

ENGINEERING RECOMMENDATION **G.12/2**
CHIEF ENGINEERS' CONFERENCE,
SYSTEM DEVELOPMENT CONSULTANCY GROUP, AUGUST 1982.

THE ELECTRICITY COUNCIL

NATIONAL CODE OF PRACTICE

ON THE

**APPLICATION OF PROTECTIVE
MULTIPLE EARTHING**

TO

**LOW
VOLTAGE NETWORKS**

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AMENDMENTS	
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ENGINEERING RECOMMENDATION G. 12/2

NATIONAL CODE OF PRACTICE ON THE APPLICATION OF PROTECTIVE MULTIPLE EARTHING TO LOW VOLTAGE NETWORKS

1. FOREWORD

This Engineering Recommendation has been revised to take account of:

- i The requirements of the several Multiple Earthing Approvals issued by the Secretary of State in 1983.
- ii The developments in distribution engineering since Engineering Recommendation G12/1 (ERG12/1) was issued in 1975.

2. SCOPE

The Recommendation sets out the requirements which should be adopted when protective multiple earthing (PME) is applied to Area Board's overhead and underground low voltage distribution systems. It constitutes a code of practice which should be followed for PME systems but requires to be supplemented by each Board's own PME code of practice for the detailed engineering and technical requirements of PME application.

3. FORMS OF APPROVAL

This Recommendation is mainly concerned with the application of PME to LV distribution systems. For completeness, reference has also been made to the other forms of Approval issued by the Secretary of State which give permission for the multiple earthing of the neutral of the LV distribution system and the use of a common neutral/earth sheath conductor for the wiring of a consumer's installation. Copies of the standard Approval documents are included as Appendices to this Recommendation.

The Secretary of State has issued to all Area Boards 'blanket' Approvals for multiple earthing of the neutral, for protective multiple earthing and for multiple earthing of street lighting columns under the 1983 conditions, which however, are not retrospective in their application.

Systems which are at present covered by ad hoc or earlier 'blanket' Approvals will continue to be so covered unless they are brought into line with the requirements of the 1983 Approval conditions.

When privately owned transformers, convertors or generating plant supply an installation in such a way that there is no direct connection with the Board's LV system either normally or under alternative supply arrangements there is no necessity for the Board to have an Approval to cover the use of CNE type cables or wiring on the consumer's installation. The consumer would, of course be well advised to comply with the requirements of the PME Approval in the same way as he would do so if his CNE type cable or wiring was connected to the Board's LV system.

3.1 Multiple Earthing of Neutral (MEN)

MEN allows the multiple earthing of the supply neutral conductor of a LV distribution system and consequently permits the permanent interconnection of the supply neutral conductors of different distribution systems. The supply neutral conductor cannot be used to provide protective earthing facilities for consumers unless there is compliance with the PME requirements in addition.

The 'blanket' Approvals issued in 1983 are in the form shown in Appendix 1.

3.2 Multiple Earthing of Neutral (Street Lighting Columns)

This method allows the use of the supply neutral conductor of LV distribution systems for earthing street lights or other street furniture. The technical requirements are generally similar to those for PME.

Where 'blanket' Approvals have been issued to Boards these may be deemed to include the street lighting authority's own cables. It will not be necessary therefore to make individual ad hoc applications where the street lighting authority wish to use the neutral of their distribution and service cables for earthing purposes. This does not apply to the use of CNE type cable (eg single core MICC) for the wiring in street furniture. In such cases an ad hoc earth sheathed wiring Approval will be required.

The 'blanket' Approvals issued in 1983 are in the form shown in Appendix 2.

3.3 Protective Multiple Earthing (PME)

PME refers to the technique of using the supply neutral conductor of the LV distribution system to provide protective earthing facilities for consumers. This Approval is shown in Appendix 3.

3.4 Earthed Sheath Return Wiring Installation (ESRW)

If a CNE type cable or wiring is used on all or part of a consumer's installation, an ESRW Approval (Appendix 4), which is based on the current PME conditions, is required. Application for this Approval must be made by the Board to the Secretary of State, giving full details of the installation and the system from which it is supplied. These Approvals are issued on an ad hoc basis, normally only for industrial or commercial installations. If CNE cables are used for distribution purposes only then a Consumer's Distribution Installation using Combined Neutral/Earth Conductors (CCNE) Approval will be more appropriate; see Clause 3.5.

3.5 Consumer's Distribution Installation using Combined Neutral/Earth Conductors (CCNE)

This Approval (Appendix 5) allows the Board to connect to their supply system the consumer's multiple earthed neutral distribution system when the consumer's system meets the same technical standard as the Boards are required to meet on a PME system. It may cover a CNE cable distribution system, an overhead system or a mixture of systems including mixed CNE and SNE systems but does not cover the use of CNE conductors for complete wiring installations where an ESRW Approval is appropriate (see Clause 3.4). Application for this Approval must be made by the Board to the Secretary of State, giving full details of the installation and the system from which it is supplied. These Approvals are issued on an ad hoc basis, normally only for industrial and commercial installations.

3.6 Outside Broadcast Vehicles

The 1983 PME Approval prohibits, unless otherwise approved by the Secretary of State, a connection between the earth continuity conductor of a caravan and the neutral of the supply system. The Secretary of State has agreed that outside broadcast vehicles operated by the British Broadcasting Company or the Independent Broadcasting Authority may be provided with a PME earthing terminal subject to the terms of the Approval shown in Appendix 6.

4. CHANGES AND ADDITIONS SINCE THE ISSUE OF ER G12/1

Since ER G12/1 was published in June 1975 additional Approvals have been issued to cover a consumer's distribution installation using combined neutral/earth conductors (Clause 3.5) and the use of PME earthing terminals by outside broadcast caravans (Clause 3.6). These Approvals have been re-written and re-issued and the opportunity has been taken to widen the scope of the latter Approval to allow connection direct from a Board's own works.

The 1974 Approvals have also been re-written in a more readable form, now becoming the 1983 Approvals, and the opportunity has been taken to incorporate a number of minor modifications.

The modifications are:-

- a Low voltage is now defined as a voltage normally exceeding 50 volts but not exceeding 1000 volts.
- b The definition of service line now includes the previous definition of a multi-service line and covers an electric line supplying up to four consumers occupying adjacent premises.
- c Sizes of Bonding Conductors are specified in a table which relates their minimum size to the size of associated neutral connection between the cut-out and the metering equipment.
- d The Approval to the use of half-section neutrals has been extended to cover two phase three wire distributing mains including systems using two phases of a three phase system.

A copy of the covering letter from the Department of Energy to the Electricity Boards when issuing the Approvals is included as Appendix 7 to this Recommendation.

5. APPLICATION

The 1983 Approval encourages the application of PME to both new and existing distribution systems in the same way as the 1974 Approval and in particular assists in the integration of CNE and separate neutral and earth (SNE) cables.

It is not necessary to apply PME either to all the distributors fed from a substation or to the entire length of an individual distributor. Neither is it necessary for all the consumers on a distributor to which PME has been applied to make use of the earthing facility. Those with satisfactory sheath return earthing may retain this method. Although this type of 'mixed' system is permitted it is desirable that where a network is converted every consumer's installation should make use of the PME facility. In the case of a consumer being unwilling to make use of the facility offered then the existing earthing arrangements should remain if satisfactory. Otherwise the consumer should be advised to fit a residual current operated device to give earth-fault protection.

6. SUBSTATION METALWORK (HIGH VOLTAGE) EARTH

The metalwork associated with the high voltage system including the transformer tank shall be connected to an earth electrode or system of electrodes, the value of which should be such that the high voltage protection will operate in the event of a breakdown between either the HV windings of the transformer or the HV line and the supporting metalwork at the transformer position. This does not apply to a high voltage system earthed through a continuously rated arc suppression coil equipped with fault alarm facilities.

7. SUBSTATION NEUTRAL CONDUCTOR (LOW VOLTAGE) EARTH

An earth electrode or system of electrodes shall always be installed at or near the substation for the purpose of earthing the LV neutral and it is recommended that the value should not normally exceed 40 ohms. The functions of this earth connection include protection in the event of an HV/LV interwinding fault.

If required for testing purposes, disconnection facilities in the form of substantial bolted links may be provided in the neutral earth lead at the substation.

8. COMBINATION OF HV AND LV EARTHS

The HV and LV earths may be combined where their combined overall resistance to earth would not exceed 1 ohm. This includes any contribution which may be obtained from the HV and LV cable sheaths which are connected to the earthed metal of the substation equipment and from any other electrodes which are connected to the neutral of the LV network. An overall resistance of 1 ohm may be assumed if more than 800 metres of electrically continuous non-insulated metallic sheathed HV and/or LV cable, laid direct in soil of average resistivity, is included in the earthing system. This assumption will not apply in the case of cables with insulated sheaths or where the sheath is not in contact with earth. Hessian or jute serving is not considered to form an insulated sheath.

Where the combined resistance exceeds 1 ohm, the HV metalwork earth and LV earth must be kept separate. The LV neutral should be earthed to a separate earth electrode or electrode system at or near the substation with a resistance to earth not normally exceeding 40 ohms and being outside the resistance area of the HV metalwork earth.

Several arrangements of HV metalwork and LV earthing arise in practice. Typical methods of bonding and segregating are shown diagrammatically in Figures 1 to 5.

8.1 Pole Type Substation

Pole Transformer Feeding Overhead Line (Fig 1)

Segregation of the neutral earth normally will be necessary. This can most conveniently be effected by installing the neutral earth electrode at the first LV pole, a span length away from the transformer pole. If, however, this is not practical, the neutral should be connected by means of an insulated wire laid underground to a suitable earth electrode outside the resistance area of the HV metalwork earth in an arrangement similar to that shown in Fig 2.

Pole Transformer Feeding Underground Cable (Fig 2)

Segregation of the neutral earth is only likely to be necessary if less than 800 metres of continuous non-insulated sheathed HV and/or LV cable, laid direct in soil of average resistivity is included in the earthing system. If the combined resistance of the HV metalwork earth, cable sheath and earth electrode connected to the neutral is more than 1 ohm segregation is required.

Where segregation of the neutral earth is necessary, this will normally be achieved by connecting the HV metalwork and LV neutral to their respective earth electrodes by means of insulated wire, in accordance with Fig 2. Alternatively the neutral may be earthed at a suitable joint located as close as practicable to the substation but outside the resistance area of the HV metalwork earth.

8.2 Ground Mounted Substation

Overall Earth Resistance 1 Ohm or Less (Fig 3)

Where the overall earth resistance is 1 ohm or less the HV and LV metalwork, cable sheaths and LV neutral should all be bonded together in accordance with Fig 3. Modern LV feeder pillars and fused cabinets usually have a combined neutral/earth bar and therefore will not be two separate bars as shown in Figures 3 and 4.

Overall Earth Resistance Greater Than 1 Ohm (Fig 4)

If the earth resistance of the cable sheaths and earth electrodes combined would exceed 1 ohm the HV metalwork earth must be segregated from the LV neutral earth.

This may be achieved by keeping the HV and LV cables well apart and in cases where the separating distance is less than 3 metres by wrapping any non-insulated sheathed HV cables with non-hygroscopic insulating tape.

Where LV cables with non-insulated sheaths are used between the transformer and feeder pillar or fuseboard, it is necessary to provide insulation for the sheaths and armouring by the use of an insulating gland or similar means, at the transformer LV cable box. The metallic shell of the feeder pillar must also be segregated from all non-insulated sheathed cables.

All LV cables with non-insulated sheaths should also be wrapped with non-hygroscopic insulation tape where they are within 3 metres of the foundation plinths of any equipment connected to the HV earth electrode.

In the case of a fuse cabinet bolted directly to the transformer (Fig 5), the cabinet itself will inevitably be connected to the HV metalwork earth. The neutral busbar, earth bar if any, and the sheath and armouring of the LV distribution cables will be insulated from the HV metalwork earth

and will be connected to the neutral earth electrode by PVC insulated cable. This electrode must be installed at a distance of at least 3 metres away from any other metalwork or cable associated with the HV system. Alternatively, the neutral may be earthed at a suitable joint located as close as practicable to the substation but outside the resistance area of the HV metalwork earth.

9. EARTHING OF SUPPLY NEUTRAL CONDUCTOR OF LV DISTRIBUTORS

In addition to the LV neutral earth at or near the substation it is necessary to connect the supply neutral conductor at other points either to earth electrodes or to the supply neutral conductor of another distributing main. This connection is required on each distributor or branch thereof to which a service line with a PME earthing terminal is to be connected and must not be nearer to the substation than the most remote service having an earthing terminal connected to the neutral. The connection may be made at a service termination and if necessary an earth electrode installed, but neither the consumer's earthed metalwork nor gas and water service pipes may be used for this purpose. Where this method of earthing the neutral is adopted, the supply neutral conductor of the service shall have a minimum cross section of 22 sq mm aluminium or 16 sq mm (0.0225 sq in) copper: this does not apply to street lighting fed from separate street lighting mains.

On overhead and new underground cable networks, it will normally be advantageous to make the earth connection at the end of the distributor rather than at the most remote PME service since the facility of PME will then be available to all the consumers on the distributor. On existing underground cable networks it will usually be more economical to make the earth connection at the most remote PME service joint position since earthing at the end of the distributor may require a separate joint and excavation.

Where the neutrals of distributors are interconnected at the normally open points of the phases - as permitted by the MEN Approval (Appendix 1), it will not be necessary to install additional earth electrodes on those distributors. PME facilities may be made available on these distributors providing the requirements of Clauses 12 and 19 in this Recommendation are met.

However, where there are branches off these distributors, earthing facilities may only be offered if additional earth electrodes are connected to the neutral of the branch. These additional connections must be made at points not less remote from the substation than the most remote service line which is to have an earthing terminal connected to the neutral.

In order to achieve the overall resistance of the neutral in compliance with Clause 12, it may be necessary to install additional electrodes along the route of the distributor and these should, as far as possible, be evenly spaced along its length. In any case, additional earth electrodes should be installed at intervals of not more than eight span lengths along the route of an overhead distributor.

10. UNDERGROUND CABLE NETWORKS

CNE cables are now in general use and the 1983 Approval facilitates the integration of these cables with SNE types. Although CNE cables of various types of construction are in use, there are common rules and techniques which should be adopted in their application. Typical applications of CNE cables are included in Figure 6 and these can be extended to include almost any situation providing certain safeguards are taken, particularly with regard to the earthing of the supply neutral conductor of the distributor.

As a general rule it will be necessary to provide an earth electrode at the end of the CNE cable most remote from the distribution substation. The whole of the distributor between the substation and this earth point will then be suitable for PME whether or not all the distributor is made up of CNE cable. However, where the supply neutral conductor of the distributor is permanently interconnected with another supply neutral conductor it will not be necessary to install an additional earth electrode at the end of the CNE cable section.

Existing earth terminals bonded to the sheaths of SNE cables may be retained after the whole or part of the distributor has been converted to PME.

