insects, raindrops or pollution may locally enhance the electric field strength sufficiently for corona discharges to occur. This can be audible in certain conditions as a “crackling” sound, occasionally accompanied by a low frequency hum. The noise level generated by a high voltage overhead line is weather-related, with highest noise levels occurring during damp conditions. Overhead lines are normally quiet during dry weather, except during long, dry spells when airborne debris adheres to the conductors. Any noise disappears when sufficient rain falls to wash the debris away.

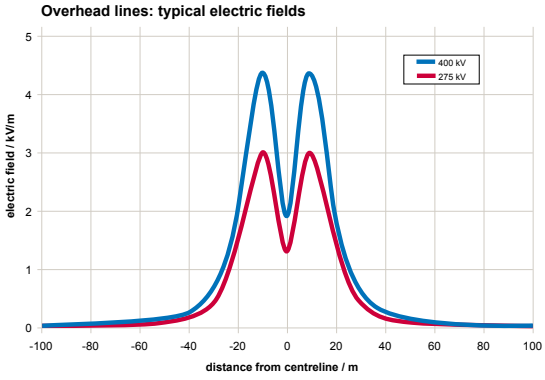
Transformers are installed at many substations, and generate low frequency hum. Whether the noise can be heard outside a substation depends on a number of factors, including transformer type and the level of noise attenuation present (either engineered intentionally or provided by other structures).

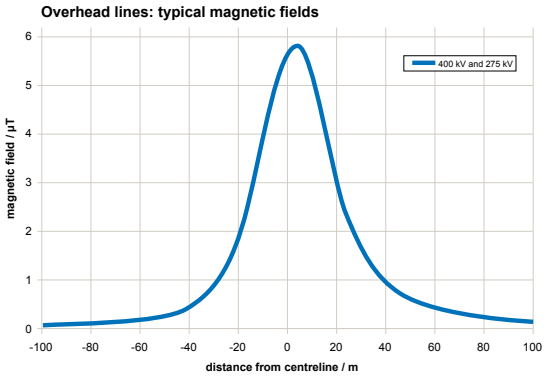
National Grid is able to provide information and advice on noise from high voltage plant to both planning authorities and developers. It is possible for the developer to mitigate significantly the effects of noise from an existing overhead line by attention to site layout and design of new developments, for example by including landscaping or by placing the noise-sensitive elements away from the high voltage plant.

The Department for Communities and Local Government Planning Policy Guidance 24 (PPG24, Planning and Noise), and Technical Advice Note (Wales) 11, guide local authorities on the use of their planning powers to minimise the adverse impact of noise. They outline the considerations to be taken into account in determining planning applications both for noise-sensitive developments and for those activities which generate noise. They also advise on the use of conditions to minimise the impact of noise.

Electric and magnetic fields

Electric and magnetic fields (EMFs) are associated with most electrical apparatus, including power lines, underground cables and domestic appliances. They diminish rapidly with distance from the source. Electric fields are associated with voltage and can cause small micro-shocks in certain instances (see “Other Electrical Effects” below). Magnetic fields vary with the current in the line or appliance. Both can be measured with appropriate meters. A separate guide to EMFs, “EMF The Facts”, is available.





While there is ongoing debate over the possibility of a hazard to health from low-level EMFs, the balance of the scientific evidence to date is against there being health effects.

The Health Protection Agency (HPA, previously the National Radiological Protection Board) is responsible for monitoring the hazards to health from all forms of radiation, and is highly respected for its independent scientific opinions. The Government relies on the scientific advice of the HPA, and has brought EMF exposure limits into force in the UK accordingly.

All of the electricity system, including all overhead lines, complies with these limits. The limits are set to prevent all established effects of EMFs on people, and the HPA advises that there is insufficient evidence of harmful effects (for example, cancer) below these levels to reduce the limits. The Government are considering whether any precautionary measures might be justified in addition to the exposure limits, based on a report from a stakeholder group called SAGE, but have not yet introduced any. Therefore, in the UK at present, there are no restrictions on EMF grounds on building close to overhead lines.

