Rise of Earth Potential at Electricity Stations
About this document...

Author

The author of this document may be contacted at:

Pete Whelan
Manager, Electrical Protection
Openreach Network Capability & Development (BEAC24)
Post Point G08/Polaris
Adastral Park
Martlesham Heath
Ipswich
Suffolk
IP5 3RE
Tel: 01473 642254 (BTnet: 00 164 2254)
Fax: 01473 614580
Email: pete.whelan@openreach.co.uk

Content approval

This is Issue T77 of this document.
The information contained in this document is not approved for use.

Filing

The filing reference for this document is EPT/PPS/B012.

History

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Author</th>
<th>Reason</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Issue 7</th>
<th>7-Dec-2007</th>
<th>Pete Whelan</th>
<th>Introduction of risk assessment areas and general update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue 6</td>
<td>28-Feb-2006</td>
<td>Pete Whelan</td>
<td>Change of author and update of text to include risk assessment for off-site-hot premises</td>
</tr>
<tr>
<td>Issue 5</td>
<td>22-Apr-2005</td>
<td>Ian Gauntlett</td>
<td>Change of author and approver</td>
</tr>
<tr>
<td>Issue 4</td>
<td>23-Apr-2004</td>
<td>David Levitt</td>
<td>Change of Author/Approver</td>
</tr>
<tr>
<td>Issue 3</td>
<td>1-Feb-1998</td>
<td>Bob Ruddock</td>
<td>Up Issue - paragraph 7 revised</td>
</tr>
<tr>
<td>Issue 2</td>
<td>1-Feb-1998</td>
<td>Bob Ruddock</td>
<td>Up Issue</td>
</tr>
<tr>
<td>Issue 1</td>
<td>1-Dec-97</td>
<td>Bob Ruddock</td>
<td>Up issue</td>
</tr>
</tbody>
</table>
Contents

1 General 6
2 Introduction 6
3 Estimation of rise of earth potential 7
4 Rise of earth potential: limiting conditions 9
5 Zone of rise of earth potential (hot zone) 10
6 Replacement of the 100 metre zone 11
7 Hot site register 13
8 Action to be taken on receipt of register(s) and enquiries of electricity companies 14
9 Protection at construction sites of large generating stations 17
10 Records 17
11 Liaison officers 17
12 Responsibility for costs 17
13 Situations of close approach 20
13.1 Exchanges and repeater stations near ESI stations 20
13.2 Distribution substations (11kV/415V) 21
14 Customers’ premises within the hot zone of ESI stations 24
15 Substations on BT property 24
16 Underground Openreach cables in the vicinity of ESI stations 25
16.1 Metallic sheathed BT cables 25
16.2 Proximities between metal power line towers and Openreach underground plant 25
17 Enquiries 26
18 Appendix 1- Sample Letter 26
19 Appendix 2 – ENA Report ETR 128 26
1 **General**

This document implements a policy which has been agreed with the Electricity Supply Industry (ESI) for the provision of telephony based services (traditionally supplied by BT) at electricity generating and transforming stations and adjacent premises. It should be read in conjunction with EPT/PPS/B013 and EPT/PPS/B014.

The majority of electricity companies forming the ESI are affiliated to the Energy Networks Association (ENA) which produce various industry documents governing procedures and risk assessment at power sites.

*Note:* This document incorporates changes agreed (2007) with the ENA, based on risk assessment of hot-sites and allows for less protection equipment to be fitted at off-site-hot end-user locations – See Section 14.

*Note:* Full protection **must** still be fitted for all users within the hot-site HV compound/boundary fence.

2 **Introduction**

At generating stations and transformer substations some form of low resistance connection with the general mass of the earth must be provided. This is to provide a return path for fault currents and for protection purposes. It is sometimes difficult to obtain a really low resistance connection with the general mass of the earth - particularly in areas of high resistivity. Under these conditions, should a heavy earth fault current flow, it is possible for metalwork which forms an earth system (normally assumed to be at earth potential) to acquire an appreciably high voltage, up to several thousands of volts, relative to a remote or ‘true’ earth for periods of up to one second.

This voltage exists for the duration of the fault and is equal to the product of the earth fault current and the impedance of the station earthing system through which it flows. Potential gradients are also produced in the earth in the vicinity of the station.

