ARTICLE III
RULES FOR THE INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

Section 301. Duties of mine foreman and superintendent

It shall be the duty of the mine foreman and superintendent to see that the requirements of this article for the installation and maintenance of electrical equipment are observed in all coal mines.

Section 302. Definitions

As used in this article, the following words and terms shall have these meanings:

(1) "Branch circuit"—A branch circuit shall be any tap taken off a main circuit.

(2) "Difference of potential"—The difference of electrical pressure or electromotive force existing between any two points of an electrical system, or between any point of such a system and the earth, as determined by a voltmeter or other suitable instrument. The terms "potential" and "voltage" are synonymous and mean electrical pressure.

(3) “Explosion or flame proof”—Explosion or flame proof casings or enclosures are those which, when completely filled with a mixture of methane and air and the same exploded are capable of either entirely confining the products of such explosion within the casing or of so discharging them from the casing that they cannot ignite a mixture of methane and air, combined in proportions most sensitive to ignition and entirely surrounding the points of discharge, and in most intimate proximity therewith.

(4) “Potential of a circuit”—The potential or voltage of a circuit machine, or any piece of electrical apparatus is the potential difference normally existing between the conductors of such circuit or the terminals of such machine or apparatus.

(5) “Low voltage supply”—Where the conditions of the supply of electricity are such that the difference of potential between any two points in the circuit cannot exceed three hundred volts.

(6) “Medium voltage supply”—Where the conditions of the supply of electricity are such that the difference of potential between any two points in the circuit may at any time exceed three hundred volts, but cannot exceed six hundred and fifty volts.

(7) “High voltage supply”—Where the conditions of the supply of electricity are such that the difference of

potential between any two points in the circuit may at any time exceed six hundred and fifty volts.

(8) “Approved”—Approved means in strict compliance with this act or in the absence of specific mention, approved by the secretary.

(9) “Armored cable”—An armored cable is a cable provided with a wrapping of metal, usually steel wires or tapes, primarily for the purpose of mechanical protection.

(10) “Borehole cable”—A borehole cable is a cable designed for vertical suspension in a borehole or shaft and is used for power circuits in the mines.

(11) “Cable shield”—A cable shield is a metallic shield consisting of nonmagnetic material applied over the insulation of the individual conductors.

(12) “Cable sheath (nonmetallic)”—A cable sheath is a covering consisting of composition tapes, compound jackets of natural or synthetic rubber, thermoplastic or fiber braids applied over the conductor assembly and insulation of multiple conductor cables.

(13) “Circuit breaker”—A circuit breaker is a device which may be controlled by relaying or protective equipment for interrupting a circuit between separable contacts under normal or abnormal conditions.

(14) “Delta-connected”—A delta-connected power system is one in which the windings of transformers or A.C. generators are connected to form a triangular phase relationship, and with the phase conductors connected to each point of the triangle.

(15) “Effectively grounded”—Effectively grounded is an expression which means grounded through a grounding connection of sufficiently low impedance (inherent or intentionally added, or both) so that fault grounds which may occur cannot build up voltages in excess of limits established for apparatus, circuits, or systems so grounded.

(16) “Electric system”—Electric system means all electric equipment and circuits that pertain to the operation of the mine and are under control of the mine management.

(17) “Electrical face equipment”—Face equipment is mobile or portable mining machinery having electric motors or assessory equipment normally installed or operated inby the last open crosscut in any entry or room.

(18) “Flame-resistant cable”—A flame-resistant cable is a cable that has met the department requirements for flame resistance and has been assigned an approved number (P-number). All flame-resistant cables used

underground shall have the “P” number embossed or indented on the jacket at intervals not to exceed twelve feet.

(19) “Ground (earth)”—A ground is a conducting connection, whether intentional or accidental, between an electric circuit or equipment and earth, or to some conducting body which serves in place of the earth.

(20) “Ground or grounding conductor (mining)”—A grounding conductor (also referred to as a safety ground conductor, safety ground and frame ground) is a metallic conductor used to connect the metal frame or enclosure of an equipment, device or wiring system, with an effective grounding medium.

(21) “Primary ground”—A primary ground is a low impedance ground bed or system consisting of several interconnected ground rods or buried conducting mesh, or both, located near an outdoor substation and used as a lightning arrestor or station ground, or separately, as a basic ground for one conductor of a power transmission or distribution system. A single ground rod of any length is not considered a primary ground.

(22) “Lightning arrestor”—A lightning arrestor is a protective device for limiting surge voltages on equipment by discharging or by-passing surge current; it prevents continued flow of follow current to ground

and is capable of repeating these functions as specified.

(23) "Machine operator"—A qualified person who is placed in charge of a portable or mobile face machine of any sort.

(24) "Mine power center"—A mine power center is a combined transformer and distribution unit, and may include a rectifier, complete within a metal enclosure, from which one or more low-voltage or medium-voltage power circuits are taken.

(25) "Neutral point"—A neutral point in a wye-connected A.C. power system means the connection point of transformer or generator windings from which the voltage to ground is nominally zero, and is the point generally used for system grounding.

(26) "Neutral (derived)"—A derived neutral is a neutral point of connection established through the use of a "zig-zag" or grounding transformer with a normally ungrounded delta power system.

(27) "Nonmetallic armor"—Nonmetallic armor means a tough outer covering or cable sheath of rubber, rubber compound or thermoplastic, designed to protect the cable conductors and insulation from abrasion or other damage from external sources.

(28) “Portable (trailing) cable”—A portable cable is a flexible cable or cord used for connecting mobile, portable, or stationary equipment in mines to a trolley system or other external source of electric energy where permanent mine wiring is prohibited or is impracticable.

(29) “Protection (electrical)”—Protection is provided by fuses or other suitable automatic circuit-interrupting devices for preventing damage to circuits, equipment, and personnel by abnormal conditions, such as over-current, high or low voltage and single-phasing.

