SPESIFICATION FOR SURGE SUPPRESSOR

1.0 GENERAL

This document describes the tender specification requirement of lightning and surge protection system for essential / critical equipment installed such as:-

a) Main switch board, Sub-switch board and critical equipment's distribution board.
b) Fire alarm system
c) Other electronics equipment that is susceptible to surges.

2.0 TECHNICAL BACKUP, ENGINEERING SUPPORTS AND TRACK RECORDS

2.1 The supplier/local agent of the protection equipment shall be able to provide full technical and continuous engineering support in the event of any lightning/surge/power problems. As such it is mandatory that the local agent must have at least 10 years proven experience in the lightning and surge protection field or holding an agency/representation in lightning surge products for at least 10 years.

2.2 It also important that they must have qualified engineers, trained technician and appropriate laboratory to ensure that their products are compatibly matched with the power supply safety requirements, local power adaptation, active testing quality assurance certification and good & proven track j records in the tropical condition. A factory / site visit may be required.

3.0 WARRANTY

3.1 As part of contract requirements, the local agent must provide pre and post local authorized warranty or certification. As such, only genuine products with local authorized distributor will be considered and all products offered must be provided with country of origin certification for originally marking and minimum 5 years spare part support. A letter of support from manufacturer shall be submitted.

3.2 The local authorized agent shall be able to provide technical specialist to directly address technical matters raised during on-site servicing, routine checks and performing technical assessment and other related issues.

4.0 STANDARDS

4.1 All stages of equipment shall comply with the specifications. The suppressor units shall be tested in accordance to ANSI/IEEE C62.41 or IEEE 587 or VDE 0675 or IEC 61024-1/ IEC 61312-1

5.0 ON-SITE WARRANTY

5.1 In event of extreme lightning and surge discharges, a suppressor unit often sacrifices itself in protecting the equipment. As such an on-site warranty must be provided to monitor the condition of the suppressor units at regular intervals (not longer than 6 months). The respective suppressor modules shall be checked using a dedicated suppressor tester where applicable including visual inspection of the flag status.

6.0 PROTECTION CONCEPT

The protection shall comprise of the following:-

A) Power-line Protection

1. LHSS-MDB Lightning Horn Surge Suppressor for Level 1 at MSB
2. XFSS-AG, Fine Surge Suppressor for Level 2 at SSB/DB
3. SSS, Series Surge Suppressor for Level 3 at Critical Equipment Terminal /DB

B) Remote premises power-line protection.

1. CPSS, Combined Power Surge Suppressor for remote premises.

C) Signal Data line Protection for Level 4

i. DSS, Data line Surge Suppressor
ii. CXSS, Coaxial Surge Suppressor

7.0 POWER LINE PROTECTION at MSB/GENSET BOARD

7.1 The Lightning Horn Surge Suppressor (LHSS-MDB) shall be a heavy-duty electronic controlled surface arrester unit utilizing the arc chopping principle to limit and discharge lightning surges.

7.2 The Lightning Horn Surge Suppressor (LHSS-MDB) unit shall be a single channel modular type mountable on standard DIN rails and of

7.3 Non-fusible elements capable of limiting surge voltages from indirect and direct lightning strikes and have a long service life.

7.4 The Lightning Horn Surge Suppressor (LHSS-MDB) unit shall be tested to withstand up to 50kA of long duration 10/350us lightning waveform in accordance to latest revision of IEC 61024-1 and IEC 61312 standards.

7.5 The lightning gap unit (neutral to earth) shall also be tested to withstand up to 100kA of 10/350us lightning waveform and rate at 260v.

7.6 The LHSS-MDB unit shall conform to the following specifications :-

1.	Nominal rated voltage	-	240V AC per phase
2.	Maximum rate voltage	-	330V AC per phase
3.	Max lightning current (as per IEC):		
	a) Phase Lightning suppressor 10/350us waveform	-	50kA per phase
	b) Net follow current self extinguishing at 400VAC	-	50kA
4.	Neutral- Earth Lightning gap 10/350s waveform	-	100kA
5.	Voltage limitation at max lightning current	-	< 900V
6.	Response Time	-	< 100ns
7.	Surface discharge arrester	-	Electronic Arc Chopping Gap
8.	Connection	-	3 + 1 Configuration suitable for TT-system.

