Case S-0001-14

Electricity Safety Standards and Rules

URA electricity standards and rules regulating works and safety of persons in the vicinity of electricity grids

December 2014

The Rules and the 1st Amendment have been approved by the Utilities Regulatory Authority and gazetted.

The Rules

1. Introduction

1.1. The Rules

Under the Utilities Regulatory Authority Act (**URA Act**) the URA is mandated to ensure the provision of safe, reliable and affordable regulated services, maximize access to regulated services throughout Vanuatu and promote the long term interests of consumers. To achieve its purpose, the URA has been specifically empowered to issue safety standards and rules in relation to the safety of a regulated service (electricity service) and safety orders directing any person to do or refrain from doing anything in relation to the safety of a regulated service. Additionally, the URA has the power to employ a safety inspector to investigate potential safety hazards.

To effectively fulfill this function, the URA is adopting and approving these Electricity Safety Standards and Rules (**Rules**), which prescribe:

(a) safe distances applicable to persons working within the proximity of an electricity grid;

(b) safe distances between the network and objects such as infrastructure, non utility cables, designated public areas/zones and vegetation located within the proximity of an electricity grid;

(c) the conditions that persons have to conform to when working or operating machinery within the proximity of an electricity grid; and

(d) the roles and responsibility of the utility, the public, Government authorities and the URA in relation to the Rules.

1.2. Objective

The URA is adopting these Rules:

(a) to minimize electricity safety incidents that may occur as a result of people working near or under an electricity grid; and

(b) to ensure utility activities and other business activities are conducted unhindered without burdening the persons involved.

(c) to ensure fairness, transparency, consistency in URA's actions with due process when addressing complaints regarding application of safety Rules.

1.3. Applicability

The Rules apply to construction of Grids (as defined below) in Vanuatu.

The Rules regulate actions or inactions of persons working in the vicinity of the Grids in Vanuatu to ensure safety of public and Grid.

All professionals, workers, builders and contractors involved in work(s) in the vicinity of the Grid must adhere to the Rules.

The Rules are to apply to any works begun after the commencement date of this Order; existing grids in operation or works begun before the aforementioned date are not concerned.

To ensure public safety, Governmental authorities responsible for approving certain activities by the public in the vicinity of the Grid must also adhere to these Rules. In the event approvals/permits are granted by authorities to the public for works that are in contravention of the Rules, the URA will hold the permit holder responsible and be compelled to issue safety orders against the person (individual or entity) who requested the approval/permit or is carrying out the work.

1.4. Contravention of the Rules

In the event of non-compliance with the Rules the URA would be entitled to issue safety orders pursuant to the URA Act against the person(s) directly or indirectly responsible for non-compliance, including order such person(s) to cease and desist from performing certain actions, destroy the construction built in contravention of the Rules, etc. Non-compliance with a safety order will result in an issue of infringement notice and levy of penalty by the URA against such person in accordance with the URA Act and the rules and regulations issued pursuant thereto.

1.5. Planned Activity Permit

1.5.1 Prospective Construction Work

(a) Prior to commencing construction work (including extension of existing premises or infrastructure) within 10 metres of the Grid, a prospective builder must approach the relevant utility in writing and request for an approval in respect to that proposed construction work. The prospective builder must provide all relevant information to the utility necessary for the utility to review the proposal and give access to the relevant construction site such as location of works, type of activities to be undertaken and commencement date. Upon examination of information and inspection of site, the utility shall determine if the proposal is in compliance with the Rules and shall accordingly issue an approval (Permit). The utility shall complete its examination and inspection and give a reasoned response in writing within 10 (ten) days of the application. The response must clearly and concisely state whether the proposal is in compliance or contravenes the Rules and reasons for the same.

(b) The utility may inspect the site, but only during normal working hours and by giving the applicant prior notices of when the inspection shall be made. The representative of the utility during the inspection must carry appropriate identification, authorization documents and disclose to the persons on site the reason for the visit.

(c) In the event the proposed work plan set out in the application contravenes the Rules, the utility must inform the applicant of changes that may be made to the proposed work so that it is in compliance with the Rules.

(d) Once a Permit is obtained from the utility, the applicant must implement the project consistent with the plans submitted to the utility. In the event of any material deviation from the information

provided to the utility that may impact the safety, revised plan should be submitted to the utility and permission obtained.

(e) If the applicant performs its actions in accordance with the Permit and such actions result in a violation of the Rules, the responsibility shall lie with the utility.

(f) When issuing the Permit, the utility shall also provide the applicant with updated technical drawings and schematics of the Grid within the vicinity of the areas as stated in the Permit.

(g) If a prospective builder commences construction without first obtaining a Permit, the utility shall not provide it temporary electricity service, or, where appropriate, terminate the electricity source that the person is using for such construction purposes.

1.5.2 Visual displays or advertisements

No person shall put up a signage, banner, by whatever name called, on the poles, wire, transformers, sub-stations, etc. without first obtaining an authorisation from the utility in accordance with Rule 1.5.1. If the applicant performs its actions in accordance with the authorization and such actions result in a violation of the Rules, the responsibility shall lie with the utility.

