

NR 10 –ELECTRICAL SAFETY - INSTALLATIONS AND SERVICES

Publication

GM Ordinance no. 3.214 of June 8th, 1978

D.O.U.

06/07/78

Amendments/Updates

SSMT Ordinance no. 12 of June 6th, 1983

D.O.U.

14/06/83

MTE Ordinance no. 598 of December 7th, 2004

08/09/04

MTPS Ordinance no. 508 of April 29th, 2016

02/05/16

(Text given by GM Ordinance no. 598 of December 7th, 2004)

10.1 - OBJECTIVE AND SCOPE

10.1.1 This Regulatory Norm - (NR) establishes the minimum requirements and conditions aiming the implementation of control measures and preventive systems, in order to ensure the safety and health of workers who directly or indirectly interact in electrical installations and services using electricity.

10.1.2 This NR applies to the generation, transmission, distribution and consumption phases, including the stages of design, construction, assembly, operation, maintenance of the electrical installations and any work performed in the surroundings, observing the official technical standards established by the competent bodies and, in the absence or omission thereof, the applicable international standards.

10.2 - CONTROL MEASURES

10.2.1 For all interventions in electrical installations, preventive control measures of electrical risks and other additional risks shall be adopted, through risk analysis techniques, in order to ensure health and safety at work.

10.2.2 The adopted control measures shall be integrated with other initiatives of the enterprise within the scope of preserving occupational safety, health and the environment.

10.2.3 Companies are required to keep updated single-wire electrical diagrams of electrical installations at their establishments with the specifications of the grounding system and other protective equipment and devices.

10.2.4 Establishments with installed load of more than 75 kW shall establish and maintain an Electrical Installation File. The file should include at minimal, in addition to the provisions of sub-item 10.2.3, the following:

- a) a set of procedures and technical and administrative instructions implemented and related to this NR for health and safety and a description of existing control measures;
- b) documentation of inspections and measurements of the protection system against atmospheric discharges and electrical groundings;
- c) a specification of collective and personal protective equipment and tools, applicable in accordance to what is determined in this NR;
- d) documentation proving the qualification, licensing, training and authorization of workers and any training carried out;
- e) the results of electrical insulation tests performed on personal and collective protective equipment;
- f) certifications of electrical equipment and materials in hazardous areas;
- g) a technical report on the updated inspections with recommendations and adaption timetables covered in subsection "a" to "f".

10.2.5 Companies that operate in installations or equipment that are part of the electric power system shall constitute a file in accordance with the contents of the item 10.2.4 and add the following documents:

- a) a description of emergency procedures;
- b) certifications for collective and personal protective equipment;

10.2.5.1 The companies that perform work in the surroundings of the Electric Power System shall constitute a file including subsections "a", "c", "d" and "e" of item 10.2.4 and subsections "a" and "b" of item 10.2.5.

10.2.6 The Electrical Installation File shall be organized and kept updated by the employer or by a person formally appointed by the enterprise and shall remain available to the workers involved in the electrical installations and services.

10.2.7 The technical documents provided for in the Electrical Installation File shall be prepared by a legally licensed professional.

10.2.8 - COLLECTIVE PROTECTION MEASURES

10.2.8.1 As a matter of priority, in all services performed in electrical installations, applicable collective protection measures to the activities to be undertaken shall be envisaged and adopted through procedures in order to ensure safety and health of the workers.

10.2.8.2 The collective protection measures include, in priority, the electrical de-energizing as established by this NR and, if not possible, employing a safe voltage.

10.2.8.2.1 If it is not possible to implement the provisions of subitem 10.2.8.2., other collective protection measures shall be used, such as: insulation of live parts, obstacles, barriers, signs, automatic power disconnection system, automatic non-reclosing lever.

10.2.8.3 Grounding of electrical installations shall be performed in accordance with the regulations established by competent bodies and, in the absence thereof, shall comply with International Standards.

