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TELECOMMUNICATIONS LINE ISOLATION INSTALLATION AT NEW SUBSTATIONS

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PURPOSE AND SCOPE

The guidance in this document is for the installation of Line Isolation Units (LIU's) on copper provided telecommunications services originating from an off site telephone exchange. LIU's are required to provide electrical safety to National Grid and the telecommunications provider staff under rise of earth potential conditions at hot sites.

To ensure that all relevant safety standards are met and there is consistent installation and equipment practice between sites guidance is provided for the infrastructure requirements for an installation. The guidance does not provide detailed designs for an installation, as this will vary from site to site.

Requirements in this document are applicable to installations at new substation sites only; they apply during the whole life cycle of the substation from the start of the construction and until decommissioning. This includes site construction Portacabins if they are on site when the power system becomes live.

PART 1 – GUIDANCE

1 INFRASTRUCTURE REQUIREMENTS

During the design phase for a new substation, provision of exchange line telecommunications services will be specified, typically these services will be provided by BT although other providers may exist in the future. The guidance in this document refers to services delivered over copper cables. Services delivered to site by optical fibre cables are not subject to the requirements of this document; however it should be noted that blown fibre installations shall not use metallic ducts or ducts coated with conductive material.

1.1 Rise of Earth Potential and Hot Cables

Under power system fault conditions there can be a large flow of current to earth creating a local rise in earth potential. Depending on location and ground conditions the rise of earth potential will be between several hundred volts to several thousand volts. Metallic connections to the site from a remote location will be at true earth potential. Hence there will be a potential difference between the substation known as the Hot Site and the remote connection.

Telecommunication cables originating from a local telephone exchange should therefore be considered as hot and subject to a Rise of Earth Potential (RoEP). Cables up to the line isolation units are hot cables and special installation requirements and precautions are required.

ITU(T) K33 defines the hot site threshold as being a rise of earth potential above 650 V for high reliability circuits. The area around the substation where the RoEP is above 650 V is known as the hot zone. The extent of the hot zone will be determined by a substation survey that will define and plot RoEP contours around the site. (Survey data is held in an Excel spreadsheet on the S: drive at NGT House, Warwick)

All National Grid substations for the purposes of telecommunications provision shall be considered hot sites. Although some sites may have a predicted rise of earth potential below 650 V, during the lifetime of the substation changes to the earth mat and its characteristics or the addition of extra plant at the site may change the RoEP to bring the site above the 650 V threshold.

1.2 Requirement for Exchange Line Services

Local exchange lines will be used for a variety of administrative uses at a site giving diversity from services provided over the operational telecommunications network and to provide services to other users collocated at a substation site for example DNO's, Environment Centres and contractors.

The service requirements differ with each site; typical requirements are listed in Appendix A. Included in the list are services for contractors that may be working on site constructing new facilities after the substation has entered service. Although contractor services may not be required for some time after a substation is commissioned their requirements are included so that the space and infrastructure are in place for additional Line Isolation equipment to be installed when required. This will ensure that additional LIU's are fully integrated into the base installation rather than being ad-hoc because there is not sufficient space available to install them. But more importantly it will ensure that LIU's installations added at a later date will meet the safety requirements.

The overall requirement for Line Isolation Units for all exchange line services varies between 8 and 14 depending on the size of site and number of users see Appendix A for typical requirements at different sites.

1.3 Types of Service Available

A list of the line isolation units available from BT is included in Appendix B. They range from standard 2 wire exchange line PSTN services for telephone and modem data services such as Fax, these will be the most common, to ISDN2 and ADSL data services.

Operational data services which require a 4 wire connection will normally be provided over the operational telecom network which will be delivered to site by optical fibre and therefore not require line isolation. If there is a requirement for a BT provided 4 wire service the line isolation provided will normally be a National Grid PSI 896 isolation transformer.

A drawing showing typical services to site is contained in Appendix C.

1.4 Outlet Cable Presentation

Delivery of the telecommunications circuits to the substation will be on a multi-pair copper cable known as an outlet cable. This cable shall have no metallic armouring or any other metallic components other than the copper conductors. It is usual for BT to install a standard armoured cable up to the boundary of the hot zone where it is jointed to an un-armoured cable crossing the hot zone boundary.

The outlet cable shall be routed in a dedicated duct up to the point in the telecommunications room where the isolating links are fitted. From the duct the outlet cable shall be routed adjacent to the isolating links. The multi-pair cable shall be stripped back and individual pairs in the cable insulated with red PVC sleeving with a minimum thickness of 0.5mm and a minimum dielectric strength of 25 kV/mm to IEC 684-3-100. At the breakout point the individual sheathed pairs shall be housed in suitable sized trunking.

The number of pairs required in the outlet cable will depend on the size and requirements of the substation. It is suggested that a minimum of 20 pairs shall be installed at small sites and 30 pairs at large sites. In any case the number of pairs installed shall be at least double the requirement envisaged. This allows for faulty pairs and unforeseen future usage.

Note: BT documentation refers to the cable delivering services as an outlet cable so the term has been used here. It is also common for the cable to be referred to as an 'Inlet Cable'.

1.5 Isolating Links

Isolating links provide a physical means of isolating the hot outlet cable so that work can be safely completed on hot cabling up to the LIU. Each sleeved 2 wire pair from the outlet cable shall be connected directly to BT isolating links 6E, from the isolating links each pair shall be connected directly to an LIU.

Each isolating link shall be labelled with the telephone number and circuit designation assigned by BT.