1.5.3 Aerial and Earth work:

Prior to undertaking any aerial or earth work including road works, laying of underground telephone cables, installation of overhead telephone lines internet lines, fiber optics, other services or maintenance works, the person must notify the utility in writing at least 10 working days before commencing work. Such intimation must be given on a normal working day.

(a) Once such intimation is received by the utility, it shall be the responsibility of the utility to inspect the site prior to commencement of work and, if necessary, request for information from such person to ensure that such aerial or earth work is in compliance with the Rules. If the utility suspects that the work may be in contravention of the Rules, it must inform the person and URA in writing immediately and give reasons and corrective measures that may be taken to ensure compliance with Rules.

(b) If such work is in contravention of the Rules and if the utility could reasonably have identified such violation at the time of its inspection or review of information and failed to inform the person and URA in accordance with sub-rule (a), the responsibility shall lie with the utility.

(c) Notwithstanding anything provided in sub-rule (a), if aerial or earth work is required to be undertaken immediately on account of an emergency, the person undertaking the work must inform the utility immediately of the emergency. The person and the utility must cooperate in good faith and ensure that the work is carried out safely and in accordance with the Rules. The utility must treat all emergency cases as priority and inspect the site promptly.

For the purposes of this sub-rule an emergency shall mean any situation that requires immediate attention and rectification failing which it may cause serious injury or death to any person, serious environmental pollution or serious damage to critical infrastructure.

1.5.4 Additional Utility Role and Obligation

In the event of any contravention or expected contravention of the Rules or Permit/authorization etc., the utility shall promptly intimate the URA and request for a safety order. The utility shall timely perform all actions and take such corrective measures as instructed by URA in the safety order and assist in the swift execution and implementation of the safety order.

1.6. Fee

1. Rule 1.6

1.6.1 The utility shall charge the following application fee for a Planned Activity Permit:

(a) 1500 vatu for residential buildings

(b) 3000 vatu for non-residential buildings

(c) 5000 vatu for construction works related ground surface infrastructures other than buildings and for underground infrastructures

1.6.2 The utility shall not charge any fees for activities performed under these Rules other than the fees set out in rule 1.6.1.

1.7. Obligation of utility to inform the public

The utility shall display the Rules on its website.

The utility shall quarterly publish an advertisement in a widely circulated newspaper in its concession area so as to remind the public of their obligations under the Rules.

Utility shall keep in all their office(s) copies of the Rules and shall provide them to the public, if so requested, free of charge.

The utility must inform the public by posting on its website of the department/designated person who may be contacted for any queries that the public may have in respect of the Rules or application for Permit/authorisation, etc.

2. <u>Definitions</u>

Terms used in these Rules shall have the same meaning as assigned to them in the URA Act. The following terms shall have the meaning as set out below:

(i) **Grids**: means HV and LV electricity grids, the public networks for the supply and conveyance of electrical energy and ancillary facilities. These include street lighting facilities jointly connected to a supply grid or otherwise.

(ii) **Fixtures and fittings**: means all the equipment and appliances (electrical or otherwise) installed in private premises and which are not works.

(iii) **Contractor**: means any undertaking carrying out works distinct from the subcontractors of the utility.

(iv) **Buildings**: includes any construction on the ground in excess of 3 metres high ordinarily accessible by persons":

(a) Ground surface infrastructure: visible structures that are built on the ground surface such as roads, towers, fences, billboards etc.

(b) Underground infrastructures: structures that will be build underground such as cables conduits, water supply pipes, railways, tunnel etc.

(v) **Voltage range**: (HT = high voltage - HV; BT = low voltage LV; TBT = very low voltage - VLV).

Voltage	***DC range***	***AC range***
VLV	0 <voltage ≤ $120V_{DC}$	0 < voltage ≤ $50V_{AC}$
LV	120 < voltage ≤ $1500V_{DC}$	50 < voltage ≤ $1000V_{AC}$
HV A	1500 < voltage ≤ $75000V_{DC}$	1000 < voltage ≤$50000V_{AC}$
HV B	voltage exceeding $75000V_{DC}$	voltage exceeding $50000V_{AC}$

3. Safety of members of the public and workers in the vicinity of grids

3.1. Safety distances for contractors and other persons

Where work or activities are taking place near grids, contractors and members of the public are prohibited from entering the following areas:

(a) Within less than 3 metres from HV/LV lines in the case of overhead grid that is not insulated (bare cables)

(b) Within less than 1 metres from HV/LV lines in the case of insulated overhead grid

(c) Within less than 0.5 metres from HV/LV lines in the case of underground grid if work is carried out with mechanical gear. Work is allowed if agents of the utility are in attendance on site for control purposes and the work is carried out by hand.

3.2. Right of the utility in the event of non-compliance with distances by any person or contractor

Where a contractor or a person is found to be working in a restricted area, the operations officer of the utility or his agent is empowered to stop works if there is any imminent risk. A letter is to be addressed to the person concerned setting out the grounds for such decision with recommended solution, with copy to the Utility Regulatory Authority. In the event of dispute on site, the police will be called to enforce compliance with the distances specified in these rules.