(30) “Rectifiers”—Rectifiers as referred to in this law means alternating-current to direct-current power conversion devices of the mercury-arc or semi-conductor (silicon, selenium or other) type.

(31) “Wye-connected (Y-connected)”—A wye-connected power system is a system in which one end of each phase winding of transformers or A.C. generators are connected together to form a neutral point, and the other ends of the windings are connected to the phase conductors.

(32) “Zig-zag transformer (grounding transformer)”—A zig-zag transformer is a three-phase transformer used to provide a neutral point on “delta” systems and

capable of carrying continuously the maximum ground fault current of the system.

Section 303. Plan of electrical system

A plan shall be kept at the mine showing the location of all stationary electrical apparatus in connection with the mine electrical system, including permanent cables, conductors, switches, and trolley lines. The plan shall be of sufficient size to show clearly the position of such apparatus, and the scale shall not be less than five hundred feet per inch. There shall be stated on the plan the capacity in horsepower of each motor, and in kilowatts of each generator, rectifier or transformer, and the nature of its duty. Such plans shall be corrected as often as may be necessary to keep them up to date, or at intervals not exceeding six months.

Section 304. Protection against shock

Mats of rubber, insulated platform or other suitable insulating materials shall be provided at all stationary transformers, rectifiers, motors, generators and their controls, except portable and mobile equipment. Gloves or mats of rubber or other suitable insulating material shall be provided by the operator and used by qualified persons so engaged when repairs are made to the energized parts of any electrical apparatus, or

when the energized parts of electrical apparatus have to be handled for the purpose of adjustment.

Section 305. Restoration from shock

Instruction shall be posted in every generating, transforming and motor room and at the entrance to the mine, containing directions as to the restoration of persons suffering from electric shock, and all employees working in connection with electrical apparatus shall be familiar with and competent to carry out these instructions.

Section 306. Report of defective equipment

In the event of a breakdown or damage or injury to any portion of the electrical equipment in a mine, or overheating, or the appearance of sparks or arcs outside of enclosed casings, or in the event of any portion of the equipment, not a part of the electrical circuit, becoming energized, the equipment shall be disconnected from its source of power, the occurrence shall be promptly reported to a mine official, and the equipment shall not be used again until necessary repairs are made.

Section 307. Damage or alteration to mine electrical system

No person shall willfully damage or, without authority, alter or make connections to any portion of a mine electrical system.

Section 308. Capacity

All electrical apparatus and conductors shall be sufficient in size and power for the work they may be called upon to do, and as hereinafter prescribed, efficiently covered or safeguarded, and so installed, operated, and maintained as to reduce danger from accidental shock or fire to the minimum, and shall be of such construction, and so operated, that the rise in temperature caused by ordinary operation will not injure the insulating materials. Where these conditions are not met, affected equipment shall be removed from service until corrective action is taken.

Section 309. Joints in conductors

All joints in conductors shall be mechanically and electrically efficient. Suitable connectors or screw clamps shall be used. All joints in insulated wire shall, after the joint is complete, be reinsulated to at least the same extent as the remainder of the wire.

Section 310. Cables entering fittings

The exposed ends of cables, where they enter fittings of any description, shall be protected and finished off so that moisture cannot enter the cable, or the insulating material, if of an oily or viscous nature, leak. Where unarmored cables or wires pass through metal frames, or into boxes or motor casings, the holes shall be substantially bushed with insulating bushings, and, where necessary or required, with gas-tight bushings which cannot readily become displaced.

Section 311. Switches, fuses and circuit breakers

(a) Fuses and automatic circuit breakers shall be so constructed as to effectively interrupt the current on short circuit, or when the current through them exceeds a predetermined value. Open type fuses shall be provided with terminals. Circuit breakers shall be of adequate interrupting capacity.

(b) Circuit breakers used to protect feeder circuits shall be set to trip when the current exceeds by more than fifty percent the rated capacity of the feeder. In case the feeder is subjected to overloads sufficient to trip the circuit breaker, but of short duration, the circuit breaker may be equipped with a device which will prevent its acting unless the overload persists for a longer period than ten seconds. Trip current shall be indicated at the circuit breaker.

(c) Fuses shall be stamped or marked, or shall have a label attached indicating the maximum current which they are intended to carry. Fuses shall only be adjusted or replaced by a competent person authorized by the mine foreman.

(d) Fuses used to protect feeders shall be a less current rating than the feeder.

(e) All switches, circuit breakers and fuses shall have incombustible bases.

Section 312. Lightning protection

If the surface transmission lines of low or medium voltage from the generating station are overhead, there shall be lightning arrestors installed in connection therewith at the generating station. If the distance from the generating station to the point where the line enters the mine is more than five hundred feet, an additional arrestor shall be installed at this point.

Section 313. Underground power supply

(a) Ground Detectors. All underground systems of distribution that are completely insulated from earth shall be equipped with properly installed ground detectors of suitable design, maintained in working condition. The condition of such system as indicated

by the ground detector shall be noted each day by the person in charge of the underground electrical system, or by another competent person, who shall immediately report to the mine foreman the occurrence of a ground.

(b) Protection of Circuits Leading Underground.

(1) In every completely insulated feeder circuit in excess of twenty-five kilowatts capacity, leading underground and operating at a potential not exceeding the limits of medium voltage, there shall be provided above ground a circuit breaker arranged to open simultaneously each ungrounded conductor. In addition, a positive disconnect means shall be installed outby the circuit breaker. Overload protection shall be provided to open the circuit breaker in case of overload on any conductor. Fuses may be substituted for circuit breakers in circuits transmitting twenty-five kilowatts or less. Each power circuit in excess of fifty kilowatts leading underground shall be provided with a suitable ammeter.

(2) Every alternating current feeder circuit leading underground and operating at a potential exceeding the limits of medium voltage shall be provided above ground with a suitable circuit breaker, such breaker to be equipped with automatic overload trip, arranged to open simultaneously each ungrounded

power-carrying conductor. Each such circuit shall also be provided with a suitable ammeter.