Where a new CNE service or an existing service replaced by CNE cable is connected to an SNE distributor which does not already form part of a PME system, the consumer may be offered PME facilities provided that an earth electrode connected to the neutral is placed at the service joint position, that the necessary bonding is carried out at the consumer's premises in accordance with Clause 19 and the other requirements of the PME Approval are satisfied. Alternatively, some other form of earth fault protection must be provided.

The metallic sheath of an SNE cable laid direct may generally be assumed to be the earth electrode and in this case it is necessary to bond the supply neutral conductor of the distributor to the cable sheath in the service joint. In all cases where a distributor includes both CNE and SNE cables, the sheath of the SNE cable should be connected to the neutral of the CNE cable at the joint position.

Where a section of SNE distributor is replaced by CNE cable, the earthing arrangements of existing consumers transferred to the CNE cable need not necessarily be converted to PME. Where the earthing terminal is connected to the lead sheath or separate earth conductor of the service cable the consumer's installation must be converted to PME unless adequate alternative provisions are made to limit the voltage rise on the consumer's metalwork following a break in the neutral/earth conductor of the CNE cable. Such arrangements include connecting the remote end of the neutral/earth conductor with the neutral conductor of another distributor or to a sufficient length of non-insulated metallic sheathed cable

laid direct in the ground. In all cases the lead sheath or the separate earth conductor of the service cable must be connected to the neutral/earth conductor of the CNE distributor at the joint position.

Where PME is applied to a distributor which consists partly of overhead line and partly of SNE cable, the sheath and armour of the cable should be bonded to the supply neutral conductor at both ends of the cable section.

In all cases where metallic pole boxes are used on PME systems, these should also be bonded to the supply neutral conductor.

11. TYPES OF EARTH ELECTRODES

Where it is necessary to install earth electrodes in order to comply with the 1983 Approval, these should normally consist of driven rods but where this is not appropriate eg sites where rock is close to the surface of the ground, plates or copper conductor may be buried.

If several driven rods are used to form an electrode system the distance between them should not normally be less than 3 metres and in any case not less than the depth to which the rods are driven.

Metallic joint boxes, link disconnecting boxes or non-insulated metallic cable sheaths of SNE cables which are electrically continuous and in direct contact with the general mass of earth for a minimum length of 20 metres may be considered to be earth electrodes. (In appropriate cases the supply neutral conductor of an adjacent network may be used instead of separate earth electrodes.)

12. VALUES OF EARTH ELECTRODE RESISTANCE

It is desirable on any PME system to reduce the HV metalwork and overall LV neutral earth resistances to as low a value as possible, but the extent to which this can be achieved will be governed by technical and economic factors. The following paragraphs summarise the basic parameters:-

- a HV metalwork earth must be of such value as to ensure that the HV protection will operate (Clause 6).
- b Substation LV neutral earth should preferably not exceed 40 ohms (Clause 7).
- c Combined resistance of all LV neutral earth electrodes must not exceed 20 ohms (before the connection of consumers' earthing terminals to the neutral).

The resistance of the earth electrodes at the substation should be measured before being connected to the supply neutral conductor and HV/LV metalwork. Since the combined resistance of the extensive earthing system provided by the neutral electrodes cannot conveniently be measured, the value should be calculated by assuming that the individual resistance values are connected in parallel.

13. TYPE AND SIZE OF EARTH CONNECTIONS

Earthing and bonding connections where buried direct in the ground should preferably be of copper conductor. Where aluminium connections are used both the conductor and the joint to the earth electrode must be adequately protected against corrosion.

The minimum size of earthing and bonding connections shall be as follows, all sizes in items a to h and j referring to copper equivalent conductors:-

a	HV metalwork earth at substation	To suit the short circuit rating of HV systems. Minimum size 16 sq mm.
b	Bonding connections to substation equipment associated with HV system	Ditto
c	Earth leads to neutral earth electrode	16 sq mm
d	Supply neutral conductor of service line where neutral is earthed at service termination	14.1 sq mm (equivalent to 22 sq mm aluminium)
e	Bonding connection between neutral busbar and earth busbar at substation (where applicable).	To be not less than half the current carrying capacity of the largest phase conductor in the distributor cables
f	Bonding connections to link boxes and network feeder pillars (where applicable)	16 sq mm
g	At consumer's premises, connection between service neutral and Board's earthing terminal	16 sq mm or half the size of the Board's neutral meter tail whichever is the larger
h	Connection between sheath of SNE cable and neutral of CNE cable	16 sq mm

- i At consumer's premises, the main equipotential bonding connections between the Board's earthing terminal and all metal structures, metal pipes and other metalwork in accordance with Table 1:-

TABLE 1

Cross Sectional Areas of Board's Neutral Meter Tail (Copper Equivalent)	Minimum Cross Sectional Area Copper Equivalent of Main Equipotential Bonding Connections in Sq mm
35 sq mm or less	10 sq mm
over 35 sq mm but not more than 50 sq mm	16 sq mm
over 50 sq mm but not more than 95 sq mm	25 sq mm
over 95 sq mm but not more than 150 sq mm	35 sq mm
over 150 sq mm	50 sq mm

These minimum sizes apply only to connections required by the PME Approval. Supplementary bonding conductors and circuit protective conductors in the consumer's installation should be of the size specified in the current edition of the Institution of Electrical Engineers (IEE) Wiring Regulations.

- j At street lighting columns and other street furniture, connections between the service neutral, the Board's earthing terminal and any metalwork in electrical contact with the general mass of earth
- 6 sq mm copper equivalent or the size of the neutral conductor whichever is the smaller

14. CARAVAN AND BOAT INSTALLATIONS

The 1983 Approval does not permit the general provision of PME earthing terminals for caravan and boat installations. However, this does not preclude:-

- a A supply being given to an individual caravan or a caravan site from a PME distributing main.
- b A PME earthing terminal being provided for use in permanent buildings on a caravan site such as the site owner's living premises and any bars, shops, or brick built toilet blocks, etc.
- c An ad hoc PME Approval being issued for a specific caravan site or yacht marina, if the distribution is such that the risk of discontinuity of the neutral is very remote. In such cases, the Board must submit to the Secretary of State an individual application giving full details of the proposals, in the same way as for an earthed sheath return wiring system.
- d A PME earthing terminal being provided to a vehicle used by the British Broadcasting Corporation or the Independent Broadcasting Authority for the purpose of outside broadcasts in accordance with the conditions approved by the Secretary of State (see Clause 15)

Except as allowed for in (c) and (d) above, the supply to the caravan should be two wire phase and neutral supplied through residual current operated earth leakage circuit breakers which must be provided by the consumer or site owner (see Figure 9 for the recommended method of giving a supply to a caravan site).

Mobile homes and temporary site offices which are constructed so that a person in contact with the general mass of earth cannot touch any metalwork of the mobile or temporary premises which would be connected to a PME earthing terminal may be treated in the same manner as permanent premises and provided with a PME earthing terminal if the installation complies with the requirements of the PME Approval.

15. OUTSIDE BROADCAST VEHICLES

The Secretary of State has agreed that outside broadcasting vehicles may be provided with a PME earthing terminal subject to the Approval shown in Appendix 6.

This decision was based on the grounds that these vehicles are built and maintained to a high standard, are normally equipped with fault loop testing equipment, are usually surrounded by a heavy rubber mat, and those circuits which can acceptably be protected by an ELCB are so protected. Additionally the vehicles are controlled by technically competent people and before any outside broadcast is arranged the relevant site is surveyed for such matters as electricity supply.

When the broadcasting supply is taken from premises supplied with a PME earthing terminal or from the Board's works which comply with the PME Approval the authority may connect their earth continuity conductor to the supply neutral, provided that one of the following conditions is satisfied:

- either a The chassis of the caravan is effectively connected to earth by means of a metal spike, driven into the earth near the caravan, or by connection to the metal frame of a building or other metalwork near the caravan, which is itself effectively connected to earth;
- or b The electricity supply to the installation in the caravan is given by means of a cable sheathed in metallic braid, that braid and the earth conductor of the cable both being connected to the chassis of the caravan and to effectively earthed metalwork at the premises from which the supply is taken.

It is not necessary to make individual applications for Approval, as the Secretary of State has issued 'blanket' Approval to cover all such installations.

16. HIGH RISE BUILDINGS AND BUILDING COMPLEXES

The 1983 Approval permits the application of PME to the Board's LV distribution systems in high rise buildings and other large building complexes. Certain safeguards have to be taken with regard to the connection of the supply neutral conductor to earth at the extremities of such mains. It is recognised that the provision of an earth electrode could be very difficult or expensive in these situations and the connection of the neutral of the main to any suitable metal piping (other than gas pipes), conduit or other earthed metalwork will meet the requirements of the Approval. It is essential to ensure that such piping or metalwork is electrically continuous, of adequate current carrying capacity and effectively earthed; this may be difficult to prove and a separate earth wire may be a preferable solution. Alternatively, if there are several separate distributing mains, the connection together of the supply neutral conductors at their far ends will satisfy the necessary requirements of the Approval.

Boards may therefore install CNE cables in high rise buildings and building complexes, but particular attention should be paid to the methods adopted in making the neutral connections and their size so as to minimise the risk of an open circuit. Bonding of the gas, water, other services and accessible metallic structures to the supply neutral conductor in individual flats, offices, shops, etc. will be necessary in accordance with Clause 19.2 in addition to the bonding required at the point of entry into the building.

17. INSULATION OF NEUTRAL EARTHING LEADS

Except at ground mounted substations where the overall earth resistance is less than 1 ohm, LV neutral earthing leads shall be insulated with black PVC of minimum thickness 0.8 mm, or equivalent.

18. SUPPLY NEUTRAL CONDUCTOR

The supply neutral conductor in any three phase four wire, two phase three wire or single phase three wire distributor or service must not be less than half the cross sectional area of the phase conductors; two phase three wire systems include two phases of the three phase system.

In the cases of single phase two wire distributors and services the cross-sectional area of the supply neutral conductor must be equal to that of the phase conductor.

In every case where the Board wish to retain a neutral cross-sectional area less than is required by the 1983 Approval as above, an application must be made to the Secretary of State for an ad hoc Approval, each case being treated on its merits. It is unlikely, however, that applications for ad hoc Approvals will be necessary as it is thought that the 1983 Approval covers all appropriate cases.

No fusible cut-out, circuit breaker or switch is to be included in the supply neutral conductor.

In view of the importance of avoiding the possibility of an open circuit in the supply neutral conductor, it is essential to pay particular attention to its integrity through the design, construction, maintenance and operation of the distribution system.

Compression joints or duplicate connectors should be used on overhead lines at all points of connection between copper neutral conductors, eg at section poles and at service connections. Where the supply neutral conductor is aluminium, compression joints only should be used.

On underground cable networks, the design of cables, joints and terminations should be such as to minimise the risk of an open circuit of the neutral.

19. CONSUMER'S INSTALLATIONS - GENERAL

19.1 Earthing Terminal

The Board will provide an earthing terminal connected to the supply neutral conductor at the service position by either a copper conductor with a minimum cross-sectional area as specified in Clause 13 or a cut-out incorporating an integral earthing terminal. Any bolted link between the neutral and the earthing terminal shall be of equivalent cross-sectional area.

The metallic sheath and armouring of underground service cables shall be connected to the earthing terminal, neutral terminal or neutral connector block as appropriate, by means of a copper

conductor of minimum cross-sectional area as specified in Clause 13. The connection to the cable sheath should be made by means of either an earthing clamp complying with the tests specified in BS 951 *Earthing Clamps*, or a substantial sweated lug.

Where service cables with a concentric neutral are used, the concentric neutral and any separate earth conductor (which must be included in the cable) shall be connected to the earthing terminal, neutral terminal or neutral connector block, as appropriate.

19.2 Bonding of Metalwork

The principle of bonding other services and extraneous metalwork is to form an equipotential zone within the consumer's premises. It is essential that the zone is maintained so that, in the unlikely event of a break in the supply neutral, dangerous voltages cannot exist between any two simultaneously accessible conductive parts within the zone.

Water, gas and any other metallic services (except telephonic) must be connected to the earthing terminal either separately or by means of a common main equipotential bonding lead having a minimum cross-sectional area as specified in Clause 13. Any other metallic structures which are or might be expected to come into electrical contact with earth and which are within reach of any exposed non-current carrying metalwork of the consumer's installation should also be connected to the earthing terminal. The connection to the service pipes should be by means of clamps suitable for the pipe diameters and complying with the tests specified in BS 951 and should be made as near as possible to the point of entry of the service into the premises.

In the case of gas services, the connection should always be made to the pipework on the consumer's side of the gas meter (see Figure 8).

If an insulated insert is provided between the incoming service pipe and gas meter, this will result in the incoming service pipe being left unbonded to the neutral but, under normal circumstances this is considered acceptable by the Secretary of State.

Incoming unused gas service pipes should not be bonded but, if such pipes extend well inside the building, the pipe should be insulated in such a way that the insulation cannot readily be removed.

Where doubts arise on the need for bonding particular items of extraneous metalwork the criteria to follow are:-

- a All structural metalwork which is embedded in the earth and is situated such that a person may make simultaneous contact with it and any other exposed metalwork which is to be connected to the earthing terminal must be bonded by a main equipotential bonding lead having a minimum cross-sectional area as specified in Clause 13.
- b Supplementary local bonding connections may sometimes be required to maintain the equipotential zone but, exposed extraneous fixed metalwork within the zone which is not in contact with the earth need not be bonded unless it is likely to come into fortuitous contact with other earthed or bonded metalwork. Bonding connections with cross-sectional areas in accordance with the current edition of the IEE Wiring Regulations are then required.

19.3 British Railways Premises

In the case of supplies to British Railways' premises adjacent to lines electrified on the a.c. 50 Hz single phase system, the bonding of all metallic structures to the earthing terminal includes bonding of the traction return rail, subject to the agreement of the Electricity Board.

It is recognised that under starting current or traction fault conditions, a voltage gradient can appear on the traction return rail which could be impressed on the combined neutral/earth of the supply cable from a PME system, and give rise to unbalanced voltages.

Investigation has shown that such potential differences to earth are normally unlikely to exceed 5 volts and therefore the bonding of the metalwork to the Electricity Board's earthing terminal can be adopted.

In the case of lines electrified on a d.c. system there is normally no deliberate connection to earth and traction rails are not therefore bonded to metallic structures; premises adjacent to such lines may therefore be provided with an earthing terminal.

Individual consideration should be given to the provision of earthing terminals to premises adjacent to those d.c. electrified lines which are normally earthed.

