STATUTORY INSTRUMENTS
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STATUTORY INSTRUMENTS SUPPLEMENT

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S T A T U T O R Y I N S T R U M E N T S

2019 No. 58.

THE NATIONAL BUILDING (STANDARDS FOR ELECTRICAL INSTALLATIONS IN BUILDINGS) CODE, 2019.

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S T A T U T O R Y I N S T R U M E N T S

2019 No. 58

The National Building (Standards for Electrical Installations in Buildings) Code, 2019.

(Under sections 46(1) and (2) (d) of the Building Control Act, 2013, Act No. 10 of 2013).

In exercise of the powers conferred on the Minister responsible for building works by section 46 of the Building Control Act, 2013 and in consultation with the National Building Review Board, this Code is made this 2nd day of October, 2018.

Part I—Preliminary

1. Title.

This Code may be cited as the National Building (Standards for Electrical Installations in Buildings) Code, 2019.

2. Application.

This Code shall apply to—

(a) electrical installations that operate at a voltage not exceeding 11,000 V a.c supplied from the public supply or from a private generation plant;

(b) residential, commercial and public premises; and

(c) electrical installations supplied from an external source or from a private generation plant.

3. Interpretation.

In this Code, unless the context otherwise requires—

"accessory" means a device, other than current-using equipment, associated with such equipment or with the wiring of an installation;

"Act" means the Building Control Act, 2013;

"ambient temperature" means the temperature of the air or other medium where the equipment is to be used;

"apparatus" means an electrical apparatus, and includes all apparatus, machines and fittings in which conductors are used, or of which they form a part;

"appliance" means an item of current-using equipment other than a luminaire or an independent motor;

"Authority" means Uganda Electricity Regulatory Authority established under the Electricity Act, 1999, Cap. 145;

"authorised person" means a person employed or appointed, by the Authority to carry out duties incidental to the generation, transmission, distribution or use of electrical energy, and holds an appropriate certificate of competency issued in accordance with the provisions of the Electricity Act, 1999;

"automatic fire alarm system" means a system which detects the occurrence of fire in its incipient stage and immediately signals without human intervention;

"barrier" means a part providing a defined degree of protection against contact with live parts from any usual direction of access;

"basic insulation" means insulation applied to live parts to provide basic protection against electric shock and which does not necessarily include insulation used exclusively for functional purposes;

"bonding conductor" means a protective conductor providing equipotential bonding;

"BS" means British Standard;

"building services engineer" means other engineering professionals such as mechanical, electrical and telecom engineers;

"building void, accessible" means a space within the structure or the components of a building only at certain points;

"building void, non-accessible" means a space within the structure or the components of a building which has no ready means of access;

"bulk meter" means a meter used to measure the aggregate electricity consumption of a multi-unit complex, and includes any associated equipment, systems and technologies;

"cable tray" means cable support consisting of a continuous base with raised edges and no covering and cable tray is considered to be non- perforated, where less than 30% of the material is removed from the base;

"cartridge fuse link" means a device comprising a fuse element or several fuse elements connected in parallel enclosed in a cartridge usually filled with arc-extinguishing medium and connected to terminations;

"currency point" has the value assigned to it in Schedule 1;

"ceiling rose - semi-recessed or flush-type" means a ceiling rose intended for mounting with its base partially or completely sunk into a box complying with BS 31, BS 4568: Part 2, BS 4607: Part 5 or BS 4662;

"ceiling rose - surface type" means a ceiling rose provided with a seating surface such that when mounted as intended it projects wholly outside the surface on which it is mounted;

"ceiling rose" means an accessory for connection to the fixed wiring of an installation to pass current to a lamp holder or a luminaire by means of the conductors of a flexible cord;

"conduit" means a part of a closed wiring system for cables in electrical installations, allowing them to be drawn in or replaced, but not inserted laterally;

"connector" means the part of a cable coupler or of an appliance coupler which is provided with female contacts and is intended to be attached to the end of the flexible cable remote from the supply;

"consumer unit" means a particular type of distribution board comprising a co-coordinated assembly for the control and distribution of electrical energy, principally in domestic premises, incorporating manual means of double pole isolation on the incoming circuits and an assembly of one or more fuses, miniature circuit-breakers, residual current operated devices or signaling and other devices purposely manufactured for such use;

"current-carrying capacity of a conductor" means the maximum current which can be carried by a conductor under specified conditions without its steady state temperature exceeding a specified value;

"current-using equipment" means equipment which converts electrical energy into another form of energy, such as light, heat or motive power;

"danger" means risk of injury to persons or livestock where expected to be present;

"direct contact" means contact of persons or livestock with live part which may result in electric shock;

"distribution circuit" means a category I circuit connecting the origin of the installations to—

(a) an item of switchgear, or

(b) an item of control gear or a distribution board to which one or more final circuits or items of current-using equipment are connected;

"distribution board" means an assembly containing switching or protective devices associated with one or more outgoing circuits fed from one or more incoming circuits;

"double insulation" means insulation comprising both basic insulation and supplementary insulation;

"duct" means a closed passageway formed underground or in a structure and intended to receive one or more cables drawn in;

"extra-low voltage" means voltage not exceeding 50 V a.c. or 120 V ripple free d.c, whether between conductors or to earth;

"engineer" means an engineer registered under the Engineers Registration Act;

"essential services" means services for which it is critical to maintain power supply at all times;

"false alarm" means a fire alarm signal caused by technical malfunctions in the fire alarm system or spurious alarms resulting from the fire detector being "misled";

"fault" means a circuit condition in which current flows through an abnormal or unintended path;

"fault current" means a current resulting from a fault;

"final circuit" means a circuit connected directly to current-using equipment;

"fire alarm system" means the equipment and parts, matched for correct interaction used in a fire alarm system;

"high voltage" means voltage exceeding 33kV but not exceeding 220 kV;

"IEE" means Institution of Electrical Engineers;

"insulation" means suitable non-conductive material enclosing, surrounding or supporting a conductor;

"isolator" means a disconnector or a mechanical switching device which, in the open position, complies with the requirements specified for isolation;

"live part" means a conductor or conductive part intended to be energised in normal use, including a neutral conductor but, by convention, and does not include a pen conductor;

"low voltage" means voltage exceeding extra-low voltage but not exceeding 1000Va.c. and d.c. between conductors, or 600V a.c. and d.c. between conductors and earth;

"luminaire" means a complete light unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps and ballasts and to connect the lamps to the power supply;

"medium voltage" means voltage exceeding 1kV but not exceeding 33 kV;

"neutral conductor" means a conductor connected to the neutral point of a system and contributing to the transmission of electrical energy;

"non-rewirable plug" means a plug so constructed that it forms a complete unit with the flexible cord after connection and assembly by the manufacturer of the plug;

"over-current" means a current exceeding the current-carrying capacity of a conductor;

"phase conductor" means a conductor of an a.c. or d.c system for the transmission of electrical energy other than a neutral conductor, a protective conductor or a pen conductor;

"point" means a termination of the fixed wiring intended for the connection of current-using equipment;

"Protective Multiple Earthing (PME)" means an earthing arrangement, found in t-n-c-s systems, in which the supply neutral conductor is used to connect the earthing conductor of an installation with earth;

"public supply" means the supply of electrical energy to the premises of any person by licensed electricity service provider;

"PV" means Photo Voltaic;

"PV array" means mechanically and electrically integrated assembly of PV modules and other necessary components, to form a d.c. power supply unit;

"rewireable plug" means a plug so constructed that a flexible cord can be fitted or replaced using general purpose tools;

"short-circuit current" means an over-current resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions;

"smoke detector" means a detector which responds to products of combustion or pyrolysis or suspended matter contained in the air;

"socket-outlet" means a device, provided with female contacts, which is intended to be installed with the fixed wiring, and intended to receive a plug;

"sounders" means devices in which electrical signals are converted into sound signals;

"sub-meter" means a meter used to measure the electricity consumption of a unit and includes any associated equipment, systems and technologies;

"sub-metering system" means a system that manages the activities in relation to sub-meters in multi-unit complexes, for such classes of property or consumers as may be prescribed, subject to such conditions as may be prescribed;

"substation" means any premises, or that part of any premises in which electrical energy is transformed or converted to or from voltage above low voltage, except for the purpose of working instruments, relays, or similar auxiliary apparatus;

"switch" means a mechanical device capable of making, carrying and breaking current under normal circuit conditions;

"switchboard" means an assembly of switchgear with or without instruments;

"switchgear" means main switches, cut-outs or fuses, conductors and other apparatus in connection therewith, used for the purpose of controlling or protecting electrical circuits or machines or other current using appliances; and

"US" means a Uganda Standard issued by the Uganda National Bureau of Standards.

4. Technical designs.

(1)The Authority shall issue or authorise issuance of graphical symbols to be used in all drawings, wiring plans and other technical designs for electrical installation of buildings.

(2) Provision for accommodation of substation, transformer, switch room, lift wells and other equipment rooms, service cable ducts, rising mains, sub-distribution boards, openings and chases in the floor and walls for all required electrical installations shall be specified at planning stage by the engineer.

(3) A substation for a group of buildings shall be at the load center located on the ground floor.