Areas within which the earth potential may rise above a prescribed limit are known as ‘hot zones’. Any part of such a zone which is outside the boundary of the electricity supply site is referred to as ‘off-site-hot’.

The rise of potential of the earth system under fault conditions does not normally endanger the personnel in the station since it is general practice to bond all non current carrying metalwork within a station to the earth system, and thus all the station metalwork is at the same potential and personnel cannot come into contact with two sets of metalwork of differing potentials.
However, it is necessary to lead telecommunications circuits into generating and transformer stations. These circuits are usually earthed at telephone exchanges and so their conductors should therefore be considered to be at true earth potential. If a heavy earth fault current flows at the station, the consequent rise of earth potential can cause two hazards:

- The risk of electric shock to a telephone user (insulated only lightly from the remotely earthed BT plant) in contact with metalwork connected to the station earth system.

- The risk of damage due to the potential impressed upon the insulation of telephone cables near the station earth system. If this insulation were to fail, in addition to damage to the cable, damage to apparatus at the distant exchange or, more important still, injury to personnel working on the circuits may occur.

Furthermore, should telecommunications circuits require a connection to earth at a generating or transformer station for operational reasons and this connection is near the station earth system then, under fault conditions, its potential may rise with consequent risk of shock to personnel and damage to telecommunications plant remote from the station.

Similarly, telephone lines provided for customers in off-site hot areas may be subject to hazardous voltages for the duration of electricity supply fault current flow if the equipment itself or a person using it is in contact with metalwork at local earth potential, for example radiators, water mains. The risk to such end users has been determined as low and as a consequence the guidelines, as detailed, in Section 14 should be used for off-site-hot situations. In the majority of off-site-hot cases most end users will probably fall within the lower voltage area and not require isolation equipment fitted.

3 Estimation of rise of earth potential

To enable the precautions for safeguarding telecommunications plant against rise of earth potential to be determined, it is necessary to assess the magnitude of the potential rise of the station earth system under fault conditions. Figure 3.1 shows in simplified form the conditions which arise when a fault occurs on a system whose neutral point is earthed at the station.
Figure 3.1 Fault Conditions with Neutral Point Earthed at the Station

An earth fault on a line fed from the station will cause a line fault current \( I_1 \) to flow in the earth unless the power line is provided with a continuous earth-wire or a metallic cable sheath bonded to the earth electrode system, when a return current \( I_2 \) will flow in that path. In this case a smaller current, that is the fault current less the return current \((I_1 - I_2)\), will flow in the earth. The currents \((I_1 - I_2)\) and \( I_2 \) flow back to the system neutral point over the paths shown and it is the earth current \((I_1 - I_2)\) flowing through the impedance \( Z \) of the station earth electrode system, which raises the potential of the system relative to that of true earth. The rise of the earth potential at the station will thus be \((I_1 - I_2) Z \) volts.

Should the fault be at a remote station (not shown on the diagram) the earth electrode current would produce a potential rise in the earthing systems at both stations.

If a fault occurs within the station itself the result is different. Such conditions are shown, in a very simplified form by Figure 3.2. The fault current \( I_3 \), fed from the local transformer(s), does not produce a rise of earth potential as it flows back through the station metalwork to the system neutral point.
Rise of earth potential: limiting conditions

Studies have shown that special precautions against rise of earth potential are normally only required in respect of stations where the rise of station earth potential exceeds 430V rms under the most severe fault conditions. If the rise of earth potential does not exceed 430V rms special precautions are not required.

The limit of 430V rms may be extended to 650V rms if the Electricity Company confirms that all the power lines contributing to the earth fault current from which the rise of earth potential is assessed are in the 'high-reliability' category. High reliability lines are normally those operating at 33kV or greater voltages and controlled by switchgear provided with main protection equipment which will disconnect a fault current in less than 500ms and generally within 200ms.

