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TECHNICAL JOB SPECIFICATION

783/3

REVISION 0

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

INTERNAL LIGHTNING PROTECTION SYSTEM

QUALITY ASSURANCE PAGE

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CONTENTS

REFERENCE DOCUMENTS

1.0 SCOPE

2.0 GENERAL CONSIDERATIONS

3.0 STANDARDS AND LEGISLATION

4.0 GENERAL SYSTEM DESIGN CONSIDERATIONS

5.0 SELECTION OF MATERIALS FOR EARTHING AND BONDING

6.0 ELECTRICAL POWER SYSTEM CHARACTERISTICS

7.0 SURGE ARRESTER APPLICATION AT 20 kV and 6.3 kV APPLICATIONS

8.0 SURGE ARRESTER APPLICATION AT 0.4/0.24 kV LOW VOLTAGE SYSTEM

9.0 ENVIRONMENTAL CONDITIONS

10.0 ARRESTER CLASSIFICATION AND TEST REQUIREMENTS

11.0 ARRESTER IDENTIFICATION

12.0 ARRESTERS CLASSIFICATION

13.0 INFORMATION GIVEN BY MANUFACTURER WITH TENDER

FIGURE 1

REFERENCE DOCUMENTS

Job Spec. No. 700/1
[General Notes for Electrical Equipment & Materials]

Job Spec. No. 700/5
[General Electrical]

Job Spec. No. 710/1
[General Earthing Systems]

Job Spec. No 721/3
[Electrical Switchboards]

Job Spec. No 783/2
[External Lightning Protection]

ELOT EN 60071-1
[Insulation co-ordination - Part 1: Definitions, principles and rules]

ELOT EN 60071-2
[Insulation co-ordination - Part 2: Application guide]

ELOT EN 60099-4
[Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems]

ELOT EN 60099-5
[Surge arresters - Part 5: Selection and application recommendations]

ELOT EN 60664-1
[Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests]

ELOT EN 61643-11
[Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and tests]

ELOT EN 62305-1
[Protection against lightning - Part 1: General principles]

ELOT EN 62305-2
[Protection against lightning - Part 2: Risk management]

ELOT EN 62305-3
[Protection against lightning - Part 3: Physical damage to structures and life hazard]

ELOT EN 62305-4
[Protection against lightning - Part 4: Electrical and electronic systems within structures]
IEC 60364-4-44
Low voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and measures against electromagnetic influences
IEC 61000 series
Electromagnetic compatibility (EMC)

1.0 SCOPE

This specification specifies general criteria which must be used in designing, selecting of the appropriate material, as well as the basic necessary erection provisions for constructing an Internal Protection System against Atmospheric and Inherent to an Electrical System Overvoltages.

This Job Specification is applicable to civil and industrial buildings as well as for the industrial process areas where the internal lightning protection system shall be according to **ELOT EN 62305-4.**

As for as the Electrical System is concerned is applicable from 0,22 kV up to 20 kV voltage levels.

2.0 GENERAL CONSIDERATIONS

This Specification shall be read in conjunction with the general electrical specifications **Job Spec. No. 700/5,** with **Job Spec. No. 710/1** for what concerns coordination with the general earthing and bonding system and with **Job Spec. No. 783/2** for what concerns the determination of the risk of hazard against lightning and the coordination with the External Lightning Protection System.

By no means can this specification be used to substitute or to alter any design criteria imposed by referenced Job Specifications. In fact it may be used as a positive supplement towards the best design solution of an overall electrical system.

3.0 STANDARDS AND LEGISLATION

This Job Specification has to be read in conjunction with the following codes and standards:

ELOT EN 60071-1

ELOT EN 60071-2

ELOT EN 60099-4

ELOT EN 60099-5

ELOT EN 60664-1

ELOT EN 61643-11

ELOT EN 62305-1

ELOT EN 62305-2

ELOT EN 62305-3

ELOT EN 62305-4

4.0 GENERAL SYSTEM DESIGN CONSIDERATIONS

4.1 ASSESSMENT OF THE RISK OF HAZARD

This should be done according to **para 5.0 of Job Spec. No. 783/2.**

4.2 LIGHTNING PROTECTION ZONES OF A STRUCTURE

With respect to the threat of lightning the following Lightning Protection Zones LPZs are defined according to **ELOT EN 62305-1 (see Figures 2 and 3 in ELOT EN 62305-1)**:

LPZ 0_A : zone where the threat is due to direct lightning flash and the full lightning electromagnetic field. The internal systems may be subjected to full or partial lightning surge current.