10.2.9 - INDIVIDUAL PROTECTION MEASURES

10.2.9.1 When collective protection measures are technically infeasible or insufficient to control risks referring to works in electrical installations, appropriate personal protective equipment shall be adopted and suitable for the activities underway, in compliance with the provisions of NR 6.

10.2.9.2 Work clothing shall be suitable for the activities and shall include conductivity, flammability and electromagnetic influences.

10.2.9.3 The use of personal adornments is prohibited for work performed with or near electrical installations.

10.3 - SAFETY ON PROJECTS

10.3.1 It is mandatory that electrical installation designs define the circuit-breakers which have capabilities to re-energizing towards a warning signal that indicates the operating condition.

10.3.2 As far as possible, the electrical design shall provide for the installa-

tion of isolation devices that allow to prevent the circuit from being reenergized.

10.3.3 With respect to the sizing and location of its components and external influences, the design of electrical installations shall consider a safe space when operating and performing construction and maintenance services.

10.3.3.1 Electrical circuits with different purposes, such as: communication, signaling, electric control and traction shall be identified and installed separately, except when technological development enables sharing, and respecting the design definitions.

10.3.4 The design shall define the configuration of the grounding scheme, whether or not the connection between the neutral conductor and the protective conductor and the connection to the ground of the conducting parts not intended for the conduction of electricity are mandatory.

10.3.5 Whenever technically feasible and necessary, sectioning devices incorporating fixed equipotentialisation and grounding for the sectioned circuit shall be planned for.

10.3.6 Every design shall envisage conditions for the adoption of temporary grounding.

10.3.7 The design of the electrical installations shall be available to authorized workers, legal authorities and other persons authorized personnel by the enterprise and shall be kept up to date.

10.3.8 The electrical design shall comply with the provisions in the Occupational Safety and Health Regulatory Norms, the established official technical regulations, and be signed by a legally licensed professional.

10.3.9 The design's specifications shall, at a minimum, contain the following safety items:

a) specifications of the characteristics related to protection against electric shock, burns and other additional risks;

b) indication for the position of the circuit breakers: (Green - "D", off and Red - "L", on);

c) description of the identification system for electrical circuits and equipment, including operation, control, protection and interlocking devices and drivers and their own equipment and structures, defining how such indica-

tions should be applied physically to the components of the installations;

d) recommendations for restrictions and warnings regarding who has access to the installation's components;

e) applicable precautions to external influences;

f) the functional principle of the protection devices, set within the design, intended for people's safety;

g) a description of the compatibility of protective devices with the electrical installation.

10.3.10 Designs shall ensure that facilities provide workers with adequate lighting and a safe working position, in accordance with NR 17 - Ergonomics.

10.4 - SAFETY IN CONSTRUCTION, ASSEMBLY, OPERATION AND MAINTENANCE

10.4.1 Electrical installations shall be constructed, assembled, operated, renovated, expanded, repaired and inspected in a way that ensure the safety and health of workers and users, and be supervised by an authorized professional, in accordance with this NR.

10.4.2 Preventive measures shall be taken in the tasks and activities referred to above to control additional risks, especially with respect to height, confinement, electric and magnetic fields, explosiveness, humidity, dust, fauna and flora and other worsening factors, with the adoption of safety warning signs.

10.4.3 Only electrical equipment, devices and tools compatible with the existing electrical installation may be used at workplaces, preserving the protection characteristics, and respecting the manufacturer's recommendations and external influences.

10.4.3.1 Equipment, devices and tools that have electrical insulation shall be suitable for the voltages involved, and shall be inspected and tested in accordance with existing regulations or manufacturers' recommendations.

10.4.4 Electrical installations shall be maintained in safe operating condition and their protection systems shall be periodically inspected and controlled in accordance with existing regulations and design definitions.

10.4.4.1 Electrical service locations, compartments and enclosures of electri-

cal equipment and installations are exclusive for this purpose, and their use for the warehousing or storage of any objects is expressly prohibited.

10.4.5 Adequate lighting and a safe working position shall be provided for the workers for activities at electrical facilities in accordance with NR 17 - Ergonomics, in a way that allows workers to have their upper limbs free to carry out tasks.