National Grid follows the advice of the Government and the HPA. National Grid recognises that some public concern exists over this matter. National Grid, together with the Energy Networks Association, can provide information on the research carried out worldwide on this subject or, alternatively, can direct interested parties to experts, independent of the electricity industry, who can provide advice and guidance.

Other electrical effects

Induced voltages

High voltage equipment produces electric fields which can cause nearby conductive objects to acquire a charge. When discharged to earth through a person touching the object, a small microshock may be experienced. For instance, a car parked under an overhead line can pick up a voltage and when a person touches it, a small spark may occur between the car and that person. Microshocks may sometimes be annoying, but are not normally regarded as dangerous or a health risk.

Metal-clad buildings and metal fences under overhead lines can similarly pick up a voltage. These should be appropriately earthed to reduce the effect of such voltages.

Magnetic fields from power cables and overhead lines can also induce voltages on conductive services, such as pipelines or telecommunication cables, that run parallel and close by. These voltages can be significant if the length of parallelism is considerable. In such cases, an assessment of the impacts of induced voltages will be required and National Grid should be consulted for further advice.

At petrol filling stations and other sites where flammable materials are stored, where spark discharges can be a safety hazard, appropriate electrical screening and earthing of the site may be required if it is located under a high voltage overhead power line. A safety assessment should be carried out with the effects of the nearby power line taken into account, and National Grid consulted for further advice.

Computer screen interference

Some monitors or display screens used with computers suffer a distortion of the displayed image, usually a “flicker” or “wobble” in the presence of 50 Hz magnetic fields above about 0.5 microteslas. Such magnetic fields can be found around most electrical equipment, including high voltage overhead power lines. The magnitude of interference will be dependent on the proximity and orientation of the display screen to the overhead line and the magnitude of current flowing in the line. Flat Screen Displays are not affected.

Distribution wiring in buildings and adjacent equipment can also generate a magnetic field of sufficient level to interact with computer screens.

For existing equipment that is being affected, there are techniques available that can reduce the interference. National Grid can provide information and advice to minimise interference to computer screens in the design and layout of new buildings. If Flat Screen Displays are specified for new installations, the need for any such mitigation will be removed.

Electromagnetic compatibility (EMC) issues

Some electronic and radio communications equipment may be susceptible to the electromagnetic fields and low level radio noise produced by high voltage equipment. Generally, it is easier and less costly to design and plan to avoid EMC issues than it is to correct the problems after they have arisen. As such, it would be prudent for the electromagnetic environment to be taken into consideration when new electronic equipment is being specified.

The locations of television and radio aerials relative to high voltage electricity transmission lines or substations can sometimes result in poor reception. The careful siting of such aerials can usually resolve this issue.

Development plan policy

Many of the considerations which have given rise to National Grid's approach to the siting of substations and the routeing of lines are also relevant to proposals for development close to such high voltage plant.

Some local planning authorities have included policies in their development plan documents which state that, when considering new development, the effect of overhead lines on amenity should be taken into account. National Grid believes that this is an appropriate approach. While National Grid cannot control development (except for safety reasons) under and adjacent to lines, it believes that there are operational benefits to National Grid, and amenity benefits to potential occupiers and the local community, in controlling the siting of such development.

National Grid will support policies in development plan documents which seek to control, on amenity grounds, built development under and immediately adjacent to lines. National Grid is pleased to be consulted on relevant development plan policies and wishes to encourage dialogue with local planning authorities in order to achieve these objectives.

National Grid cannot support policies or proposals in development plans which rely on EMF and related health concerns as justification to control or direct development and will therefore continue to make representations against such policies.

As previously stated, it is National Grid's policy to adhere to HPA (previously NRPB) guidelines.