19.4 Street Lighting and Other Street Furniture

a CNE Systems

The 'blanket' Approvals issued to Boards also allow the Street Lighting Authority to use CNE cables for their own distribution system. The internal wiring of the street furniture should consist of separate phase, neutral and circuit protective conductors. Exposed extraneous conductive parts of the street furniture must be bonded to the neutral terminal by a conductor with a cross-sectional area of 6 mm² copper equivalent or the size of the neutral conductor whichever is the smallest. If more than one item is supplied, an earth electrode must be installed at the last or penultimate unit unless the remote end of the neutral is connected to the neutral of another distributor.

b SNE Systems

A private system with BS 6346 cable may be operated as an SNE system supplied from a PME point of supply. Bonding of metalwork in the individual items of street furniture should be in accordance with the current edition of the IEE Wiring Regulations subject to a minimum size of 1.5 sq mm copper equivalent conductor. The steel wire armouring must be of adequate conductivity to act as the circuit protective conductor and should be connected to the earthing terminal.

At the point of supply bonding will be required to comply with Clause 13(i). An additional earth electrode connected to the steel wire armour at the last lamp is recommended if the circuit supplies more than three lamps.

c Bonding of Small Isolated Metal Parts

Small isolated metal parts not likely to come into contact with exposed or extraneous parts or with earth, for example small metallic doors and door frames in concrete units, need not be earthed.

d Earth Electrodes

All earth electrodes installed must comply with Clause 11. It is not permissible to consider metallic street furniture to be earth electrodes.

19.5 Inaccessibility of Earthing Terminal

Until the Board is satisfied that the requirements of Clause 19.2 have been complied with, the earthing terminal should be rendered electrically inaccessible so as to prevent unauthorised connection.

20. CONSUMER'S INSTALLATIONS REQUIRING SPECIAL ATTENTION

Whilst a PME earthing terminal provides a very satisfactory means of protection for the majority of installations there are a number of special situations where the consumer should provide an additional or alternative form of earth-fault protection. The following situations fall into the special categories, but the list is by no means exhaustive and individual situations will need to be considered on their merits.

20.1 Construction Sites

It is usually impractical to comply with the bonding requirements of the PME Approval on construction sites and a PME earthing terminal should not be provided. For large temporary supplies which require their own substation it will usually be possible to provide an earthing terminal connected directly to the transformer neutral. In all other cases the consumer should provide a suitable form of earth-fault protection. Possible solutions include the developer installing a 1:1 isolating transformer of the appropriate rating enabling a separately earthed neutral LV system to be created within the boundaries of the site, or the use of residual current devices.

20.2 Farms, Milking Parlours, etc

A PME earthing terminal may be given provided all extraneous conductive parts are bonded to the earth terminal but, there may be some difficulty in achieving the bonding requirements where remote buildings are involved. When such cases arise consideration should be given to the following measures.

The pipes and metalwork of isolated buildings, whether or not they have an electricity supply, should be segregated from metalwork connected to the PME earthing terminal. Any supplies to such buildings should be controlled by a residual current operated device and the associated earth electrode and protective conductor must also be segregated from any metalwork connected to the PME earthing terminal.

Where segregation is not possible then the alternative of using residual current operated devices for the whole of the installation should be considered or if a dedicated transformer is used to supply the premises then protective neutral bonding (PNB) may be used.

At premises remote from the source small voltage displacements may be detectable on bonded metalwork, in such places as milking parlours, when a PME earthing terminal is used. In such cases a metal grid placed in the floor and connected to the bonded metalwork may be needed.

20.3 Swimming Pools

Supplies to swimming pools, including those at domestic premises, should preferably be separately protected with a high sensitivity residual current operated device. All metalwork and pipes supplying the pool should be connected to an earth-electrode and segregated from the rest of the installation. If segregation is impractical then all metalwork (including metal handrail, pipes and any other exposed metalwork which may be in contact with earth) must be effectively bonded and an additional earth electrode installed. A residual current operated device should then be installed in addition to the PME earthing terminal.

20.4 Sports Pavilions

Remote sports pavilions having PME supplies may present problems due to out of balance conditions, particularly if the service is of an appreciable length. Low values of voltage may appear

on the neutral due to out of balance conditions. No problems will exist if concrete floors have an earth grid bonded to the earthing terminal. However, in the majority of cases the earth grid will not be installed and low levels of voltage could occur between the metalwork which is bonded to the neutral conductor and the general mass of earth causing unpleasant sensations.

If an earth grid cannot be installed the consumer should be advised to install a residual current device and the PME earthing facility should not be provided.

20.5 110 V Centre-Tapped Supplies via an Isolating Transformer

A number of buildings with bar services have a 2 kVA isolating transformer with a 110 V centre-tapped secondary winding to give 55 V to earth. A supply is given via a flexible armoured cable to delivery tankers which are fitted with 1 hp pump motors.

The transformer does not however provide isolation for the centre-tap of the 110 V winding if it is connected to the PME earthing terminal. A form of connection has been agreed as shown in Figure 7. The risk from providing supplies outside the equipotential zone is considered to be slight particularly as the time the tanker will be connected to the supply will be short.

20.6 Quarries

A PME earthing terminal may be provided for the part of the installation associated with permanent buildings, such as offices, provided that there is no interconnection with the earthing arrangements associated with the plant used in the production work of the quarry.

21. CONSUMER'S SERVICE POLARITY TESTING

If the live and neutral conductors are crossed on a PME service, a dangerous situation could arise in that the consumer's metalwork becomes alive at line voltage. In these circumstances the earth in the vicinity of the premises also tends to rise to line voltage and tests intended to establish polarity may be misleading, indicating correct polarity even though it is reversed.

In order to ensure that errors do not occur, it is recommended that the testing procedure is carried out, by the Board, strictly in accordance with Engineering Recommendation G14 (Protective Multiple Earthing: Recommended Principles of Testing to Ensure Correct Polarity.)

22. LABELS AND NOTICES

Area Boards have now generally adopted MEN for the LV distribution system and progressively these networks are being converted to PME. Therefore, there is no need to fix at substations or at the normally open points of the LV systems labels drawing particular attention to special precautions which should be taken to safeguard the integrity of the supply neutral conductor. However, a general direction needs to be issued by Boards to the effect that neutral links should not normally be removed.

Where PME facilities are used by a consumer, a label should be affixed at the service position drawing attention to the fact that the installation is connected to a PME system.

23. USE OF EARTH LEAKAGE CIRCUIT BREAKERS

When consumers wish to provide additional protection or are unable to make use of an earthing terminal provided by the Board they should be advised to install residual current operated devices to provide protection against earth-faults. These units should be installed in accordance with the current IEE Wiring Regulations.

The use of voltage operated earth leakage circuit breakers is not normally recommended due to the difficulties in ensuring that the operating coil is not shorted out and the possibility of multiple operations in adjacent premises.