(c) Cables in Shafts, Slopes, and Boreholes.

(1) All cables passing underground through inclines, boreholes and shafts shall be installed in a manner that will prevent undue strain in sheath, insulation or conductors and damage by chafing of cables against each other or against the borehole casing or shaft. All underground power conductors in shafts, boreholes and inclines shall be covered with suitable insulating materials and installed to provide a minimum tensile factor of safety of five. Conductors shall be securely fastened and properly supported out of contact with combustible materials. When the weight, length and construction of a cable are such that suspension from its upper end only would subject the cable to possible damage, it shall be supported at intervals necessary to prevent undue strains in the sheath, insulation, and conductors, and to provide a minimum tensile factor of safety of five. Adequate protection shall be provided so that no damage can result from water, electrolysis, moving cages, skips, ice, coal or other falling or moving materials.

(2) Installation of direct-current and alternating-current cables carrying in excess of twenty-five

kilowatts in the same borehole shall require approval of the secretary.

(d) High Voltage Underground Transmission Systems. (1) High voltage conductors or cables leading underground and extending underground shall be of the flame resistant type with either a rubber, plastic, or armor sheath meeting the requirements of the department for flame resistance. When such cable is fed by high voltage systems other than that described in Article III., sub-article F, Alternating Current Installations, of this act, it shall be either metallic armored, installed in rigid steel conduit, or buried one foot below combustible material. When circuit and protective requirements are met, the cable construction and method of installation may be that described in Article III., sub-article F. Cables, shall be adequate for the intended current and voltage. Splices made in cable shall provide continuity of all components and shall be made in accordance with cable manufacturers' recommendations. The making of such splices shall be supervised by a competent person designated by the mine electrician.

(e) Braid Covered Cable.

(1) No power wires or cables having what is commonly termed as weatherproof insulation or insulation consisting of braided covering, which is susceptible to moisture absorption from the outer

surface to the conductor shall be installed in any mine.

(2) All insulated power cables purchased for use in any mine after the effective date of this act shall be protected by a flame-resistant jacket and assigned a "P" number unless either armored or installed in rigid steel conduit, a metal enclosure, or a fire-proof room.

(f) Ventilation.

(1) In any gassy mine, bare power conductors shall not be installed in any air current that has passed through or by the first working place in the air split.

(2) In all mines, high voltage transmission cable, high voltage motors and high voltage transformers shall not be installed in any air current that has passed through or by the first working place in the air split.

(g) Cables in Haulage Roads.

(1) Where the cables or feed wires other than trolley wires, in main haulage roads, cannot be kept at least twelve inches from any part of the mine car or locomotive, they shall be specially protected by proper guards.

(2) Cables and wires, except trailing or portable cables or bare return cables shall be installed on roof, ribs, walls or timbers by means of efficient insulators or suitable supports. In no instance shall the method of support damage the cable jacket or armor.

(3) When main or other roads are being repaired, or blasting is being carried on, suitable temporary protection from damage shall be given the cables.

(4) All other wires, except telephone, shot-firing and signal wires shall be on the same side of the road as the trolley wire.

(5) Haulage block signal circuits and other control circuits powered from the trolley shall be located on the same side of the road as the trolley.

(h) Branch Circuit Protection. When the potential of a branch circuit exceeds the limit of medium voltage, it shall be protected by a circuit breaker, except as otherwise permitted under section 331, subsection (h). Such circuit breaker shall be equipped with an automatic overload trip arranged to open simultaneously each ungrounded power carrying conductor. Provision for positive disconnection of the branch circuit shall be included.

(i) Underground Transformer and Substation Rooms.

(1) Construction. Any motor-generator, rectifier (except those described in subsection (j) of this section), rotary converter, or oil-filled transformer installed in a mine shall be enclosed in a fireproof chamber of masonry or in an effectively grounded approved steel structure. Such buildings shall be provided with automatically closing fire-doors, but the automatic features of fire-doors may be omitted if a substation attendant be employed. The openings of all such doors shall be so safeguarded by grillwork that the room may be entered only by authorized persons. No electrical equipment containing inflammable material shall be placed within eight feet of a door, or opening, in any such underground building. All such underground substations containing rotary machinery shall have an attendant constantly on duty while rotating machinery is in operation, unless adequate control and protection of the equipment is assured by the use of suitable automatic devices. No transformer, circuit breaker, controller or other device containing more than twenty gallons of inflammable liquid shall be placed in any underground substation. The substation shall be adequately ventilated by a separate split of air. No substation shall be built in any mine until the location, material, construction

and method of ventilation thereof have received the approval of the secretary.

(2) Switchboards. Main and distribution switch and fuse boards shall be made of incombustible, moisture resistant, insulating material, and be fixed in as dry a situation as practicable, or shall be of suitable metal construction, exposed portions of which shall be effectively grounded. All switches, circuit breakers, rheostats, fuses and instruments used in connection with underground motor-generators, rotary-converters, high voltage motors, transformers, and low and medium voltage motors of more than fifty horsepower or fifty KVA capacity, shall be installed upon a suitable switchboard or in a metal-clad switchgear structure. Similar equipment for low and medium voltage motors of fifty horsepower and less, may be separately installed if mounted upon insulating bases of suitable material or effectively metal-clad.

(3) Clearances.

(i) In underground stations where switchboards are installed, there shall be a passageway in front of the switchboard not less than three feet in width and, if there are any high voltage connections at the back of the switchboard, any passageway behind the switchboard shall not be less than three feet clear. The floor at the back of

the switchboard shall be properly floored and insulated with nonconducting material, accessible from each end, and in the case of high voltage switchboards, shall be kept locked, but the lock shall allow the door being opened from the inside without the use of a key.

(ii) Where the supply is at a voltage exceeding the limits of medium voltage, there shall be no live metal work on the front of the main switchboard within seven feet of the floor or platform, and the space provided under subsection (i)(3)(i) of this section shall not be less than four feet in the clear. Insulating floors or mats shall be provided for medium voltage boards where live metal work is on the front.