By appropriate site design it is often possible to incorporate amenity areas free of built development along a overhead line route and round a substation without sterilising significant areas of land. Appropriate uses for this land are public open space; nature conservation; or structural landscaping in residential areas, or for parking and storage in employment areas. For further information please visit the Sense of Place website at: www.nationalgrid.com/uk/senseofplace

National Grid wishes to encourage local planning authorities to consult it on draft development plan documents and on planning applications. It would particularly welcome discussions early in the development plan documents process.

Appendix I

Glossary

The following terms are generally used by National Grid in relation to its transmission equipment:

Cable
An insulated conductor designed for underground electricity transmission or distribution.

Central Electricity Generating Board (CEGB)
Until March 1990, the CEGB was responsible for the generation of electricity in bulk and the transportation of this power through a nation-wide transmission system called the national grid to the then Area Boards.

Circuit
Term used to describe specific electrical paths on the transmission system. i.e. Overhead Line.

Conductor
Wire strung between towers, used for transmitting electricity.

Damper
Metal devices fixed to insulators to avoid conductor damage in windy conditions which can cause vibration of the conductors.

Development Plan Documents (DPDs)
Planning documents prepared by local planning authorities to outline key development goals. DPDs cover the core strategy for the area, a proposals map and site-specific development allocations.

Earth wire
Wire strung between the tops of towers, used for lightning and system protection. This wire may also be used to carry telecommunication signals.

Electricity line
Either an overhead line or an underground cable used to transmit electricity.

Electric and magnetic fields (EMFs)
Electric and magnetic fields (EMFs) are produced by any electrical apparatus, including domestic appliances and overhead power lines.

Flashover
A disruptive electrical discharge between equipment at phase voltage and earth, or between two phases, including breakdown across the surface of an insulator as well as sparkover through air.

High voltage
275,000 volts and over. National Grid's transmission lines generally operate at 275,000 volts and 400,000 volts. Lower voltage lines, such as 132,000 volts and 33,000 volts are generally owned by local distribution companies.

Insulator
Used to attach the conductors to the towers preventing electrical discharge to the steelwork. Usually made from porcelain or glass units, joined together to form an insulator string.

kV
Kilovolt (one thousand volts).

Local distribution companies
Generally own and operate lines with a voltage of 132,000 volts and below and supply electricity to homes and businesses.

MW
Megawatt (one million watts or one thousand kilowatts).

Outage
The withdrawal from service of any part of the transmission system for a period of time in connection with repair, maintenance, or construction of the transmission system.

Permanent easement
Legal right in perpetuity granting National Grid the right to install, use and maintain its equipment. A permanent easement is granted in exchange for a one-off capital payment. Also known as a Deed of Grant of Easement.

Pylon
See tower.

Refurbishment
Repair and renewal of conductors, earthwire, fittings and insulators and where necessary remedial works to the tower and foundations.

Route mile
The length, measured in miles, of the transmission line which connects two or more points on a transmission system, irrespective of the number of circuits of which the line is comprised.

Spacer
Metal device which maintains conductor separation at intervals along the span between towers.

Substations
Transforming or switching stations to control the voltage and direction of electricity. Transforming stations are used to increase the supply of electricity (to 275kV or 400kV) into the national grid system for transmission, and to reduce the voltage to lower levels (to 132kV) for distribution by the local distribution companies. Switching controls the direction of electricity and ensures fault protection.

System security
The ability of a transmission or distribution system to withstand a disturbance and/or the loss of certain circuits.

Tower
Overhead line structure used to carry overhead electrical conductors, insulators and fittings. They are commonly known as pylons and are of a lattice steel construction. See Appendix II.

Wayleave agreement
A licence granted by the owner and occupier of land giving National Grid the right to install, use and maintain its equipment. Terms of the Wayleave Agreement provide for the annual rental and compensation payments to be made.

Appendix II

Main features of a transmission line

National Grid uses a variety of tower designs for the support of overhead line conductors which transmit high voltage electricity from generating stations to where it is needed.