10.4.6 Electrical laboratorial tests or field tests or commissioning of electrical installations shall comply with the regulations established in items 10.6 and 10.7 and shall only be performed by workers who meet the qualification, licensing, training and authorization conditions established in this NR.

10.5 - SAFETY AT DE-ENERGIZED ELECTRICAL INSTALLATIONS

10.5.1 Only the electrical installations freed for work shall be considered de-energized, using the appropriate procedures, complying with the sequence below:

- a) sectioning;
- b) prevention of re-energizing;
- c) confirmation of lack of tension;
- d) installation of temporary grounding with equipotentialization of the circuit conductors;
- e) protection of energized elements in the controlled area (Annex II);
(Amended by MTPS Ordinance no. 508 of April 29th, 2016)
- f) tag out with statement prohibiting unauthorized re-energization .

10.5.2 The state of de-energized installation shall be maintained until the authorization for reenergizing, and it shall be re-energized respecting the order of procedures below:

- a) removal of tools, fittings and equipment;
- b) removal from the controlled zone of all workers not involved in the reenergize process;
- c) removal of temporary grounding, equipotential devices and additional pro-

tections;

d) removal of signage prohibiting unauthorized re-energization;

e) release, if any, and reconnection of the sectioning devices.

10.5.3 The measures set forth in the subsections offered in items 10.5.1 and 10.5.2 may be altered, replaced, expanded or eliminated, depending on the peculiarities of each situation, by a legally licensed and authorized professional with a prior written technical justification, provided that the same level of safety as originally established is maintained.

10.5.4 Any services performed in disconnected electrical installations with the possibility of being energized, by any means or reason, shall comply with the provisions in item 10.6.

10.6 - SECURITY IN ENERGIZED ELECTRICAL INSTALLATIONS

10.6.1 Activities in electrical installations with a voltage equal to or greater than 50 Volts in alternating current or greater than 120 Volts in direct current shall only be performed by workers who comply with the provisions from item 10.8 of this Regulation.

10.6.1.1 The workers referred to in the previous item are required to receive safety training for work at energized electrical installations along with a minimum curriculum, workload and other determinations established in Annex III of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.6.1.2 Elementary operations, like turning electrical circuits on and off, carried out in low voltage, with materials and electrical equipment kept in perfect condition, suitable for operation, may be carried out by any person who is not warned.

10.6.2 Work that requires entrance into the controlled area shall be carried out through specific procedures respecting the distances provided for in Annex II. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.6.3 Services in or near energized installations shall be suspended immediately in the event of an any immediate incident that could put workers at risk.

10.6.4 Whenever technological innovations are implemented or new electrical installations or equipment is to be put into operation, risk analyzes, developed with de-energized circuits, and respective working procedures shall

be prepared in advance.

10.6.5 The party responsible for the execution of the service shall suspend activities when a situation or condition of unplanned risk is perceived, whenever its elimination or immediate neutralization is not possible.

10.7 - WORK INVOLVING HIGH VOLTAGE (HV)

10.7.1 Workers involved in high voltage energized electrical installations who perform their activities within the limits established as controlled and risk areas according to Annex II, shall comply with the requirements of item 10.8 of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.7.2 The workers referred to in item 10.7.1 shall receive safety training that focuses on safety at and near the electrical power system (SEP), and with a minimum curriculum, course load and other determinations established in Annex III of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.7.3 Services in energized high voltage electrical installations, as well as those performed in the Electric Power System - SEP, may not be performed individually.

10.7.4 Every work in energized high voltage electrical installations, as well as those that interact with the SEP, shall only be carried out through a specific service order for the date and location, signed by a senior official responsible for the area.

10.7.5 Before starting work on HV energized circuits, the immediate official and team responsible for the execution of the service shall carry out a prior evaluation, and study and plan the activities and actions that will be undertaken in order to comply with the basic technical principles and the best electrical safety techniques applicable to the service.

10.7.6 Services in energized high voltage electrical installations shall only be done when there are specific procedures that are detailed and signed by an authorized professional.