4. Overhead HV grids (power lines)

4.1. General guidelines in relation to overhead HV power lines

(a) The supply grids are usually designed for three-phase 50 Hz alternating current supply with a nominal voltage of 5.5 kV, 20 kV or 33 kV.

(b) The lines are installed either as bare conductors or as insulated conductors, on reinforced or pre-stressed concrete supports, or timber or metal poles.

(c) Protection against direct contact is ensured by keeping a certain distance.

(d) Each support or pole must carry a warning about the danger of lines that have fallen on the ground and the risks of climbing the support.

(e) Distances from the ground of overhead power lines are indicated for a maximum temperature of the lines reached under normal operation, for HV it is set at 40°C.

4.2. Safety distance above ground – Bare HV lines

The minimum distance to be observed above ground is 6 m vertically and 3 metres sideways.

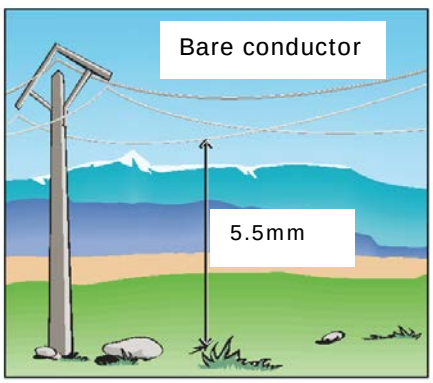

Figure 1: Safety distance between bare HV conductor and ground

(a) The vertical distance may be reduced to 5.5 metres as a result of the natural ground being uneven occurring within a small area along a straight line (a few square metres) causing an obstacle for traffic. This distance is also applicable to HV grids in rural areas and villages, with no or minor traffic.

~~(b)~~ Across a road open to public vehicle traffic (excluding private roads and access), the minimum vertical distance to be observed is increased to 8 metres.

4.3. Safety distance within the vicinity of buildings – Bare HV lines

(a) In the vicinity of all buildings (see definition), the minimum distance to be observed over and above is 3.2 metres and sideways 3 metres, except for protruding parts usually accessible to persons (balconies, terraces, footbridges), where the prescribed distance is 6 metres vertically and 3 metres sideways.

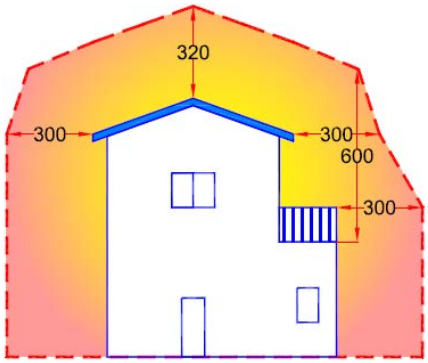

Figure 2: Prohibited zone for bare conductor (distances in centimetres)

(b) Protruding parts of buildings not normally accessible to the public (antennas, signs, lights), premises restricted to electricians, fixtures and fittings such as advertising sign boards, bus shelters, etc. are excluded. In such cases, the minimum distance to be observed in every direction is 3 metres.

(c) Construction of a new building under a bare HV line is prohibited

4.4. Safety distance above ground – insulated HV lines

(a) The minimum distance to be observed above ground is 5 metres vertically and 1 metres around.

(b) The vertical distance may be reduced to 4.5 metres as a result of the natural ground being uneven occurring within a small area along a straight line (a few square metres) causing an obstacle for traffic.

(c) Across a road open to traffic (excluding private roads and access), the minimum vertical distance to be adhered to is increased to 8 metres.

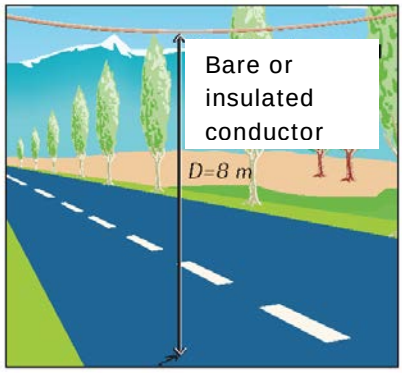

Figure 3: Safety distance between public road and insulated HV line

4.5. Safety distance in the vicinity of buildings – insulated HV lines

(a) In the vicinity of all buildings (see definition), the minimum distance to be observed over and above and sideways is 1 metres, except for protruding parts usually accessible to persons (balconies, terraces, footbridges), where the prescribed distance is 5 metres vertically and 1 metres sideways.

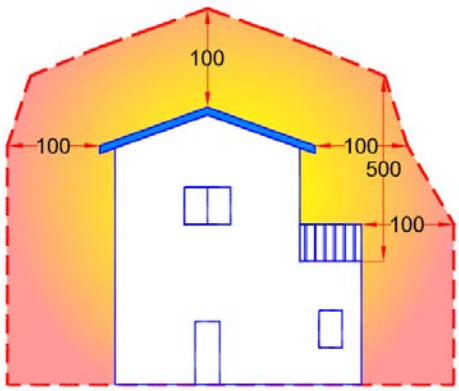

Figure 4: Prohibited zone for HV bare conductor (distances in centimetres)

(b) Protruding parts of buildings not normally accessible to the public (antennas, signs, lights), premises restricted to electricians, fixtures and fittings such as advertising sign boards, bus shelters, etc. are excluded. In such cases, the minimum distance to be observed in every direction is 1 m.