7.6 The Lightning Horn Surge Suppressor (LHSS-MDB) shall be incorporated with non-welding type of fuses and precision power lightning surge monitoring system.

8.0 POWER LINE PROTECTION at SSB/DB

8.1 The extra fine surge suppressor (XFSS-AG) unit shall be a rail mountable, modular two-piece construction type with base element and a protection plug suppressor suitable for protection of distribution boards and its loads.

8.2 The protection plug shall be equipped with a flag to indicate the status of the components and a remote warning contact shall be integrated in the suppressor unit to act as a remote warning switch in the event of suppressor failure.

8.3 The extra fine surge suppressor (XFSS-AG) unit shall be suitable for TT-system and configured to match installation option before and after Earth Fault device.

8.4 The XFSS-AG unit shall conform to the following specifications:-

a)	Phase Neutral Fine Suppressor		
1.	Rated voltage	-	240V
2.	Voltage limit at 5kA	-	< 550V/<900V
3.	Rated surge current	-	20kA/ 40kA
b)	Neutral to Earth Fine Suppressor		
1.	Rated voltage	-	260V
2.	Rated surge current	-	40kA

8.5 The fine surge suppressor (FSS-AG) shall be incorporated with non-welding fuses and FM output free contact interface for remote monitoring.

8.5.1 OPTIONAL, EXTRA FINE SURGE SUPPRESSOR- (XFSS/D-AG system may be specified to provide differential protection between phases and it shall conform to the following specification.

a) Phase Neutral Fine Suppressor
1) Rated voltage- 240V
2) Voltage limit at 5Ka- < 550V
3) Rated surge current- 20kA

b) Neutral to Earth Fine Suppressor
1) Rated voltage- 260V
2) Rated surge current- 40kA

c) Phase to Phase Fine Suppressor
1) Rated voltage- 500V
2) Rated surge current- 30kA

9.0 POWER LINE PROTECTION for CRITICAL EQUIPMENT

9.1 The series suppressor shall employ the Transient Tracking Technology multistage and multi-level suppression system to provide full time protection of the incoming power to sensitive equipment.

9.2 The main stage of the series suppressor shall be operated in a series connection with transient tracking control technologies for intelligent tracking and suppression for transients, spikes and noise along the sine wave.

9.3 Instant absorption and suppression of the transients shall provided by a combination system of reliable series and shunt surge absorption components utilizing the high energy transient tracking control module.

9.4 It shall also be equipped with an output stage for bi-directional protection against internally generated transient and with an overall lower let through voltages.

9.5 EMI and RFI noise rejection modules can be incorporated into the three phase series suppressor system for units above 100A as per specification requirements or drawings.

SPECIFICATION FOR LIGHTING PROTECTION SYSTEM FOR STRUCTURES

1.0 GENERAL

This section of the specification describes and specifies requirement for the design, supply, deliver, installation, testing, commissioning, handling over in approved working order and maintenance therefore during the Defects Liability Period of the whole lighting protection system in accordance with the Specifications, Supplementary Notes, Bills of Quantities, Condition of Contracts, Drawings etc.

The lighting protection system shall include either air termination network or early steamer emission air terminal, down conductors; joints and bonds, testing joints, lighting flash counter, earth terminations, earth electrodes and other accessories incidental to he completion of the whole systems as specified in the Drawings and/or Bill of Quantities.

Generally, the lighting protection system shall comply with BS 6651 or NF C 17-102, as the case may be.

2.0 AIR TERMINAL

2.1 AIR TERMINATION NETWORK

Air termination network shall consist of a network of vertical and horizontal conductors generally as shown in the Drawings. All salient of the structure shall be incorporated in the air termination network. All metallic projection, chimneys, ducts, gutters, vent pipes, aerial masts, etc. on or above the main surface of the roof of the structure whether shown in the Drawings or not shall be bonded to and form part of the air termination networks, Air terminals or vertical finials shall be provided if specified in the Drawings and/or Bills of Quantities.