10.7.7 Any activities at energized high voltage electrical installations within the limits established as a risk zone, according to Annex II of this NR, may only be performed through a deactivation, also known as lock out, of the automatic reclosing sets and devices of the circuit, system or equipment. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.7.7.1 Deactivated equipment and devices shall be tagged, identifying the deactivation condition, according to the specific standardized working procedure.

10.7.8 Insulated equipment, tools and devices or equipped with insulating materials for use in high voltage work are subject to electrical tests or periodic laboratory tests that are in compliance with the manufacturer's specifications, the enterprise's procedures and, in the absence thereof, on an annual basis.

10.7.9 All workers at electrical installations using high voltage, as well as those involved in activities at the SEP, shall have equipment that allows permanent communication with the other members of the team or with the operation center while services are being performed.

10.8 - LICENSING, QUALIFICATION, TRAINING AND AUTHORIZATION OF WORKERS

10.8.1 A qualified worker is one considered to demonstrate the completion of a specific course in the electrical field which is recognized by the Official Educational System.

10.8.2 A worker previously qualified and registered in the professional council is considered to be a legally licensed professional.

10.8.3 A trained worker is someone considered to simultaneously meet the following conditions:

a) received training under the guidance and responsibility of a licensed and authorized professional; and

b) one who works under the responsibility of a licensed and authorized professional.

10.8.3.1 The training shall only be valid for the enterprise that performed the training and under the conditions established by the licensed and authorized professional responsible for the training.

10.8.4 Qualified or trained workers and licensed professionals are considered authorized after a formal consent of the enterprise.

10.8.5 The enterprise shall establish an identification system that allows at any time to know the comprehensiveness of each worker's authorization, according to item 10.8.4.

10.8.6 Workers authorized to work in electrical installations shall have this condition entered into the enterprise's employee registration system.

10.8.7 Workers authorized to undertake activities in electrical installations shall undergo a health examination compatible with the tasks that are to be carried out and performed in accordance with NR 7, along with being registered in their medical records.

10.8.8 Workers authorized to carry out duties in electrical installations shall have specific training on the risks arising from the use of electric energy and the primary measures of accident prevention in electrical installations, in accordance to what has been established in Annex III of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.8.8.1 The enterprise, in the form of this NR, shall grant authorization to the trained or qualified workers and to the licensed professionals who have participated in these courses with a satisfactory evaluation and approval included in Annex III of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.8.8.2 A refresher training shall be conducted every two years or whenever any of the following situations occur:

- a) change of position or change of enterprise;
- b) return to work after a leave or inactivity for a period exceeding three months;
- c) significant changes in electrical installations or changes in methods, processes and organization of the work.

10.8.8.3 The course load and the programmatic content of the refresher training complying with subsections "a", "b" and "c" of item 10.8.8.2 shall meet the needs of the situation that motivated it.

10.8.8.4 Work in hazardous areas shall be preceded by specific training according to the hazards involved.

10.8.9 Workers involved in activities that are not related to electrical installations undertaken in the free zone and in the vicinity of the controlled zone, as defined in this NR, shall be formally instructed with the knowledge to identify and evaluate possible hazards and to adopt the appropriate precautions.

10.9 - PROTECTION AGAINST FIRE AND EXPLOSION

10.9.1 Areas where electrical installations or equipment are located shall be provided with protection against fire and explosion, as provided in NR 23 - Protection Against Fire.

10.9.2 Materials, parts, devices, equipment and systems intended for use in electrical installations in environments with potentially explosive atmospheres shall be evaluated for their conformity within the framework of the Brazilian Certification System.

10.9.3 Processes or equipment likely to generate or accumulate static electricity shall be provided with specific protection and electrical discharge devices.

10.9.4 Protection devices such as an alarm and automatic sectioning shall be adopted in electrical installations at areas that are hazardous or subject to a marked risk of fire or explosion to prevent over voltages, over currents, insulation failures, heating or other abnormal operating conditions.