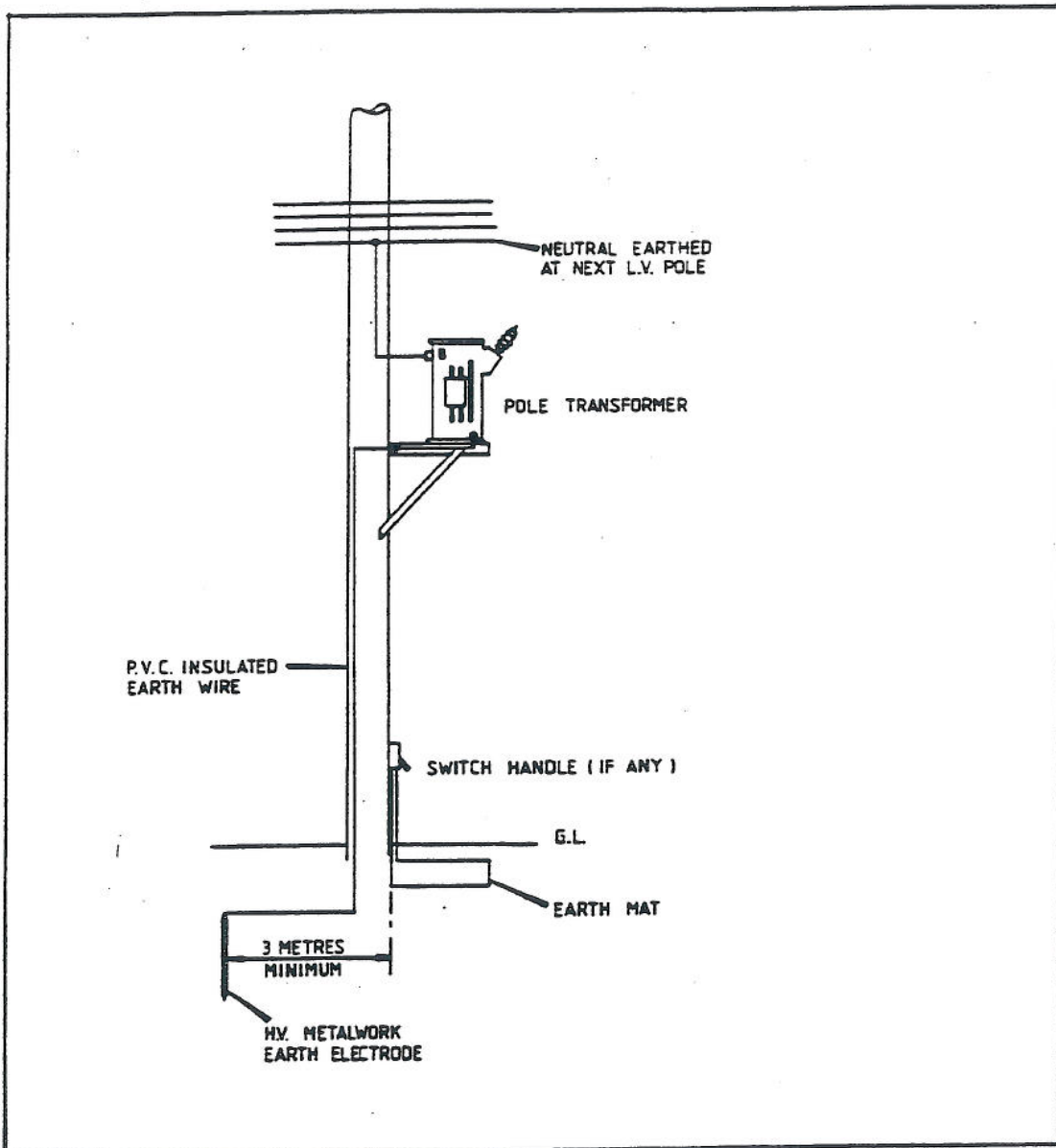


FIGURE 1: POLE TRANSFORMER FEEDING OVERHEAD LINE

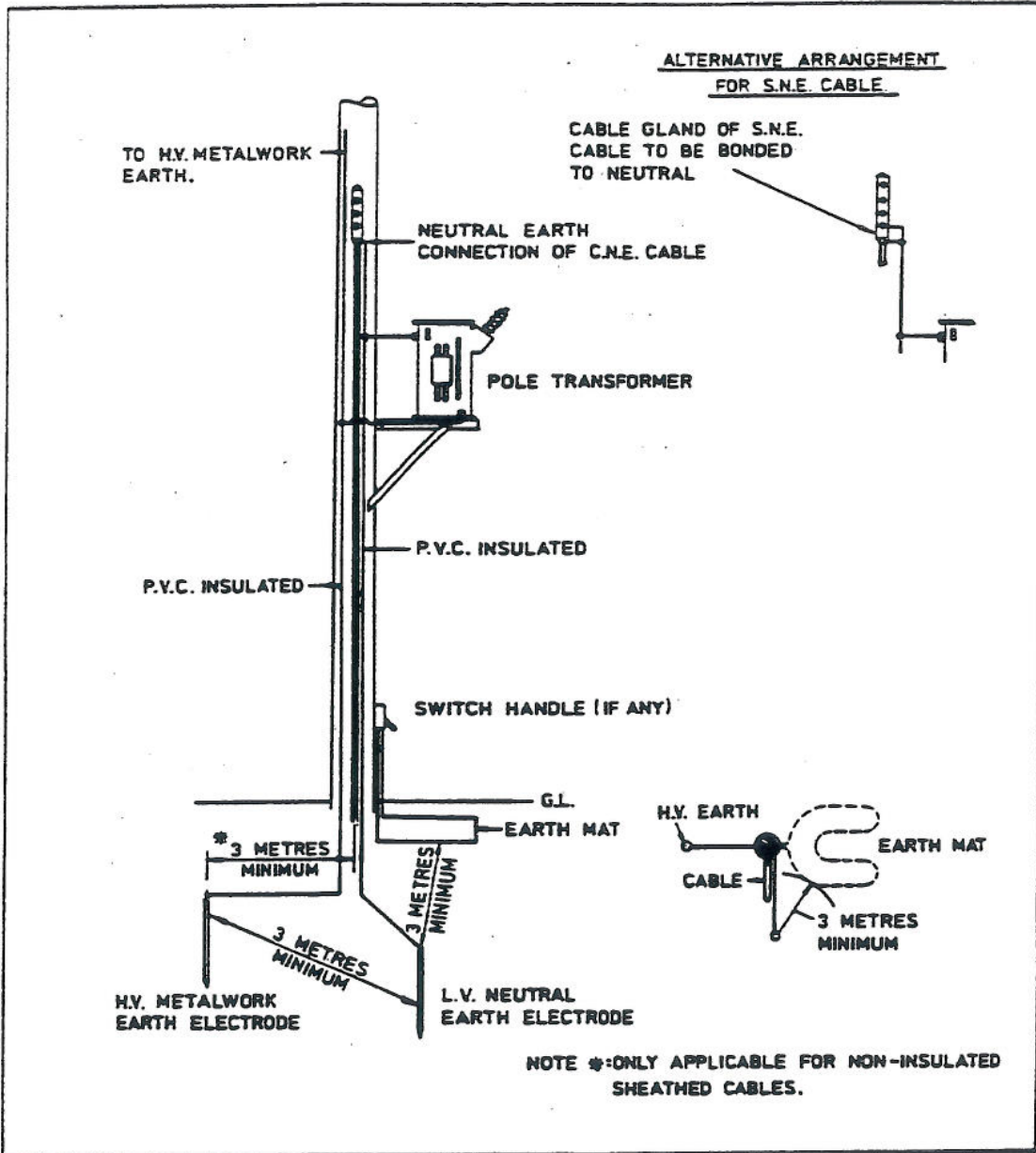


FIGURE 2: POLE TRANSFORMER FEEDING UNDERGROUND CABLE

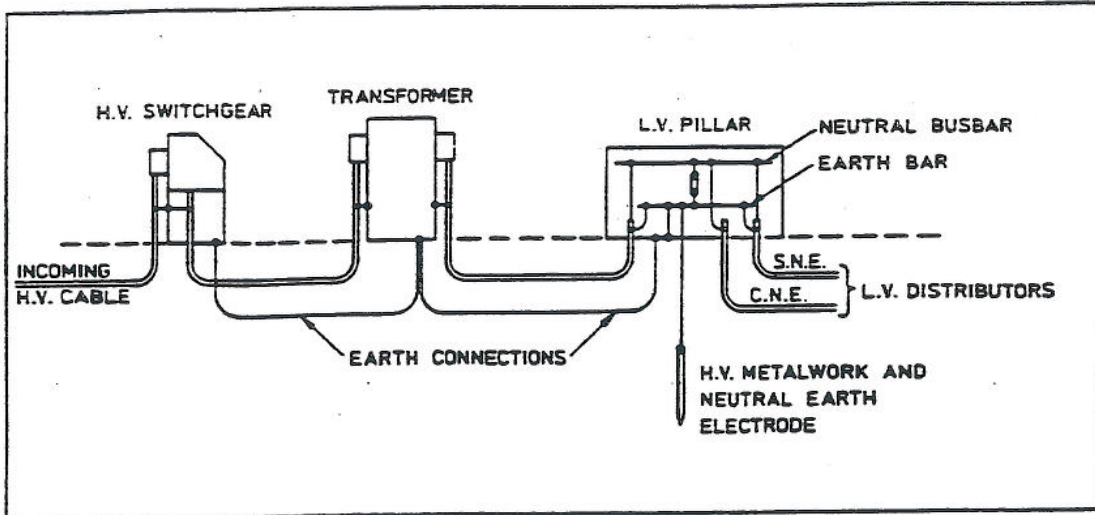


FIGURE 3: GROUND MOUNTED SUBSTATION
OVERALL EARTH RESISTANCE ONE OHM OR LESS

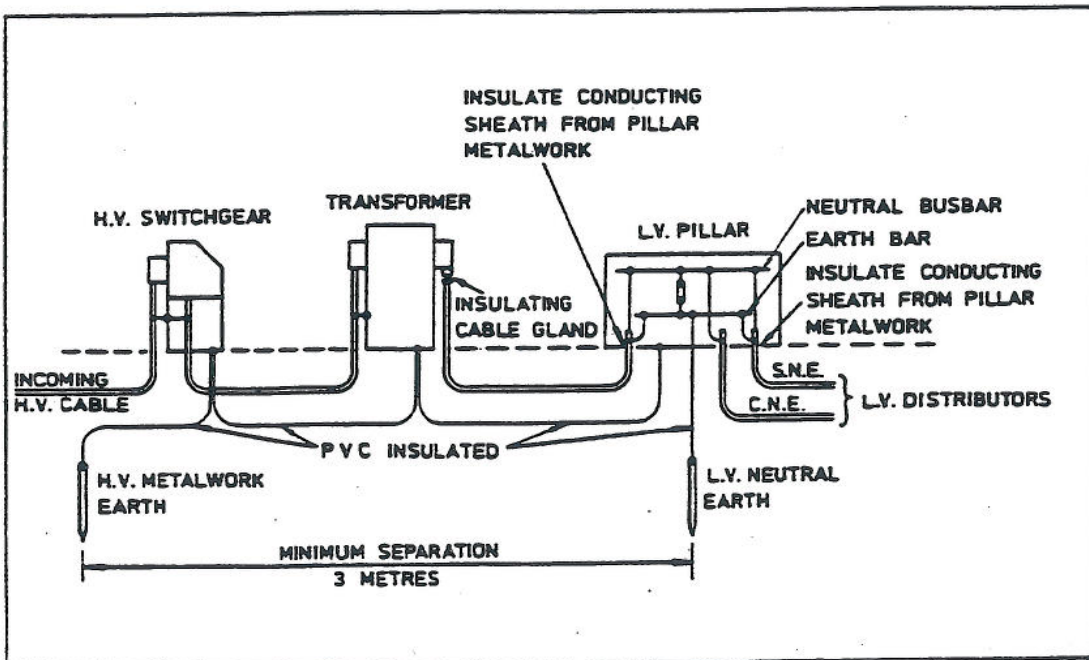


FIGURE 4: GROUND MOUNTED SUBSTATION
OVERALL EARTH RESISTANCE, IF COMBINED, GREATER THAN ONE OHM

NOTE- IF SEPARATE H.V. SWITCHGEAR IS USED THIS MUST BE BONDED TO THE TRANSFORMER METALWORK IN ACCORDANCE WITH FIGURES 3 AND 4

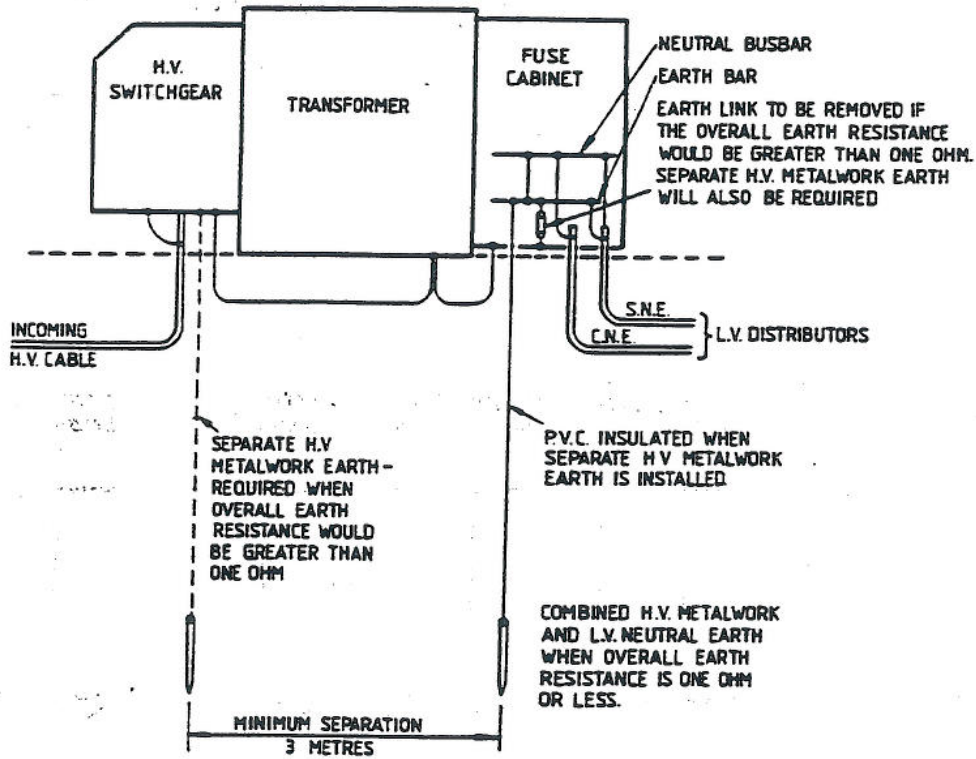


FIGURE 5: GROUND MOUNTED SUBSTATION WITH TRANSFORMER MOUNTED FUSE CABINET

TERMINOLOGY :- S/S = SUBSTATION; L/B = LINK DISCONNECTING BOX (PHASE NORMALLY OPEN, NEUTRAL SOLID)

C.N.E. = COMBINED NEUTRAL AND EARTH CABLE.

S.N.E. = SEPARATE NEUTRAL AND EARTH CABLE.

 = P.M.E. ELECTRODE

 = BOND BETWEEN SHEATH OF S.N.E. CABLE AND NEUTRAL OF C.N.E. CABLE





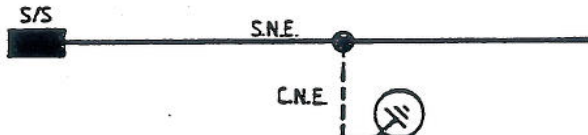

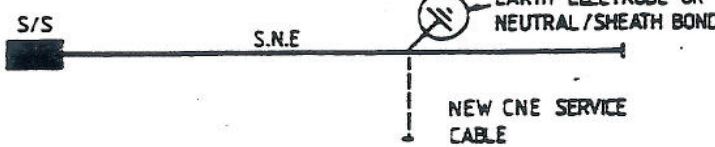
EXAMPLES	P.M.E. FACILITIES AVAILABLE
<p>1. </p>	ALONG WHOLE LENGTH OF DISTRIBUTOR
<p>2. </p>	ON C.N.E. SECTION ONLY
<p>3. </p>	ALONG WHOLE LENGTH OF DISTRIBUTORS FROM BOTH SUBSTATIONS
<p>4. </p>	ALONG WHOLE ROUTE OF MAIN DISTRIBUTOR BUT NOT BRANCH
<p>5. </p>	ON C.N.E. BRANCH AND MAIN DISTRIBUTOR BETWEEN S/S AND C.N.E./S.N.E. JOINT
<p>6. </p>	BETWEEN S/S AND EARTH ELECTRODE
<p>7. </p>	BETWEEN S/S AND SERVICE JOINT POSITION