Unless otherwise specified, all air termination networks other than air terminals or vertical finals shall be 25 mm x 3 mm annealed copper tape. The method and nature of the fixing shall be simple, solid and permanent. The air termination network shall be secured to the structure by means of Naval Brass purposed made fixings with base phosphor screws at the intervals not exceeding 500 mm.

Air terminals or vertical finals shall be tapered pointed and made of copper. They shall be of 300 mm in length and 100 mm diameter. The base for supporting the air terminal or vertical final shall be of Gun-metal and purpose made.

If portions of the structure vary considerably in heights, any necessary air termination network of the lower portions shall, in addition to their own conductors, be bonded to the conductor s of the taller portions. The methods and materials used for the construction and installation of the air terminal network shall comply with BS 6651.

2.2 EARLY STREAMER EMISSION AIR TERMINALS

An early streamer emission (ESE) air terminal shall consists of a hybrid assembly consisting of an air terminal, with an early streamer emission initiator, a sensing device a triggering device and a supported rod with a down conductor connecting system. The ESE air terminal is characterized by its initiation advance that response dynamically to the appearance of lighting down-leader in the demonstrated during evaluation tests (100 operation test and field confirmation test) compliance with NF C 17-102, Such tests compare an ESE air terminal against a simple rod air terminal situated in the same conditions. The ESE air terminal shall be made of copper, copper alloy or stainless steel.

The ESE air terminal shall be of non-radioactive, and shall not be dependent upon external power supplies for any part of its operation and/or piezoelectric type.

Supporting rod elevation shall support the ESE air terminal. The supporting rod or elevation mast shall be made of stainless steel or reinforced fiberglass material. The stainless steel supporting rod and the ESE air terminal tip shall have a conductive cross-sectional area not less than 120 mm^2.

The ESE air terminal shall install on the highest point of the supporting structure. It shall always be the highest point within the area that it protects. The tip of ESE air terminals shall be at least 2 meters higher than the area it protects, including antennae, cooling towers, roofs, tanks, etc. ESE air terminal and their supports shall be mounted in such a way to withstand the lighting currents, electromotive forces, corrosion and the effects of weather, heat, humidity and wind. Where the ESE air terminal is steadied by conductive guy lines, these shall be connected at the bottom attaching points, by means of a conductor equivalent in size to that of the down conductors.

The number of ESE air terminal installed shall provide protection against lighting to the structure indicated in the Drawings and/or Bills of Quantities. The protection radius of each ESE air terminal shall be calculated according to the NF C 17-102 for the protection level II.

Document and data sheets including calculations and drawings showings location shall be submitted to the S.O's Representative. No work shall proceed unless such documents and data sheets are submitted.

Upon completion Electrical Contractor shall submit to S.O's Representative; ESE manufacturer's Certificate of Compliance, Test Report and Certificated of Guarantees and Warranties for the complete installation.

2.3 DOWN CONDUCTORS

Down conductors shall be 25mm x 3 mm bare copper tapes installed around the outside walls of the structure. No down conductors shall be routed inside the service ducts.

The down conductors shall be installed in such a way that its path is as possible between the air terminal and/or air terminal network and earth termination network. It shall be as straight as possible along the shortest path without sharp bends or upward sections. They shall securely fix at intervals not exceeding 500 mm by means of Naval Brass fixings with base phosphor bronze screws. The bend radius shall not be less than 200 mm. Deep re-entrant loops; routing round parapet or cornices shall be avoided. However, a maximum height increase of 400 mm is permissible for passing over a parapet wall with a slope of 45° or less.

All the conductors shall be connected together mechanically and electrically effective, by means of purposed made copper clamps or by welding, soldering or brazing. The overlap shall not be less then 20 mm. All wall or other building penetrations shall made in manner to prevent the ingress of water/water moisture and PVC sleeve shall be provided.