1.6 Insulated Distribution Box

It has been common practice to have an insulated distribution box in between the isolating links and the LIUs so as individual circuits can be patched between incoming line and LIU should for example a pair become faulty. In order to maintain safety when working on the distribution box all isolating links should be removed. However this has not usually been done since some circuits could be carrying operational tele-protection data and therefore requires a formal outage to enable links to be removed.

To maintain a safe installation all new sites will have a connection made **directly** from the isolating links to the LIU with no intervening distribution box. This will enable individual circuits to be safely worked on by removing the isolating link for that service.

1.7 LIU Installation

The LIU generally consists of 2 circuit boards, hot and cold, housed in an ABS box with a lid. LIU's are primarily designed to be wall mounted or mounted onto a wallboard. The hot side of the LIU is line powered from the BT exchange. The cold side is locally powered. Optical fibre connections between the hot and cold side of the LIU provided the electrical isolation. The units are tested to 20 kV and rated at 10 kV.

The LIU's and trunking should be mounted on a Unistrut framework mounted to the wall. Appendix D drawing 4 gives an example of the framework with positioning dimensions applicable at the time of writing. At the time of installation the sizes of various components should be checked and the positioning of the framework adjusted if necessary.

Each design of LIU can be a different size depending on the type used, therefore a mixture of LIU's in an installation do not lend themselves to be easily mounted on a frame. If required straps can be mounted between the horizontal Unistrut members to accommodate different size units. The design authority for the LIU's rests with BT and although there has been some standardisation in size of each type of LIU there is no guarantee that the size and mounting method won't change with later models.

Irrespective of the number of LIU's to be initially installed, a sufficient number of spare channel nuts (zebedee nuts) should be inserted into the channels to allow the framework to

be fully populated. They may not be readily available at a later date when additional LIU's are installed.

The LIU's should be vertically mounted on to the framework so as the cable glands on the LIU are adjacent to the hot and cold trunking simplifying the installation.

For standard 2-wire telephony circuits LIU 3D shall be used. This unit is compatible with telephone, modem and Ericson PAX's.

Note: the requirement for an LIU 3D must be specified on the BT order for the service otherwise other LIU's compatible with the service required might be provided.

Adjacent to each LIU on the cold circuit a BT line jack type NT5 shall be installed for test purposes. Local wiring shall be connected to the Krone strip on the front plate of the line jack.

Diagrams of the overall installation are shown in Appendix D where the layout for a large and small site are illustrated. Also shown is the layout where LIU's are to be installed at a later date and temporary Junction Boxes (JB) have been used to store the hot cables see section 1.12.

Note: The isolating links only provide isolation when the link is removed, this renders the line out of service for maintenance purposes. With the link in place the circuit is only safe or "cold" after the LIU.

1.8 LIU Cabling

The interface between hot and cold cabling is at the LIU, up to this point hot and cold cables shall be segregated. To ensure segregation of hot and cold cables hot and cold trunking is used. In practice it has been found that 50mm slotted trunking provides adequate space for the cables and allow easy entry and exit of the hot cables.

Trunking should be installed with either mitred or butt joints constructed so as to fully enclose the cable.

1.9 Hot Cables

From the isolating links trunking shall be used to contain the hot cables and keep them segregated from any cold cables. The cabling used shall be BT CW1308 that is sleeved in red PVC or over-sheathed with red PVC to increase the levels of insulation.

The over-sheathing is a separate process where an additional sheath is applied to manufactured cable. Some cable distributors offer an over-sheathing service. The additional sheath should have a wall thickness of at least 0.5 mm, however it is common for this process to have a minimum wall thickness of 1 mm.

1.10 Cold Cables

From the isolated side of the LIU signal cables and power supply cables shall be routed in trunking to maintain segregation from the hot cables and to keep their identity clear.

Cables from the isolated side of the LIU shall be routed via the BT line jack. Cables from the line jack to the LIU shall be routed via the trunking and not run directly to the LIU.

There are no restrictions on the routing of the cables once they are removed from the immediate vicinity of the LIU's other than following normal installation practices. Cold cables from the LIU in CW1308 should be routed in trunking to a Krone junction box which can be used for marshalling or patching.

Telecommunications cables that will be routed around the site will normally be run in steel wire armoured cable such as CW1128. A gland plate should be installed adjacent to the Krone junction box to terminate the armoured cables.

1.11 LIU Power Supplies

LIUs are supplied with the option of 230 V ac or 50 V dc supply. The LIUs are dual powered so either supply can be chosen at the time of installation. Within substations only the 50 V dc option should be used, this can be derived from the station 50 V battery or a local PER providing a 50 V telecommunications supply. This will ensure that public telecommunications services are available at all times.



Each LIU shall have a separate fused supply from a dedicated power distribution box. It is recommended that terminal blocks with a feed-through and fuse disconnect are used so that individual LIU's can be isolated. With this type of terminal block the positive and negative supplies are distributed together. See photograph above for an example power distribution box.

Where appropriate the connection between local power distribution or PER and the LIU distribution box should be armoured cable. The main supply feed to the power distribution box shall be fused at 10 A, this will give adequate discrimination between the main supply fuse and each LIU fuse rated at 500 mA.

On the inside of the lid of the distribution box a label shall be attached with the circuit designation of each fuse together with a fuse rating as shown in the photograph.

The outside of the box shall be labelled 'LIU Power Distribution Box' '50 V dc'

1.12 Temporary Junction Boxes

Line isolation units are supplied by BT under a rental agreement to National Grid. It is therefore not cost effective to install LIU's for each service likely to be required during the substation life cycle.