(4) A substation in a multi–storeyed building shall be installed at the lowest floor level, with direct access from the street for installation or removal of equipment.

(5) The floor level of the substation or switch room shall be above the highest flood level of the locality with a load center between the geometrical center and the air-conditioning plant room.

(6) A substation shall have the following rooms—

(a) switchgear room;

(b) transformer room determined by the rating of the transformer; and

(c) stand-by generator room determined by the rating of the generator.

(7) In all large installations, except where a substation is provided, a separate switch room shall be provided as close as possible to the electrical load center.

(8) The switch room shall be placed in such a position that rising ducts may readily be provided there from, to the upper floors of the building in one straight vertical run.

(9) In larger buildings, more than one rising duct and horizontal duct may be required for running cable, from the switch room to the foot of each rising main.

(10) Suitably segregated cable ducts shall be reserved for the electrical services including low and extra-low voltage installations.

5. Planning and designing.

(1) The design and plan of an electrical installation shall take into account all the prevailing conditions which may include—

(a) the type of supply;

(b) the envisaged load having regard to the requirements of the owner or occupant;

(c) the probable modifications and future extensions;

(d) the degree of electrical and mechanical protection necessary;

(e) the probable operation and maintenance cost taking into account the electricity supply tariffs available;

(f) the relative cost of various alternative methods; or

(g) the need for radio and telecommunication interference abatement.

(2) The electrical layout shall be considered after proper locations of all outlets for lamps, fans, and appliances both fixed and transportable have been selected and best methods of wiring determined.

(3) Before commencement of works, runs of wiring and exact positions of points of switch-boxes and other outlets shall be marked on the plans of the building and approved by the engineer in charge.

(4) The design of an electrical installation shall ensure the—

(a) protection of persons, livestock and property; and

(b) proper functioning of the electrical installation for the intended use.

(5) The information required as a basis for design shall be—

(a) nature of current, whether a.c or d.c;

(b) nature and number of conductors—

(i) for a.c—

(aa) phase conductor;

(bb) neutral conductor; or

(cc) protective conductor; and

(ii) for d.c—

(aa) positive conductor; or

(bb) neutral conductor;

(c) voltage and voltage tolerances;

(d) frequency and frequency tolerances;

(e) maximum current allowable;

(f) prospective short-circuit current;

(g) nature of demand;

(h) emergency supply or supplies; and

(i) environmental conditions.

(6) Every electrical equipment shall bear the following markings—

(a) the manufacturers name, trademark or other recognised symbol of identification;

(b) catalogue number or type;
(c) voltage;
(d) rated load amperes;
(e) watts, volt-amperes or horsepower;
(f) whether the equipment is for d.c, a.c or both;
(g) number of phases;
(h) frequency in Hertz;
(i) rated load speed in revolutions per minute;
(j) designation of terminals; and
(k) whether the equipment is for continuous or intermittent duty.

(7) Each service box, at the time of installation, shall be marked in a conspicuous, legible and permanent manner to indicate clearly the maximum rating of the over-current device which may be used for this installation.

(8) At each distribution point, circuit breakers, fuses and switches shall be marked in a conspicuous and legible manner indicating—

(a) the installation or portion of installation they protect or control; and

(b) the permitted maximum rating of over-current device.

(9) The design of a building meant for commercial purposes shall make provisions for sub-metering.

(10) The sub-meters provided for and installed in commercial buildings shall meet the meter standards prescribed by the Uganda National Bureau of Standards and the metering requirements as prescribed by the Authority.

Part III—Methods of Installation

6. General requirements for approval of buildings.

(1) Requirements for approval of building plans shall include drawings for electrical installations and equipment in accordance with paragraph 4.

(2) All completed electrical works shall be inspected and tested in accordance with this Code before they commence service to the public.

(3) Every installation and its components shall be in accordance with this Code and the laws governing electricity installation and usage in Uganda.

(4) All buildings shall conform to the Electricity (Safety Code) Regulations, 2003 and provisions governing over-head cable lines in Item A of Schedule 2.

Requirements for Safety

7. Workmanship and materials.

(1) Electrical equipment shall be constructed or installed in a way that they are capable of being maintained, inspected and tested.

(2) All electrical equipment shall be suitable for the maximum power necessary for current-using equipment when it is functioning in its intended manner.

(3) Electrical conductors shall be effectively insulated and of sufficient current carrying capacity for the intended purpose.

(4) All electrical conductors and electrical equipment likely to be exposed to weather, corrosive and explosive atmospheres, inflammable surroundings, or other adverse conditions shall be constructed or protected to prevent danger likely to arise from such exposure.

8. Protective devices.

(1) Every installation and circuit shall be protected against over current by devices that—

(a) operate automatically at values of current which are suitably related to the safe current rating of the circuit;

(b) are of adequate breaking capacity and where appropriate, making capacity;

(c) are suitably located and are constructed to prevent danger from overheating, arcing or the scattering of hot particles when they come into operation; and

(d) permit ready restoration of the supply without danger.

(2) Every switch, circuit-breaker, and isolating link shall be—

(a) constructed, placed or protected to prevent danger;

(b) constructed and adjusted accurately to make and maintain good contact;

(c) provided with an efficient handle or other means of working, insulated from the system and arranged that the hand cannot inadvertently touch live metal; and

(d) constructed or arranged so that it cannot accidentally fall.

(3) Every switch intended to be used for breaking a circuit and every circuit-breaker shall be constructed in a manner that ensures that it is not left in partial contact.

(4) Subparagraph (3) shall apply to single pole, double-pole, and multi-pole switches or circuit breakers.

(5) Suitably located efficient means shall be provided for cutting off all voltage from every part of a system as may be necessary to prevent danger.

(6) Every fuse shall have a fusible metal that will be readily renewed or replaced without endangering personnel.

(7) Every electrical joint and connection shall provide durable electrical continuity, insulation and adequate mechanical strength.

(8) Where one of the conductors of a system is connected to earth, a single-pole switch other than a link for testing purposes or a switch for use in controlling a generator, shall not be placed in such conductor or any branch of the conductor.

(9) Notwithstanding subparagraph (8), a switch or automatic disconnector or other cut-out may be placed in the connection between the conductor and earth at the generating station, for use in testing and emergencies only.

9. Portable appliances.

(1) Every flexible wire for portable apparatus shall be connected to the system either by efficient permanent joints or connections, or by a properly constructed connector.

(2) The metal-work of a portable apparatus, pendant lamps with switches and any flexible metallic covering of the conductors shall be efficiently earthed.

(3) A lamp holder shall not be in metallic connection with the guard or other metal-work of a portable or pendant lamp.

(4) Any portable apparatus and its flexible wire shall be controlled by efficient means suitably located and capable of cutting off the supply.

(5) Where the voltage exceeds low voltage, the metal-work shall be efficiently earthed independently of any flexible metallic cover of the conductors and any flexible cover shall be independently earthed.

10. Switchboard and switchgear.

(1) Switchboards for the control of equipment rated at 240V/415V shall conform to standard US IEC 60439 and panels shall be free standing of uniform height, flush mounted and totally enclosed protection in accordance with US IEC 60144.

(2) Each switchboard shall be controlled by a suitable isolating switch or circuit breaker and the general arrangement of switchboards shall ensure that—

(a) all parts which may have to be adjusted or handled are readily accessible;

(b) the course of every conductor may where necessary be readily traced;

(c) conductors that are not arranged for connection to the same system are kept well apart, and can, where necessary, be readily distinguished; and

(d) all bare conductors are placed and protected as to prevent danger from accidental short circuit.

(3) The base of a panel shall be effectively sealed against the ingress of vermin and termites, and any ventilation louvers shall be backed by brass fine mesh gauze or any other non-corrosive material to exclude vermin and termites.

(4) Framework for the panels may be fabricated from mild steel sheet of 3mm minimum thickness, or any other appropriate material approved by the Building Committee, to provide a rigid structure.

(5) All bolts, nuts, screws, hinges, handles shall be corrosion resistant with the interiors furnished with white and the exterior furnished with a light grey shade except the plinth that shall be furnished black.

(6) Cabling access from the rear shall be by means of gasketted bolt-on plates, which shall be fitted with handles to facilitate removal or replacement.

(7) Access to the cubicles or cubicle compartments for all normal routine maintenance shall be from front by hinged and lockable doors fitted with neoprene gaskets which shall be termite resistant and chromium plated lockable tee type handles.

(8) All doors shall be electrically bonded to the main frame, using adequate flexible conductors, protected against mechanical damage.

(9) All locks on a given panel unit shall be operated by the same key.

(10) Every multi-compartment control panel shall comprise an assembly of individually constructed cubicles which shall be assembled to include a metallic sheet between adjacent cubicles.

(11) A multi-compartment control panel in subparagraph (10) shall have at least one empty compartment for future use.

(12) Panels shall be readily capable of extension at either end, within the bus bar rating but where panel size is excessive, easily handled sections shall be supplied for site assembly.

(13) All bus-bars shall be of electro tinned copper, and shall be of uniform section throughout the length of the panel.