10.9.5 Services in the hazardous areas of electrical installations shall only be carried out after a work permit that includes a formalized clearance, as established in item 10.5, or suppression of the risk agent that determines the classification of the area.

10.10 - SAFETY SIGNAL

10.10.1 Adequate safety signs shall be adopted in electrical installations and services that are intended for warning and identification, in compliance with the provisions of NR-26 - Safety Signaling, in order to meet, among others, the following situations:

- a) identification of electrical circuits;
- b) lock out of devices and control and command systems;
- c) access restrictions and impediments;
- d) delimitations of areas;
- e) signalling of traffic areas, public roads, vehicles and cargo handling;
- f) tag out to prevent energization;

g) identification of impeded equipment or circuit.

10.11 - WORK PROCEDURES

10.11.1 Services in electrical installations shall be planned and performed in accordance with specific, standardized work procedures that possess a detailed step by step description of each task signed by a professional that complies with what has been established in item 10.8 of this NR.

10.11.2 Services in electrical installations shall be preceded by specific work orders, that are approved by an authorized worker, and minimally containing the type, date, location and references to the work procedures that are to be adopted.

10.11.3 The work procedures shall minimally contain the objective, scope of application, technical basis, competencies and responsibilities, general provisions, control measures and final guidelines.

10.11.4 The work procedures, health and safety training and the authorization referred to in item 10.8 shall be taken into account in any development process from the Specialized Service in Occupational Safety and Health – SESMT, when applicable.

10.11.5 The authorization referred to in item 10.8 shall be in accordance with the training performed, provided in Annex III of this NR. *(Amended by MTPS Ordinance no. 508 of April 29th, 2016)*

10.11.6 All work team shall have one of their workers appointed and able to supervise and conduct the work.

10.11.7 Before starting working in teams, its members, along with the responsible person for the execution of the service, shall perform a preliminary evaluation, study and plan the activities and actions to be carried out in the place in order to comply with the basic technical principles and the best safety techniques applicable to the service.

10.11.8 The alternation of activities shall consider a risk analysis of the tasks and the competence of the workers involved in order to ensure health and safety at work.

10.12 - EMERGENCY SITUATIONS

10.12.1 Emergency actions involving electrical installations or services with

electricity shall be included in the enterprise's emergency plan.

10.12.2 Authorized workers shall be able to perform rescues and provide first aid to injured personnel, particularly through Cardiopulmonary resuscitation (CPR).

10.12.3 The enterprise shall have standardized rescue methods suitable to its activities, providing the means for their implementation.

10.12.4 Authorized workers shall be able to handle and operate firefighting equipment in electrical installations.

10.13 - RESPONSIBILITIES

10.13.1 Liability regarding compliance with this NR is for both parts contracting companies and contractors involved in the process.

10.13.2 It is the responsibility of the contractors to keep workers informed of the hazards which they are exposed to, as well as to instruct them on the procedures and control measures against the electrical hazards that should be adopted.

10.13.3 The enterprise shall propose and adopt preventive control measures, in the event of work accident involving electrical installations and services with electricity.

10.13.4 It is the workers' responsibility to:

- a) look after their safety and health and of others who may be affected by their actions or oversights on the job;
- b) be responsible along with the enterprise for complying with legal and regulatory provisions, including internal safety and health procedures; and
- c) report forthwith to his immediate supervisor any situation which he has reasonable justification to believe presents a serious and imminent danger to his safety or health, and of others.

10.14 - FINAL PROVISIONS

10.14.1 Workers shall discontinue their duties by exercising their right of refusal whenever they find evidence of serious and imminent danger to their health and safety or that of others, immediately informing their superior who shall take appropriate action.

10.14.2 Companies shall promote actions to control risks in their electrical installations originated by others and immediately, when appropriate, file a complaint to the competent bodies.

10.14.3 In the event of non-compliance with the rules in this NR, the Ministry of Labor shall adopt the measures established in NR-03.

10.14.4 The documentation provided for in this NR shall be permanently available to workers who work in electrical services and installations, respecting the comprehensiveness, limitations and activities in the tasks.