The national grid until the late 1950s consisted of a series of overhead lines at a voltage of up to 132kV. As demand grew, a system of 275kV lines was developed to feed the major conurbations. This system was further developed and uprated to 400kV in the 1960s. A 400kV line carries about three times as much power as a 275kV line, and about 18 times that of a 132kV line depending on the precise line designs. Local distribution companies generally own and operate lines with a voltage of 132kV and below.

Figure 1 shows National Grid's L2 and L6 double circuit towers which are those most widely in use for high voltage transmission. The L2, a typical transmission tower from the 1950s, carried steel-reinforced aluminium conductors in pairs from each insulator. When quadruple conductors were introduced in the 1960s, larger and more substantial towers were needed. The L6 designs were then introduced. The development of lighter all aluminium alloy conductors allowed the smaller L12 design to be brought into use in the 1980s.

The size, height and spacing of towers are determined by safety, topographical, operational and environmental considerations.

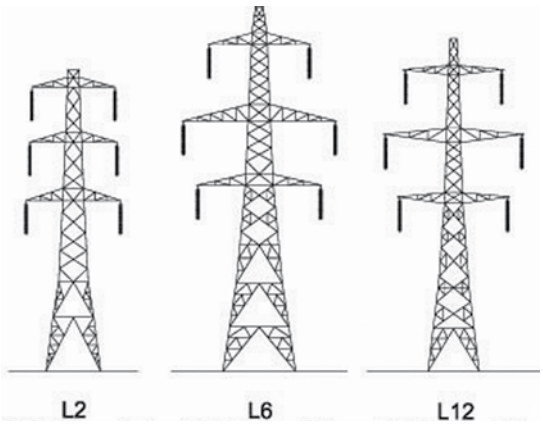


Figure 1: Typical suspension towers

A typical National Grid overhead line route will involve the use of three main types of tower. They are as follows:

- Suspension towers – these support the conductor on straight stretches of line. Conductors are suspended by a vertical insulator string
- Deviation towers – these occur at points where the route changes direction. Conductors are attached by horizontal insulator strings
- Terminal towers – these towers are of greater bulk in order to ensure stability. They occur at the end of overhead lines where they connect with substations or underground cables.