(14) The bus-bars under subparagraph (13) shall be run in a separate screened compartment divided with barriers into compartments and cubicles in the panel, and access to individual compartments shall be via bolt-on cover plates each bearing the legend in white on a red background

"DANGER" – "LIVE BUS-BARS,"

with a red arrow symbol denoting danger from electric shock.

(15) The neutral bus-bars shall not be less than half the cross sectional area of the base bars and phase bus-bars shall be colour coded red, yellow and blue and black for neutral.

(16) Panels shall be equipped with an electro tinned earthing strip running the full length of the panel rated to withstand without damage, the thermal and dynamic effects of earth fault currents, and the minimum size of the earthing strip shall be 25mm x 3mm.

(17) The contractor shall be responsible for ensuring that all components, sub-assemblies, including gland plates are solidly bonded to earth using green or yellow insulated copper conductors of appropriate cross sectional area.

(18) Joining different metal types for electrical continuity is prohibited.

(19) Surge arresters shall be installed on the 240V/415V bus-bar of the low voltage panel, connected permanently between each phase and earth, being as near as possible to the incoming circuit breaker with each unit seated and encapsulated with connecting tails suitable for continuous operation at 415V.

(20) The panel shall comply with 2.5kA requirements and the solid state control or electronic devices located within the panel, shall be individually protected by surge arresters in accordance with US IEC 60099.

(21) Suitably sized compression type cable glands shall be provided for all cables, and glands used for armoured cable shall include provision for sealing the armour wires to protect them from corrosion and to prevent ingress of moisture into the cable.

(22) Lugs shall be provided for connection of the cable armouring to earth and adequately sized blank gland plates shall be provided below each out-going terminal section to accommodate the requisite glands.

(23) Gland plates shall be positioned 20mm minimum above the base of the cubicle, and shall be solidly bonded to earth and all moving iron type indicating instrument shall have a quadrant scale with a minimum length of 75 mm and shall conform to US IEC 60051 with an accuracy of class 2.5 or more.

(24) The main switchboards and control panels to the moving instrument shall be equipped with voltmeter and ammeter selection switches, and all instruments and protective relays shall be flush mounted and effectively sealed against ingress of moisture, dust or insects.

(25) Control and selector switches shall have their positions clearly labeled with each having a separate label to indicate the switch function.

(26) Interlocks of a substantial mechanical type shall be provided on each cubicle between door and the circuit breaker or fused switch such that the door cannot be opened unless the circuit breaker or fused switch is in the off position.

(27) The "ON/OFF" switches and circuit breakers shall be padlockable in the 'OFF' position.

(28) Push buttons and indication lamps shall be selected from a matching range and shall be colour coded in compliance with US IEC 60073 in Table 1 of Schedule 3.

(29) Each indicating lamp shall incorporate a push-test feature.

(30) Lamp fittings shall be capable of pre-lamping from the front of the panel, and shall be locked against rotation.

(31) All exposed terminals on the rear of door mounted components shall be shrouded to prevent accidental contact when the panel doors are open and component labels shall be of laminated plastic and show the reference by which it is identified on the schematic diagram.

(32) Where an item of switchgear is required by the Standard to disconnect all live conductors of a circuit, it shall be of a type such that the neutral conductor cannot be disconnected or reconnected before the phase conductors.

(33) A switchgear shall be of 240 V or 415 V grade according to application. The switchgear shall be single pole and neutral, double pole and neutral, triple pole and neutral, and quad pole and neutral, as specified.

(34) Consumer units shall comply with US IEC 60439 and Miniature Circuit Breaker US IEC 60898, except that cartridge fuse links, fuse carriers, bases and associated parts that comply with US IEC 60083 shall be used in the installation as specified and agreed by

the Building Committee and residual current operated circuit breakers that comply with US IEC 60898 shall be included to give protection against earth faults.

11. Switch gear terminals.

(1) Three phase switchgear terminals shall be connected with phases red, yellow and blue in that order from left to right.

(2) All main gear shall be sign-written with the place of isolation where it is remote from isolation.

(3) Complete fuse charts shall be fixed in lids or mounted adjacent to all distribution boards.

(4) Labels engraved "DANGER 415 VOLTS" shall be attached to all three phase switches and distribution gear.

12. Isolation to protect against direct contact.

(1) Every switchboard having exposed bare conductors shall, where not located in an area or areas set apart for the purpose, be suitably fenced or enclosed.

(2) A person, except an authorised person, or a person acting under the immediate supervision of an authorised person shall not have access to any part of the area referred to under subparagraph (1).

(3) All apparatus pertaining to a switchboard and requiring handling, shall as far as is practicable, be placed or arranged to be operated from the working platform of a switchboard.

(4) All measuring instruments and indicators connected therewith shall, as far as practicable, be placed to be observed from the working platform but where such apparatus can be worked or observed from any other place, adequate precautions shall be taken to prevent danger.

(5) Where bare conductors are exposed and arranged in such a way that they can be touched when live, a clear and unobstructed passage-way, free from danger, of ample width and height, with a firm even floor shall be provided.

(6) Where necessary, adequate precautions shall be taken either by earthing or by other suitable means to prevent any metal other than the conductor from getting electrically charged.

(7) Adequate precautions shall be taken to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when a person is working on the conductor or apparatus.

(8) Insulating stands or screens shall be provided and kept permanently in position, and shall be maintained in sound condition.

(9) Portable insulating stands, screens, boots, gloves or other suitable means shall be provided and used when necessary to prevent danger, and shall be periodically examined by an authorised person.

(10) Adequate working space and means of access, free from danger, shall be provided for all apparatus that has to be worked or attended to by any person.

(11) All the parts of premises in which apparatus is placed shall be adequately lit to prevent danger.

(12) A person except an authorised person of the apparent age of eighteen or acting under immediate supervision of the authorised person shall not undertake any work such as repair, alteration, extension, cleaning or such work where technical knowledge or experience is required on an electrical installation.

(13) A substation shall be constructed and arranged to ensure that only an authorised person can obtain access to the substation through an alternative entrance other than the main entrance, and that a person cannot interfere with the apparatus or conductors in the substation from the outside.

(14) A substation shall be provided with efficient means of ventilation and, in the cases of an open-air substation, it shall be kept dry.

(15) A substation shall be under the control of an authorised person or a person acting under his or her immediate supervision.

(16) An underground substation that is not easily and safely accessible shall be provided with adequate means of access by a door, or trap door, with a staircase or ladder securely fixed and placed to ensure that no live part of any switchboard or any bare conductor is within the reach of a person on the substation.

(17) Instructions as to the treatment of persons suffering from electric shock shall be affixed in all premises where electrical energy is generated, transformed or used.

13. Cable terminations to switch gear.

(1) Unless otherwise recommended by the Building Committee, cable termination boxes to switchgear shall be supplied and fixed under a separate contract.

(2) The cable contractor shall be required to make the cable terminations and supply all necessary compounds, solder, tape and bonding materials.

Wiring and Wiring Accessories

14. Cable wiring.

(1) Wiring of the main and final sub-circuits shall be carried out in PVC insulated and PVC sheathed cables as specified on the drawings or contract documents.

(2) All cables shall be manufactured and tested in accordance with US 602 and 605 except that the conductors shall not necessarily be tinned.

(3) All cables shall be of a minimum 240 V rating unless stated otherwise and not less than 1.5mm^2.

(4) The final sub-circuit wiring for all services shall be of such cross-section that the permissible voltage drops allowed in the current edition of the IEE Wiring Regulations are not exceeded.

(5) Calculations shall be based on final sub-circuit distribution board and the last point in the circuit.

(6) Cables forming sub-circuits connected to different distribution boards shall not be drawn in the same conduit or draw-in box.

(7) Reduction of the number of strands forming the conductors may be allowed at switch or other terminals, and all strands shall be efficiently secured by screws or nuts and washers or some other approved method.

(8) Cables shall not be installed within 300mm of galvanized iron roofs when run on surface unless authorised by the engineer.

(9) Unless otherwise specified, all outdoor wiring shall be carried out in PVC/XPLE cables buried underground and protected by conduit or other suitable means where rising above ground.

(10) Except where it is specifically indicated on the drawing, not more than one phase of the a.c. installation shall be brought into a switch, ceiling rose or socket-outlet or other fitting in the lighting or single phase power circuits.

(11) All flexible conductors to lighting fittings, ceiling fans among others shall be visible without exception.

(12) Cable joints shall be kept to a minimum in any part of underground wiring system but where such joints are unavoidable and are specified on the drawings, they shall be “made off” to an approved terminal block, of approved current rating for the associated cable, housed within a suitable case or box.

(13) Connections between flexible cables and conduit wiring shall be made by means of an approved connector secured in a suitable case or box.

(14) Lighting switches shall be connected in the phase line of all circuits.

(15) Ceiling switches when called for shall be fixed at a distance of not less than 300mm from the point they control and shall not foul the associated fitting.

(16) Sheathed cables without conduit protection shall only be used where approved by the Building Committee.

(17) Sheathed cables shall be secured to the surface of walls and ceiling by means of saddles or clips.

(18) Where the materials of a building are unsuitable for direct cable mounting, timber battens shall be provided for securing cables.