10.14.5 The documentation provided for in this NR shall be permanently available to the competent authorities.

10.14.6 This NR is not applicable to electrical installations powered by extra-low voltage.

GLOSSARY

1. **High Voltage (HV)**: voltage greater than 1,000 volts for alternating current or 1,500 volts for direct current, between phases or between phase and the ground.

2. **Hazardous Area**: a place with the potential for an occurrence of an explosive atmosphere.

3. **Temporary Electrical Grounding**: effective and reliable ground connection intended to ensure equipotential bonding and continuously maintained during activities performed at an electrical installation.

4. **Explosive Atmosphere**: a mixture with the air, under atmospheric conditions, of flammable substances in the form of gas, vapor, mist, dust or fibers, in which combustion is spread after ignition.

5. **Low Voltage (LV)**: voltage greater than 50 volts for alternating current or 120 volts for direct current and equal to or less than 1,000 volts in alternating current or 1,500 volts in direct current, between phases or between phase and the ground.

6. **Barrier**: a device that prevents any contact with live parts of electrical installations.

7. **Right of Refusal:** an instrument that assures that a worker may halt a work activity because that person considers that there is a serious and imminent danger to safety and health for the employee or for others.

8. **Collective Protection Equipment (CPE):** a collective, fixed or mobile device, system, or medium, intended to preserve the physical integrity and health of workers, users and third parties.

9. **Segregated Equipment:** equipment rendered inaccessible by casing or barrier.

10. **Extra-Low Voltage (ELV):** voltage not exceeding 50 volts in alternating current or 120 volts in direct current, between phases or between phase and the ground.

11. **External (outside) influences:** variables that shall be considered in the definition and selection of measures of protection for people safety and performance of the components of the installation.

12. **Electrical Installation:** a set of electrical and non-electrical parts associated with coordinated characteristics that are required for the operation of a determined part of an electrical system.

13. **Installation Freed for Services (LV/HV):** an installation which guarantees safe conditions for workers through appropriate procedures and equipment from the beginning to the end of the work and freed up for use.

14. **Prevent re-energizing:** a condition that guarantees the non-energization of the circuit through appropriate resources and procedures, under the control of the workers involved in the services.

15. **Casing:** enclosure of energized parts intended to prevent any contact with internal parts.

16. **Electrical Insulation:** process to prevent the passage of electric current through the interposition of insulating materials.

17. **Obstacle:** element that prevents accidental contact, but does not prevent direct contact by deliberate action.

18. **Hazard:** situation or condition of risk likely to cause physical injury or damage to human health due to a lack of control measures.

19. **Warned Person:** an informed person or with sufficient knowledge to

avoid the dangers of electricity.

20. **Procedure:** sequence of operations to be done in order to perform a determined task, with the inclusion of material and human resources, security measures and circumstances that make it possible to render them.

21. **Electrical Installation File:** a file organized in order to contain a dynamic memory of information pertaining to installations and workers.

22. **Risk:** capacity of a magnitude with the potential to cause injury or damage to people's health.

23. **Additional Risks:** all other groups or risk factors, in addition to electrical, specific to each environment or work processes that, directly or indirectly, may affect health and safety at work.

24. **Signaling:** standardized procedure designed to guide, alert, advise and warn.

25. **Electrical System:** circuit or interconnected electrical circuits intended to achieve a certain objective.

26. **Electrical Power System (SEP):** set of installations and equipment for the generation, transmission and distribution of electric energy up to and including measurement.

27. **Safety Voltage:** extra low voltage from a safe source.

28. **Working in Proximity:** work during which the worker may enter the controlled zone, even if it is with a part of his body or with conducting extensions, represented by materials, tools or equipment that the worker manipulates.

29. **Lock out:** an action intended to maintain, through mechanical means, a switching device fixed in a certain position in order to prevent an unauthorized operation.

30. **Risk Area:** vicinity of a non-segregated energized conductive element, accessible even accidentally, of dimensions established according to the voltage level, which shall only be approached by authorized professionals and with the adoption of appropriate work techniques and instruments.