FIGURE 6: TYPICAL APPLICATIONS OF C.N.E. CABLES

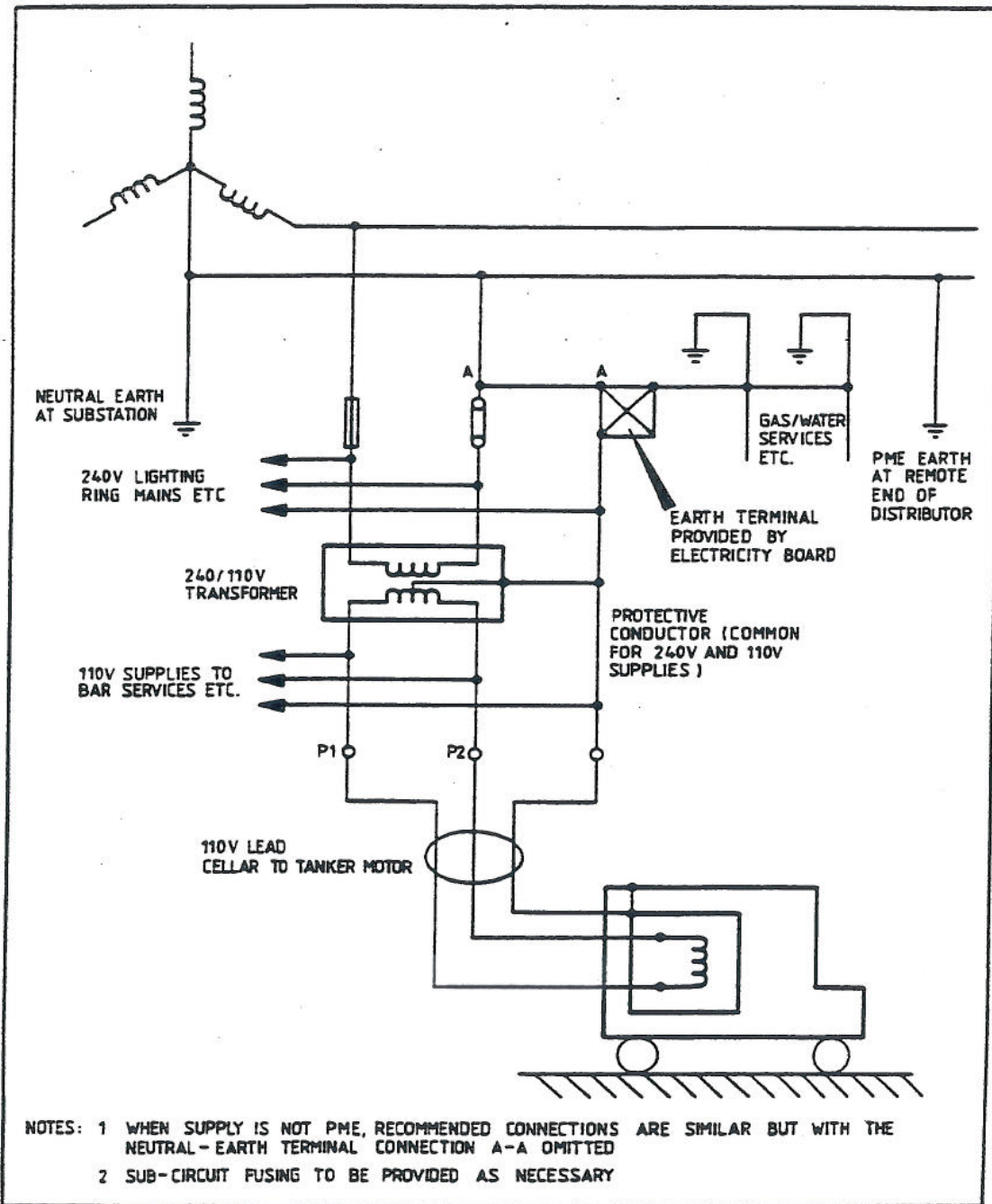


FIGURE 7: RECOMMENDATIONS FOR CONNECTIONS OF 240V AND 110V INTERNAL DISTRIBUTION WHEN SUPPLY IS PME

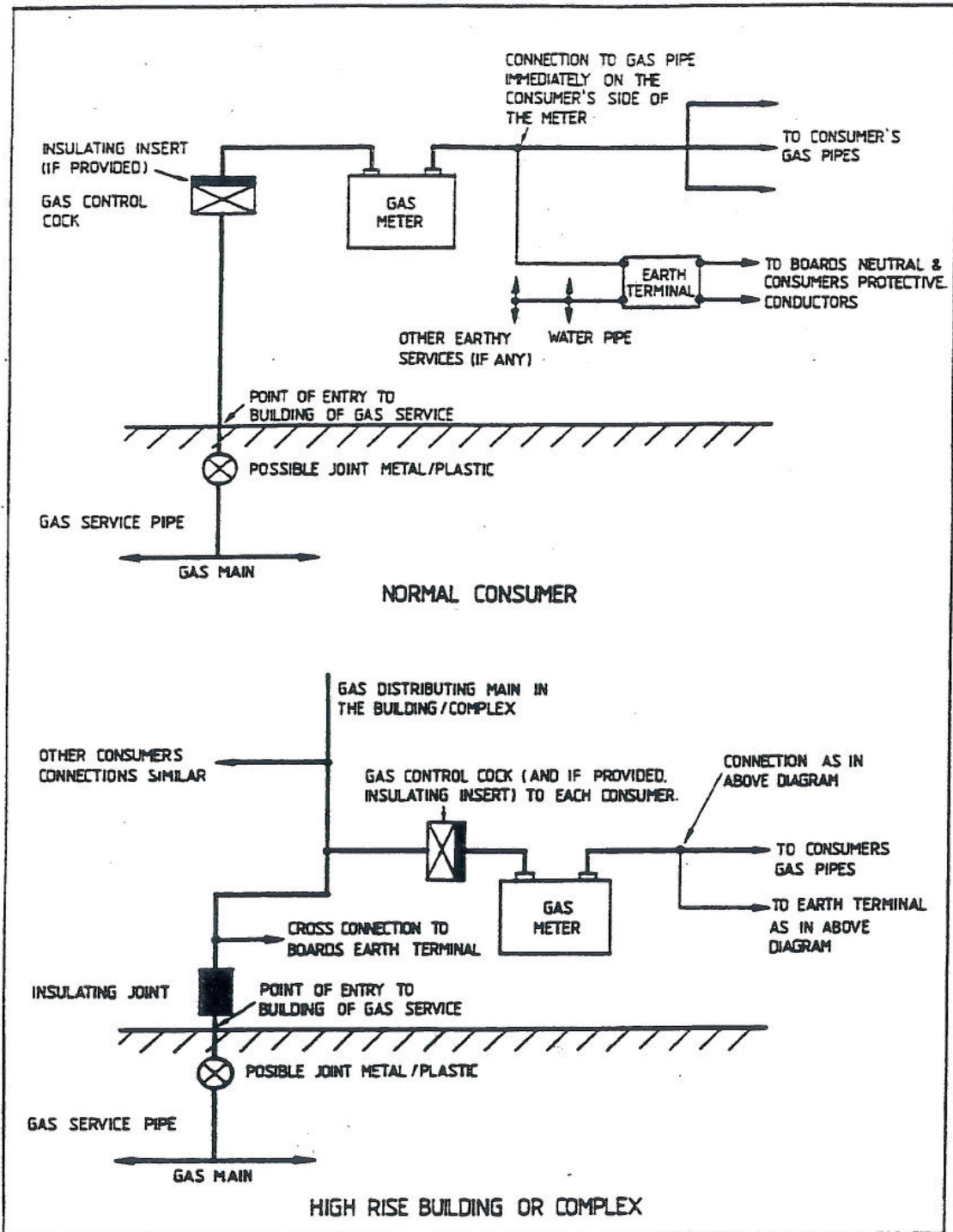


FIGURE 8: METHOD OF BONDING GAS SERVICE PIPES TO MAIN EARTH TERMINAL

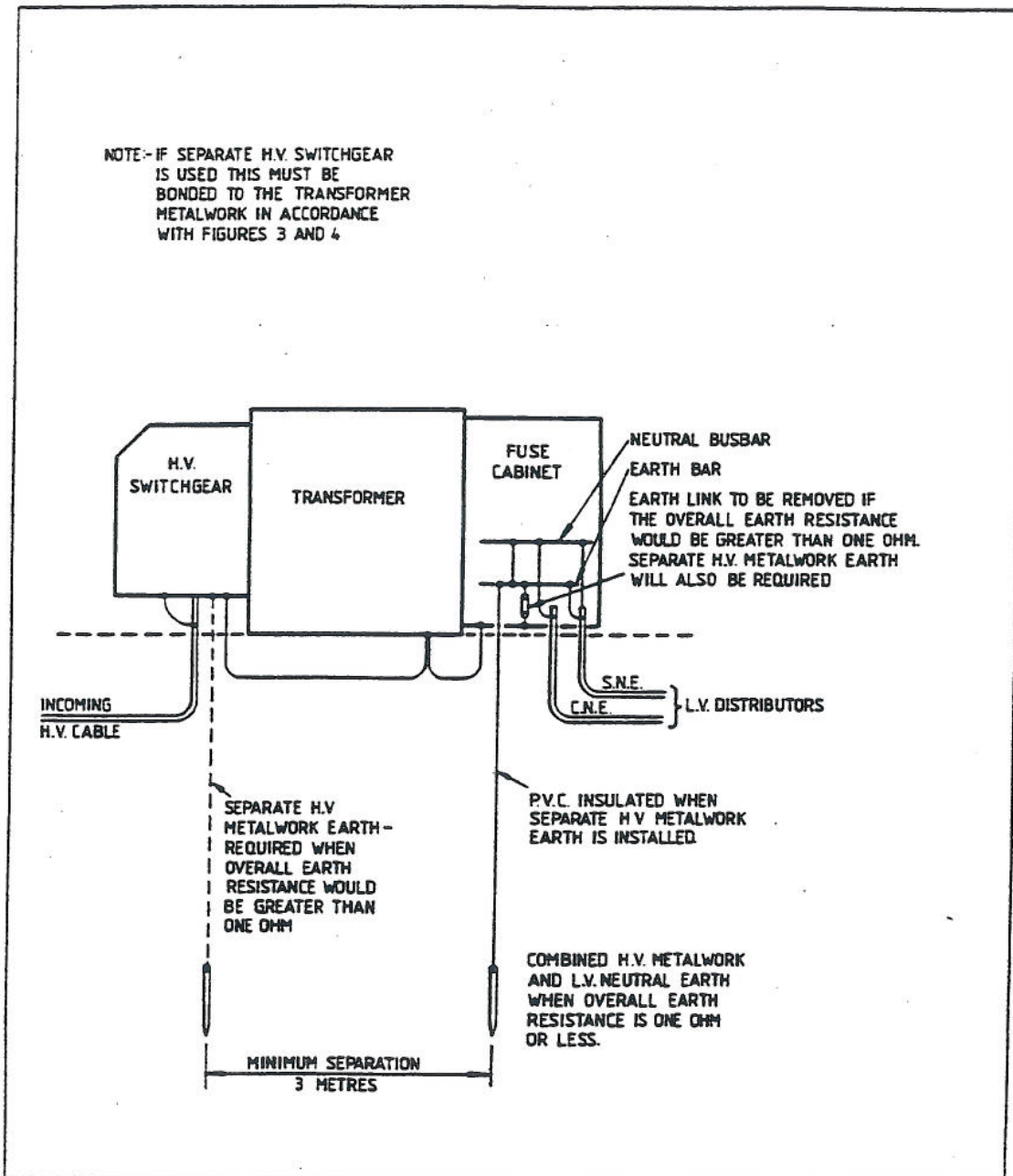



FIGURE 5: GROUND MOUNTED SUBSTATION WITH TRANSFORMER MOUNTED FUSE CABINET

TERMINOLOGY:- S/S = SUBSTATION; L/B = LINK DISCONNECTING BOX (PHASE NORMALLY OPEN, NEUTRAL SOLID)

C.N.E = COMBINED NEUTRAL AND EARTH CABLE.

S.N.E = SEPARATE NEUTRAL AND EARTH CABLE.

 = P.M.E. ELECTRODE

 = BOND BETWEEN SHEATH OF S.N.E. CABLE AND NEUTRAL OF C.N.E. CABLE





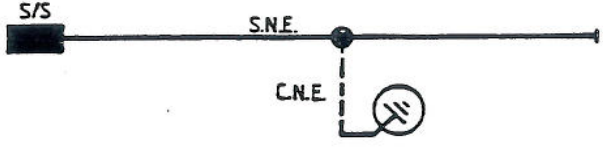

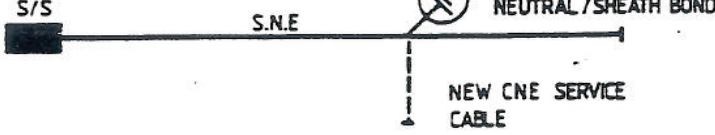
EXAMPLES	P.M.E. FACILITIES AVAILABLE
<p>1. </p>	ALONG WHOLE LENGTH OF DISTRIBUTOR
<p>2. </p>	ON C.N.E. SECTION ONLY
<p>3. </p>	ALONG WHOLE LENGTH OF DISTRIBUTORS FROM BOTH SUBSTATIONS
<p>4. </p>	ALONG WHOLE ROUTE OF MAIN DISTRIBUTOR BUT NOT BRANCH
<p>5. </p>	ON C.N.E. BRANCH AND MAIN DISTRIBUTOR BETWEEN S/S AND C.N.E./S.N.E. JOINT
<p>6. </p>	BETWEEN S/S AND EARTH ELECTRODE
<p>7. </p>	BETWEEN S/S AND SERVICE JOINT POSITION