(c) Construction of a new building under a insulated HV line is prohibited

4.6. Safety distance from telephone lines – HV lines both bare and insulated

(a) Where an HV overhead power line cuts across an overhead telephone line, the power line must run above it, and the minimum distances to be complied with are as follows:

(i) 2 metres for bare conductors

(ii) 1 metre for insulated conductors

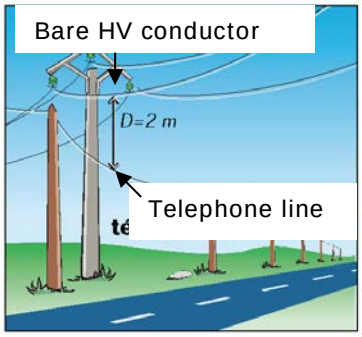

Figure 5: Safety distance between telephone line and bare HV conductor

(b) Where an HV overhead power line runs alongside an overhead telephone line, both with their own supporting poles, the minimum distance to be complied with is:

(i) 2 metres for bare conductors

(ii) 1 metre for insulated conductors

(c) Telephone lines may be supported, in whole or in part, on the same poles as an HV power line, in which case:

(i) The power line must be above the telephone line by at least 2 metres for bare or insulated conductors.

(ii) The insulating level of the telephone line in relation to the mass of the power line must be at least 6 000 V.

(iii) Any work on the telephone line has to be carried out with the consent of the utility or in compliance with the terms and conditions specified by the latter under an agreement.

4.7. Safety distance from obstacles – HV lines, both bare and insulated

In the case of constructions on the ground not normally accessible to the public (street lamps, posts, and advertising signs), the minimum distances to be observed are:

(a) 3 metres for bare conductors

(b) 1 metre for insulated conductors

4.8. Educational, sporting or open air recreational facilities in the vicinity of HV lines, both bare and insulated

(a) The poles/ supports are not to be installed within the enclosure of any educational or sporting facilities. If this requirement cannot be met, for some exceptional reason, every measure is to be taken so that the area in the immediate vicinity of the poles installed inside such areas is not accessible.

(b) No conducting pole (steel, concrete, timber with down earth wire, etc) is to be established at less than 10 metres from an open air swimming pool.

5. <u>Overhead LV power lines</u>

5.1. General guidelines for overhead LV power lines

(a) The supply grids are usually designed for a three-phase supply of alternating current, 50 Hz, with a rated voltage between 220 and 240 V (phase-neutral) and between 380-410 V (phase-phase).

(b) The lines are installed as insulated conductors on supports made of reinforced or pre-stressed concrete, timber or steel.

(c) Protection against direct contact is ensured by the insulation of the cable and the distance.

(d) Distances from the ground of overhead power lines are indicated for a maximum temperature of the lines reached under normal operation, for LV it is set at 40°C.

5.2. Safety distance above ground – insulated LV lines

(a) The minimum distance to be observed above ground is 5 metres vertically and 0.3 metres around.

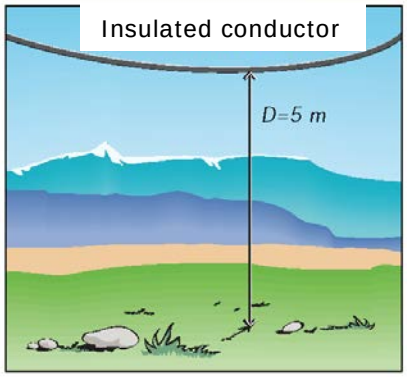

Figure 6: Safety distance between ground and insulated LV line

(b) The vertical distance may be reduced to 4.5 metres as a result of uneven ground occurring naturally within a small area along a straight line (a few square metres) causing an obstacle for traffic.

(c) This basic distance may be reduced to 4 metres over restricted passages between building frontages, if such passages are not used by vehicles in excess of that height. This distance is also applicable for LV grids in rural areas and villages, with no or minor traffic.

(d) Across a road open to traffic (excluding private roads and access), the minimum vertical distance to be observed is increased to 6 metres.

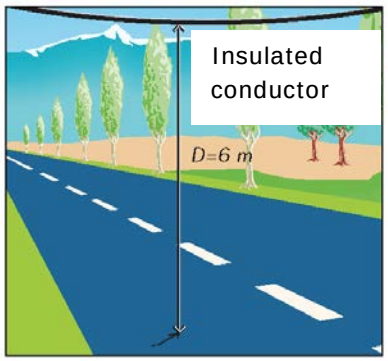

Figure 7: Safety distance between public road and insulated LV line

5.3. Safety distance in the vicinity of buildings – insulated LV lines

(a) Insulated conductors along a front wall: The minimum distance is set at 0 metres between insulated conductors and a front wall and shall be increased where necessary to ensure that damage to cable insulation is avoided and public safety is not compromised. Safety distances need to be observed in relation to windows and any other metallic component. The conductors are to be kept out of reach by placing effective obstacles or through insulation. In particular,

they must be protected from the shock of metal hand-tools all along their height below 2 metres down to the ground.