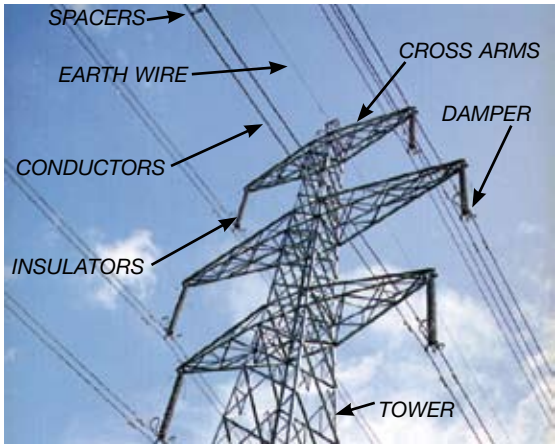


Figure 3: The main features of a transmission line

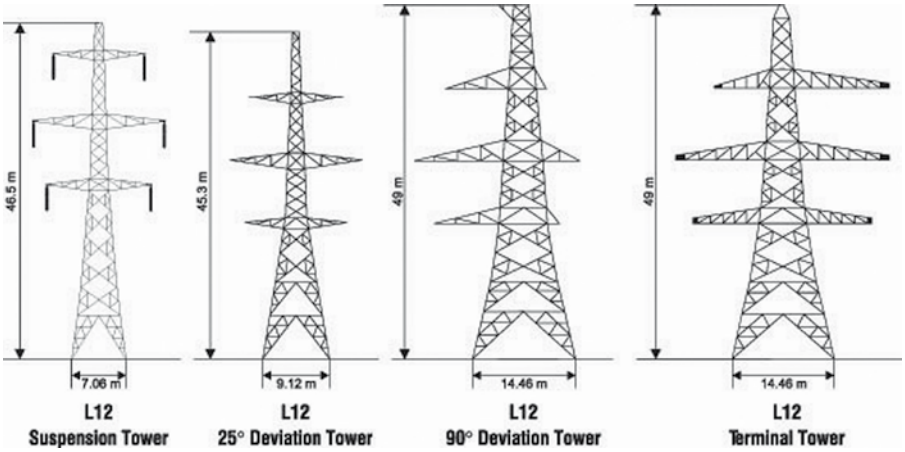


Figure 2: Typical towers in a 400kV route

Appendix III

Safety clearances

Making contact or near contact with overhead lines is dangerous. Overhead electric conductors are normally bare (uninsulated) and if an object approaches too closely it is possible that a flashover will occur and an electric current flow with the likelihood of fatal or severe shock and burns to any person nearby. In order to prevent such incidents minimum safety clearance for overhead lines are prescribed.

Overhead transmission lines must conform to the specifications contained in the Electricity Safety, Quality and Continuity Regulations 2002. The minimum heights at which the conductors are strung between towers are given for lines operating at specified voltages.

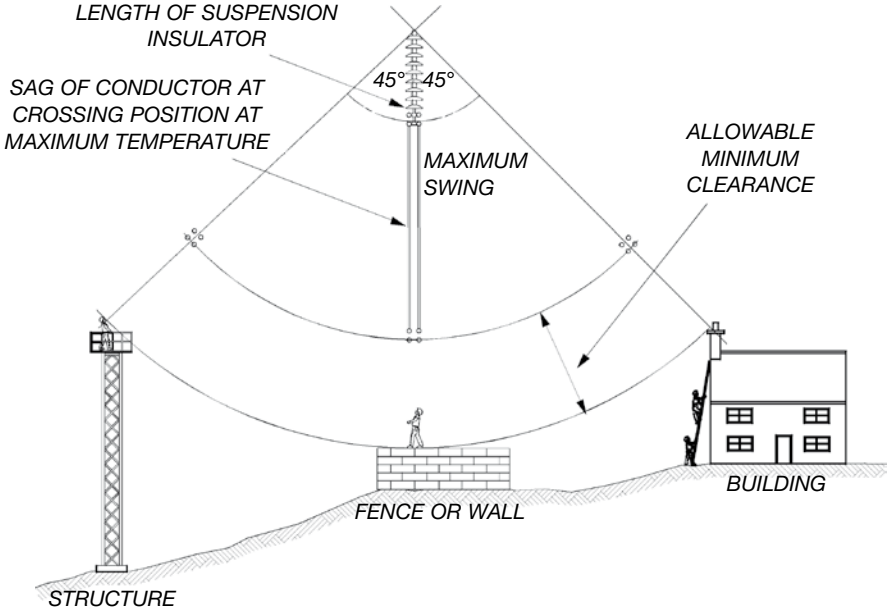


Figure 4: Clearance to objects (on which a person can stand)

Overhead lines are also constructed to conform with the Energy Networks Association's (ENA's) technical specifications which govern the minimum clearance to be maintained between the conductors, ground, roads, trees and objects on which a person may stand. A summary of ENA's Technical Specification 43-8 "Overhead Line Clearances" is given in table 1, the application of safety clearances are illustrated in figures 4, 5 and 6. The minimum clearance to ground for a 400,000 volt line is 7.6m and for a 275,000 volt line is 7.0m.

It is important to note that the information in table 1, giving the minimum safety clearances is for illustrative purposes only. The necessary clearance at a specific location will be dependent on factors including the location the line is passing over, the line's construction, design, and its operating voltage. It is therefore important to contact National Grid where it is intended to construct or alter the ground levels within the vicinity of a National Grid overhead line so that detailed advice on safety clearances and other relevant information may be given.