31. **Controlled Area:** vicinity of a non-segregated energized conductive element, accessible, with dimensions established according to the voltage level.

el and which shall only be approached by authorized professionals.

ANNEX II

Risk Zone and Controlled Zone

Table of radii delimitation of risk, controlled and free zones.

Nominal voltage range of the electrical installation in kV	Rr - Radius of delimitation between risk and controlled zone in meters	Rc - Radius of delimitation between controlled and free zone in meters
1	0.20	0.70
≥1 and <3	0.22	1.22
≥3 and <6	0.25	1.25
≥6 and <10	0.35	1.35
≥10 and <15	0.38	1.38
≥15 and <20	0.40	1.40
≥20 and <30	0.56	1.56
≥30 and <36	0.58	1.58
≥36 and <45	0.63	1.63
≥45 and <60	0.83	1.83
≥60 and <70	0.90	1.90
≥70 and <110	1.00	2.00
≥110 and <132	1.10	3.10
≥132 and <150	1.20	3.20
≥150 and <220	1.60	3.60
≥220 and <275	1.80	3.80
≥275 and <380	2.50	4.50
≥380 and <480	3.20	5.20
≥480 and <700	5.20	7.20

Figure 1 - Distances in the air that radially delimit the risk, controlled and free zones

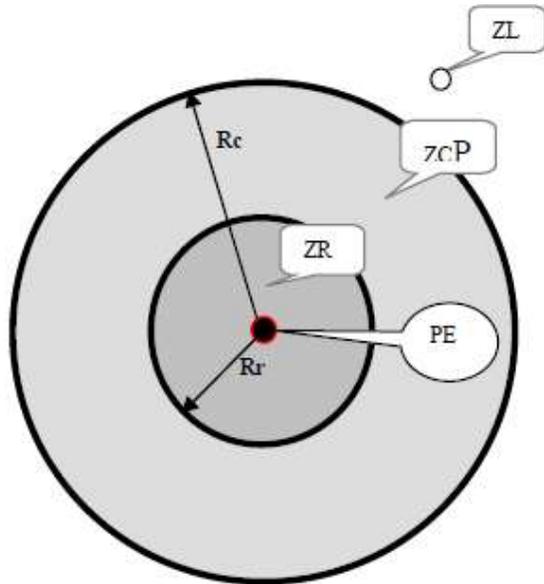
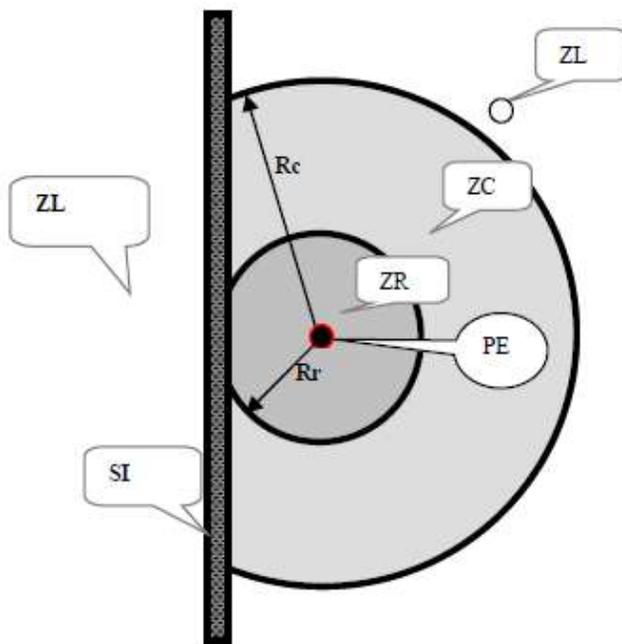


Figure 2 - Distances in the air that radially delimit the risk, controlled and free zones, with interposition of adequate physical separation surface.



ZL = Free Zone

ZC = Controlled zone, restricted to authorized workers.

ZR = Risk zone, restricted to authorized workers and with the adoption of techniques, instruments and equipment appropriate for the activities.