(19) Where sheathed cables pass through ceilings, the holes shall be made good to prevent any possibility of spread of fire.

(20) Where cables pass through walls and floors, the holes shall be fitted with sleeves with bushed or belled ends to avoid any possibility of damage to the cables.

(21) Where a switchgear is mounted on the external surface of buildings, all cables entering the building must be enclosed in conduit.

(22) Where a building is fed by an overhead line distribution system, the service cable shall be led to the switchgear in conduit constructed in such a manner as to prevent the ingress of moisture.

(23) Flexible cords shall be—

(a) not less than 0.75mm^2;

(b) fire resistant; and

(c) manufactured and tested in accordance with US IEC 60227-1:2007 and BS 6500, and particular attention must be paid to the application of Regulations BS 36 and the current IEE Regulations.

(24) Unless otherwise stated, cables shall be coloured as follows—

(a)	Red phase	:	Red or Brown;
(b)	Yellow phase	:	Yellow or Brown;
(c)	Blue phase	:	Blue or Brown;
(d)	Neutral	:	Black or Blue;
(e)	d.c. positive	:	Red or Brown;
(f)	d.c. negative	:	Black or Blue; and
(g)	Earth wire	:	Green or Yellow.

(25) In circumstances where brown is used, phases shall be clearly marked or taped.

15. Cable trunking.

(1) Trunking of all sizes shall be secured at intervals of not more than 1200mm, and joints shall overhang fixings by more than 600mm.

(2) All tees and bends shall leave the trunking trough clear of obstructions and continuously open, except when passing through walls and floors.

(3) When trunking passes through walls, floors and ceilings, the covers shall be solidly fixed to 13mm of either sides of walls, and 150mm of either side of floors and ceilings.

(4) Trunking shall not be installed with its cover on the underside except where it is detailed on the drawing or authorised by the Building Committee.

(5) Screws and bolts securing trunking covers shall be designed to prevent damage to cables when fixing the covers.

(6) Adjoining sections of trunking shall be tightly secured and joined by appropriate bending links and the trunking shall be electrically and mechanically continuous throughout its length.

(7) Where switchgear and fuse boards are secured to trunking, such connections shall be made by necks and not by multiple conduit couplers unless specifically authorised by the Building Committee.

(8) Where trunking is slotted to receive connecting necks, gaskets made from synthetic resins bonded fabric to US IEC 60893-2, 20mm smaller than the trunking, shall be fixed in position to prevent abrasion to cables on sharp edges.

(9) Where cables are installed in trunking, each group of cables comprising a circuit shall be half hitched at 600mm intervals, and the circuit reference identified with approved tape at 1800mm intervals on straight runs and 150mm back from tees and bends.

16. Conduit wiring.

(1) Steel conduiting shall—

(a) not be less than 20mm diameter;

(b) be manufactured and tested in accordance with the requirements of US IEC 604237, US IEC 61386 and US IEC 61950, and all conduit boxes shall be provided with covers;

(c) be of heavy gauge, solid drawn or welded steel, galvanized or sheradised when run externally with black enamel or "high impact" rigid grade plastic where run internally; and

(d) where internal surface conduit is detailed in the case of bathrooms, kitchens, laundries, ducts and any damp disputations, be galvanized.

(2) Fixing screws for all conduits, switches and box covers shall be made of appropriate material using spacer bar type saddles for fixing conduits on the surface of walls and ceilings.

(3) Saddles shall be installed within 300mm on either side of conduit boxes except where the free length of the conduit exceeds this distance.

(4) Multiple saddles shall be used where two or more surface conduits run parallel and adjacent to each other.

(5) Where a conduit passes through a floor, wall, partition or ceiling, the fabric shall be made good with cement or the fabric medium to the thickness of floor, wall, partition or ceiling.

(6) Where conduits terminate at a main switchboard, distribution board, consumer unit, box or any metal-clad accessory, screwed sockets shall be used and arranged to be in good mechanical and electrical contact with the metal case, with internal brass male bushes into the sockets from the inside of the case and locked together.

(7) Not more than two right angle bends shall be permitted without the inter-positioning of a draw box.

(8) Conduits concealed in the building fabric shall be arranged as a "looping- in" system and elbows, tees or bends, solid or inspection type, shall not be employed.

(9) Conduits shall be kept at least 150mm clear of gas piping and colour coded where required.

(10) Conduit shall be kept at least 150mm clear of steam and hot water systems and preferably installed beneath the gas piping or hot water systems services.

(11) Care shall be taken when installing conduit to see that the enamel is removed from threads and from the interior of the fitting to ensure good connection.

(12) The interior of conduit ends shall be rendered free from burrs and sharp edges and where threads are exposed on conduit after it has been screwed into equipment, all such threads shall be painted with an approved paint to prevent rusting.

(13) Conduit runs shall be complete before wiring is started and shall not be dismantled for wiring operations.

(14) Conduit used in flameproof installations shall be of the solid drawn type.

(15) Where conduit crosses expansion joints, the contractor shall provide expansion couplers with an earth wire running between the nearest conduit box from each side of the coupling and the earth wire shall be solidly bonded at each box.

(16) Plastic conduiting shall conform to US IEC 61386 and EAS 178-1,2.

17. Mounting heights of wiring accessories.

(1) The approximate positions of lighting fittings, socket outlets, main switchgear and distribution boards shall be indicated on the drawings.

(2) The contractor shall determine the exact positions of any conduit runs, when necessary, in consultation with the engineer on site.

(3) Switchgear, distribution boards and consumer units shall, unless detailed to the contrary, be mounted with the lower edge of 2000mm from the finished floor level.

(4) Light switches, other than ceiling switches, shall be fixed at 1400mm to the center of the switch above a finished floor level.

(5) Isolators and switch fuses other than those mounted on bus bar chambers or providing local control shall be, unless otherwise stated on the drawings, fixed at 1400mm from finished floor level to underside of fitting.

(6) Socket outlets in offices and corridors shall, unless otherwise specified, be fixed 300mm above finished floor level to underside of fittings.

18. Ceiling roses and lamp holders.

(1) Ceiling roses shall be of best quality white bakelite in accordance with US IEC 423.

(2) Every lamp holder shall be of the "bayonet cap" US IEC 61184 type and best quality bakelite suitably reinforced and fitted with shade carrier rings.

(3) Batten type lamp holders shall be suitable for mounting direct on a conduit box and shall be of best quality bakelite suitably reinforced and fitted with shade carrier rings.

(4) Lamp holders for lamps rated 200 watts and above shall be of the Edison screw type.

19. Switches and socket outlets.

(1) Lighting switches shall conform to US IEC 60669-1, 5 amp or 15 amp where necessary, insulated pattern, single pole, quick make and slow break type for a.c. circuits and quick make and quick break for d.c. circuits, unless prior approval to the contrary is obtained from the Building Committee.

(2) Ceiling switches shall be complete with pull cords and suitable for mounting direct on a conduit box.

(3) At all times, the successful action of switches shall not depend wholly upon spring action.

(4) A single-phase socket outlet shall be 3 pin rectangular, shuttered as prescribed in the US IEC 60884-2-5 BS 2814, (1363-2)1957, with boxes conforming to US IEC 60669-1 with unstitched outlets unless instructed otherwise by the Building Committee.

(5) A three phase socket outlet and three phase with neutral outlet shall be of the 4 pin or 5 pin scraping earth pattern respectively.

(6) Socket outlets shall be of switched type unless prior approval to the contrary is obtained from the Building Committee.

(7) The third pin of every single phase socket outlet shall be effectively earthed.

20. Motors.

(1) A motor shall be installed by an authorised person.

(2) An earth wire, green or yellow insulated copper cable, shall be run to connect the frame of the motor to the earth termination of the controlling isolator.

(3) When installing welding transformers and big motors of 10kW and above, the local power supply authority shall be consulted.

(4) The method of starting motors unless otherwise stated shall be as follows—

(a) motors up to and including 5.5kW shall be started direct on line; and

(b) motors above 5.2kW shall be started by star-delta or auto transformer.

21. Final circuits.

For low voltage systems of 240V/415V A.C—

(a) all final three phase and single phase circuits to motors and fixed equipment shall be controlled locally by the appropriate three phase and neutral (T.P.N.) double phase and neutral, or single phase and neutral (DP or SP. N) isolating switch;

(b) separate switches may be omitted where combined motor starters and isolators are used;

(c) additional isolators shall be provided adjacent to equipment or a motor where normal control gear or starting is installed remotely from the equipment or motor and for purposes of this subparagraph, control gear of more than 1800mm from equipment shall be considered remote; however, this distance may be increased at the discretion of the supervising authorised person or as instructed on drawings;

(d) single pole switching and fusing shall be used on single phase circuits where one conductor is earthed;

(e) double pole switching and fusing shall be used on single phase systems such as 1:1 transformers and low voltage systems where neither conductor is earthed;

(f) a conductor of low voltage supply system shall be earthed when the utilisation of the supply makes the use of one conductor for earthing possible;

(g) where a transformer is used to supply a secondary circuit, the control switch shall be on the primary side; and

(h) switching and fusing shall be single, double or triple.