(4) Transformers. The primary of each underground power transformer shall be protected by a suitable circuit breaker equipped with automatic overload trip arranged to open simultaneously each ungrounded power conductor. The primary of a transformer of less than twenty-five KVA capacity operated at a potential lower than high voltage may be protected by fuses. When a transformer is the only load on a branch circuit, the branch circuit protection can be considered the transformer protection.

(5) Outgoing Feeder Protection. Main circuits leaving underground substation or transformer stations shall be protected by circuit breakers.

(6) Grounding. All metallic coverings, metal armoring of cables, and the frames and bedplates of generators, transformers and motors shall be effectively grounded.

(7) Identification of Hazard. All high voltage machines and apparatus shall be marked to clearly indicate that they are dangerous, by the use of the words “Danger, High Voltage”.

(8) Protection of Terminals. All terminals on machines, motors, or equipment over medium voltage underground shall be protected with insulating covers or with metal covers effectively connected to ground.

(9) Unauthorized Persons. No person other than one authorized by the mine foremen or mine electrician shall enter a station or transformer room or interfere with the working of any apparatus connected therewith.

(10) Fire Protection. Rock dust or fire extinguishers suitable for extinguishing electrical fires shall be kept at electrical stations and transformer rooms, ready for immediate use.

(j) Fireproof Rectifiers and Transformers. A portable rectifier with dry type transformer, except those using pumped tubes or glass bulb mercury arc tubes, or dry type transformer designed for underground use with adequate automatic electrical protection and substantially of fire-proof construction, fully metal-clad, which will not be in the same location in excess of one year, may be installed in any intake air current, not beyond the last open crosscut and not closer than two hundred and fifty feet along the air route to pillar workings. The location where such fireproof rectifier or transformer is installed need not be made fireproof with masonry or steel, but shall be equipped with doors, grill work or otherwise to prevent entry or access by unauthorized persons.

Section 314. Storage battery equipment

(a) All storage battery equipment and charging stations shall be designed, operated and ventilated so that gas from the batteries will be safely diluted. Storage battery charging stations shall be on a separate split of air.

(b) Smoking or the presence of flammable materials is not permitted in any storage battery room or charging station. Signs to this effect shall be posted in all battery rooms or charging stations.

(c) Storage battery operated equipment may be used in face areas of gassy mines when all electrical parts that it is practicable to enclose are enclosed in explosion-proof casings and the batteries are adequately ventilated.

Section 315. Steam cleaners

(a) Steam cleaning units used underground shall be only electrically operated. Their use shall be confined to repair shops where ventilation shall be arranged to conduct their exhaust to return air with baffles installed to prevent distribution of oil and grease in the return airway.

(b) Machines shall be equipped with a pressure relief valve and a soft plug. Cut-off valves shall not be installed in the discharge nozzle.

(c) The area in which the machine is used shall be cleaned after each operation. Oil, grease and other residue shall be put in metal containers and removed from the mine.

(d) Steam cleaner operators shall be provided with a protective mask when chemical and detergent solvents are used.

Section 316. Electrical face equipment

(a) Voltage Restriction. Motors of electrical face equipment shall not be operated at higher than medium voltage, except as approved by the secretary under section 334 and except those on hand held tools which shall be restricted to low voltage.

(b) Grounding. The frame of all off-track face equipment shall be effectively grounded through a safety ground conductor in its trailing cable, or by an approved grounding device.

(c) Hand Held Tools. Electric drills and other electrically operated rotating tools intended to be held in the hands shall be equipped with an integrally mounted electric switch designed to break the circuit when the hand releases the switch.

(d) Trailing Cables.

(1) Trailing cables for face equipment shall be safely and efficiently insulated and constructed with an outer sheath or jacket of flame resistant material. They shall be approved by the secretary.

(2) Cables for hand held tools shall be especially flexible, heavily insulated and effectively protected from damage.

(3) Each trailing cable in use shall be examined daily by the machine operator for abrasions and other defects, he shall also carefully observe the trailing cable while in use, and shall at once report any defect to the mine official in charge.

(4) In the event of the trailing cable in service breaking down or becoming damaged in any way, or of its inflicting a shock upon any person, it shall be put out of service at once. The faulty cable shall not be used again until it has been repaired and tested by a properly authorized person.

(5) The trailing cable shall be divided at the machine in which it is supplying power, but only for such length as is necessary for making connection to the machine terminals, and the cable, with its outer covering complete, shall be securely clamped to the machine frame in a manner that will protect the cable from injury and prevent any mechanical strain being borne by the single ends connected to the machine terminals.

(6) No more than five temporary splices shall be made in any trailing cable. After the fifth such splice is made, the cable shall be changed before the machine is operated on the following shift. Trailing cables on equipment without cable reels shall have no temporary splices within fifty feet of the machine before the machine is operated on the

following shift. Cable jacket repairs not involving conductors or conductor insulation are not considered temporary splices.

(7) Trailing cables shall be hung or adequately protected to prevent their being run over and damaged by mobile machinery.

(8) Trailing cables on off-track equipment, not provided with an approved grounding device, shall contain a safety ground conductor which shall be solidly connected to the machine frame. A ground continuity test of the cable on each machine shall be made upon completion of each temporary splice in that cable. Cables found to contain defective grounds shall be repaired before use or replaced. The safety ground conductor shall have a cross sectional area of at least fifty percent of that of a single power conductor unless used with ground trip protective systems employing ground fault current limiting devices in which case a smaller safety ground may be used.

(e) Motors. In all mines, all electrical equipment in use inby the last open crosscut shall have all their current carrying parts completely enclosed in explosion-proof enclosures. This shall not include trailing cable, except where terminated, and shall not include flexible cable as required between motors, controllers, terminal boxes and other auxiliaries. These

enclosures shall not be opened except by an authorized person, and then only when the power is switched off. The power shall not be switched on while the enclosures are open.