PE = Energized installation point.

SI = Insulating surface constructed of resistant material and equipped with all safety devices.

ANNEX III TRAINING

1. BASIC COURSE - SAFETY IN INSTALLATIONS AND SERVICES WITH ELECTRICITY

I - For authorized workers: minimum course load - 40hrs:

Basic Agenda:

1. introduction to safety with electricity.
2. risks at installations and services with electricity:
 - a) electric shock, mechanisms and effects;
 - b) electric arcs; burns and falls;
 - c) electromagnetic fields.
3. Risk Analysis Techniques.
4. Electrical Risk Control Measures:
 - a) de-energization.
 - b) functional (TN/ TT/ IT), protection and temporary grounding;
 - c) equipotentialisation;
 - d) automatic power disconnection;
 - e) leakage current devices;
 - f) extra low voltage;
 - g) barriers and enclosures;
 - h) lock-out;
 - i) obstacles and bulkheads;
 - j) isolation of live parts;
 - k) double or reinforced insulation;
 - l) placing out of reach;
 - m) electrical separation.
5. Brazilian Technical Standards - NBR of ABNT: NBR-5410, NBR 14039 and others;
6. MTE regulations:

- a) NRs;
- b) NR-10 (Safety in Electrical Installations and Services);
- c) qualification; licensing, training and authorization.

7. Collective protection equipment.

8. Personal protective equipment.

9. Work routines - Procedures.

- a) installations de-energized;
- b) release for services;
- c) signaling;
- d) inspections of areas, services, tools and equipment;

10. Documentation of electrical installations.

11. Additional risks:

- a) height;
- b) confined environments;
- c) classified areas;
- d) moisture;
- e) atmospheric conditions.

12. Protection and fire fighting:

- a) Basics;
- b) preventive measures;
- c) extinction methods;
- d) practice;

13. Accidents of electrical origin:

- a) direct and indirect causes;
- b) discussion of cases;

14. First aid measures:

- a) concepts on injuries;
- b) prioritization of care;
- c) application of artificial respiration;
- d) cardiac massage;
- e) techniques for removal and transport of injured persons;
- f) practices.

15. Responsibilities.

2. COMPLEMENTARY COURSE - SAFETY IN THE ELECTRICAL POWER SYSTEM (SEP) AND IN ITS SURROUNDINGS.

It is a prerequisite to participate satisfactorily in previously defined basic course in order to attend this additional course.

Minimum course load - 40hrs

(*) These topics should be developed and tailored to the working conditions of each branch, standard of operation, level of voltage and other peculiarities specific to the type or special condition of activity, keeping in mind the hierarchy in the technical improvement of the worker.

I - Basic Agenda:

1. Organization of the Electric Power System - SEP.

2. Organization of the work:

- a) programming and planning of services;
- b) teamwork;
- c) Electrical Installation File;
- d) working methods; and
- e) communication.

3. Behavioral aspects.

4. Impeditive conditions for services.

5. Typical SEP risks and their prevention (*):

- a) proximity and contacts with energized parts;
- b) induction;
- c) atmospheric discharges;
- d) static;
- e) electric and magnetic fields;
- f) communication and identification; and
- g) work heights, special machines and equipment.

6. Risk Analysis Techniques in SEP (*)

7. Working procedures - analysis and discussion. (*)

8. Working techniques under voltage: (*)

a) on live line;

b) to potential;

c) in internal areas;

d) work from a distance;

e) night work; and

f) underground environments.

9. Work equipment and tools (choice, use, conservation, verification, testing) (*).

10. Collective protection systems (*).

11. Personal protective equipment (*).

12. Postures and work garments (*).

13. Safety with vehicle and transport of persons, materials and equipment (*).

14. Signaling and isolation of work areas (*).

15. Freeing up an installation for service and for operation and use (*).

16. Training in techniques for the removal, care and transport of injured persons (*).

17. Typical accidents (*) - Analysis, discussion, protective measures.

18. Responsibilities (*).