FIGURE 6: TYPICAL APPLICATIONS OF C.N.E. CABLES

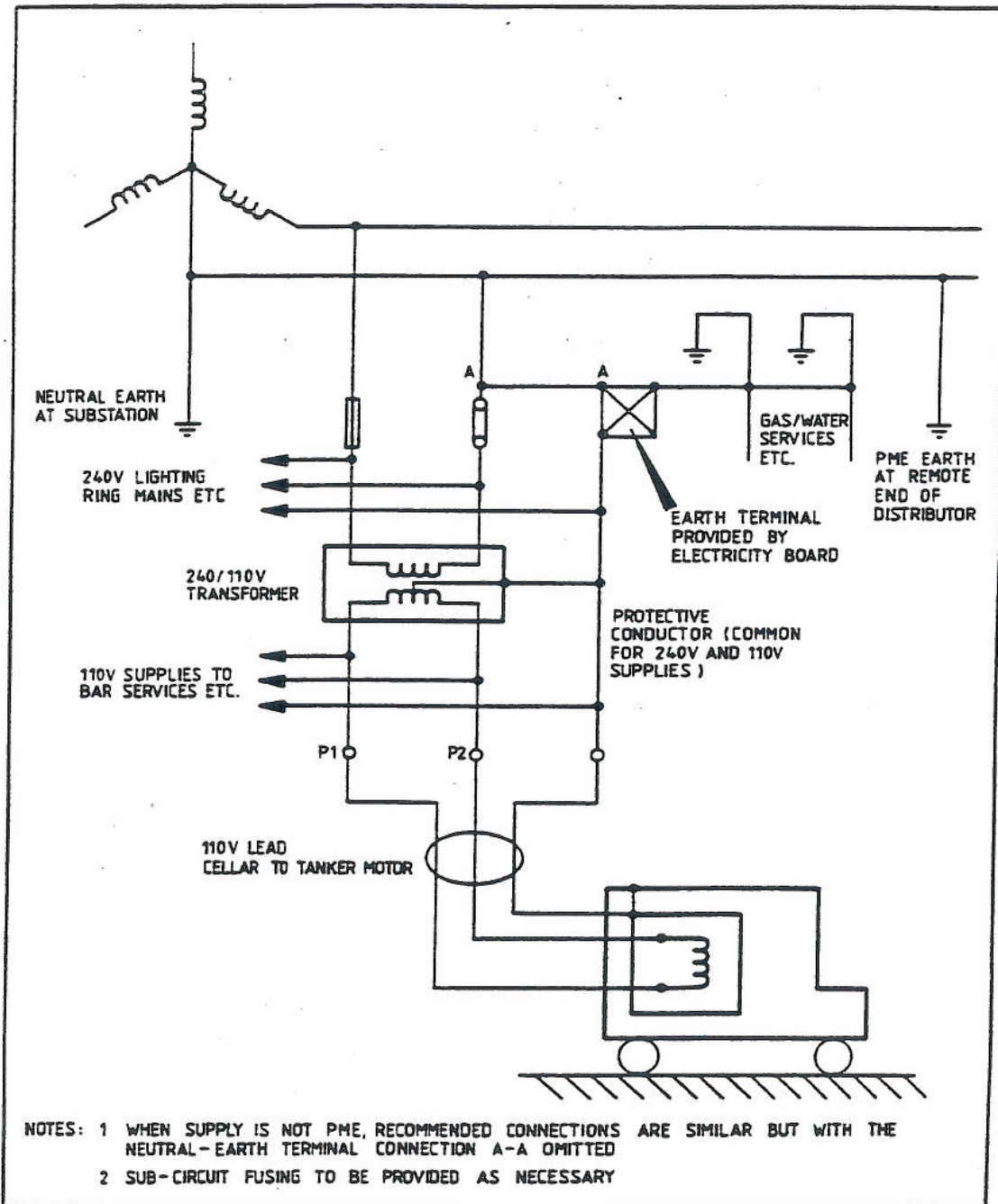


FIGURE 7: RECOMMENDATIONS FOR CONNECTIONS OF 240V AND 110V INTERNAL DISTRIBUTION WHEN SUPPLY IS PME

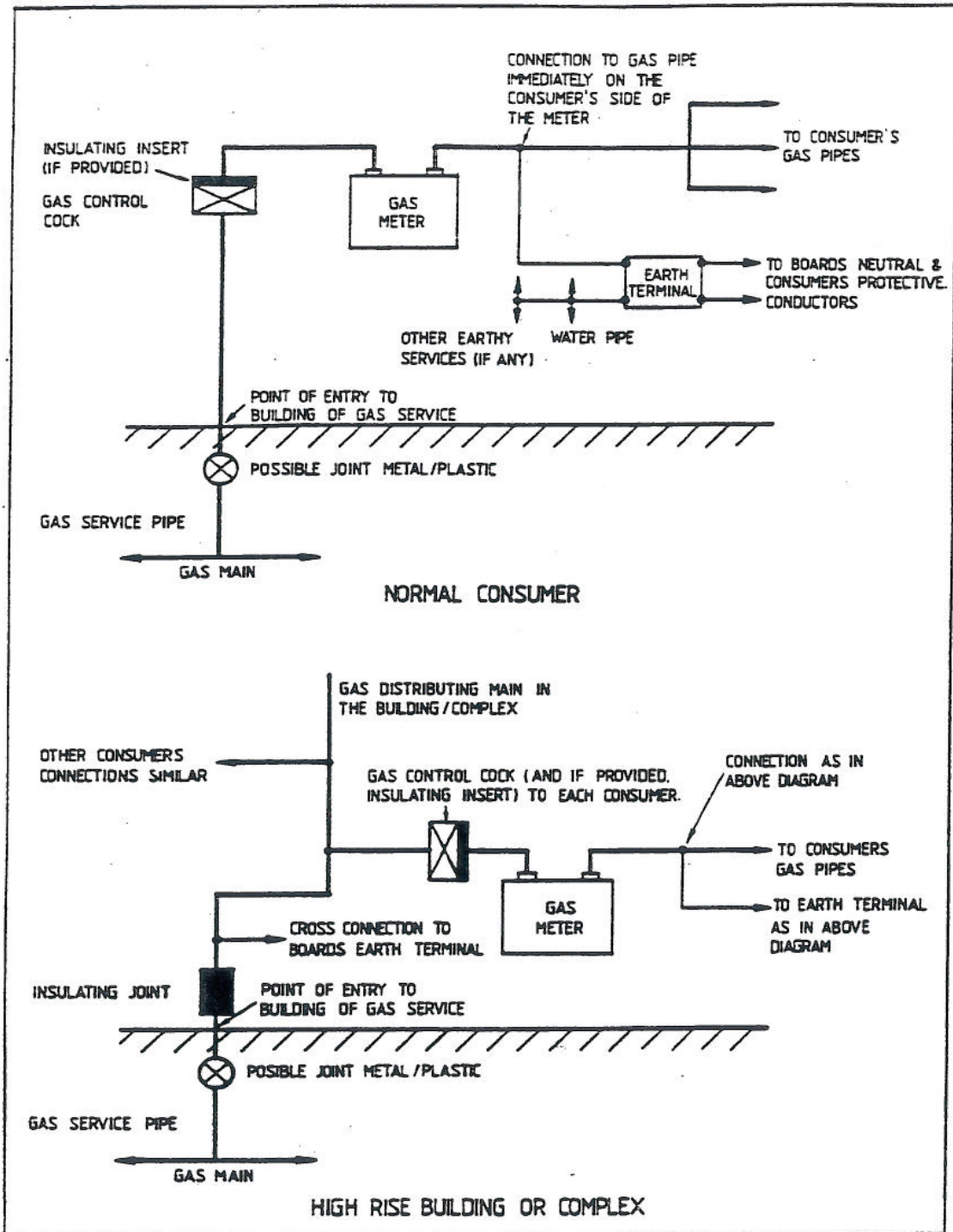


FIGURE 8: METHOD OF BONDING GAS SERVICE PIPES TO MAIN EARTH TERMINAL

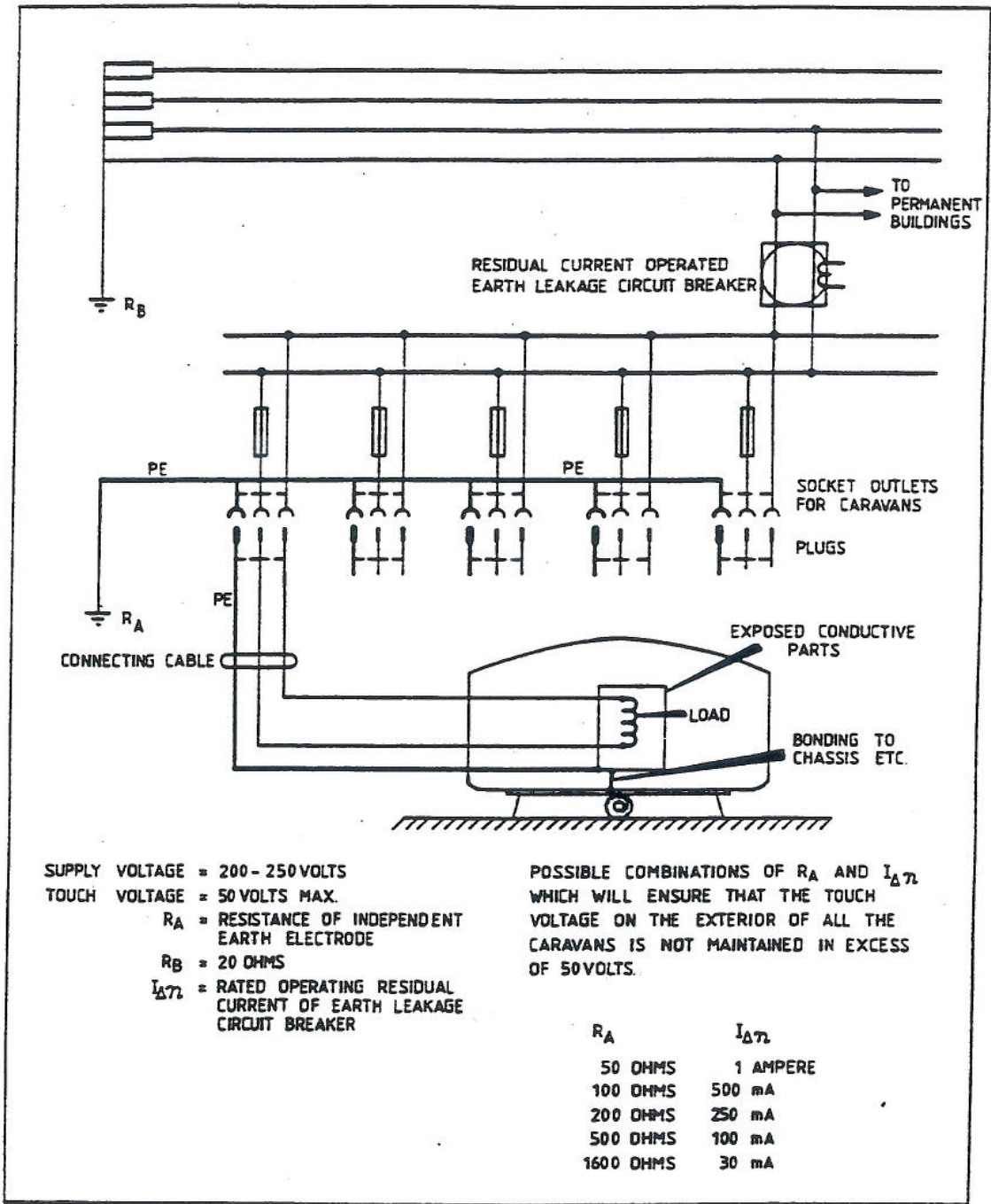


FIGURE 9: RECOMMENDED METHOD OF SUPPLYING A CARAVAN SITE

ELECTRIC LIGHTING (CLAUSES) ACT 1899
ELECTRICITY ACT 1947
APPROVAL FOR MULTIPLE EARTHING

- 1 The Secretary of State, in the exercise of powers bestowed by Section 10(c) and 73(1) of the Schedule to the Electric Lighting (Clauses) Act 1899(a), as incorporated in the Electricity Act 1947(b) by section 57(2) of that Act, and now vested in him(c), and with the concurrence of the British Telecommunication Corporation hereby APPROVES connections with earth made by the Electricity Board in circumstances such that the Board's works satisfy the conditions for a system of multiple earthing described in paragraphs 3 to 6 of this Approval.

INTERPRETATION

- 2 (1) In this Approval -

"the Board" means the

Electricity Board;

"the Board's works" means the supply transformer, distributing main and service lines through which a supply of electricity is given to consumers;

"distributing main" means the electric line between the supply transformer and a service line;

"earth electrode" means a metal rod or other conducting object, other than a gas pipe, which provides an effective connection with the general mass of earth;

"high voltage" means a voltage normally exceeding 1000 volts between conductors;

"neutral conductor" means the conductor connected with earth in any distributing main or service line;

"supply transformer" means the transformer at which electric energy intended for supply to a consumer is reduced to the appropriate voltage.

- (2) In this Approval, unless the contrary intention appears, words in the singular include the plural and words in the plural include the singular.

THE BOARD'S WORKS

Earthing of Metalwork at Transformer

- 3 The metal case of the Board's supply transformer and any metalwork supporting or enclosing any high voltage electric lines connected to that transformer shall be connected to an earth electrode.

Earthing of Neutral Conductor

- 4 (1) The neutral conductor of the distributing main shall be connected to -
- (a) an earth electrode situated at or near the supply transformer;
 - (b) any metal sheathing and any metal armouring of that distributing main; and
 - (c) to either
 - (i) an additional earth electrode
or
 - (ii) the neutral conductor of any other distributing main which provides an alternative path to an earth electrode.
- (2) The earth electrode referred to in sub-paragraph (1)(a) of this paragraph shall be situated outside the resistance area of the earth electrode referred to in paragraph 3 unless any connection between them would result in a resistance to earth of 1 ohm or less.

Size of Neutral Conductor

- 5 (1) The copper equivalent cross-sectional area of the neutral conductor -
- (a) throughout all three phase four wire, two phase three wire and single phase three wire distributing mains shall, when measured at any point, be not less than one half of the copper equivalent cross-sectional area of the phase conductor at that point;
and
 - (b) throughout all single phase two wire distributing mains shall, when measured at any point, be not less than the copper equivalent cross-sectional area of the phase conductor at that point.

Continuity of Neutral Conductor

- 6 (1) No fusible cut-out, circuit breaker or switch shall be included in the neutral conductor.

SAVING FOR RIGHTS OF OWNERS AND THE BRITISH TELECOMMUNICATION CORPORATION

7 Nothing in this Approval shall -

- (a) confer upon the Board any right to connect the neutral conductor to any earth electrode, metal pipe or other metal structure without the permission of its owner; or
- (b) affect any right or remedies of the British Telecommunication Corporation in relation to any injury or injurious affection of British Telecommunication Corporation telegraphic lines, or confer any exemption from liability or penalty in respect of such injurious affection.

MODIFICATIONS AND REVOCATION OF APPROVAL

8 The Secretary of State may modify or revoke this Approval at any time after due notice to the Board.

REVOCATION OF PREVIOUS APPROVAL

- 9 (1) The Approval given to the Board on 19 in relation to multiple earthing is hereby revoked.
- (2) Section 16(1) of the Interpretation Act 1978(a) shall apply as if the approval revoked by subparagraph (1) of this paragraph were an Act of Parliament thereby repealed.

Dated 19

Authorised by the Secretary of State
for Energy to act in that behalf.

ELECTRIC LIGHTING (CLAUSES) ACT 1899
ELECTRICITY ACT 1947

APPROVAL FOR MULTIPLE EARTHING (STREET LIGHTING COLUMNS)

- 1 The Secretary of State, in the exercise of powers bestowed by Section 10(c) and 73(1) of the Schedule to the Electric Lighting (Clauses) Act 1899(a), as incorporated in the Electricity Act 1947(b) by section 57(2) of that Act, and now vested in him(c), and with the concurrence of the British Telecommunication Corporation hereby APPROVES connections with earth made by the Electricity Board in circumstances such that the Board's works, the consumer's wiring and the distribution installation satisfy the conditions for a system of multiple earthing described in paragraphs 3 to 7 of this Approval.

INTERPRETATION

- 2 (1) In this Approval -

"the Board" means the Electricity Board;

"the Board's works" means the supply transformer, distributing main and service lines through which a supply of electricity is given to consumers;

"circuit protective conductor" means a protective conductor connecting exposed conductive parts of equipment to the main earthing terminal, but does not include the neutral conductor in consumer's wiring, unless the Secretary of State has expressly approved its use for that purpose;

"consumer's wiring" means so much of the electrical installation of a street lighting column which is, or is required to be, connected to a circuit protective conductor;

"distribution installation" means an electric line through which electricity is supplied, or is intended to be supplied, at low voltage to the supply terminals of more than one street lighting column either from a distributing main or directly from the premises of the Board;

"distributing main" means the electric line between the supply transformer and a service line or distribution installation;

"earth electrode" means a metal rod or other conducting object, other than a gas pipe, which provides an effective connection with the general mass of earth;

"high voltage" means a voltage normally exceeding 1000 volts between conductors;

"low voltage" means a voltage normally exceeding 50 volts but not exceeding 1000 volts between conductors;

"neutral conductor" means the conductor connected with earth in any distributing main, service line, or distribution installation;

"service line" means an electric line through which electricity is supplied at low voltage to the supply terminals of a single street lighting column either from a distributing main or distribution installation or directly from the premises of the Board;

"street lighting column" means a permanent fixture which is or is intended to be connected to a supply of electricity which is in and is associated with a highway;

"supply terminals" means the points where the conductors of the distributing mains or service lines are connected to the conductors of the street lighting column installation;

"supply transformer" means the transformer at which electric energy intended for supply to a consumer is reduced to the appropriate voltage.

- (2) In this Approval, unless the contrary intention appears, words in the singular include the plural and words in the plural include the singular.

THE BOARD'S WORKS

Earthing of Metalwork at Transformer

- 3 The metal case of the Board's supply transformer and any metalwork supporting or enclosing any high voltage electric lines connected to that transformer shall be connected to an earth electrode.

THE CONSUMER'S INSTALLATION

Metalwork and Circuit Protective Conductors to be Connected to the Neutral Conductor

- 4 The exposed metalwork of a street lighting column which is or may reasonably be expected to come into electrical contact with the general mass of earth shall be connected to the neutral conductor by a conductor having a minimum copper equivalent cross-sectional area equal to that of the supply neutral conductor at that point or of 6 sq mm whichever is the smaller. Any circuit protective conductor in the street lighting column shall be connected to the neutral conductor.

EARTHING OF NEUTRAL CONDUCTOR

- 5 (1) The neutral conductor of the distributing main or distribution installation shall be connected to -
- (a) an earth electrode situated at or near the supply transformer;
 - (b) any metal sheathing and any metal armouring of that distributing main; and
 - (c) to either
 - (i) an additional earth electrode
or
 - (ii) the neutral conductor of any other distributing main which provides an alternative path to an earth electrode.
- (2) The earth electrode referred to in sub-paragraph (1)(a) of this paragraph shall be situated outside the resistance area of the earth electrode referred to in paragraph 3 unless any connection between them would result in a resistance to earth of 1 ohm or less.
- (3) The connection referred to in sub-paragraph (1)(c) of this paragraph shall be made at -
- (a) a point no nearer to the supply transformer than that junction between the distribution installation and the consumer's wiring which satisfies the conditions set out in paragraph 4 and which is most remote from that transformer (all distances being measured along the line in question); and
 - (b) such other points as may be necessary to ensure that the overall resistance to earth of the neutral conductor -
 - (i) does not anywhere exceed 20 ohms; and
 - (ii) shall be such that the fuses or automatic circuit breaker protecting the high voltage side of the transformer will operate in the event of a breakdown between the windings of the transformer unless -
 - (A) the high voltage side of the supply transformer is earthed through a continuously rated arc suppression coil; and
 - (B) adequate arrangements have been made for a warning to be given to the Board of any faults which may occur in the transformer.

SIZE OF NEUTRAL CONDUCTOR

- 6 (1) The copper equivalent cross-sectional area of the neutral conductor -
- (a) throughout all three phase four wire, two phase three wire and single phase three wire distributing mains, service lines and distribution installations, shall, when measured at any point, be not less than one half of the copper equivalent cross-sectional area of the phase conductor at that point; and
 - (b) throughout all single phase two wire distributing mains, service lines and distribution installations shall, when measured at any point, be not less than the copper equivalent cross-sectional area of the phase conductor at that point.
- (2) Where, for any reason abnormal loads in the neutral conductor can reasonably be expected to occur, the copper equivalent cross-sectional area of that conductor shall be increased so as to render it capable of bearing such loads.

CONTINUITY OF NEUTRAL CONDUCTOR

- 7 (1) No fusible cut-out, circuit breaker or switch shall be included in the neutral conductor.
- (2) In the design, construction, maintenance and operation of the distribution system, all reasonable precautions to avoid the possibility of an open circuit in the neutral conductor shall be taken.

SAVING FOR RIGHTS OF OWNERS AND THE BRITISH TELECOMMUNICATION CORPORATION

8 Nothing in this Approval shall -

- (a) confer upon the Board any right to connect the neutral conductor to any earth electrode, metal pipe or other metal structure without the permission of its owner; or
- (b) affect any right or remedies of the British Telecommunication Corporation in relation to any injury or injurious affection of British Telecommunication Corporation telegraphic lines, or confer any exemption from liability or penalty in respect of such injurious affection.

MODIFICATIONS AND REVOCATION OF APPROVAL

9 The Secretary of State may modify or revoke this Approval at any time after due notice to the Board.

REVOCATION OF PREVIOUS APPROVAL

- 10 (1) The Approval given to the Board on _____ 19__ in relation to the multiple earthing of street lighting columns is hereby revoked.
- (2) Section 16(1) of the Interpretation Act 1978(a) shall apply as if the approval revoked by sub-paragraph (1) of this paragraph were an Act of Parliament thereby repealed.

Dated _____ 19__

Authorised by the Secretary of State
for Energy to act in that behalf.