An ESI site is classed as 'hot' if the rise of earth potential under fault conditions exceeds 430V for normal reliability power lines or 650V for high reliability lines.
5 Zone of rise of earth potential (hot zone)

Prior to 2007, the hot zone was always defined as the entire zone within 100m of the boundary of the station high voltage (HV) compound. This definition assumes:

- The station earth mat covers roughly the same ground space as the HV compound.
- The size of the HV compound does not exceed 200m measured as the length of a diagonal.
- The rise of earth potential does not exceed twice the relevant limit defining a hot site.
- It is not usually necessary to consider the area of the earth mat extended due to metalwork, cable sheaths, etcetera bonded to it (normally these are small or protected by anti-corrosion coatings which reduce the current they can inject into the soil and so limit the rise of earth potential to a very small area in their immediate vicinity). The normal clearances described in BT Memorandum A231 (b), Protection of BT Lines from High Voltage Power Lines, cover this aspect. Please Click Here

The 100m zone may be wholly within or partly outside the station curtilage. In some areas of the country, the hot zone may extend a considerable distance outside of the boundary fence due to the terrain and difficulties in obtaining a low resistance earth at the station. For transmission line towers see Section 16.2.

When the 100m zone extends beyond the HV compound reference to Section 14 of this document should be made, and further data obtained from the site owner.

A typical case is indicated in Figure 5.1.
6 Replacement of the 100 metre zone

Energy Networks Association (ENA) Recommendation S34, A Guide for Assessing the Rise of Earth Potential at Substation Sites, now provides Electricity Companies with a standard procedure for calculating not only the rise of earth potential at hot sites, but also the location of the 650V or 430V contour which marks the boundary of the true hot zone. This can be advantageous for both BT and the electricity company and the zone can be considerably smaller than 100m; conversely it may mean that more protection is required for off-site-hot end users.
The location of the hot zone boundary (the 650V or 430V contour) is calculated and given in terms of a ‘radius’ applied to define a uniform hot zone around the site earth electrode system or boundary fence (see Figure 5.1). This hot zone boundary calculation enables Electricity Companies to produce and provide BT with the plan described in Section 9.

Figure 6.1 Hot Site - Calculated Zone Boundary

The plan showing the hot zone boundary will also show the location of any conductors, such as strip earth electrodes and the non-effectively insulated metallic sheath/ armouring of power cables, that is hessian or jute covered, which might extend the site earth electrode system and therefore the hot zone. As with the ‘100 metre zone’ principle, these conductors are not expected to present any hazard to BT beyond the distance of 100 metres from the site, but between the boundary of the calculated hot zone and the limit of the ‘100 metre zone’ the potential in the ground in the vicinity of these conductors could be hazardous under fault conditions. To take account of such protrusions from the calculated hot zone boundary, a zone of 2 metres either side of these conductors should be drawn and the channel it encloses should be considered hot for a distance of up to 100 metres from the site earth electrode system or boundary fence. (However, if by local negotiation it can be demonstrated that values other than the 2m or 100m exist then these may be adopted).
Protrusions due to power cables or strip earth electrodes cannot occur at sites where the hot zone radius exceeds 100 metres.

Effectively insulated power cables (for example polyethylene sheathed) are not expected to present a hazard and the normal separations given in Memorandum "W:\219\A231(b)\A231.pdf should be used.

The calculation of a hot zone boundary is an onerous task and Electricity Companies may be reluctant to do this unless there is some definite advantage in doing so, for example avoiding the costs of altering plant or providing protection. With the introduction of Risk Assessment methods for determining when isolation equipment is required within hot-zones and the relative ease with which computer modelling can calculate zones there is less reluctance to provide detailed mapping of such areas.

7 Hot site register

As operators of the power system the responsibility for calculation of the value of rise of earth potential rests with the ESI. Communication Providers and Openreach staff may require this information either because the ESI have requested the provision of telecommunication circuits to the site or because Openreach plant exists in close proximity to it. Openreach expects BT and other Communications Providers to inform them which sites that service is being provided to are hot-sites.

Each Electricity Company in England, Scotland, Wales and Northern Ireland is responsible for compiling and maintaining a register of hot sites and graciously providing a copy to to Openreach Safety Services (eddie.connell@openreach.co.uk). Ideally, the registers should be updated every 12 months with all amendments highlighted. Additionally, ENA will assemble a national list of contacts accessible via http://www.energynetworks.org/roep/index.asp

Note: Not all electricity supply companies are part of ENA, so will not centralise their information at a national level.