For air terminal networks, unless otherwise as shown in the Drawings and/or Bills of Quantities, the number of down conductors is one of each 20 meters or part therefore the perimeter at roof level or ground level, whichever is the greater. Structure over 20 meters high shall have one per 10 meters or part therefore. Where more than one down conductor is used, the down conductors shall be arranged evenly and distributed around the outside walls of the structure.

For ESE air terminals, each ESE air terminal shall be connected to the earth termination network by at least one down conductor. Two or more down conductors are required when the horizontal projection of the down conductor is larger than its vertical projection or the height of the structure is more 28 meters. However the total number of down conductors required shall be as recommended by the original manufacturer of the

ESE air terminal. The Electrical Contractor shall submit such recommendation to the S.O. Representative before the installation is carried out.

Where purpose designed and/or structure copper conductor cable being used instead of 25 mm x 3 mm bare annealed copper tapes as down conductors, the Electrical Contractor shall submit all relevant and data to substantiate the effectiveness of such to safety conduct the lighting energy from the ESE air terminal down to the earth.

3.0 JOINTS AND BONDS

The lighting protection system should have as few joints as possible. However if joints are to be made, the followings procedure are to adhered to:-

a) Joints and bonds shall be mechanically and electrically effective by means of purposed made copper clamps or by welding, soldering or brazing. With overlapping joints, the length of the overlap shall not be less than 20 mm.

b) Contact surfaces shall first clean then Inhibited from oxidation with a suitable non-corrosive compound.

c) The resistance from any part of the lighting protection system to earth shall not exceed the value given in Item 6.0 of this Specification.

4.0 TESTING JOINTS

Each down conductor shall be provided with a testing joint along the route of the down conductor. The testing joints shall be purposed made copper clamp. Unless otherwise specified, each testing joint shall be installed at 2500mm above the ground level.

5.0 EARTH TERMINATIONS

An earth termination shall be connected to each down conductor. Earth termination shall be 25 mm x 3 mm copper tapes connecting the down conductor at the testing joint to the earth electrodes. The portion of the earth termination between testing joint and ground shall be enclosed in a PVC conduit or using of suitable size.

All earth terminations shall be inter-connected by 25mm x3mm copper tapes.

Each of the earth termination shall have a resistance to earth not exceeding the product given by 10 Ohms times the number of earth terminations to be resistance to earth not exceeding 10 Ohms.

Bonding conductor of 70mm2 PVC insulated green / yellow twin-colored cable shall be provided for connection between the earth termination for the lighting protection system and the main earthing bar for the electrical installation.

6.0 EARTH ELECTRODES

Earth electrode shall be of copper-jacketed steel care with 16mm diameter and supplied in 1500mm length and shall have provision of screw coupling with another standard length. The copper jacket of 99.9% purity electrolytic copper shall be of minimum radial thickness 0.25mm and shall be molecularly bounded to the steel core to ensure that the copper jacket and steel core are not separable. Each earth electrodes shall be driven 3000mm in depth.

Where the desired earth resistance value cannot be achieved after the first earth electrode have been driven, sufficient number of earth electrodes in parallel shall be installed outside the resistance area until required value is reached. Mutual separation between two earth electrodes shall be equal to driven depth of the earth electrode. Interconnection between different earth electrodes shall be by means of 25mm x 3mm annealed copper tape.

The connection of the earthing conductor and / or the earth electrode to the earth electrode shall be soundly made by the use of plumbed joints, either by brazing using zinc-free material with a melting point of at least 600°C or by exothermic welding or by cold pressure welding.

Each earth electrode shall be provided with heavy-duty type inspection chamber with removable cover. The compressive strength of the inspection chamber and cover shall be minimum 6 N/mm^2 lifting hook shall be provided in the cover.

Each earth electrodes shall be identified by permanent label legibly marked with word “Lighting Earth – Do Not Remove” permanently fixed at the point of connection of every down conductor to an earth termination and at every earth electrodes.

7.0 LIGHTING FLASH COUNTER

Where lighting flash counter is specified in the Drawings and / or Bills of Quantities, the counter shall be of outdoor weather proof type and of the type that is triggered whenever it encounter a 1.5 kA impulse current in 1.5 microseconds duration. The counter shall record up to minimum 9.999 lighting strikes. The counter shall be installed on the most direct down conductor above the testing joint or any location in the Drawing and, in any case, at the height of about 2000mm above ground.