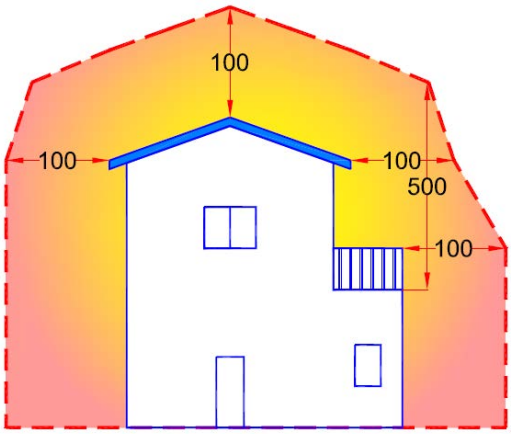

Figure 8: Prohibited zone for LV bare conductor (distances in centimetres)

(b) No connector is to be within reach in those areas accessible by persons, the minimum distance being 2 metres.

5.4. Safety distance from telephone lines – Insulated LV lines

(a) Where an overhead LV power line cuts across a telephone line, the power line must be located above, at a minimum distance of 1 metre.

(b) Where a LV overhead power line runs alongside an overhead telephone line, both with their own supporting poles, the minimum distance to be complied with is 1 metre.

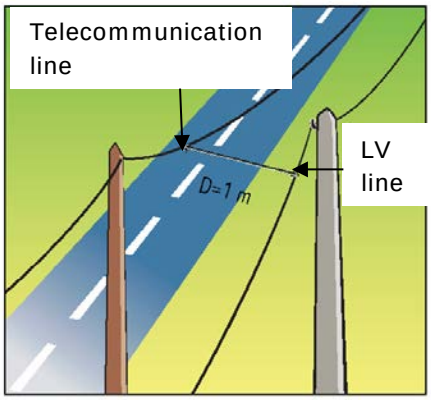

Figure 9: Safety distance between LV overhead line and telephone line

(c) Where a LV overhead power line and a telephone line are supported by common poles, the power line is to be located above at a minimum distance of 0.25 metres.

5.5. Educational, sporting or open air recreational facilities in the vicinity of insulated LV power lines

Overhead LV power lines stretching over educational, sporting or open air recreational facilities must be installed as insulated conductors.

6. Overhead HV and LV grids: In the vicinity of other grids or networks, safety distances from trees and miscellaneous items

6.1. Construction of a new overhead HV power line

Where a new HV line cuts across or runs alongside an existing HV or LV line, the minimum distance to be observed:

(a) if the HV line is a bare conductor is 2 metres;
(b) if the 2 lines are insulated conductors they can be as close as possible as long as there is sufficient spacing between cables to avoid the risk of rubbing and deterioration of insulating material

6.2. Construction of a new overhead LV power line

(a) Where a new LV line as insulated conductor cuts across or runs alongside an existing HV line, the minimum distance to be observed:

(i) if the HV line is a bare conductor is 2 metres;

(ii) if the 2 lines are insulated conductors they can be as close as possible as long as there is sufficient spacing between cables to avoid the risk of rubbing and deterioration of insulating material.

(b) Where a new LV line as insulated conductor cuts across or runs alongside an existing insulated LV line, the minimum distance between the cables can be as close as possible as long as there is sufficient spacing between cables to avoid the risk of rubbing and deterioration of insulating material.

6.3. Dual lines HV (bare conductors) and LV overhead power lines

Where a LV line, as bare or insulated conductor, and an HV line as bare conductor are both installed on the same poles or share at least one pole, the following requirements are to be complied with:

(a) The LV conductors are to be located below the HV conductors, at least 1 metres below on the poles.

(b) On each pole, between the two power lines, a warning device is to be installed so as to remind any workers called upon to work on the LV line of the danger that the HV line presents for them.

(c) The insulating level of the LV line in relation to the pole must be at least 6 000 V.

(d) This provision is not applicable on HV-LV aerial substation.

6.4. Dual lines HV (insulated conductors) and LV overhead power lines

Where a LV line, as bare or insulated conductor, and a HV line as insulated conductor are both installed on the same poles or share at least one pole, the following requirements are to be complied with:

(a) The LV conductors are to be located below the HV conductors, at an interval of at least 1 metre on the poles

In addition, at least one of the following three requirements must be met:

(a) The insulating level of the LV line in relation to the pole is to be at least 6 000 V.

(b) The carrier of the overhead cables bearing the HV line (line to ground) is isolated from the pole by an insulating material at a level of at least 6 000 V.

(c) The pole is not considered to be a conductor (timber, for example).

6.5. Construction of non insulated HV grids in the vicinity of trees

For the construction of HV lines as non-insulated conductors and as suspended insulators, it is necessary to trim tree branches appropriately in order to comply with the following distances:

(a) For trees growing over and above the grid, the branches must be at a distance of more than 5 metres away from the cables sideways, in zero wind conditions, and must not overhang, this is prohibited.

(b) For trees remaining at a height below the grid, the branches must be at a distance of more than 3 metres away from the cables, in all directions, in zero wind conditions.

6.6. Construction of insulated HV/LV grids in the vicinity of trees

(a) For lines established as insulated conductors, the branches, in zero wind conditions, must be more than 1 metre away from the cables, in all directions, and not overhang the power line, this is prohibited.