Each register will list the name, operating voltage and address/map reference of all existing (or firmly proposed) generation/transmission, grid and primary substations which have been classified as hot. These sites operate exclusively at high voltage. It is not intended to include HV / LV (11kV/415V) ground or pole mounted transformers in the register (see Section 13.1).

The registers will also identify exceptional sites where the hot zone boundary is expected to exceed 100 metres (e.g. parts of Wales, Scotland, most windfarms)

Note: Prior to working at an electricity station, confirmation should be sought as to the status of the site (hot or cold). If no information can be obtained from the
power company as regards the site status, then it must be assumed to be hot.

8  **Action to be taken on receipt of register(s) and enquiries of electricity companies**

The hot site registers which local Openreach, BT or other CPs offices receive should coincide with the national BT & Openreach records and merely confirm the status and location of hot sites. However, they will inevitably identify a number of hot sites which Openreach had previously regarded as cold, or had otherwise been unaware of, and exceptionally those sites where Openreach were unaware that the hot zone boundary might exceed 100 metres.

No action need be taken at hot sites which have telecom services already installed in accordance with the ‘100 metre zone’ rule. However, for those existing sites whose registers may newly identify to Openreach as being hot and for all future sites the procedure described below will apply:

a. A ‘100 metre zone’ should be assumed initially to determine the amount of telecom plant likely to be affected.

b. Where there is minimal or no plant in the vicinity of a site and it is a simple matter to conform with the ‘100 metre zone’ principle, as before, then the measures described in EPT/PPS/B013 should be taken accordingly. At such a site the Electricity Company should not be asked to calculate the extent of the actual hot zone.

c. Where there is a considerable amount of telecom plant within the ‘100 metre zone’ of a site, or where private customers are affected or where, for other reasons, the true calculation of the hot zone boundary might bring significant benefit to BT, the Electricity Company should be contacted, using the standard letter shown in Appendix 1, to provide a calculated hot zone ‘radius’. This calculation should show the full extent of the hot zone (430V or 650V) and also the intermediate zone (1150V or 1700V respectively). See Figures 12.2 – 12.4.

d. For the sites where Registers may identify or suggest the existence of a hot zone of greater than 100 metres, and where a calculated zone of greater than 100 metres is not already in use by BT, the Electricity Company should be contacted to provide a calculated hot zone radius and intermediate zone, again using the standard letter.

In response to the standard letter the Electricity Company will provide BT with the following information.

- Confirmation of the site classification, that is hot or cold.
The appropriate limiting voltage used for the hot site and zone classification, that is 430V or 650V.

The maximum assessed present, or foreseeable, rise of earth potential that may be experienced.

The voltage contour for the intermediate zone, as defined in ENA document ETR 128 (1150V or 1700V depending on zone classification)

If the site is declared, or is likely to be assessed, as a present or future hot site, a plan to a scale of not less than 1-2500, should be provided showing details of hot zone, intermediate zone and site boundary. The plan should also show the location of any known buried conductors connected to the main earthing of the site and which could function as part of the earth electrode system including the non-effectively insulated metallic sheath/armour of power cables, that extended for a distance of 100 metres beyond the site boundary fence or up to the extremity of the hot zone, whichever is the greater. The Electricity Company should, as of 2007, always supply the contours of the area according to ETR 128. The only instances they may not do this is when the maximum expected ROEP is less than the intermediate zone; in this instance they will only provide the 430/650V contour or state that 100m applies.

If the reply to the letter confirms that the site is cold, only the precautions set out in EPT/PPS/B013 Sections 2 and 5 should be observed. If, however, the site is declared hot then, in addition to the precautions set out in EPT/PPS/B013 Sections 3 and 6, the special precautions for hot sites described in EPT/PPS/B013 Sections 4 and 7 should be adopted.

Replies from the ESI giving a site’s earth potential rise and other information should be retained for the life of the ESI installation or until superseded.

*Figure 8.1* shows a flowchart for the procedures described in this paragraph.
Figure 8.1 Action to be Taken on Receipt of Registers from Electricity Companies

Note: [1] N = minimal or no plant, no private end users
Y = considerable or private end users
9 Protection at construction sites of large generating stations

Large generating stations take many years to construct and bring into operation. The plant may be brought into service over a period while it is brought up to its full generating capacity. Hence contractors may be on site for a long period and may remain on site after the station is working for completion of ancillary works.