8.0 TEST, TEST INSTRUMENTS AND TEST CERTIFICATES

8.1 TEST AND CALIBRATION OF MEASURING AND TEST INSTRUMENTS

All measuring and test instruments used for testing of the lighting protection system installations shall be regularly tested and calibrated by the manufactures or test and calibration laboratories for their functionality and accuracy. Basic measurements accuracy for these instruments shall be within 5%. In case of analogue instruments, a basis accuracy of 2% of full-scale deflection shall be provided. Test and Calibration Reports or Certificates for the measuring and test instruments issued by calibration laboratory shall be valid for two years from the date of issuance. The instruments and their Test and Calibration Reports of Certificated shall be submitted to S.O. Representative for verification two weeks before of the electrical installation being carried out. No test on the electrical installation shall be carried out without prior approval of the S.O. Representative.

Notwithstanding the validity of the aforesaid Reports or Certificated the measuring and test instruments shall be re-calibrated if so required by the S.O. Representative after any mechanical or electrical mishandling. Fee required for the testing and calibrating and test instruments is deemed to be included in the Contract.

8.2 TEST AND TEST CETIFICATES

After the installation work has been aforesaid Reports or Certificates of Practical Completion is issued, the whole lighting protection system electrical installation covered under this part of the Contract shall be tested in accordance with BS 6651 or NF-C-17-102 as the case may be, and other test deem necessary by the S.O. Representative. In the event the installation fails to pass any of these tests, the Electrical Contractor shall take such measure as are necessary to remedy the defects and the installation shall not be considered until all such tests have been passed.

The test to be carried out by the Electrical Contractor shall consist to the following test as a minimum requirement:-

a) Continuity of air termination network.
b) Continuity of air termination network or ESE air terminals and the down conductors.
c) Continuity of air termination and the main earthing bar for the electrical installation.
d) Earth electrode resistance
e) Earth termination network resistance.

Fee required for the check, test and calibration as described above is deemed to be include in the Contract.

The S.O.'s Representative reserves the right to be present at all test and the Electrical Contractor shall give at least one-week notice in writing to the S.O.'s Representative for this purposed. In any case, no test shall be carried out without prior approval of the S.O.'s Representative. Copies of all the test certificates together with as-installed drawing properly bound and titled shall be submitted to the S.O.'s Representative within one week after the completion of the testing.

Upon completion for the whole lighting protection system installation, Electrical Contractor shall also submit to the S.O.'s representative ESE manufacturing's Certificate of Compliance, Test Report and Certificated of Guarantees and Warranties.

9.0 SERVICE AND MAINTENANCE

During the Defects Liability Period, the Electrical Contractor shall be responsible for the service and maintenance work for the complete installation, all works shall be carried out by competent person. All labor, material, tool and parts necessary to rectify the defect due to manufacturing / installation faults shall be supplied / executed at the Electrical Contractor's cost.

The service and maintenance to be performed and defects to rectify and making good shall include but not limited to the following:-

a) Replacing or making good all ESE air terminals and lighting flash counters that do not meet the manufacturer's guarantees and warranties.
b) Replacing and making good all loose joints and termination, all mechanical support linkage, earth electrode chambers and covers, etc.
c) Making good any damage to roads, buildings, drains, cables, pipes, and concrete arising out of his work.
d) All other works as deemed necessary by the S.O.'s representative.

All works shall be carried out as soon as the Electrical Contractor is being informed by the S.O.'s Representative or the occupant and shall be completed within reasonable time except under emergency situation as stipulated in the Supplementary Conditions for Electrical Work. If the Electrical Contractor fails to comply with the above requirements, the S.O.'s Representative the right to engage another party out the work, in which case, the Electrical Contractor shall be responsible for all the expenses incurred.