6.7. Grids in operation in the vicinity of trees

(a) For HV grids as bare conductors, the minimum distance to be observed is not to be less than 2 metres in all directions, under conditions of maximum temperature (40 °C) and zero wind. No overhanging branches over the power line, this is prohibited.

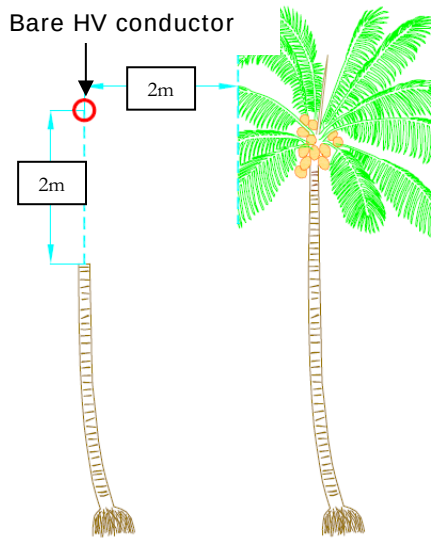

Figure 10: Safety distances between trees and bare HV conductors

(b) Guard against the risk of rubbing and deterioration of the insulating material must be ensured at all time for grids as insulated conductors (HV and LV).

(c) Regular inspections of the overhead lines are to be carried out in order to detect any faults/ deficiencies and assess the trimming and felling of trees that may be necessary, especially in the case of trees that are dead or dying and likely to fall on the lines. The dates and findings of such inspections are to be recorded in a book or kept together in a file available to the inspection division.

6.8. Rules jointly applicable to overhead HV and LV power lines

(a) Safety distance in respect of waterways (river and sea):

(i) In the absence of any river or maritime navigation regulations, the safety distance overhead is 8 metres.

(ii) Where a mast height 'h' is specified in river or maritime navigation regulations, the safety distance overhead is 'h'.

(b) Pyrotechnic establishments: The minimum distance of HV/LV grids from such establishments is (excluding the service connection):

(i) 20 metres for bare conductors

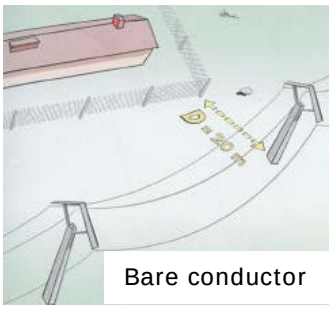

Figure 11: Safety distance of bare over heard power lines from Pyrotechnic establishments

(ii) 10 metres for insulated conductors

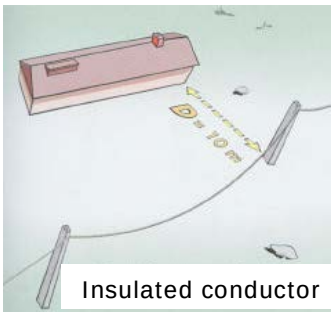

Figure 12: Safety distance of insulated over heard power lines from Pyrotechnic establishments

(c) Premises where inflammable products are stored: It is forbidden to have HV/LV lines running over specified areas of liquid or gaseous inflammable products.

6.9. Lighting devices located on poles carrying overhead power lines

Lighting devices and their accessories, when installed on poles carrying overhead power lines must be located at least 2 metres away from the bare HV conductors.

6.10. Exceptional case of aero-underground rises

Insulated conductors can be located at heights below the height prescribed in the preceding sections as long as they run along a support or a building. Appropriate mechanical protections (steel tube, section…) must safeguard the cables from the shocks of metal hand-tools, from 0.5 metres below ground level up to 2 metres above, at least.

7. <u>Underground grids</u>

7.1. General guidelines in respect of underground grids

(a) Buried electricity ducts are to be protected against damage caused by subsiding soil, contact with hard items and the shock of metal hand-tools.

(b) As a rule, cables are laid within the public domain reserve, and preferably beneath footpaths.

7.2. Safety distance for underground grids

(a) Cables are buried with or without additional protection (conduits or bed of sand) down to a minimum depth of 0.65 metres under a footpath or shoulder of a road and 0.85 metres under the surface of a road and any other cases. These measurements are to be taken from the upper part of the cable once laid.

(b) In the event of any particular constraint, the depth can be reduced provided appropriate mechanical protection means are installed (synthetic conduits embedded in concrete, metallic conduits, …) in order to protect the cables from compressive pressure caused by movements at the surface and shocks that can be caused by tools such as pickaxes or shovels.

7.3. Safety distance between underground grids and other networks or grids

(a) A minimum distance of 0.20 metres is to be observed at the junction of two buried electrical ducts and the junction of a buried electrical duct and a telephone cable.

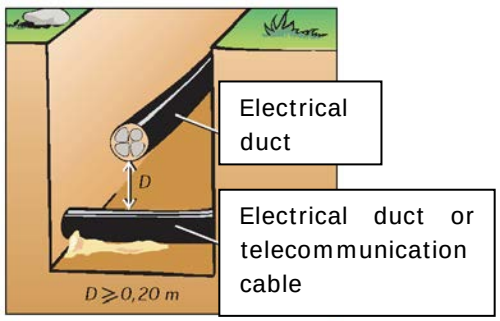

Figure 13: Safety distance between underground electrical ducts and other underground network

(b) The following minimum distances are to be observed in the vicinity of a buried electrical duct (not being a junction):

(i) 0.50 metres in respect of a telecommunications cable buried directly into the ground.