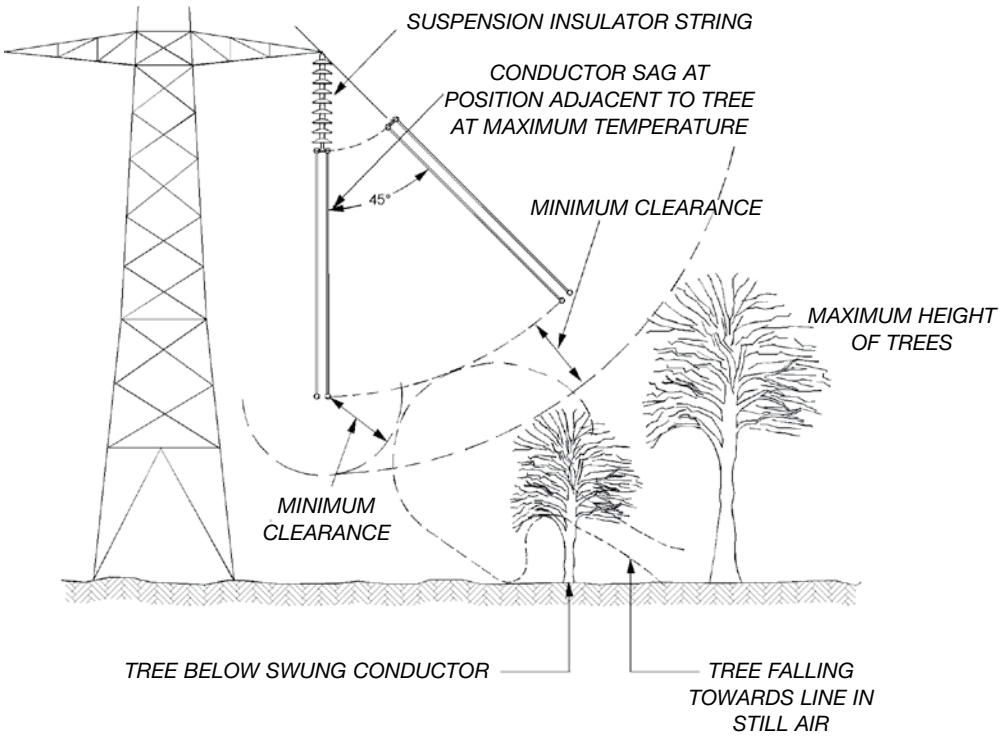


Figure 5: Clearance to trees

In order to ensure that safety clearances are not infringed where works are planned near to overhead lines, National Grid can provide profiles of the overhead line crossing specific sites which detail the height above ground of the lowest conductor. Line profiles are drawn at the time of construction to illustrate the position of the conductors at maximum sag. The position of the conductors at maximum swing should also be taken into account.

Developments adjacent to overhead lines should be designed to facilitate their construction without infringing electrical safety clearances. Care should be taken when unloading, stacking or moving material under conductors. Those involved should be acquainted with the Health and Safety Executive Guidance Notes GS6(rev) and HSG47 which advises on the avoidance of danger from overhead electrical lines and underground services respectively.