(f) Safeguarding. The person in charge of electrical face machinery shall not leave such machinery while it is working and shall, before leaving the working place, see that power is cut off the trailing cables.

(g) Explosion Tested Compartments. All explosion tested compartments shall be properly secured with cover clearance tolerances not exceeding four one-thousandths of an inch. Packing glands shall be correctly assembled and the packing compressed by a packing nut tightened to within no less than one-eighth of an inch of its seat.

(h) Detection of Gas.

(1) In working places where explosive or noxious gas is likely to be encountered, an approved safety lamp for the detection of such gas shall be provided for use with each machine when working, and should any indication of gas appear on the flame of the safety lamp, the person in charge shall immediately stop the machine, cut off the current at the nearest switch, and report the matter to a mine official.

(2) In any gassy mine no electrically-operated face equipment shall be taken in by the last open break-through until the machine operator shall have made an inspection for gas in the place where the machine is to work, unless such examination is then made by some other competent person authorized or appointed for that purpose by the mine foreman. If any explosive gas is detected in the place by an approved safety lamp, the machine shall not be taken in. The place shall be dangered off until the gas has been removed or rendered harmless.

(3) No electrically-operated face equipment shall be continued in operation in a gassy mine for a longer period than half an hour without an examination as above described being made for gas, and if gas is found the current shall at once be switched off the machine, and the trailing cable shall forthwith be disconnected from the power supply.

(4) The person finding gas shall at once report the fact to the mine foreman, assistant mine foreman or mine examiner and the machine shall not again be started in such place until the mine examiner or a person duly authorized by the mine foreman, has examined it and pronounced it safe.

(5) In any gassy portion of a mine, if any electric sparking or arc be produced, outside of a coal-

cutting or other portable motor, or by the cables or rails, the machine shall be stopped, disconnected from the power supply, and not be worked again until the defect is repaired and the occurrence shall be reported to a mine official.

Section 317. Inspection of equipment

(a) All electrical face equipment shall be inspected by the mine electrician or person designated by him at least once every ten operating days, and, where necessary, shall then be cleaned and repaired.

(b) All electric motors and cables in mechanical sections shall have all excessive coal dust removed from their exterior surfaces once each operating shift.

Section 318. Stationary motors

Every stationary motor underground together with its starting equipment shall be protected by a fuse or circuit breaking device on each ungrounded pole, and by switches arranged to entirely cut off the power from the motor. The above devices shall be installed in a convenient position near the motor, and every stationary underground motor of one hundred brake horsepower or over shall be provided with a suitable meter to indicate the load on the machine.

Section 319. Permanent underground installation

All electrical equipment not covered elsewhere in this act, and except room hoists and gathering pumps, which will remain in the same location for a period of one year or more, shall be completely housed in an incombustible structure built of tile, brick, stone, concrete or of grounded steel plates not less than one-eighth inch in thickness, securely joined.

Section 320. Underground illumination

(a) In all mines the sockets of fixed electric lamps shall be of so-called "weatherproof" type, the exterior of which shall be entirely nonmetallic. Flexible-lamp cord connections are prohibited, except for portable lamps, as covered by rule subsection (c) of this section.

(b) Electric lamps shall be so placed that they cannot come in contact with combustible material.

(c) In gassy mines, portable electric lamps, other than battery lamps, shall not be used in connection with repair and inspection of machines and equipment in face areas. When used elsewhere, they shall be protected by a heavy wire cage completely enclosing both lamp and socket, and shall be provided with a handle to which both cage and socket are firmly

attached and through which the lead-in wires are carried.

(d) Electric lamps, when used in face areas of any mine, shall be installed in explosion-proof enclosures.

(e) Electric lamps shall be replaced by a competent person only, and in face areas of gassy mines, after an examination for gas has been made with an approved safety lamp.

(f) In gassy mines, underground photography using flash bulbs or other sources of artificial illumination shall be prohibited unless immediately preceded by an examination for gas by a qualified person and the place found safe.

Section 321. Telephones and signaling

(a) Telephone service or equivalent two-way communication facilities shall be provided in all mines between the surface and each working section that is more than one thousand five hundred feet from the main portal.

(b) Telephone lines, other than cables, shall be carried on insulators, installed on the opposite side from power or trolley wires, and where they cross power or trolley wires they shall be adequately insulated.

(c) Lightning arrestors shall be provided at the points where telephone circuits enter the mine.

(d) Telephone cables permanently installed on power boreholes containing unarmored power cables shall be either armored or protected at top and bottom by insulating transformers.

(e) All proper precautions shall be taken to prevent electric signal and telephone wires from coming into contact with other electric conductors, whether insulated or not.

(f) Bells, wires, insulators, contact-makers, and other apparatus used in connection with electric signaling underground, shall be of suitable design, of substantial and reliable construction, and erected in such a manner as to reduce the liability of failures or false signals to a minimum.

(g) In the face areas of any mine, the potential used for signal purposes shall not exceed twenty-four volts, and bare wires shall not be used for signal circuits, except on haulage roads.

(h) The potential on signal circuits confined to intake air and using insulated conductors may be greater than twenty-four volts, but shall not exceed one hundred

twenty-five volts average. (This shall not apply to haulage block signal systems.)

Section 321.5. Application of provisions

The following provisions shall apply only to direct-current electrical systems in bituminous coal mines.

Section 322. Grounding

(a) In a direct-current electrical system grounding shall consist in so connecting any part of an electrical system, including frames, to the earth that there shall be no difference of potential between them.

(b) Only the negative side of the direct-current circuit shall be grounded.

(c) Rectifier diodes used at any bituminous coal mine shall be connected to the supply circuit through an isolating winding in order that isolation between alternating current and direct current systems is effected.

(d) The initial installation of rectifiers at any bituminous coal mine shall have the approval of the district mine inspector and the district electrical inspector before being energized.

Section 323. Voltage limitation

In no case shall the potential used in the trolley system be higher than medium voltage.