(ii) 0.20 metres in respect of a telecommunications cable within a sheath.

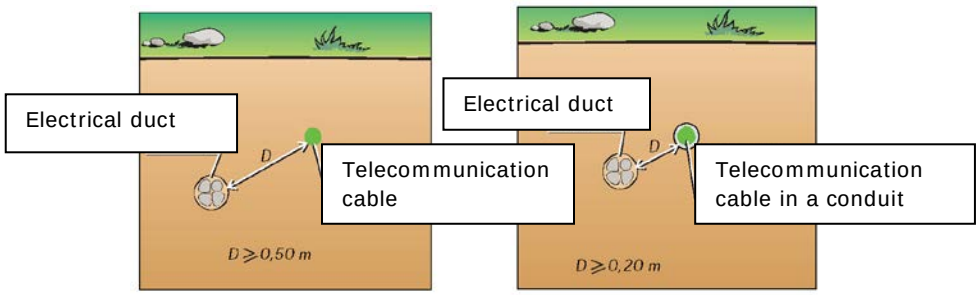

Figure 14: Safety distances between underground conductors and telecommunication cables

(c) A minimum distance of 0.20 metres is to be observed in the vicinity of a buried electrical duct and a water pipe, or pipeline, or gas pipe, compressed air or steam pipe (whether a junction or otherwise).

(d) Such distances can be reduced provided the facilities are separated by a device ensuring sufficient protection against shocks from metal hand-tools.

7.4. Protection and signage for underground grids

(a) When running across under a road, cables are to be protected by synthetic conduits so as to avoid having to reopen the trenches.

(b) In any event, a warning mesh is to be placed 0.2 metres above the upper part of the cable or its mechanical protection.

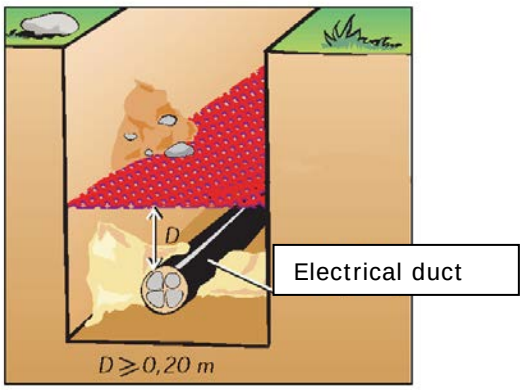

Figure 15: Placement distance of warning mesh

(c) Where cables or sets of cables belonging to different voltage ranges are laid one upon the other, a warning system/ device is to be placed above each one.

(d) The warning device is meant to indicate the proximity of a cable, a set of cables or a duct and its direction and purpose in the event of excavation work.

(e) For electrical ducts, the warning wire mesh is to be in red colour. The colours specified below are reserved for warning devices over buried pipes used for the following purposes:

(i) blue: pressurized water - yellow: gas - brown: waste water/ sewerage - green: telecommunications.

(f) A warning device is not required if the cable is placed in a mechanical protection laid in the underpinning.

(g) Cables can be submersed in swamps, ponds, navigable waterways, streams, channels or other expanses of water as long as they are protected mechanically, if necessary, against any risk of damage (anchors, dredging).

7.5. Underground cabling installed within a construction

(a) Where electricity ducts are installed in technical tunnels which can be visited but are not accessible to the public, the following provisions must be complied with:

(i) The electricity cables and the telecommunication cables are to be installed on separate supports.

(ii) The electricity cables for different voltage ranges are to be installed either on separate supports or separated by partition/ dividing wall with appropriate mechanical resistance

(iii) The electricity cables or sets of electricity cables are to be clearly marked for reference in order to identify them without any problem.

(iv) A minimum distance of 0.40 metres for cables running parallel and 0.20 metres at a junction is to be maintained between electricity cables and telecommunication cables, unless they are sheathed or separated by shelves or partitions resistant to the shock of metal hand-tools.

(v) The accessories of the electricity cables must not generate any damaging mechanical effects on the outside in the event of any internal fault.

(vi) The tracks of metal cables, bare metal ducts and other masses must be connected to the same earth conductor.

7.6. Electrical ducts in buildings

(a) The electrical ducts located in buildings other than those where access is restricted to electricians must be kept out of reach by inserting effective obstacles or by insulation. In particular, they must be protected against the shock of metal hand tools along their whole length up to 2 metres above ground.

(b) When they are set in conduits, such conduits must be designed, or measures taken, so as to ensure that a fire cannot spread out through them.

(c) The earth conductor must be connected to the main equipotential link or contact of the building.

8. <u>Protection against the risk of contact</u>

8.1. Protection against the risk of indirect contact (contact with masses accidentally connected and live)

(a) Measures must be taken to protect persons from the risks that could arise to them from simultaneous contact with grounded and conductor components which could show a difference in potential.