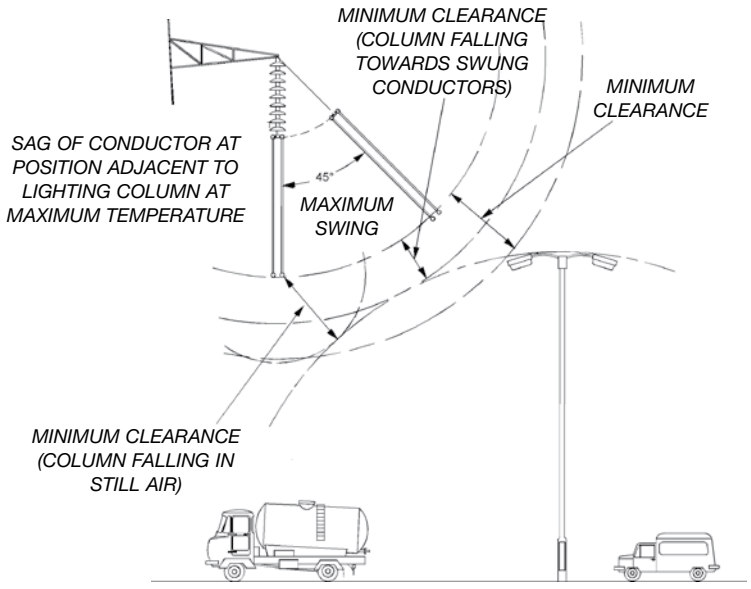


Figure 6: Clearance to lighting columns

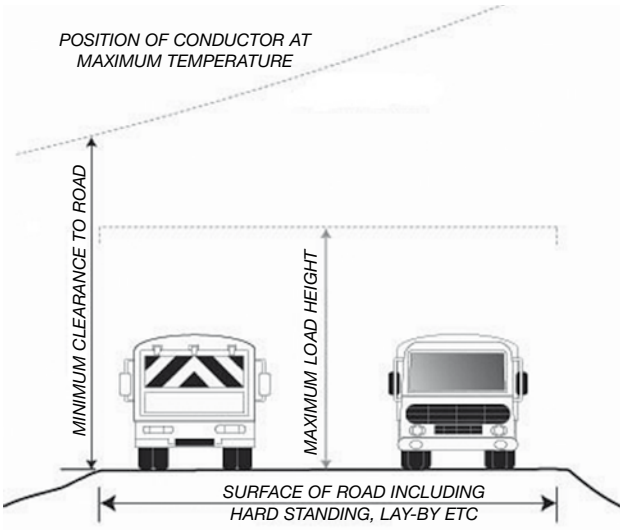


Figure 7: Clearance to roads

Table 1: Overhead line conductor clearances

Description of Clearance	Minimum clearance (metres) at 400kV	Minimum clearance (metres) at 275kV
To ground	7.6	7.0
To normal road surface	8.1	7.4
To road surface of designated '6.1 metres high load' routes	9.2	8.5
To motorway or other road surface where Skycradle can be used	10.5	9.8
To motorway road surface where scaffolding is to be used on: (i) Normal 3 lane motorways (ii) Elevated 2 lane motorways	 16.3 13.3	 15.6 12.6
To any object on which a person may stand including ladders, access platforms etc.	5.3	4.6
To any object to which access is not required AND on which a person cannot stand or lean a ladder	3.1	2.4
To trees under or adjacent to line and: (i) Unable to support ladder/climber (ii) Capable of supporting ladder/climber (iii) Trees falling towards line with line conductors hanging vertically only	 3.1 5.3 3.1	 2.4 4.6 2.4
To trees in orchards and hop gardens	5.3	4.6
To irrigators, slurry guns and high pressure hoses	30.0	30.0
To street lighting standards with: (i) Standard in normal upright position (ii) Standard falling towards line with line conductors hanging vertically only (iii) Standard falling towards line	 4.0 4.0 1.9	 3.3 3.3 1.4

References

a) The Electricity Safety, Quality and Continuity Regulations 2002 (S.I. 2002 No 2665).
b) Energy Networks Association Technical Specification 43-8 Issue 3, 2004 - Overhead Line Clearances.
c) Health & Safety Executive Guidance Note GS6(rev) - Avoidance of danger from overhead electrical lines.
d) Health & Safety Executive Guidance Note HSG47 - Avoiding danger from underground services (Second edition).

Contacts and further information

A. For planning application consultations, developer enquiries and advice on safety clearances, please contact the following:
Asset Protection Team
National Grid
Land and Development
PO Box 3484
Warwick
CV34 6TG
Switchboard: 0800 731 2961
Fax: 01926 656574

B. For development plan document consultations, general town and country planning and amenity issues, please contact the following:
Land and Development Stakeholder and Policy Manager
National Grid
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
Tel: 01926 653000
Fax: 01926 656574

C. For questions on, or issues with, EMF please contact the following:
EMF Unit
National Grid
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
Tel: 0845 7023270
Email: emfhelpline@uk.ngrid.com
Web: www.emfs.info

Land and Development
Stakeholder and Policy Team
National Grid
National Grid House
Warwick Technology Park
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