Thus, if the rise of earth potential of the ESI station is above prescribed limits protection may be necessary on contractors’ as well as ESI circuits. When a site is declared hot, all users within the boundary fence of the site should be considered hot.

10 Records

The procedure for dealing with rise of earth potential will rely for their efficient operation much more than on the accurate recording of hot zone boundaries. The ‘100 metre zone’ which has been extensively used by external planners should now be replaced by zones (as outlined in this document) of various sizes which will need to be carefully recorded by Openreach. The extent of these zones will be provided by the electricity company.

The uncertainty of where the calculated hot zone boundary may be at a given site will not affect the safety of installation, construction or maintenance staff if a thorough application of the correct protective measures has been carried out and the proper working procedures are observed. However, if field staff working in the vicinity of an Electricity Company site are in doubt they must be able to contact their supervising officer or some other nominated officer who can refer to the hot site register/plan for clarification.

11 Liaison officers

It is recommended that a central liaison point for hot site information and guidance on procedures is established within Openreach and also with all Communications Providers. Currently this is Eddie Connell, Openreach Safety Services. eddie.connell@openreach.co.uk

12 Responsibility for costs

The responsibility for expenditure by either party for the work involved in achieving the necessary protection of Openreach and CP plant and personnel
in the vicinity of Electricity Stations will generally rest with the established second corner.

Where the second comer cannot be readily identified, it has been agreed that responsibility for costs will be split on a 50/50 basis. In some instances Openreach may pass costs for isolation equipment to the Communications Provider, who may in turn recover some costs from the end user – this area is still being negotiated.

However, in the event of the hot zone boundary being greater than 100 metres, the cost of protection work within 100 metres of the hot site earth electrode will be borne as usual by the second comer, but where Openreach and the CP is a second comer, the liability for the cost of work involved in protecting plant beyond 100 metres will be agreed locally, with the cost of any work carried out by the ESI to reduce substation rise of earth potential being recognised as contributing towards the necessary protection measures. It is intended that any local agreement should compensate for the particular difficulties which large hot zones present Openreach, for example the increased protection and maintenance costs.

In all cases where the Electricity Company is the second comer all protection costs shall be borne by the Electricity Company.

*Figure 12.1* illustrates the principles described above.

a. Sites where the Hot Zone is <100m

![Diagram of EC Site Boundary, Electricity Station, Hot Zone Radius <100m, Protection costs within the hot zone borne by Second Comer]

b. Sites where the Hot Zone is >100m
Figure 12.1 Responsibility for Protection Costs

With the revised boundaries based on ENA Document ETR 128, the following diagrams show when protection (isolation & links) is required:

**Caution:** Full Hot-site working rules apply when working anywhere within the ESI site and the intermediate zone. In the outer zone, outside of the ESI site caution should be exercised as per Section 14 of this document.

Figure 12.2 Example of voltage contour boundaries outside of boundary fence
13 Situations of close approach

13.1 Exchanges and repeater stations near ESI stations

These installations should be located sufficiently apart to ensure that the exchange or repeater station earth will not be adversely affected by the most severe rise of earth potential likely to be experienced at the generating or transformer station. Minimum separations to be observed are as follows:

a. For stations operating at 132kV or higher voltage a minimum separation of 200m will be required between the boundary fences of the power and telecommunications installations. If the earth electrode system of either installation should extend beyond its boundary fence
in the direction of the other plant the 200m separation must be maintained between the extended earth electrode system, and the boundary fence or earth electrode system, whichever is the nearer, of the other installation.

b. For stations, not within the scope of Section 13.1, operating at a voltage of less than 132kV a minimum separation of 50m will be required, measured as in (a) above.

13.2 Distribution substations (11kV/415V)

13.2.1 General

These substations are numerous and contain 11kV/LV distribution transformers which are either pole or ground mounted.

They will not be included on the Hot Site registers as there are too many of them to be sensibly recorded, and the following procedures that have been agreed for the protection of Openreach plant and personnel in the vicinity of these substations make their registration unnecessary.