(b) The resistance of the earth is to have a value that is appropriate for the purpose for which the earth is to be used.

(c) The grounding must be connected:

(i) either to an earth with appropriate resistance (HV and LV)

(ii) or to the neutral conductor which is itself earthed as required (LV) if all of the following conditions are met: • immediate and automatic removal of any evident fault between phase and neutral by way of protective devices against over-currents

- overall earth resistance of the neutral conductor allowing for a threshold of 1500 volts in relation to the earths of the consumers' fittings and appliances against excess voltages resulting from the transmission of a HV single phase default to the ground
- no cut-off device on the neutral conductor when combined with the protection conductor.

8.2. Special provisions for LV grids

(a) Three-phase supply must include a neutral conductor connected to a neutral point and directly earthed.

(b) In the case of neutralizing of the grid masses, the main equipotential link of the consumer is to be connected to the neutral, which restricts possible over-voltages on the consumer's wiring and remains consistent with the use of a differential circuit-breaker if the point of separation between the neutral and the protection conductor of the wiring is located upstream from this device.

(c) Two grounding accessible simultaneously by someone must be connected to the same earthing conductor.

(d) For equipment not to have any grounding, it must be insulated twice or reinforced by construction or installation.

(e) The neutral conductor for overhead lines must be earthed at more than one point if the length of the lines exceeds 100 metres and the average number of earthing points along lines serviced by a transformer station must not be less than one per 200 metres of line.

(f) The earthing of the neutral conductor must be effected outside the transformer station so that any temporary increases in potential arising out of some insulating defect on the HV sections are not likely to cause an increase in potential on the LV conductors in excess of 1 500 volts.

(g) Where a cut-off switch cutting off both the neutral conductor and the phase conductors is installed at the exit of the transformer prior to the first earthing of the neutral conductor and the part of the wiring between the transformer and this switch is accessible, the transformer being live, the neutral point of the transformer must automatically be united with the earth of the masses of the transformer station when the switch is on the open position.

(h) In order to achieve better separation between the earth of the neutral conductor and that of the station masses, it is necessary to carry out the initial earthing of the neutral conductor at the grid itself, not on the transformer, for instance at the first pole of the LV line exiting from the transformer station, if it is far away enough that the coupling between the earths is low. The other

earthings are to be effected preferably at the point of branch circuit or connection accessory of the client.

(i) In the case of grid segments on joint poles (bearing both LV and HV lines), earthing of the neutral conductor on the conductor poles (concrete, metal, etc) is to be avoided so as to prevent any risk of communication between the two lines through the neutral conductor in the event of any insulation defect on one of the insulators along the line with the highest voltage; in such case, earthing is to be carried out preferably on those segments that are not on joint poles. In the case of joint grids along a great distance, it is necessary to carry out earthings of the neutral conductor off-side using insulated cables.

(j) The neutral point of the LV grids can be connected to the joint earth in the HV-LV stations connected to the bulk station by underground HV grids.

(k) Where stations are supplied by overhead HV grids, the earth to which the neutral of the LV grids is connected must, as a rule, be electrically separate from the masses, unless the overall earth resistance of the neutral conductor allows for the 1 500 volt threshold in relation to the earths of the consumers' fittings and appliances against excess voltages resulting from the transmission of a fault on the single phase HV to the mass.

(l) The use of green and yellow cable for neutral earthing is prohibited and must be reserved for masses earthing.

8.3. Control/Inspection of the earths and protection conductors

(a) Inspection of the resistance of the earths and the continuity of the protection conductors is to be carried out in the following manner:

(i) Resistance of the earths: During construction and then at least every ten years for earthing of the masses of an HV-LV station supplied from overhead grids, for the earthing of the neutral of a LV overhead grid and the earthing of the masses of a device placed on a pole carrying an HV overhead power line.

(b) Continuity of protection conductors and equipotential links:

(i) During construction, in any event, and then every ten years at the stations.

(ii) If the protection conductor is accessible, continuity can be checked visually, otherwise it must be done by electrical measuring.

(c) The results of the inspections and measurements may be recorded in an electronic file and statements thereof are to be kept available for the inspection division.

9. <u>Miscellaneous</u>

9.1. General guidelines concerning substations

(a) Buildings or parts of buildings ~~without any security~~ in which transformers or circuit-breakers are installed must be locked.

(b) Where there are folding closing doors, the doors must open outwards ; if they open out onto a public road or outbuildings of the river or maritime public domain, they should be able to be folded back and attached to the wall face of the building so as to limit their protrusion as much as possible.

(c) Prominent notices are to be affixed wherever necessary to warn off the public from entering.

9.2. Lightening arresters

The use of spark gaps is prohibited in HV, so lightening arresters with variable resistance should be used to protect against any over-voltages caused by storms. The earth terminals of lightening arresters and spark gaps (LV) are to be connected to the earth of the masses.

9.3. Limiting the exposure of the public to electro-magnetic fields

(a) The location of grid in relation to areas usually accessible to the public under normal operating conditions must be such that:

(i) The electrical field created in such places does not exceed 5 kV/m

(ii) The associated magnetic field does not exceed 100 μT.