Section 324. Incoming feeder disconnect switches

Disconnecting switches shall be installed underground in all main direct-current power circuits within five hundred feet of the bottom of shafts, boreholes, or at other places where main power circuits enter the mine.

Section 325. Bonding

Where air (except compressed air blasting lines) or water pipes parallel the grounded return of power circuits, the return shall be securely bonded to such pipes at frequent intervals to eliminate the possibility of a difference of potential between rails and pipes and to prevent electrolysis of the pipes. The rail return shall be of sufficient capacity for the current used, independent of the capacity of the pipes. On main haulage roads both rails shall be bonded (except welded track) and cross bonds shall be placed at points not to exceed two hundred feet apart. On secondary haulage roads, one rail shall be bounded continuously.

Section 326. Trolley installation

(a) All trolley wires and feeder lines installed on underground haulage roads shall be placed as far to one side of the passageway as is practicable, but not less than six inches outside of line of rail, and securely supported upon hangers which shall not be more than twenty-four feet apart, and efficiently insulated.

(b) In all mines, trolley and feeder wires shall not extend beyond the last open crosscut and shall be kept at least one hundred and fifty feet from open pillar workings.

(c) All branch trolley lines shall be fitted with either a trolley switch, circuit breaker, or section insulator and line switch, or some other device that will allow the current to be shut off from such branch headings. Switches or circuit breakers shall be provided on haulage roads to deenergize all trolley and feeder lines at intervals not to exceed two thousand feet.

Section 327. Connections to trolley

(a) All permanent connections to trolley or feeder circuits shall be made with suitable mechanical connectors. No connection, temporary or permanent, shall be wrapped or tied.

(b) Temporary connections for portable or face equipment may be made through fused trolley taps.

(c) Safety ground and negative connections for temporary or permanent installations shall be made directly to the track, a bond, or the system ground.

Section 328. Guarding

At all landings and partings or other places where men are required to regularly work or pass under trolley or other bare power wires, which are placed less than six and one-half feet above top of rail, a suitable protection shall be provided. This protection shall consist of placing boards along the wire, which boards shall not be more than five inches apart, nor less than two inches below the lowest point of the wire: Provided, That the distance between boards on curves may exceed five inches, but shall not exceed eight inches. This does not prohibit the use of other approved devices or methods furnishing equal or better protection.

Section 329. Locomotives

(a) Electric haulage by trolley locomotive is not permitted in any gassy mine except on intake air.

(b) It shall be unlawful in any gassy mine to run or operate a locomotive, fed directly or indirectly from a

trolley wire, by the open entrances to worked out places wherein the pillars have been drawn or places in which the pillars have not been drawn but in which places the roof has collapsed.

(c) No open-type electric locomotive or open-type electric machine of whatsoever name shall be taken into a working place or places in a gassy mine. Main return airways (or passageways) shall not be used as haulageways for electric locomotives operated from a trolley wire in gassy mines: Provided, however, That if at any time after the effective date of this act a mine classed as non-gassy should be declared gassy under the provisions of this act, the operator of such mine shall, within the six months immediately following such reclassification, discontinue the use of open-type electric locomotives or open-type electric machines of any kind in a working place or places in such gassy mine or portion thereof. Upon written request from the operator of any such mine, the secretary, after investigation, shall have authority to grant an additional six month period to such operator to discontinue the use of such locomotives or machines.

Section 329.5. Application of provisions; system components; basic system; resistor ground connection

(a) The following provisions shall apply to alternating current electrical systems serving portable

face equipment in bituminous coal mines. The fundamental components of such a system are (1) the outdoor substation through which power is fed to the mine, (2) high voltage underground transmission system, (3) section transformers or load centers which step the transmission voltage down to machine utilization voltage, and (4) distribution centers used to distribute utilization voltage to mining machinery. The latter may be an integral part of the section transformer or load center (3).

(b) The basic system for both transmission and distribution of alternating current power to face equipment shall be a three-phase four-wire system, with a ground fault current limiting resistor in the neutral circuit and the inby or load end of the neutral resistor solidly grounded. The ground end of the neutral resistor shall be connected to equipment frames through the cable ground conductor to prevent dangerous differences of potential between frame and ground under fault conditions.

Section 330. Outdoor substation

The outdoor substation shall be built in accordance with current Institute of Electrical and Electronics Engineers' standards and shall include--

(1) Protective fence or enclosure.

(2) Primary or incoming line lightning arrestors.

(3) Positive disconnecting means on the incoming or primary line with a circuit breaker or fuses to interrupt safely any current, normal or abnormal, which might be encountered.

(4) Transformer bank to convert the incoming or primary voltage to the transmission voltage. The use of auto-transformers for this purpose is prohibited. Secondary or underground transmission voltage shall not exceed fifteen thousand volts, nominal, phase to phase. The transformer may be connected delta-wye, wye-delta, or delta-delta. Wye-wye connections shall not be used because of voltage instability under some conditions of load. In the event that the secondary winding is delta-connected, the neutral necessary for the four-wire transmission circuit shall be derived by use of a three-phase "zig-zag" or grounding transformer. Where such grounding transformers are used, they shall be of sufficient capacity to carry maximum ground fault current continuously. Should the substation primary or supply voltage equal the mine transmission voltage, the main transformer bank may be omitted and the "zig-zag" transformer used to derive a system neutral if one is not otherwise available.

(5) Secondary lightning arrestors.

(6) Ground fault-current limiting resistor capable of continuously limiting ground fault current to fifty amperes or less. The resistor shall be adequately insulated and shall be protected by a grounded fence or screen unless mounted eight feet or more above ground.