SPECIFICATIONS FOR EARTHING SYSTEM

1.0 General Requirements

All earthing installation shall be carried out strictly in accordance with British CP 1013, the IEE Regulations, 16th Edition and requirement of TNB. It will be the responsibility of the Contractor to fully acquaint himself with these requirements.

There shall be separate earthing system for Electrical LT installation, lighting protection, isolated earth for computer/communication system, Telecom main distribution frame (MDF), and localized earth points at each building and lighting columns.

2.0 Main Earthing Bars

Main earthing bars shall be installed at the Consumer Switch Room.

The main earthing bar shall be hard drawn high conductivity copper conductors of dimensions 51mm x 6.25mm and length to suit the number of inter-connecting tapes. The earthing bars shall be installed in the swithrooms with suitable brass bolts and fittings. Sufficient space shall be allowed to facilitate connections. The diameter of the bolt holes in the bars shall not exceed ¼ of the width of the bars. Ferrous screws, bolts and fittings shall not be used.

3.0 Interconnecting Tapes

Interconnecting conductors shall be copper tapes with cross-sectional area not less than the dimensions as recommended in Table 3 of C.P. 1013.

All earthing conductors shall be run in approved positions, and fixed in an approved manner generally along square symmetrical lines using 'Furse No.44' gunmetal saddles or approved equivalent for securing at intervals not exceeding I metre apart. All conductors shall be in full unbroken lengths unless unavoidable and with the consent of the Engineer, in which case the joint shall be arranged to be placed in a visible and accessible position.

All tee-joints and connection faces shall be brazed or tinned, rigidly riveted and soldered. All connections to electrical equipment shall be made by a bolted connection. Conductors and joints that are exposed to corrosion shall be protected by the application of approved anti-corrosion joint or serving or sheath.

The earth connection for all section of the installation shall be electrically continuous throughout.

All cable armour / tapes and glands shall be bonded to the earth system.

The Main Earthing System shall be interconnected in a loop with the two ands of the loop connected to the Main Earthing Bar.

4.0 Earthing Pits

The earthing electrodes shall be of round 16mm diameter copper-weld or copper-bond steel-core rods in standard lengths of 1.83m. The total earth resistance measured at the main earthing bar for electrical installation with the interconnecting tapes disconnected shall not exceed 1 ohm. The Contractor shall allow in his tender the cost of the necessary number of earthing electrodes, points and interconnections to obtain the required earth resistance value of 1 ohm. The number of earthing points indicated in the drawings shall only serve as a guide and shall in no way imply that the earthing points are sufficient to obtain the value of 1 ohm. Additional claim by the Contractor on this item will not be allowed.

Concrete chambers with bitumen coated steel cover shall be installed over the earthing points. The earthing points shall be interconnection by copper tapes clamped on the top of the electrodes.

5.0 Protection against Earth-Leakage Current

Exposed metal-work of all apparatus other than double insulated appliances and all non-current carrying metal-work system including cable sheaths and armour, conduits, ducts, trunkings, boxes, etc., and earth pins of socket-outlets shall be effectively earthed in accordance with Reg. D22 of the I.E.E. regulations. Where it is not possible to obtain effective earthing, the use of current or voltage operated earth-leakage circuit-breakers to prevent danger arising from earth-leakage currents may be permitted at the discretion of the Engineer. Earth continuity conductors shall be in accordance with Reg. D28 to D30 of the I.E.E. Regulations and earthing system shall conform to C.P. 1013.

6.0 Equipment, Motors, Submains and Sub-Circuit Earthing

The Contractor shall supply, install and connect all earth continuity wiring for effective earthing of the equipment, motors, submains and sub-circuit installation in accordance with the requirements of the I.E.E. Regulations. E.C.C. having a cross-sectional area of 6mm2 and under shall be protected throughout with PVC insulation coloured green and yellow or green. All conduit runs shall have their own appropriate size continuity conductors shall terminate back at their respective distribution board earthing terminals.

For all 3 phase submains in trunkings, a separated copper tape of appropriate size corresponding to its current capacity shall be maintained for the full length of the trunking. All submains earthing conductors shall terminate back at their corresponding switchboard earthing terminals.