The various ways in which power faults can develop and produce a dangerous rise of earth potential at these substations are far fewer than at grid or primary HV/HV substations. Only an earth fault on the HV, 11kV, side of the transformer can cause a local rise of earth potential in excess of 430V ac. In urban areas, the connection on the 11kV side is generally cabled, which limits earth faults to insulation failures - a very rare occurrence. In rural areas, exposed 11kV connections on poles do increase the likelihood of faults developing at these transformers, although in general the fault rate is still low.

Therefore, with two exceptions, it has been agreed that at 11kV/LV distribution transformers the danger presented by possible rise of earth potential is negligible and no protection measures above the normal requirements of BT Memoranda A231 (b) and A80 (e) need be applied. The two exceptions where the danger cannot be considered negligible concern the proximity of telephone exchanges and repeater stations and, a set of special cases.

13.2.2 Telephone exchanges and repeater stations

The concentration of Openreach, BT, CP plant and personnel at telephone exchanges (including repeater stations) increases the risk of danger associated with rise of earth potential from HV/LV distribution substations. The increased level of risk cannot be ignored and the following precautions should be taken to ensure that an adequate separation is maintained between the earthing systems of a distribution transformer and an adjacent exchange:
a. In the first instance, BT should avoid siting exchanges within 10 metres of a pole or ground mounted transformer.

b. Where such a separation is not feasible that local Electricity Company can be contacted, using the standard letter, to establish whether the site is hot and if so whether the position of the calculated hot zone boundary may still permit the siting of the exchange, that is the hot zone boundary will not encompass any part of the exchange earthing system.

c. If it is known that the transformer is and is likely to remain cold then a minimum distance of 2 metres should separate the HV earth electrode and the exchange earth.

BT accepts a minimum separating distance of 6 metres between its own exchange earth electrode and the HV earth electrode of a hot distribution transformer (technical conditions included in the wayleaves and lease agreements drawn up when Electricity Company transformers are to be sited on BT property). The 10 metre figure which is to be adopted as the separating distance between the BT exchange (boundary fence) and the Electricity Company transformer itself is intended to ensure that the 6 metre separation between earths is maintained, that is it assumes that the HV earth electrode does not extend more than 4 metres from the pole or ground mounted transformer and similarly that the BT exchange earth does not extend beyond the boundary fence (see Figure 13.1).

Conversely, when an Electricity Company plans the installation of an HV/LV transformer within 10 metres of a BT exchange, the Company will provide BT with the same information normally requested in the standard letter. With this information BT will be able to advise the Company of whether there is adequate separation between the exchange earthing system and their HV/LV transformer to permit its installation.
13.2.3 Special cases

Although in general none of the usual hot zone protection measures (for example no joints, BT earths, distribution points or cabinets etcetera) need be taken around HV/LV distribution transformers, there are a number of special cases where, as with the proximity of exchanges, the risk of electrical hazard cannot be considered negligible.

There include:

- Where there is a local knowledge or history of power problems or incidents associated with these substations.
- Exposed or vulnerable sites which are fed by overhead 11kV lines.
- Sites which otherwise give rise to local concern.

In any of these circumstances, a 10 metre hot zone should be applied in the first instance and full protection measures adopted as described in EPT/PPS/B013. However, where there may be benefit in knowing the location of the calculated hot zone boundary, then the Electricity Company can be contacted using the standard letter (see Appendix 1).
14 **Customers’ premises within the hot zone of ESI stations**

No special requirements are needed for providing telephone service to premises in the vicinity of Electricity Stations declared as cold for the present and for the foreseeable future. For confirmed hot sites and future hot sites the methods indicated in EPT/PPS/B013 Section 15 should be applied.

In the event of customers being affected by a change of electricity site status from cold to hot, protection must be ultimately provided for the telecommunications service to continue to be supplied to the customers’ premises. These cases must be dealt with sympathetically, but in no circumstances can dates be promised or undertakings be given.

The Electricity Company may suggest the protection of nearby customers’ premises by either:

- Extending the Electricity Station hot zone protection to include the customers’ premises, and serving the customers’ telephone needs via the station telecommunications room, or
- By provision of a drainage electrode system connected to a remote earth electrode system.