(7) A secondary or mine feeder circuit breaker with interrupting capacity adequate for any possible condition of fault and no less than the short circuit capacity of the system supplying power to the breaker. Positive disconnect means shall be provided on the input and output side of the breaker. Use of automatic reclosing circuit breakers is prohibited. Breaker automatic tripping shall be through protective relays and shall provide as a minimum tripping, by undervoltage, instantaneous and inverse time limit phase overcurrent, ground fault current not exceeding fifteen amperes and ground-continuity check not exceeding seven amperes. The ground-continuity check-circuit shall continuously monitor the integrity of the neutral circuit leading underground and shall cause the breaker to open when either the ground or pilot check wire is broken. An ammeter capable of reading current in each phase and a voltmeter capable of reading phase-to-phase voltage shall be provided at the circuit breaker.

(8) Surge protection or station ground bed to which shall be connected all lightning arrestor grounds,

substation equipment frame grounds, fence (if metallic) and substation structure (if metallic). There shall be no direct connection between this ground bed and either the grounded side of the mine direct current system or the neutral ground bed described below.

(9) Neutral or primary ground bed located at least twenty-five feet away from the station ground at its closest point and to which shall be connected only the inby or load end of the neutral current limiting resistor. To prevent current transformer core saturation by stray direct current return currents, or neutral conductor damage, there shall be no direct or metallic connection between any point of the high voltage alternating current neutral circuit and the mine direct current ground.

(10) Ground bed resistance shall be measured at least every six months and appropriate action taken to assure the maintenance of the lowest possible value of ground resistance. A record of these resistance measurements shall be kept in a book provided for that purpose.

Section 331. High voltage underground transmission system

(a) High voltage cables leading underground and extending underground shall be of the multiple conductor flame resistant type with either a rubber,

plastic or armor sheath meeting the requirements of the department for flame resistance. They shall be equipped with metallic shields around each power conductor. One or more ground conductors shall be provided of a total size either (1) not less than one-half the power conductor size, or (2) capable of carrying two times the maximum ground fault current. There shall also be provided an insulated conductor not smaller than No. 10 AWG for the ground continuity check circuit. Cables shall be adequate for the intended current and voltage. Splices made in the cable shall provide continuity of all components and shall be made in accordance with the cable manufacturers' recommendations. The making of such splices shall be supervised by a competent person designated by the mine electrician.

(b) High voltage cables subject to repeated flexing shall be similar in construction to type SH-D in accordance with Insulated Power Cable Engineers Association standard S-19-81.

(c) If couplers are used, they shall be of the three-phase type with a full metallic shall, and shall be adequate for the voltage and current expected. All exposed metal on the couplers shall be grounded to the ground conductor in the cable. The coupler shall be constructed so that the ground continuity conductor shall be broken first and the ground conductor shall be broken last when the coupler is being uncoupled.

(d) At locations where cables cross haulage-ways or travel-ways or where equipment must pass over or under the cable, they shall be either installed in a trench in the roof, protected by some mechanical means, or buried at least twelve inches below combustible material and adequately protected from crushing by the weight of equipment passing over it.

(e) High voltage cables shall be installed only in intake airways. They may be installed on intake haulage-ways only with written approval of the secretary. Such cable may be installed by hanging on suitable hooks or clamps, or by supporting by a suitable messenger cable, or by burying or by installation in metal conduit. When suspended, distance between supports shall not exceed twenty feet and they shall be so placed that they do not damage the cable jacket. When hung in a haulage entry containing a trolley wire, the cable shall be installed at least twelve inches from the trolley wire or feeder wires and away from the track.

(f) Any excess cable which is connected and supplying a load shall be coiled, stored on a reel, or otherwise stored, at a place near the load where it can be protected by dangering off the place. Such cable shall not exceed one thousand feet in length.

(g) Frames and enclosures of high voltage switch units, transformers, metallic cable couplers, and splice boxes shall be grounded to the common or primary ground for the system in the high voltage cable.

(h) Taps or branch circuits from the high voltage feeder shall be made through circuit breakers adequate to interrupt any fault current which might occur. Relaying protection on such breakers shall include instantaneous and inverse time limit phase overcurrent, under-voltage, ground fault and ground continuity check functions. A separate ground continuity check circuit originating at the branch circuit breaker shall be extended into each branch and shall be connected to ground at the frame of the load served. The ground continuity check circuit shall be so wired that the ground wire or ground continuity conductor or any connection on either wire cannot be broken without interrupting the check circuit unless such break occurs on a branch which has been disconnected. A suitable load break switch may be used in lieu of a circuit breaker provided that the ground continuity check circuit shall be wired as provided in subsection (h) of this section.

(i) When nonload breaking disconnect switches are used for sectionalizing high voltage circuits, they shall be fully metal clad, equipped with a door interlock to break the ground continuity check circuit, thus tripping the feeding breaker when the door is open,

and a voltmeter or indicating lights to verify that the circuit is deenergized before the disconnect switches are opened.

Section 332. Load center

Transmission voltage shall be reduced to machine utilization voltage by a portable transformer or load center of adequate capacity for the equipment powered by it. The transformer shall be of the dry type, ventilated, nonventilated, or sealed, substantially constructed and completely enclosed in a metal case. The metal enclosure shall be connected to the high voltage system ground conductor in the high voltage cable. Complete load center construction shall render it essentially fireproof. In addition to these requirements, the following shall be observed.

(1) Connection of the high voltage cable to the load center shall be made through a cable coupler of the type described in subsection (c) of section 331.

(2) The load center shall be equipped with a positive disconnect means on the incoming or high voltage circuit. This may consist of a circuit breaker, load break switch, disconnect switch, or other device.

(i) If a circuit breaker is used for this purpose, it shall be equipped with instantaneous and inverse

time limit phase overcurrent and undervoltage relaying protection.

(ii) If a device other than a circuit breaker is used, it shall be so arranged that it cannot be operated until the ground continuity check circuit in the high voltage cable has opened causing the nearest feeding circuit breaker to trip.

(3) The restriction of subsection (d) of this section pertaining to transformer connections and use of zig-zag grounding transformers also apply to the load center.