ELECTRIC LIGHTING (CLAUSES) ACT 1899
ELECTRICITY ACT 1947
APPROVAL FOR PROTECTIVE MULTIPLE EARTHING

- 1 The Secretary of State, in the exercise of powers bestowed by Section 10(c) and 73(1) of the Schedule to the Electric Lighting (Clauses) Act 1899(a), as incorporated in the Electricity Act 1947(b) by section 57(2) of that Act, and now vested in him(c), and with the concurrence of the British Telecommunication Corporation, hereby APPROVES connections with earth made by the Electricity Board in circumstances such that both the Board's works, and the relevant consumer's installation satisfy the conditions for a system of protective multiple earthing described in paragraphs 3 to 7 of this Approval.

INTERPRETATION

- 2 (1) In this Approval -

"the Board" means the Electricity Board;

"the Board's works" means the supply transformer, distributing main and service lines through which a supply of electricity is given to a consumer;

"circuit protective conductor" means a protective conductor connecting exposed conductive parts of equipment to the main earthing terminal, but does not include the neutral conductor of a consumer's installation unless the Secretary of State has expressly approved its use for that purpose;

"consumer's installation" means the electrical apparatus under the control of the consumer on the consumer's premises which is or is intended to be connected to the supply terminals, together with the wiring by which it is so connected, but does not include any meter owned by the Board for measuring the value of the supply to those premises;

"distributing main" means the electric line between the supply transformer and a service line;

"earth electrode" means a metal rod or other conducting object, other than a gas pipe, which provides an effective connection with the general mass of earth;

"high voltage" means a voltage normally exceeding 1000 volts between conductors;

"low voltage" means a voltage normally exceeding 50 volts but not exceeding 1000 volts between conductors;

"neutral conductor" means the conductor connected with earth in any distributing main or service line;

"service line" means an electric line through which electricity is supplied, or is intended to be supplied, at low voltage to the supply terminals of a single consumer, or to two, three or four consumers occupying adjacent premises, either from a distributing main or directly from the premises of the Board;

"supply terminals" means the point at which the service lines are connected to the consumer's installation;

"supply transformer" means the transformer at which electric energy intended for supply to a consumer is reduced to the appropriate voltage.

- (2) In this Approval, unless the contrary intention appears, words in the singular include the plural and words in the plural include the singular.

THE BOARD'S WORKS

Earthing of Metalwork at Transformer

- 3 The metal case of the Board's supply transformer and any metalwork supporting or enclosing any high voltage electric line connected to that transformer shall be connected to an earth electrode.

EARTHING OF NEUTRAL CONDUCTOR

- 4 (1) The supply neutral conductor of the distributing main shall be connected to -
- (a) an earth electrode situated at or near the supply transformer; and
 - (b) any metal sheathing and any metal armouring of that distributing main; and

(a) 1899 c.19 (b) 1947 c.54 (c) S.I. 1957/48, 1969/1498, 1970/1537

- (c) to either
 - (i) an additional earth electrode
 - or
 - (ii) the neutral conductor of any other distributing main which provides an alternative path to an earth electrode.
- (2) The earth electrode referred to in sub-paragraph (1)(a) of this paragraph shall be situated outside the resistance area of the earth electrode referred to in paragraph 3 unless any connection between them would result in a resistance to earth of 1 ohm or less.
- (3) The connection referred to in sub-paragraph (1)(c) of this paragraph shall be made at -
 - (a) a point no nearer to the supply transformer than that junction between the distributing main and service line supplying a consumer's installation, satisfying the conditions set out in paragraph 7, which is most remote from that transformer (all distances being measured along the line in question); and
 - (b) such other points as may be necessary to ensure that the overall resistance to earth of that supply neutral conductor -
 - (i) does not anywhere exceed 20 ohms; and
 - (ii) shall be such that the fuses or automatic circuit breaker protecting the high voltage side of the transformer will operate in the event of a breakdown between the windings of the transformer unless -
 - (A) the high voltage side of the supply transformer is earthed through a continuously rated arc suppression coil; and
 - (B) adequate arrangements have been made for a warning to be given to the Board of any faults which may occur in the transformer.

SIZE OF NEUTRAL CONDUCTOR

- 5 (1) The copper equivalent cross-sectional area of the neutral conductor -
 - (a) throughout all three phase four wire, two phase three wire and single phase three wire distributing mains and service lines, shall, when measured at any point, be not less than one half of the copper equivalent cross-sectional area of the phase conductor at that point; and
 - (b) throughout all single phase two wire distributing mains and service lines shall, when measured at any point, be not less than the copper equivalent cross-sectional area of the phase conductor at that point.
- (2) Where, for any reason abnormal loads in the neutral conductor can reasonably be expected to occur, the copper equivalent cross-sectional area of that conductor shall be increased so as to render it capable of bearing such loads.

CONTINUITY OF NEUTRAL CONDUCTOR

- 6 (1) No fusible cut-out, circuit breaker or switch shall be included in the neutral conductor.
- (2) The Board shall, in the design, construction, maintenance and operation of their distribution system, take all reasonable precautions to avoid an open circuit in the neutral conductor.

THE CONSUMER'S INSTALLATION

Extraneous Metalwork and Circuit Protective Conductors to be Connected to Neutral Conductor

- 7 (1) Subject to the provisions of this paragraph, any metal structure, pipe or other metalwork on the consumer's premises which -
 - (a) is in or may reasonably be expected to come into electrical contact with the general mass of earth, and
 - (b) is so situated that any person or animal could simultaneously touch
 - (i) any such structure, pipe or metalwork, or any metalwork in electrical contact therewith, and
 - (ii) any exposed metalwork forming part of the consumer's installation but not normally carrying an electrical current, or any metalwork in electrical contact therewith;

shall be connected, by a conductor (attached at a point as close as practicable to the point at which such structure, pipe or metalwork enters the consumer's premises) to an earthing terminal connected to the neutral conductor at the supply terminals of the consumer's installation, which earthing terminal shall itself also be connected to any circuit protective conductor on the consumer's premises. The copper equivalent cross-sectional area of the conductor referred to shall be not less

than the area shown in column 2 of Table 1, the copper equivalent cross-sectional area of the supply neutral conductor associated with it is shown in column 1.

TABLE 1

Column 1	Column 2
Copper equivalent cross-sectional area of supply neutral conductor	Minimum copper equivalent cross-sectional area of connecting conductor
35 sq mm or less	10 sq mm
over 35 sq mm but not more than 50 sq mm	16 sq mm
over 50 sq mm but not more than 95 sq mm	25 sq mm
over 95 sq mm but not more than 150 sq mm	35 sq mm
over 150 sq mm	50 sq mm

- (2) No metal structure, pipe or metalwork forming part of a telegraphic, telephone or signalling circuit shall be connected to any earthing terminal except by or with the authority of the British Telecommunication Corporation.
- (3) No electrical connection shall be made in a caravan or boat between any metalwork forming part of the consumer's installation which does not normally carry electrical current, or any metalwork in electrical contact therewith, and the neutral conductor without the express approval of the Secretary of State.

SAVING FOR RIGHTS OF OWNERS AND THE BRITISH TELECOMMUNICATION CORPORATION

8 Nothing in this Approval shall -

- (a) confer upon the Board any right to connect the neutral conductor to any earth electrode, metal pipe or other metal structure without the permission of its owner; or
- (b) affect any right or remedies of the British Telecommunication Corporation in relation to any injury or injurious affection of British Telecommunication Corporation telegraphic lines, or confer any exemption from liability or penalty in respect of such injurious affection.

MODIFICATION AND REVOCATION OF APPROVAL

9 The Secretary of State may modify or revoke this Approval at any time after due notice to the Board.

REVOCATION OF PREVIOUS APPROVAL

- 10 (1) The Approval given to the Board on _____ 19 ____ in relation to the protective multiple earthing of consumer's installations is hereby revoked.
- (2) Section 16(1) of the Interpretation Act 1978(a) shall apply as if the Approval revoked by subparagraph (1) of this paragraph were an Act of Parliament thereby repealed.

Dated _____ 19 ____

Authorised by the Secretary of State
for Energy to act in that behalf

ELECTRIC LIGHTING (CLAUSES) ACT 1899

ELECTRICITY ACT 1947

APPROVAL FOR PROTECTIVE MULTIPLE EARTHING FOR AN EARTHED SHEATH RETURN WIRING INSTALLATION

- 1 The Secretary of State, in the exercise of powers bestowed by Section 10(c) and 73(1) of the Schedule to the Electric Lighting (Clauses) Act 1899(a), as incorporated in the Electricity Act 1947(b) by section 57(2) of that Act, and now vested in him(c), and with the concurrence of the British Telecommunication Corporation, hereby APPROVES connections with earth made by the Electricity Board in the system and installation listed in the Schedule to this Approval in circumstances such that both the Board's works and the consumer's installation satisfy the conditions for a system of protective multiple earthing described in paragraphs 3 to 8 of this Approval.

INTERPRETATION

- 2 (1) In this Approval -

"the Board" means the

Electricity Board;

"the Board's works" means the supply transformer, distributing main and service lines through which a supply of electricity is given to a consumer;

"circuit protective conductor" means a protective conductor connecting exposed conductive parts of equipment to the main earthing terminal;

"consumer's installation" means the electrical apparatus under the control of the consumer on the consumer's premises which is or is intended to be connected to the supply terminals, together with the wiring by which it is so connected, but does not include any meter owned by the Board for measuring the value of the supply to those premises;

"distributing main" means the electric line between the supply transformer and a service line;

"earth electrode" means a metal rod or other conducting object, other than a gas pipe, which provides an effective connection with the general mass of earth;

"earthed sheath return wiring" means a system of wiring in a consumer's installation where the phase conductor(s) are enclosed by and insulated from a concentric sheath which is used as the neutral conductor;

"high voltage" means a voltage normally exceeding 1000 volts between conductors;

"low voltage" means a voltage normally exceeding 50 volts but not exceeding 1000 volts between conductors;

"neutral conductor" means the conductor connected with earth in any distributing main or service line;

"service line" means an electric line through which electricity is supplied, or is intended to be supplied, at low voltage to the supply terminals of the consumers listed in the Schedule hereto;

"supply terminals" means the points at which the service lines are connected to the consumer's installation;

"supply transformer" means the transformer at which electric energy intended for supply to a consumer is reduced to the appropriate voltage.

- (2) In this Approval, unless the contrary intention appears, words in the singular include the plural and words in the plural include the singular.

THE BOARD'S WORKS

Earthing of Metalwork at Transformer

- 3 The metal case of the Board's supply transformer and any metalwork supporting or enclosing any high voltage electric line connected to that transformer shall be connected to an earth electrode.

EARTHING OF NEUTRAL CONDUCTOR

- 4 (1) The neutral conductor of the distributing main shall be connected to -
- (a) an earth electrode situated at or near the supply transformer;
 - (b) any metal sheathing and any metal armouring of that distributing main; and

(a) 1899 c.19 (b) 1947 c.54 (c) S.I. 1957/48, 1969/1498, 1970/1537

- (c) to either
 - (i) an additional earth electrode
 - or
 - (ii) the neutral conductor of any other distributing main which provides an alternative path to an earth electrode.
- (2) The earth electrode referred to in sub-paragraph (1)(a) of this paragraph shall be situated outside the resistance area of the earth electrode referred to in paragraph 3 unless any connection between them would result in a resistance to earth of 1 ohm or less.
- (3) The connection referred to in sub-paragraph (1)(c) of this paragraph shall be made at -
 - (a) a point no nearer to the supply transformer than that junction between the distributing main and service line supplying the consumer's installation satisfying the conditions set out in paragraph 7 which is most remote from that transformer (all distances being measured along the line in question); and
 - (b) such other points as may be necessary to ensure that the overall resistance to earth of the neutral conductor -
 - (i) does not anywhere exceed 20 ohms; and
 - (ii) shall be such that the fuses or automatic circuit breaker protecting the high voltage side of that transformer will operate in the event of a breakdown between the windings of the transformer unless -
 - (A) the high voltage side of the supply transformer is earthed through a continuously rated arc suppression coil; and
 - (B) adequate arrangements have been made for a warning to be given to the Board of any faults which may occur in the transformer.

SIZE OF NEUTRAL CONDUCTOR

- 5 (1) The copper equivalent cross-sectional area of the neutral conductor -
 - (a) throughout all three phase four wire, two phase three wire and single phase three wire distributing mains and service lines, shall, when measured at any point, be not less than one half of the copper equivalent cross-sectional area of the phase conductor at that point; and
 - (b) throughout all single phase two wire distributing mains and service lines shall, when measured at any point, be not less than the copper equivalent cross-sectional area of the phase conductor at that point.
- (2) Where for any reason abnormal loads in the neutral conductor can reasonably be expected to occur, the copper equivalent cross-sectional area of that conductor shall be increased so as to render it capable of bearing such loads.

CONTINUITY OF NEUTRAL CONDUCTOR

- 6 (1) No fusible cut-out, circuit breaker or switch shall be included in the neutral conductor.
- (2) The Board shall, in the design, construction, maintenance and operation of their distribution system, take all reasonable precautions to avoid an open circuit in the neutral conductor.

THE CONSUMER'S INSTALLATION

Requirements to be met by Earthed Sheath Wiring Installation

- 7 (1) There shall be electrical continuity of the sheath of the earthed sheath return wiring between the connection of the neutral conductor at the supply terminals and all terminations of the wiring. All connections to, and joints in, the outer and inner conductors of the earthed sheath return wiring shall be made in accordance with the recommendations of the manufacturers of the wiring. At every joint in the outer conductor, and at its termination, the continuity of that conductor shall be ensured by a bonding conductor additional to the means used for sealing and clamping the outer conductor.
- (2) All cables, earth continuity conductors and connections shall be of adequate size and rated in accordance with the provisions of the current edition of the IEE Wiring Regulations, as approved from time to time for this purpose by the Secretary of State, or the appropriate British Standard, or Electrical Research Association testing specification, or as agreed by the Secretary of State.
- (3) Where the outer conductor of the earthed sheath return wiring might come into contact with material which could cause it to corrode, it shall be served with a plastic sheathing. Aluminium cables shall be served with a plastic sheathing before being buried in plaster or concrete.

- (4) There shall be a connection from the outer conductor of the earthed sheath return wiring to both the neutral and earth terminals of each socket outlet. Except in the case of equipment which does not have to be connected with earth to comply with the provisions of the current edition of the IEE Wiring Regulations, as approved from time to time for this purpose by the Secretary of State, wiring from fixed points such as plugs in socket outlets shall consist of a phase conductor, a neutral conductor, and a circuit protective conductor.
- (5) No fusible cut-out, automatic circuit breaker, removable link or single-pole switch shall be included in the outer conductor of the earthed sheath return wiring.