22. Direct current systems.

(1) The minimum size of cable to d.c. socket outlets shall be 2.5mm^2 but larger cables may be used on low voltage d.c. systems at the discretion of the engineer on site to prevent excessive proportional voltage drop.

(2) The main distributing spur maybe adopted to serve more than one point as allowed by the current edition of IEE Regulations.

(3) Double pole fusing shall be employed except where one conductor is common to several voltages in which case the common conductor shall be solid.

(4) D.C supplied outside the limit of 240 V or 15 amps shall be treated individually, preferably by a permanent connection to the apparatus served through an approved isolator.

(5) Exposed terminal connection shall not be used on d.c. equipment rated at 50 V or above.

Underground Cables

23. Cable specifications.

(1) The cables shall be of approved manufacture in accordance with US IEC 60227-1-3, 60228 & 60502-1 and specification and shall be suitable for the voltage and nature of the supply specified.

(2) Low voltage cables shall be XLPE SwA, PVC 2, 3 or 4 core with high conductivity copper shaped conductors of equal section and complying in all respects with US IEC 60245-1 for 1,100 V cables or aluminium cables approved by the Building Committee.

(3) 240 V d.c. services shall be XLPE SwA PVC 2, 3 or 4 core with high conductivity copper shaped conductors of equal section and complying in all respects with US IEC 60245-1or aluminium cables approved by the Building Committee.

(4) Telephone cables shall have high conductivity copper conductors of 3kg or 9kg per mile weight and shall be polythene insulated PVC sheathed overall.

(5) Multi-core cables shall have a minimum of 2.5mm^2 high conductivity copper conductors and shall be PVC/XLPE insulated, with galvanized steel wire armour and an outer PVC sheath.

24. Cable laying.

(1) All cables shall be buried in open ground or drawn into earthenware or other ducts where crossing roadways, paths exceeding 1500mm in width, and on entry into buildings.

(2) Cables shall be laid in such manner that no electrical or mechanical damage is sustained during the laying process.

(3) Where more than one cable is laid in a trench, cables shall be spaced in accordance with Table 2 set out in Schedule 2.

(4) All cables shall be separated by at least 230mm from gas and water mains.

(5) Cables shall not cross in straight run trenches except where cables have to branch from main run.

(6) At every draw-in point or junction box, and at the foot of any pole, the cable shall be laid snaked, to the satisfaction of the engineer on site.

(7) Cables to termination points in substations or buildings shall enter via glazed earthenware piped, supplied and fixed and shall be sealed in an approved manner after the cables have been laid.

(8) Appropriate sealing compound mixture shall be provided at both outlet ends of the pipe.

(9) Before cables are laid, the bottom of the trench shall be evenly graded and cleared of loose stones, and shall be covered with 50mm layer of sand or sieved earth pressed through a sieve with a maximum mesh of 13mm.

(10) The cables shall be carefully laid in the bed without dragging and they shall be covered with fine sand or sieved earth in such quantity as to ensure a cover of 75mm after tamping.

(11) Where cover tiles are required before the sand or sieved earth is filled in, the cable run shall be marked with temporary wood pegs, in order to ensure that when the warning covers are laid over, they overlap the cable each side by 50mm.

(12) Sand shall be used where the engineer agrees that the ground is unsuitable for sieving.

(13) Cables shall not be laid in ashes, organic refuse or other materials likely to damage them and where such conditions are encountered, the method of laying the cables shall be agreed with the engineer on site.

(14) Cables having a run of more than 1800mm inside a building shall be cleated or saddled to walls or ceilings with cleats or saddles at spacing recommended by IEE Wiring Regulations current edition.

25. Warning covers.

(1) Unless otherwise stated by the supervising officer, warning covers shall be provided over all cables except as detailed in subparagraph (2).

(2) Warning covers shall not be provided over XLPE SwA, PVC cables except when the engineer on site considers that the cables are liable to damage.

(3) All covers shall be earthenware apex type in accordance with drawings and laid to provide a margin of 50mm of cover on both sides of the cable.

(4) The warning tape shall be coloured yellow or black stripes and shall bear a warning in block black capitals, at regular intervals: "CAUTION-ELECTRIC CABLE BELOW".

(5) The warning tape in subparagraph (4) shall be laid at a depth of 200mm below final grade.

26. Earthenware ducts and fiber conduits.

(1) Where cables cross under roads or paved areas, the following earthenware ducts shall be provided—

(a)	1 cable	2 x 100mm or 150mm ducts;
(b)	2 cables	3 x 100mm or 150mm ducts;
(c)	3 cables	4 x 100mm or 150mm ducts;
(d)	4 or 5 cables	6 x 100mm or 150mm ducts; and
(e)	6, 7 or 8 cables	9 x 100mm or 150mm ducts.

(2) Five or more plastic sheathed cables may be laid together, depending on the size of cable, and shall be drawn into 100mm or 150mm duct where the need arises.

(3) In supplying and laying ducts, the following conditions shall apply—

(a) trenches for stoneware ducts shall be scooped out at all points where the sockets rest, so that the body of the duct lies solid on the ground;

(b) rocky soils and a layer of soft earth shall be spread over the bottom of the trench and rammed to afford bedding for the ducts;

(c) where the soil is unstable or water logged, a foundation for the ducting should be provided by laying 75mm of suitable concrete and the contractor shall carry out all necessary cutting of ducts; and

(d) ducts and conduits shall be clear of gas or water pipes, drains and sewers.

27. Concrete cable markers.

(1) Reinforced concrete cable markers shall be installed at all positions necessary to indicate the run of cables.

(2) Concrete marker posts shall be erected at intervals of 25m and at changes of directions of cable trenches with a plate fixed to the post stating "BURIED CABLES" and their position marked on the final "AS INSTALLED" drawings.

(3) An adequate number of ducts shall be provided at points of entry into buildings in form of easy sweep ends, having a bending radius appropriate to the size of the largest cable but in any case, not less than 10 times the cable diameter.

(4) After installation and the final tests, all cable ducts shall be sealed using fine resistant materials to the satisfaction of the engineer on site, to prevent ingress into buildings of water, vermin, termites or other danger.

28. Cable jointing.

(1) Cable jointing shall be carried out in accordance with the relevant Uganda Standard or where none is in existence, in accordance with the British Standard Code of Practice, and the respective cable maker's instructions.

(2) Underground joints in all cables shall be kept to a minimum, and where underground joints are to be used, approval shall be obtained from the Building Committee.

29. Identification of cables and cable joints.

(1) At all cable terminations, cables shall be identified by labels securely attached to the cables.

(2) Labels shall be made of heavy gauge brass or gunmetal of such a size as to render their reading clear, and be punch lettered with the name of the service and size of cable, number of cores and location of termination of the other end of the cable.

(3) All underground joints in cables shall be indicated by concrete cable markers as indicated in paragraph 27, suitably lettered with details of the cable joint and placed above the joint.

30. Position of cable routes.

The positioning of all cable routes, street lighting columns and feeder pillars shall be agreed upon with the engineer on site before commencement of works.

31. Bonding and earthing of cables.

(1) Cables to any piece of apparatus shall enter via an approved type armour clamp and gland, effecting a satisfactory mechanical connection to the casing of the apparatus, and making an efficient earth connection with all metal parts of the apparatus bonded, and a wire binder provided on the armouring of the cable entering the apparatus.

(2) When joining cables buried under ground, two wire binders shall be provided on the armouring on each cable at the joint in addition to the armour clamps gripping the armouring firmly to the joint box gland or casing so that undue stress is not caused by ground movement.

(3) The armouring of all cables shall be efficiently bonded to the cable sealing and joint boxes by the use of copper tapes and the size of the copper tape shall be agreed upon with the engineer.

32. Excavation and reinstatement.

(1) A person desiring to carry out excavation shall obtain authorisation from the Building Committee prior to excavation.

(2) Works related to excavation, planking and strutting, supply of and laying of ducts, back filling, reinstatement, removal of surplus soil and any other work of this nature shall be as indicated in the drawings.

(3) Where extensive trenching is involved, the cabling contractor shall mark out in advance the positions of all cuttings.

(4) The contractor shall be held responsible for inaccurate and unsatisfactory installation of the work under subparagraph (3).

(5) Where pumping is necessary, the material in and around the excavations shall not be disturbed and temporary sumps shall be constructed if necessary and back filled on completion.

(6) A trenchless excavation shall be used when crossing roads and pathways unless otherwise approved by the Building Committee.

(7) Where necessary, the contractor shall properly timber or shore the sides of trenches, and the sides, and roofs of tunnels in such a manner as to ensure their withstanding against falls, slips, and all loose materials, and to ensure the safety of persons and protection of the work and adjoining property from damage.

(8) All excavations shall be taken out sufficiently to allow for adequate timbering and the efficient carrying out of the works.

(9) Upon completion of the laying and testing of the cables as specified, the contractor shall complete the filling in of trenches in layers of not more than 150mm thickness; each layer being well rammed until solid before the next is added.

(10) Where necessary, watering of the backfill shall be adopted to secure proper consolidation.

(11) The final reinstatement of excavations shall be left sufficiently mounded to allow for future settlement.