(4) The transformer secondary neutral, direct or derived, shall be connected to machine trailing cable safety ground conductors through a ground current limiting resistor capable of limiting ground fault current to twenty-five amperes or less. The inby side of this resistor shall be grounded to the load center frame if no D.C. equipment powered from a common mine D.C. system can contact the frames of A.C. equipment powered by this load center. In the event there is a possibility of frame contact between A.C. equipment and D.C. equipment supplied from a common D.C. mine system, the inby side of this resistor may be insulated from the load center frame and shall be solidly connected to the D.C. ground system.

(5) The load center shall be equipped with a main secondary breaker of adequate interrupting capacity with tripping devices which shall feed individual machine breakers located either in the load center or external to it in a separate distribution center. External utilization voltage connections shall be made through receptacles so arranged that they cannot be uncoupled under load.

(6) Load centers shall be located on intake air only. Load centers shall not be located beyond the last open crosscut and shall not be located closer than two hundred and fifty feet along the air route to pillar workings.

Section 333. Distribution centers

(a) Distribution centers may be used to distribute utilization power to portable equipment. The distribution center may be connected to the load center through one or more cables or conductors protected by flame resistant jackets with combined capacity sufficient to carry the maximum loads which may be encountered. The distribution center shall contain breakers adequate to interrupt any fault current which might occur, which shall feed each unit of equipment which is connected to the distribution center. Each breaker shall be equipped with tripping devices which will function on overload, phase fault, and ground fault. Distribution centers shall be located on intake air

only, and shall not be located beyond the last open crosscut nor shall be closer than one hundred fifty feet from pillar workings unless the distribution center shall have an approved explosion-proof enclosure.

(b) Utilization voltage cables shall be fitted with plug couplers and provision made so that cables cannot be uncoupled under load. All plugs and sockets shall be substantially constructed and any exposed metal portions shall be grounded. Couplers shall be constructed so that the ground conductor connection is broken last during uncoupling.

(c) Utilization voltage conductors, cables, or conductor groups shall contain one or more ground conductors which combined shall be able to carry safely and continuously at least twice the maximum ground fault current.

(d) A combined alternating and direct current distribution or load center complete within a substantially fireproof metal enclosure, with a dry type transformer and solid state rectifier and adequate automatic electrical protection, may be used to distribute alternating and direct current utilization power. The power supply to this unit may be low, medium or high voltage. When high voltage is utilized, the requirements of section 332 shall apply. When medium or low voltage is utilized, section 333 shall apply. However, when an external D.C.

distribution device is employed, the rectifier output may be taken through a main D.C. circuit breaker to that device without the use of a plug and receptacle system.

Section 334. Technological improvement

(a) The secretary shall recognize, encourage, and permit the adoption and use of alternative or new methods, materials, machinery, equipment, supplies, tools, devices, and processes in carrying out the provisions of this act pertaining to electricity in bituminous coal mines when such alternates provide protection to personnel and property equal to or in excess of the requirements set forth in any portion of this act. Any operator proposing use of such alternate or new methods, materials, machinery, equipment, supplies, tools, devices, and processes shall notify, in writing, the secretary describing such proposal in detail.

(b) Upon receipt of this proposal, it shall be given preliminary review by the secretary. If such review indicates that the proposal has potential merit, the secretary may, at his discretion, appoint either a commission or a committee consisting of three representatives of the department, three operators' engineers, a representative of the mine employees, and any others he deems pertinent. Such commission or committee shall investigate and review said proposal

to determine its effect on safety and property and report their findings in writing to the Secretary of the Department of Environmental Protection.

(c) If either the secretary, commission or committee recommends disapproval, their report shall include specific references to the requirements and standards of this act which the proposal violates and shall also specify the manner in which it fails to provide personnel and property protection equal to or in excess of such requirements or standards.

(d) Upon the approval of the commission or committee, the secretary shall forthwith issue a permit approving the alternate or new methods, materials, machinery, equipment, supplies, tools, devices, and processes.

ARTICLE IV
ACCIDENTS

Section 401. Explosion or accident; investigation by Department of Environmental Protection; Inquests

(a) Whenever a serious or a fatal accident occurs in or about any bituminous coal mine, or whenever an explosion, fire or other serious accident of an unusual nature occurs, whether fatal or not, it shall be the duty

of the superintendent or mine foreman in charge of such mine to give notice thereof forthwith, by telephone or telegraph, to the mine inspector in the district. The mine safety committee of the employees of such mine shall also be notified.

(b) If the coroner shall determine to hold an inquest, he shall notify the mine inspector of the time and place of holding the same, and the mine inspector in the district shall offer such testimony as he may deem necessary to thoroughly inform the said inquest of the cause of the death. He shall also have authority at any time to appear before such coroner or jury and examine or cross-examine any witness. No person who is, directly or indirectly, interested or employed in any capacity by the person, persons, or company owning or operating such mine, or employed in or about any other mine in which such owners or operators may be interested, shall be eligible to serve upon such coroner's jury.

(c) It shall be the duty of the mine inspector in the district, upon being notified of any fatal accident as hereinbefore provided, to proceed in person as soon as practicable to the scene of the accident, and make such suggestions or give such directions as may appear to him necessary to secure the safety of any person who may still be endangered through said accident. The said mine inspector shall proceed to investigate and ascertain the cause of the accident, and make a record

thereof, which he shall file as provided for; and to enable him to make the investigation he shall have power to compel the attendance of persons to testify, and also to administer oaths or affirmations. If it is found, upon investigation, that the accident is due to the violation of any of the provisions of this act by any person other than those who may be deceased, the mine inspector in the district shall institute appropriate proceedings against such
person or persons.

Section 402. Scene of accident; preservation of evidence

Following a mine accident resulting in the death of one or more persons and following any mine disaster, the evidence surrounding such occurrence shall not be disturbed after recovery of bodies or injured persons until an investigation by the department has been completed: Provided, however, That sufficient wreckage or debris may be moved to allow recovery work after disasters or continued general operation of the mine following fatalities not caused by mine fires or mine explosions.