Extraneous Metalwork to be Connected to Neutral Conductor

- 8 (1) Subject to the provisions of this paragraph, any metal structure, pipe or other metalwork on the consumer's premises which -
 - (a) is in or may reasonably be expected to come into electrical contact with the general mass of earth, and
 - (b) is so situated that simultaneous contact may reasonably be expected to be made by any person with -
 - (i) any such structure, pipe or metalwork, or any metalwork in electrical contact therewith, and
 - (ii) any exposed metalwork forming part of the consumer's wiring but not normally carrying an electrical current, or any metalwork in electrical contact therewith;

shall be connected, by a conductor attached at a point as close as practicable to the point at which such structure, pipe or metalwork enters those premises which contain consumer's wiring, to an earthing terminal connected to the neutral conductor at the origin of the consumer's wiring. The copper equivalent cross-sectional area of the conductor referred to shall be not less than the area shown in column 2 of Table 1, the copper equivalent cross-sectional area of the neutral conductor associated with it is shown in column 1.

TABLE 1

Column 1	Column 2
Copper equivalent cross-sectional area of supply neutral conductor	Minimum copper equivalent cross-sectional area of connecting conductor
35 sq mm or less	10 sq mm
over 35 sq mm but not more than 50 sq mm	16 sq mm
over 50 sq mm but not more than 95 sq mm	25 sq mm
over 95 sq mm but not more than 150 sq mm	35 sq mm
over 150 sq mm	50 sq mm

- (2) No metal structure, pipe or metalwork forming part of a telegraphic, telephone or signalling circuit shall be connected to any earthing terminal except by or with the authority of the British Telecommunication Corporation.

SAVING FOR RIGHTS OF OWNERS AND THE BRITISH TELECOMMUNICATION CORPORATION

- 9 Nothing in this Approval shall -
 - (a) confer upon the Board any right to connect the neutral conductor to any earth electrode, metal pipe or other metal structure without the permission of its owner; or
 - (b) affect any right or remedies of the British Telecommunication Corporation in relation to any injury or injurious affection of British Telecommunication Corporation telegraphic lines, or confer any exemption from liability or penalty in respect of such injurious affection.

MODIFICATIONS AND REVOCATION OF APPROVAL

10 The Secretary of State may modify or revoke this Approval at any time after due notice to the Board.

Dated 19

Authorised by the Secretary of State
for Energy to act in that behalf.

Approval Reference

Dated

SCHEDULE

ELECTRIC LIGHTING (CLAUSES) ACT 1899

ELECTRICITY ACT 1947

APPROVAL FOR PROTECTIVE MULTIPLE EARTHING FOR A CONSUMER'S DISTRIBUTION
INSTALLATION USING COMBINED NEUTRAL/EARTH CONDUCTORS

- 1 The Secretary of State, in the exercise of powers bestowed by Section 10(c) and 73(1) of the Schedule to the Electric Lighting (Clauses) Act 1899(a), as incorporated in the Electricity Act 1947(b) by section 57(2) of that Act, and now vested in him(c), and with the concurrence of the British Telecommunication Corporation, hereby APPROVES connections with earth made by the Electricity Board in circumstances such that both the Board's works and the consumer's installation described in the Schedule to this Approval satisfy the conditions for a system of protective multiple earthing described in paragraphs 3 to 7 of this Approval.

INTERPRETATION

- 2 (1) In this Approval -

"the Board" means the Electricity Board;

"the Board's works" means the supply transformer, distributing main and service lines through which a supply of electricity is given to a consumer;

"circuit protective conductor" means a protective conductor connecting exposed conductive parts of equipment to the main earthing terminal, but does not include the neutral conductor of consumer's wiring unless the Secretary of State has expressly approved its use for that purpose;

"consumer's installation" means the electrical apparatus on the consumer's premises which is, or is intended to be, connected to the consumer's terminals, but does not include any meter owned by the Board for measuring the value of the supply to those premises;

"consumer's distribution installation" means as much of the consumer's installation as lies between the consumer's terminals and the origin of the consumer's wiring;

"consumer's terminals" means the ends of the electric lines situate on any consumer's premises and belonging to him at which the supply of energy is delivered from the service lines;

"consumer's wiring" means so much of the consumer's installation as is, or is required to be, connected to a circuit protective conductor;

"distributing main" means the electric line between the supply transformer and the service line;

"earth electrode" means a metal rod or other conducting object, other than a gas pipe, which provides an effective connection with the general mass of earth;

"high voltage" means a voltage normally exceeding 1000 volts between conductors;

"low voltage" means a voltage normally exceeding 50 volts but not exceeding 1000 volts between conductors;

"neutral conductor" means the conductor connected with earth in any distributing main, service line or consumer's distribution installation;

"service line" means an electric line through which electricity is supplied, or is intended to be supplied, at low voltage;

"supply transformer" means the transformer at which electric energy intended for supply to a consumer is reduced to the appropriate voltage.

- (2) In this Approval, unless the contrary intention appears, words in the singular include the plural and words in the plural include the singular.

THE BOARD'S WORKS AND THE CONSUMER'S DISTRIBUTION INSTALLATION

Earthing of Metalwork at Transformer

- 3 The metal case of the Board's supply transformer and any metalwork supporting or enclosing any high voltage electric lines connected to that transformer shall be connected to an earth electrode.

Earthing of Neutral Conductor

- 4 (1) The neutral conductor of the distributing main shall be connected to -
- (a) an earth electrode situated at or near the supply transformer;
 - (b) any metal sheathing and any metal armouring of the distributing main; and

(a) 1899 c.19 (b) 1947 c.54 (c) S.I. 1957/48, 1969/1498, 1970/1537

- (c) to either
 - (i) an additional earth electrode
 - or
 - (ii) the neutral conductor of any other distributing main which provides an alternative path to an earth electrode.
- (2) The earth electrode referred to in sub-paragraph (1)(a) of this paragraph shall be situated outside the resistance area of the earth electrode referred to in paragraph 3 unless any connection between them would result in a resistance to earth of 1 ohm or less.
- (3) The connection referred to in sub-paragraph (1)(c) of this paragraph shall be made at -
 - (a) a point no nearer to the supply transformer than that junction between the consumer's distribution installation and consumer's wiring satisfying the conditions set out in paragraph 7, which is most remote from that transformer (all distances being measured along the line in question); and
 - (b) such other points as may be necessary to ensure that the overall resistance to earth of the neutral conductor -
 - (i) does not anywhere exceed 20 ohms; and
 - (ii) shall be such that the fuses or automatic circuit breaker protecting the high voltage side of that transformer will operate in the event of a breakdown between the windings of the transformer unless -
 - (A) the high voltage side of the supply transformer is earthed through a continuously rated arc suppression coil; and
 - (B) adequate arrangements have been made for a warning to be given to the Board of any faults which may occur in the transformer.

SIZE OF NEUTRAL CONDUCTOR

- 5 (1) The copper equivalent cross-sectional area of the neutral conductor -
 - (a) throughout all three phase four wire, two phase three wire and single phase three wire distributing mains, service lines and the consumer's distribution installation shall, when measured at any point be not less than one half of the copper equivalent cross-sectional area of the phase conductor at that point; and
 - (b) throughout all single phase two wire distributing mains, service lines and the consumer's distribution installation lines, shall, when measured at any point be not less than the copper equivalent cross-sectional area of the phase conductor at that point.
- (2) Where, for any reason abnormal loads in the neutral conductor can reasonably be expected to occur, the copper equivalent cross-sectional area of that conductor shall be so increased as to render it capable of bearing such loads.

CONTINUITY OF NEUTRAL CONDUCTOR

- 6 (1) No fusible cut-out, circuit breaker or switch shall be included in the neutral conductor.
- (2) In the design and construction of the distributing main, service line and the consumer's distribution installation all reasonable precautions to avoid the possibility of an open circuit in the neutral conductor shall be taken.

THE CONSUMER'S WIRING

Metalwork and Circuit Protective Conductors to be Connected to the Neutral Conductor

- 7 (1) Subject to the provisions of this paragraph, any metal structure, pipe or other metalwork on the consumer's premises which -
 - (a) is in or may reasonably be expected to come into electrical contact with the general mass of earth, and
 - (b) is so situated that simultaneous contact may reasonably be expected to be made by any person with -
 - (i) any such structure, pipe or metalwork, or any metalwork in electrical contact therewith, and
 - (ii) any exposed metalwork forming part of the consumer's wiring but not normally carrying an electrical current, or any metalwork in electrical contact therewith;

shall be connected, by a conductor attached at a point as close as practicable to the point at which such structure, pipe or metalwork enters those premises which contain consumer's wiring to an earthing terminal connected to the neutral conductor at the origin of the consumer's wiring, which earthing terminal shall itself also be connected to any circuit protective conductor in the consumer's wiring. The copper equivalent cross-sectional area of the conductor referred to shall be not less than the area shown in column 2 of Table 1, the copper equivalent cross-sectional area of the neutral conductor associated with it is shown in column 1.

TABLE 1

Column 1	Column 2
Copper equivalent cross-sectional area of neutral conductor	Minimum copper equivalent cross-sectional area of connecting conductor
35 sq mm or less	10 sq mm
over 35 sq mm but not more than 50 sq mm	16 sq mm
over 50 sq mm but not more than 95 sq mm	25 sq mm
over 95 sq mm but not more than 150 sq mm	35 sq mm
over 150 sq mm	50 sq mm

- (2) No metal structure, pipe or metalwork forming part of a telegraphic, telephone, or signalling circuit shall be connected to any earthing terminal except by or with the authority of the British Telecommunication Corporation.
- (3) No electrical connection shall be made in a caravan or boat between any metalwork forming part of the consumer's wiring which does not normally carry electrical current, or any metalwork in electrical contact therewith, and the neutral conductor without the express approval of the Secretary of State.

SAVING FOR RIGHTS OF OWNERS AND THE BRITISH TELECOMMUNICATION CORPORATION

8 Nothing in this Approval shall -

- (a) confer any right to connect the neutral conductor to any earth electrode, metal pipe or other metal structure without the permission of its owner; or
- (b) affect any right or remedies of the British Telecommunication Corporation in relation to any injury or injurious affection of British Telecommunication Corporation telegraphic lines, or confer any exemption from liability or penalty in respect of such injurious affection.

MODIFICATION AND REVOCATION OF APPROVAL

9 The Secretary of State may modify or revoke this Approval at any time after due notice to the Board.

Dated 19

Authorised by the Secretary of State
for Energy to act in that behalf

Approval Reference

Dated

SCHEDULE

ELECTRIC LIGHTING (CLAUSES) ACT 1899
ELECTRICITY ACT 1947
PROTECTIVE MULTIPLE EARTHING - CARAVANS
APPROVAL OF THE SECRETARY OF STATE

WHEREAS

- 1 Approvals granted to Electricity Boards by the Secretary of State with the concurrence of the British Telecommunication Corporation under Section 10(c) of the Schedule to the Electric Lighting (Clauses) Act 1899 for connections with earth and issued under the heading "Protective Multiple Earthing Approval" prohibit, by paragraph 7(3) of such Approvals, any electrical connection between the earth continuity conductor of a caravan or boat installation and the supply neutral conductor (as those expressions are defined in such Approvals) unless such connection has been approved by the Secretary of State.
- 2 Application has been made by the British Broadcasting Corporation for the approval of such connections in relation to installations in caravans used by that Corporation and by the Independent Broadcasting Authority for the purpose of outside broadcasts in circumstances where an electricity supply for apparatus installed in such a caravan is taken from premises or the Board's works in which connections to earth have been made pursuant to such an Approval:

Now, therefore, THE SECRETARY OF STATE hereby APPROVES any electrical connections made between any earth continuity conductor forming part of an electrical installation in a caravan of the British Broadcasting Corporation or the Independent Broadcasting Authority used for the purpose of outside broadcasts and the supply neutral conductor in the circumstances described in recital (2) above if one of the following conditions is satisfied:

- either (a) the chassis of the caravan is effectively connected to earth either by means of a metal spike driven into the earth near the caravan or by connection to the metal frame of a building or other metalwork near the caravan which is itself effectively connected to earth;
- or (b) the electricity supply to the installation in the caravan is given by means of a cable sheathed in metallic braid, that braid and the earth conductor of the cable both being connected to the chassis of the caravan and to effectively earthed metalwork at the premises or the Board's works from which the supply is taken.

Dated

19

Authorised by the Secretary of State
for Energy to act in that behalf.



DEPARTMENT OF ENERGY
 Thames House South, Millbank, LONDON, SW1P 4QJ
 Telephone: Direct Line 01-211
 Switchboard 01-211 3000

13 December 1982

Dear Sir

MULTIPLE EARTHING APPROVALS

It has in the past been necessary to issue 'ad hoc' Approvals to allow multiple earthing of the neutral to be applied to distributors which have two phase conductors and a neutral conductor whose cross-sectional area is less than that of a phase conductor. Such Approvals have been desirable, for example, in town centres where old but still usable concentric cable is installed. Experience in applying additional earths and PME to such systems has been fully satisfactory and it has been decided to include such systems in the "blanket" multiple earthing Approvals issued to all Area Boards. This decision necessitated a change in the wording of the Approvals and the opportunity to re-write them in a more easily understood and modern format has been taken. The new format is also more acceptable from a legal aspect.

While there are major changes in layout and minor ones in the definitions the only changes of substance in the new Approvals are:

- (a) The removal of the bar on the general use of multiple earthing of the neutral on two phase and neutral systems where the neutral conductor is of lesser cross sectional area than a phase conductor. The new position is that such systems are within the blanket Approval if the neutral has a cross sectional area of at least half that of the smallest phase conductor. This applies to systems fed from two phases of a three-phase system as well as those rarer cases where there is a two-phase supply.
- (b) The Approvals now include where relevant a table, felt to be necessary for legal reasons, which relates the size of the main equipotential bonding conductor to the size of the neutral at the supply terminals. These requirements are generally in line with those of the 15th Edition of the Institution of Electrical Engineers. Wiring Regulations. While a strict application of the Wiring Regulations (543-2) can result in a 6mm² bonding size where the Board's fuse link is of 60 or 80 Amp rating the general trend towards the use of 100 Amp fuse links and the desirability of having a size which is and will be nationally applicable to all domestic premises of a normal type has resulted in the adoption of a minimum bonding size of 10 mm².
- (c) In the Street Lighting Approval the minimum size of the bonding conductor is now specified as 6mm² copper equivalent or as the size of the neutral conductor whichever is the less.



The new format is followed in all the relevant Approvals which are:

(a)	Street Lighting	(blanket)
(b)	MEN	(blanket)
(c)	PME	(blanket)
(d)	ESRW	(ad hoc)
(e)	Consumers CNE Distribution	(ad hoc)

The three "blanket" Approvals (a), (b) and (c) previously issued to all Area Boards are to be replaced by the enclosed three new blanket Approvals. The new Approvals, which are not retrospective in their requirements, have an operative date of 1st May 1983.

Additionally the special blanket Approval allowing the use of PME for outside broadcasting vehicles has been re-written and re-issued and here the opportunity has been taken to widen its scope to allow connection direct from a Board's own works as well as from private premises.

Yours faithfully

R G ANSTEE