(12) All hollows formed outside the limits of the excavations or trenches due to collapse or any other cause shall be filled in with excavated material, properly backfilled, rammed and consolidated.

(13) The surplus material arising from the excavations shall be removed, deposited, spread and leveled as directed by the engineer on site.

(14) During excavation the contractor shall take particular care to avoid damaging any other services which may cross or run adjacent to the cable route, and any services uncovered shall be adequately supported by slings or other suitable means.

(15) The approximate position of existing services shall be indicated on the drawings.

(16) The contractor shall exercise great care in carrying out excavations in the vicinity of existing services and in the event of damage he or she shall be responsible for remedial work that may be necessary.

(17) Trenches shall be excavated to enable the cables to be laid at minimum depth of 600mm below finished ground level, as detailed on the drawings.

(18) Trenches staying open for construction shall be fenced off with visible marks or warning signs.

Consumer Mains

33. Feeder pillars.

(1) Feeder pillars shall be weatherproof and of robust construction with hinged lockable doors with the back having removable plates, bolted or screwed to the shell.

(2) When installed, the feeder pillar shall be mounted on a firm base or as shown on the drawings and arranged to prevent the ingress of rain water, vermin, termites or other danger within the enclosure.

(3) The capacity and number of links or fuse ways shall be as specified on the drawings and shall have phase, colour and circuit identification.

(4) Unless otherwise specified, feeder pillars shall be "dwarf type", tailless units.

34. Earthing.

(1) In every installation, a consumer's earthing shall be provided adjacent to the consumer's supply terminals.

(2) Particular attention shall be given to conduit and trunking installations to ensure that the earth continuity is reliable and permanent.

(3) All apparatus or parts not solidly connected to the earthing systems shall be connected thereto in an approved manner by a solid copper conductor secured by means of substantial bonding clamps.

(4) All services entering the installation at earth potential shall be efficiently bonded to the main earth points.

(5) All joints in the earthing system shall be made with solderless connectors or by an approved brazing method.

(6) The resistance of the earth continuity system when measured between the main earth point and any other point in the installation, including all metalwork which may provide a path to earth such as gas, water or waste pipes shall not exceed 1 ohm.

(7) All flexible metallic tubing shall have a green or yellow insulated earth conductor run with the tubing and the ends shall be securely bonded at positions accessible for inspection.

(8) The size of the earth conductor shall be as indicated in the current edition of the IEE Wiring Regulations and shall not be less than 4 mm^2.

(9) Care shall be taken to ensure that the neutral conductor does not become accidentally earthed.

(10) The neutral of the supply shall be bonded to the earth tape, in accordance with the appropriate procedure of multiple neutral earthing.

(11) The actual bonding of the neutral of supply under subparagraph (10) shall be performed by a representative of the licensed electricity service provider.

(12) The earthing terminal of every socket-outlet and mounting boxes shall be connected to the earth-continuity conductor of the final sub-circuit.

(13) Earthing shall conform to the current edition of IEE Wiring Regulations.

35. Lightning protection.

(1) All buildings including schools, churches, mosques, halls, hospitals, theatres shall be provided with a lightning protection system.

(2) Lightning protection installations shall, in general, consist of copper or aluminum tapes 20mm x 3mm section with similar clips, test clamps and copper bond earth rods which shall be mounted in the position as indicated on drawings.

(3) Each roof tape shall be provided with a similar copper or aluminum down tape to the earth test position, and from the earth test position to the earth electrode in copper only.

(4) Suitable approved arrangements shall be made for the junction of aluminum and copper tapes.

(5) The electrode shall consist of a copper bond rod buried in the ground as close as possible to the installation to be protected.

(6) The earth resistance of the completed system shall in no circumstances exceed 10 ohms and shall be as low as possible.

(7) Where earth resistance cannot be obtained by means of a single earth electrode, extra rods shall be added in parallel at a distance not less the length of the earth electrode.

Lighting

36. Street lighting.

(1) Street lighting columns shall be constructed and installed in accordance with BS 5649 and shall be of the type as indicated, columns set in ground shall be fitted with a base plate unless otherwise indicated.

(2) Each street lighting column shall be fitted with a fuse unit providing terminations adequate for the cabling to be looped in and out and shall be fitted with fuses conforming to US IEC 269-4 with appropriate rating.

(3) All necessary cut-out terminals and loop -in facilities in the base of the supporting structure shall be appropriately installed and incoming cables terminated.

(4) The street lights switching system shall be as follows—

(a) photocells may be used for individually switching street lights or may be connected to contactors for group switching;

(b) time switches shall incorporate a timing mechanism in the event of a power failure to activate contactors for switching; and

(c) any other appropriate system as designed and specified in the drawings.

(5) Luminaires shall conform to the following—

(a) the sealing of luminaires, and their resistance to ingress of water and dirt shall be as described by their international protection code IP number and shall be not less than IP34;

(b) for urban and residential roads, the light source used shall have a colour rendering index of (Ra) ≥20; and

(c) in urban centers, shopping streets, boulevards, promenades and other places where social activity is taking place, the light source used should have a colour rendering index of (Ra) ≥60.

37. Inspection and testing.

(1) On completion of the installation, the contractor shall carry out the following tests in the presence of the authorised person as applicable—

(a) tests as prescribed in the Electricity (Installations Permits) Regulations 2003;
(b) tests in accordance with US IEC 60245-1;
(c) insulation resistance tests;
(d) circuit and earth continuity tests;
(e) loop impedance and polarity tests;
(f) continuity resistance of conductors and sheathing sections;
(g) phase sequence;
(h) full load when specifically ordered; and
(i) earth resistance in accordance with the procedure in Item B of Schedule 2.

(2) Tests shall be carried out on each circuit in addition to the complete installation.

(3) The Authority shall, notwithstanding the requirements under this paragraph, conduct periodical tests on electrical installations in buildings every 5 years.

38. Application of Part.

(1) This Part shall guide safe installation and utilization of photovoltaic power supply systems as an alternative source of energy.

(2) The standards under this Part apply to 12V, 24V and 48V systems for residential applications and solar home systems but not other PV systems such as PV- pumping systems and grid connected systems.

Photovoltaic (PV) Modules

39. PV Modules (Panels) specifications.

(1) The output current and voltage of PV modules or panels shall be appropriate for the application and clearly confirmed from the manufacturer's documentation with pertinent conditions of solar radiations of 1 kW per m^2 or less and cell temperature of 35ºC or higher.

(2) A PV module shall have a quality mark from Global Approval Programme for Photovoltaics (PV GAP) or any other accredited testing laboratory on the module.

(3) The mark in subparagraph (2) shall provide assurance that the module has been tested according to US IEC 61215 or US IEC 61646.

40. PV Modules position.

(1) A PV module shall be positioned to ensure that an object including a tree or building does not shade any part of the PV-panel at any time of the day between 90 minutes after sunrise and 90 minutes before sunset.

(2) Where shading is unavoidable, it shall be compensated for by reducing the daily energy output in the system design and the reduction in output due to partial shading will be much greater than the portion of the array that is shaded.

(3) Where possible, the PV-panel shall be installed on the roof of a building near the controller and battery bank.

41. PV Module orientation.

The panel shall be inclined at an angle of between 10 and 20 degrees to horizontal plane, facing due north or south, for fixed panels.

42. PV Module lightning protection.

(1) PV-panels shall be installed lower than the highest point of the building.

(2) The support frame shall be provided with a short lightning rod with the rod being the highest point of the building.

43. PV Module support structure.

(1) The support structure for panels shall be made of permanent materials, and shall be strong enough to withstand all climatic conditions including wind, heat, and water without deflection or vibrations and shall be securely braced and fixed to the roof, the wall of a building or the ground.

(2) The support structure shall be made of non-corroding materials, or protected against corrosion by methods such as galvanization and painting.

(3) Dissimilar metals shall be kept separate except where they are sealed against water by paint or sealing compound.

44. Roof mounting PV Modules.

Mounting PV Modules to roofs shall be done in such a way that prevents leakages and corrosion of roofing materials.

45. Ground mounting PV Modules.

(1) Where ground mounting is necessary, there shall be solid foundations at each corner of the array with additional support as required by the design of the supporting structure.

(2) In order to avoid shading by grass and other vegetation, panels shall not be mounted closer than 800mm from the ground.

(3) Small arrays may be fixed to a single pole, securely buried into the ground and where necessary secured with stays.

(4) The location of the mounting shall be safely fenced from damage caused by animals.

46. Types of batteries.

Batteries shall conform to US IEC 61427-1:2013 and be of a design suitable for PV applications with deep discharge and long cycle life batteries.

47. Installation.

(1) Batteries shall be installed in enclosed equipment capable of protecting the connections or terminals against accidental short-circuiting.

(2) At least 20mm free space shall be left between the batteries, the wall, and the top of the box.

(3) Ventilation of the enclosure shall be ensured to avoid buildup of explosive gases during charging.

(4) The equipment shall be made of durable materials and if made of wood, it shall be well preserved against insects, termites, rot or acid.

(5) The equipment shall be securely fixed in position and each battery shall be marked with the date of manufacture and installation.