In either case the Electricity Company should be asked to supply details of the proposal. This is to ensure that the people dealing with the case may be advised of any additional enquiries that are required specifically for telecommunications considerations. Hopefully this will ensure that consequential difficulties are not overlooked.

Using the Risk Assessment document agreed with the ENA, ETR 128, means the need for the fitting of isolators to premises outside of the ESI boundary fence is lessened to those areas above 1150V or 1700V depending on the circuit reliability (430V or 650V respectively). See figures 12.2 – 12.4. The equipment that an end-user uses should be able to safely survive at voltages below these risk limits (based on tests performed for ENA and adherence to electrical standards). The risk also assumes the end-user is not in direct contact with bare telephony wires or any other part of the network. For Openreach engineers, the risk assessment assumes the time spent working within such an area is kept to a minimum, but also that insulated tools and minimal bare wire contact is made, i.e. avoid working in wet conditions, sit/kneel on dry plastic matting, etc.

15 **Substations on BT property**

Under circumstances where the ESI have requested space in BT premises for the siting of substations the following special technical conditions will apply:
a. The rise of earth potential of the substation shall not exceed 430V. The fault current may be limited by neutral earthing impedances at the feeding substation or other means if necessary to achieve this criterion.

b. During construction, as large a separation as practicable should be allowed between ESI and BT earth electrode systems. If the substation is connected with a Protective Multiple Earthing (PME) distribution system which does not exclusively supply BT, or is fed by power lines protected by means of arc suppression coils, the ESI will bear the cost of providing an independent exchange earthing system and protective circuit breakers if necessary to prevent noise interference on Openreach lines.

In cases where the high voltage earth system is to be bonded to the exchange main earth bar, it is not necessary to achieve a large separation of the two earth electrodes.

c. Openreach circuits which serve the substation itself should be terminated on isolating links, but further isolation equipment is not required. No isolating equipment, isolating links or special precautions need be applied to other Openreach circuits which terminate in the shared premises excepting the normal segregation between ESI and Openreach cables required by BT Memorandum A231 (b).

16 Underground Openreach cables in the vicinity of ESI stations

16.1 Metallic sheathed BT cables

Where a metallic-sheathed Openreach cable, located within the hot zone, passes within 6 metres of any metalwork forming part of, or connected to, the station earthing system (pipes, steelwork cables, earthing tapes, etcetera) it shall be replaced by a cable with a polyethylene sheath.

16.2 Proximities between metal power line towers and Openreach underground plant

To prevent risk of injury to personnel or of damage to Openreach lead-sheathed cables, or underground repeater equipment, by a rise of earth potential resulting from a fault on an adjacent metal tower it is important that there should be adequate separation as described below.
16.2.1 New situations

If a proposed 132kV or higher voltage line on metal towers has points where it will cross or approach closer than 10 metres to Openreach underground lead sheathed cables, or to underground repeater equipment, the statutory notice duty should be advised requesting that a covering letter be associated with any letter of approval, and that the covering letter should quote the location(s) of the point(s) concerned and should inform the Company that a further condition of the Openreach approval is that the towers should be placed at a minimum separation of 10 metres from the Openreach underground plant. While polyethylene sheathed or polyethylene protected cables are excluded from this requirement, the requirement must be observed in respect of local distribution cable flexibility points such as cabinets and with underground repeater equipment associated with MU and CJ cables. These are additional to the requirements of A231 (b) and A80 (e).

16.2.2 Existing situations

If a site is found where a separation of less than 10 metres exists between ESI metal towers and Openreach lead-sheathed cables etcetera as specified in Section 16.2.1 then the situation should be rectified at the earliest opportunity in compliance with Section 16.2.1. If the first comer cannot readily be identified then BT should pay for all correction work.

17 Enquiries

Enquiries about this document should be directed to the Author:

18 Appendix 1- Sample Letter

Click Here to Link to Sample Letter in Word
Please Click Here

19 Appendix 2 – ENA Report ETR 128

Please Click Here to link to ENA Report ETR 128 detailing the risk assessment process for working within hot-zones.
Appendix 3 - Memorandum A231(b)

Please Click Here to link to Memorandum A231(b)