(6) Maintenance requirements shall be clearly laid out in the manufacturers or owner's manual.

48. Controllers and circuit.

(1) Controllers shall be designed and installed to protect the batteries against overcharging and over-discharging.

(2) The rated capacity of the controller shall be selected to handle the maximum short circuit current from the PV-array and the maximum load.

(3) The charge controllers and circuit breakers or fuses shall bear manufacturer's PV quality mark, PV GAP or any other accredited testing laboratory PV quality mark.

(4) A warning system consisting of a light or an audible alarm providing at least three minutes' advance warning of self-disconnection shall be installed.

(5) Where the controller is installed in a room which is not regularly used, a remote alarm shall be installed at a place where it can be easily noticed.

(6) Essential service (ES) circuits may be provided with a switch to facilitate bypass of the over- discharge protection or to bypass the regulator completely.

(7) Subparagraph (6) notwithstanding, warning for low battery shall be included for non-essential services (NES).

(8) The owner's manual and markings on the bypass device shall clearly indicate the implications and potentially irreversible damage that may be caused by bypassing this protection.

(9) The system shall be protected against damage due to accidental short-circuits by use of fuses or circuit breakers.

(10) Each circuit shall be designed such that the peak demand does not exceed 80% of the rated capacity of the fuse or circuit breaker.

(11) Required fuses and circuit breakers may be integrated in the controller box or installed separately in a fuse or distribution box positioned near the controller and battery.

(12) Each fuse or circuit-breaker shall be clearly marked with rated capacity and for which circuit it is used.

49. Samples.

Where new components or innovative techniques are used, samples of materials and equipment shall be submitted to the Building Committee for approval before installation commences.

Design Data

50. System Design for essential and non-essential services .

(1) The client may provide data for dimensioning of each system where the design is not prepared in detail by the designer.

(2) It shall be the responsibility of the designer to ensure that such system details are consistent with the—

(a) type of lights and appliances;

(b) essential services and non-essential services; and

(c) daily load.

(3) The designer shall specify the manufacturer, types of equipment with relevant rated capacities to be installed and enclose calculations and other documentation to prove that all requirements have been met.

51. Calculations.

(1) Calculations of requirements for a functional system shall depend on whether it is considered a non-essential service or essential service.

(2) The system sizing rules shall be based on mathematical modeling with daily solar radiation records from Uganda over the period of at least 5 years, taking into account panel degradation, system autonomy as well as battery aging.

(3) Essential service and non-essential service systems shall in general be installed as separate systems.

(4) Where a combination of essential service and non- essential service are connected to the same system, it shall be sized as if all services are essential service, unless particular calculations are provided to prove that the design of the combined system shall satisfy the requirements of both types of services.

52. Essential services.

(1) The battery capacity shall be at least 5 times the maximum daily load in which shall provide a normal cycle depth of 20% or less, assuming ample battery service life, and shall provide at least 5 days' autonomy in case of total array failure.

(2) The array output current under conditions as specified above shall be at least Daily Load (DL) (Ah) /4(h).

53. Non-essential services.

(1) The total nominal capacity of the batteries in Ah shall be at least 4 times the daily load in Ah.

(2) The array output current under conditions as specified in subparagraph (1) shall be DL (Ah) /4(h).

54. Labels.

(1) All solar PV equipment shall be suitably and legibly labeled.

(2) The labels shall be made of permanent inerasable material with clearly legible letters and shall be displayed in a prominent position, providing the following information—

(a) battery enclosure to include a warning such as danger, explosive smoke, do not smoke, explosive gas, or do not use open flames as may be applicable;

(b) controller—

(i) name and address of installer;

(ii) date of installation;

(iii) interpretation of performance displays or colored lights;

(iv) operation of circuit breakers or fuses; identification of circuits from the controller; or

(v) instructions on maintenance or cleaning of photovoltaic panels; and

(c) remote warning if installed, shall have an explanation of the warning signals.

55. Inspection and testing.

(1) Upon completion of installation, the system shall be inspected by the Building Control Officer to ensure compliance with this Code.

(2) In addition to checking that all parts are correctly installed and operating satisfactorily, the Building Control Officer shall certify in writing that—

(a) voltage drop (loss) in cables does not exceed specifications;

(b) output from PV modules is within 5% of manufacturer's specified value;

(c) all wiring has been installed in an appropriate manner;

(d) safety hazards do not exist; and

(e) all signs and labels have been appropriately placed.

56. Warranties.

All installation and equipment shall have a minimum warranty period as specified in Table 3 of Schedule 3.

57. Registration, approval and acceptance for Photovoltaic Installations.

(1) The Authority shall carry out registration of authorised persons for photovoltaic installation in accordance with Electricity (Installation Permits) Regulations, 2003.

(2) Authorised persons shall be required to maintain records of all Photovoltaic installations they perform, and these records shall include the date, system type, unit installed or serial number.

58. Installation design.

(1) The installation shall be designed as efficiently as possible to minimise the loss of energy through cables and junctions.

(2) The layout of the installation shown in drawings or detailed specifications, shall be accurately followed.

(3) The design information shall be kept on file and availed to the client after completion of the installation.

Wiring Methods and Cables

59. Conduit wiring.

(1) Surface mounted conduit with single wire conductors shall be installed using saddles or supports at suitable intervals.

(2) PVC conduit may be used under floors but steel conduit should be used in all places where heavy or unpredictable loads may occur.

(3) Under floor conduit shall not be less than 20mm diameter to allow for subsequent maintenance.

60. Conductor cross-section and voltage drop.

(1) The cross-sections of the conductors shall be according to the current edition of the IEE Wiring Regulations.

(2) The rated current carrying capacity at 35°C shall not be exceeded for any given wire cross-section.

(3) Wires of a cross section area less than 2.5mm^2 shall not be used with photovoltaic systems.

(4) The voltage across any appliance shall not be less than 5% of the battery terminal voltage and a voltage of less than 10.5V shall not be permissible across an appliance.

(5) Voltage drop between the PV panels and batteries shall not exceed 1.0V or 5% measured at maximum charging current and the voltage drop measurements shall include any series or protection diodes.

61. Use of existing 240V AC wiring.

Existing wiring of 240V a.c. shall be used, provided it complies with the requirements under this Code.

62. Cable connections.

(1) Cables may be connected by the use of junction boxes, block connectors or soldering joints with insulating sleeves.

(2) The rated capacity through the joints shall not be less than that for the circuit to which they form a part of.

63. Power intake for underground and overhead cables.

(1) Underground cables shall be at least 600mm below the surface and shall be indicated with markers in coloured plastic tape, minimum 50mm wide or a lining with bricks or slates, placed at 200mm above the cable.

(2) Underground cables shall be used across all areas with vehicular traffic and may also be used for aesthetic reasons or to achieve a short cable run.

(3) The cables designed for this type of application and conduits shall be able to withstand vertical loads where heavy vehicles are expected to cross the area.

(4) Suspended cables shall be mounted so that the lowest point is at least 2700mm above ground level.

(5) The cables shall be held in position by suitable brackets and strain relief to prevent mechanical wear and stress of the electrical connections.

(6) Cables for outdoor exposed usage, shall be fully ultra violet-resistant.

(7) Attachment of cables or conduit to concrete, bricks or mortar or walls shall be made with appropriate fasteners and attachment of cables to metal or similar material shall be made by use of suitable toggles.

(8) Cables through roofing shall be contained in roof-entry boxes, which shall also form a waterproof seal to avoid leakage.

(9) Cable holes through roofing shall be avoided where possible, but where they are used, they shall be drilled at the top of corrugations and shall be thoroughly sealed and waterproof with ultra violet-resistant silicone sealant or its equivalent.

(10) Where wires or cables are fixed to or pass through particularly flammable materials such as thatch, they shall be shielded in non-flammable conduits.

(11) Fittings shall be fastened to suitable supports, which may need to be provided if not already present, and a conduit or fitting shall not be attached directly to thatch, or any other non-supportive surface.

64. Workmanship and finishing.

(1) Where detailed specifications are not provided by the client for choice of materials or workmanship, standard practice for the trade shall be followed.

(2) Standard practice regarding the approval of quality, assessing capacity of PV-panels, batteries, controllers and other components shall comply with Ugandan Standards.

65. Light fixtures.

(1) All light fixtures shall comply with US IEC 60364.

(2) Where lamps are fitted next to thatched or flammable ceiling materials, a metal lamp fitting or a metal shield shall be used to minimise the risk of fire.

(3) Appropriate high intensity lamp shall be used for outdoor lighting such as security and street lighting.

(4) Lamps with enclosures or detractors shall be capable of being opened for cleaning.

66. Sockets.

(1) Where socket outlets to be connected to solar PV system are designed for 12V, 24V and 48V d.c, 2-pin plugs shall be used and it shall not be possible to reverse the polarity.

(2) Domestic appliances such as radios, fans, spotlights, rechargeable torches, refrigerators and special instruments shall be connected to the solar PV system through socket outlets designed for such voltage or provided with suitable and efficient adaptors or inverters.

(3) A 12V, 24V and 48V appliance shall not have a 240V a.c. mains type plug attached to it.

(4) Where 240V outlets from a d.c.-a.c. inverter is provided, mains type socket shall be used.

(5) Circuit breakers and proper earth safety system shall be provided to prevent damage to the inverter in case of an overload.

(6) All installations that have d.c. sockets shall be wired so that the large diameter pin in the plug is always positive.

(7) All positive connections shall be made with red insulated wire and negative connections with black insulated wires.

67. Switches.

(1) Standard switches for 240V a.c. shall not be used as an alternative to special switches for 12V, 24V and 48V d.c. except where written approval from the manufacturer and the Authority is obtained indicating the acceptable d.c. voltage and current limits.

(2) All switches shall be rated at twice their expected current carrying load.

(3) Where particularly required, special time switches, photosensitive switches, remote and relay switches shall be specified.

(4) All switches shall include a clear visual indication of their state.

68. ICT infrastructure.

(1) Information and communication technology infrastructure planning, design and installations shall be installed or constructed in accordance with the National Information Technology Authority Act, 2009, Act No. 4 of 2009, regulations made thereunder, standards and guidelines.

(2) In addition, the following standards shall be applied with regard to planning, installation and configuring IT infrastructure—

(a) the US IEC 60950-1 on IT equipment;

(b) US ISO IEC 14763, IT on implementation and operation of customer premises cabling;

(c) US EAS 379-1 IT on configuration of customer premises cabling for applications;

(d) Integrated services digital network (ISDN) basic access standards; and

(e) US EAS 379-2, IT – Configuration of customer premises cabling (CPC) for applications and integrated services digital network (ISDN) primary rate.

(3) All providers of information technology products and services shall be certified according to the National Information Technology Authority Uganda (Certification of Providers of Information Technology Products and Services) Regulation, 2016.

(4) The service providers shall consult the National Information Technology Authority with regard to the planning, design, installation and implementation of security of information technology infrastructure.

SCHEDULE 1

CURRENCY POINT.

Regulation 3

A currency point is equivalent to twenty thousand shillings.

SCHEDULE 2

Regulations 6(4) and 37(1) (i)

ITEM A—OVERHEAD LINE CLEARANCES

Paragraph 6(4)

1. CLEARANCE IN CROSSINGS

(a) **Crossing of Main Roads**

The vertical clearances of a current-carrying conductor from the surface of a main road shall be at least:

- 0.4kV bare conductor lines	7.5m
- 0.4kV aerial bundled conductors	7.5m
- 0.4kV bare conductor lines	8.0m
- 33kV bare conductors' lines	8.0m

(b) **Crossing of Public Streets**

The vertical clearance of a current-carrying conductor from the surface of a public street shall be at least:

-0.4kV bare conductor lines	5.5m
-0.4kV aerial bundled conductors	5.5m
- 11kV bare conductor lines	6.0m
- 33kV bare conductor lines	6.0m

(c) **Crossing of Private Driveways**

The vertical clearances of a current-carrying conductor from the surface of a private driveway shall be at least:

-0.4kV bare conductor lines	5.0m
-0.4kV aerial bundled conductors	5.0m
- 11kV bare conductor lines	6.0m
- 33kV bare conductor lines	6.0m

(d) **Crossing of Pedestrian Walkways**

The vertical clearance of a current-carrying conductor from the surface of a pedestrian walkway shall be at least:

- 0.4kV bare conductor lines	4.5.m
- 0.4kV aerial bundled conductors	4.0m
- 11kV bare conductor lines	6.0m
- 33kV bare conductor lines	6.0.m

(e) **Crossing of Railway Tracks**
The vertical clearance of a current-carrying conductor from a railway track shall be at least:

-0.4kV bare conductor lines	7.0m
-0.4kV aerial bundled conductors	7.0m
-11kV bare conductor lines	7.5m
-33kV bare conductor lines	7.5m

(f) **Crossing of Water Ways**
When crossing canals or other navigable waterways, the height of the conductors from the highest shall be at the highest water level at least 20m high.

2. HORIZONTAL CLEARANCE FROM ROADS

If possible the line supports, with stays, shall be located at a distance of at least 2 meters from the edge of a road.

3. CLEARANCE FROM BUILDING
Line above or adjacent to building

(1) If the horizontal clearance of a current-carrying conductor of a low voltage overhead line from any part of the building is less than 2meters its height above the referred part should be at least 3meters.

(2) If the horizontal clearance of a current-carrying conductor of aerial bundled conductors (ABCs) from any part of the building is less than 0.5meters, its height from the referred part shall be at least 2.0meters.

(3) The horizontal clearance of 11kV and 33kV bare conductor line from buildings shall be at least 3meters.

(4). The horizontal clearances of 132kV and 220kV bare conductor line from buildings shall be at least 15meters.

4. CLEARANCE FROM TELECOMMUNICATION LINES

(1) The clearance of the conductor of a 33kV bare conductor line from a telecommunication line shall be at least—

(a) 2.3 meters from parallel line; and

(b) 1.8 meters from a crossing line.

(e) The clearance of the conductor of an 11kV bare conductor line from a telecommunication line shall be at least—

(a) 2.0 meters from parallel line; and

(b) 1.5 meters from a crossing line.

(3) Due to interference effects, it is not recommended to construct MV lines and telecommunication lines parallel with each other for long distances.

(4) The clearance of conductor of a 0.4kV bare conductor line from a telecommunication line shall be at least—

(a) 2.0 meters from a parallel line;

(b) 1.5 meters from crossing line.

(5) The clearance of a 0.4kV of aerial bundled conductors (ABCs) line from a telecommunication line shall be at least 0.3meters.

ITEM B—PROCEDURE FOR MEASUREMENT OF EARTH ELECTRODE RESISTANCE (E.E.R)

Paragraph 37(1) (i)

The following procedure shall be followed—

(a) set the pointer at zero;

(b) auxiliary electrodes "B" and "C" must be driven to a reasonably good depth into the ground;

(c) the resistance areas of the earth electrodes must not overlap;

(d) the two auxiliary electrodes must be in a straight line with the main electrode "A" under test; and

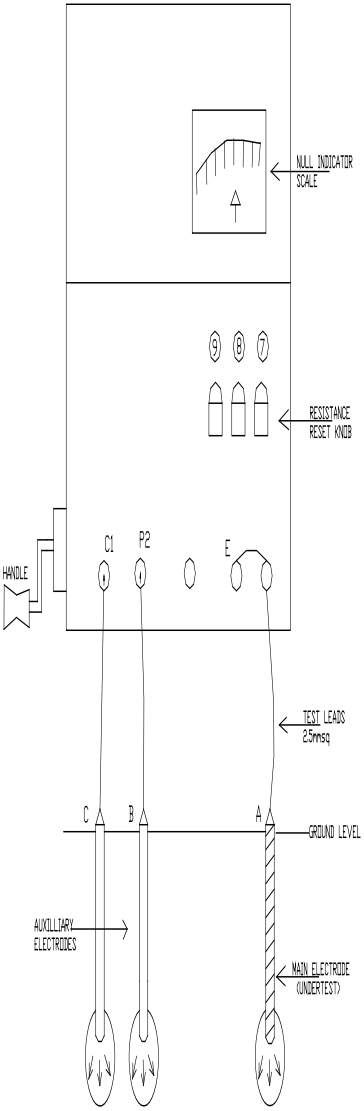
(e) the test leads must not cross each other.

Recommended results must be less than 8 ohms.

FOUR-TERMINAL EARTH TESTING MEGGER

A - MAIN ELECTRODE (UNDERTEST)

B & C AUXILLIARY ELECTRODES



SCHEDULE 3

TABLE 1 - SWITCHBOARD AND SWITCHGEAR

Paragraph 10(29)

Indicating Lamps	Colour
On	White
Off	Green
Fault	Red
Alarms	Yellow
Heaters	Blue

Push Buttons	Colour
Start	Green
Stop	Red
Alarm accept	Black
Emergency stop	Red

TABLE 2 – CABLE SPACING IN TRENCHES

Paragraph 24(3)

CABLE	Extra HighVoltage	Medium Voltage LV	Telephone		Co-Aaaxial
EHV	50mm	-	-		-
HV	50mm	-	-		-
MV	300mm	25mm	25mm		-
Telephone	300mm	300mm	25mm		-
Co-Axial	300mm	300mm	25mm		25mm

TABLE 3 – WARRANTIES.

Paragraph 56

Components	**Minimum warranty period**
Light bulbs	1 year
Batteries	1 year
PV modules and Wiring to PV modules	5 years
Controller / Inverter	3 years
	1 year

Cross references

1. The Building Control Act, 2013, Act No. 10 of 2013.

2. The Electricity Act, 1999, Cap 145.

3. National Information Technology Authority Act, 2009, Act No. 4 of 2009.

4. The Electricity (Safety Code) Regulations, 2003, S.I. No. 22 of 2003.

5. The Electricity (Installation Permits) Regulations, 2003, S.I. No. 19 of 2003.

6. The National Information Technology Authority, Uganda (Certification of Providers of Information Technology Products and Services) Regulations, 2016, S.I. No. 69 of 2016.

HON. MONICA AZUBA NTEGE,
Minister of Works and Transport.