LPZ 0_B : zone protected against direct lightning flash but where the threat is the full lightning electromagnetic field. The internal systems may be subjected to partial lightning surge current.

LPZ 1 : zone where the surge current is limited by current sharing and by surge protective devices (SPDs) at the boundary. Spatial shielding may attenuate the lightning electromagnetic field.

LPZ 2,....,n : zone where the surge current may be further limited by current sharing and by surge protective devices (SPDs) at the boundary. Additional spatial shielding may be used to further attenuate the lightning electromagnetic field.

Zone boundaries shall be defined, according to **ELOT EN 62305-4** upon evaluation of safety distances between two (2) adjacent zones.

4.3 ELECTRICAL DESIGN PARAMETERS OF LIGHTNING STROKES

According to estimated protection degree level (Lightning Protection Level, LPL) of the Lightning Protection System the electrical lightning parameters listed in TABLE 1 (TABLE 5 – **ELOT EN 62305-1**) here below shall be quoted for the design of Internal Lightning Protection System.

According to **ELOT EN 62305-1** minimum values of lightning current amplitude for the different LPLs are used to derive the rolling sphere radius in order to define the lightning protection zone LPZ 0_B which cannot be reached by direct strike (see para 8.2 and Figures 2 and 3, **ELOT EN 62305-1**). The minimum values of lightning current parameters together with the related rolling sphere radius are given in TABLE 2 (TABLE 6 – **ELOT EN 62305-1**) here below.

TABLE 1

MAXIMUM VALUES OF LIGHTNING PARAMETERS ACCORDING TO LIGHTNING PROTECTION LEVEL (LPL) (as per TABLE 5 – ELOT EN 62305-1)

First short stroke			LPL			
Current Parameters	**Symbol**	**Unit**	**I**	**II**	**III**	**IV**
Peak current	I	kA	200	150	100	
Short stroke charge	Q_{short}	C	100	75	50	
Specific energy	W/R	MJ/Ω	10	5,6	2,5	
Time parameters	T_1/T_2	μs/μs	10 / 350			
Subsequent short stroke			**LPL**			
Current Parameters	**Symbol**	**Unit**	**I**	**II**	**III**	**IV**
Peak current	I	kA	50	37,5	25	
Average steepness	di/dt	kA/μs	200	150	100	
Time parameters	T_1/T_2	μs/μs	0,25 / 100			
Long stroke			**LPL**			
Current Parameters	**Symbol**	**Unit**	**I**	**II**	**III**	**IV**
Long stroke charge	Q_{long}	C	200	150	100	
Time parameter	T_{long}	s	0,5			
Flash			**LPL**			
Current Parameters	**Symbol**	**Unit**	**I**	**II**	**III**	**IV**
Flash charge	Q_{flash}	C	300	225	150	

TABLE 2

MINIMUM VALUES OF LIGHTNING PARAMETERS AND RELATED ROLLING SPHERE RADIUS ACCORDING TO LIGHTNING PROTECTION LEVEL (LPL) (as per TABLE 6 – ELOT EN 62305-1)

Interception criteria			LPL			
	Symbol	**Unit**	**I**	**II**	**III**	**IV**
Minimum peak current	I	kA	3	5	10	16
Rolling sphere radius	r	m	20	35	45	60

On the assumption that a properly designed External Lightning System exists it can be assumed that 50% of the full lightning current, i, is distributed through the External Protection System to the earthing system, while the remaining 50% is distributed from LPZ (0) to the subsequent protection zones LPZ (1), LPZ (2) etc. If *(n)* is quoted to be the number of the services of the structure, then the maximum current to be quoted per service is:

$$i_{SER} = (0,5*i)/n$$

Telephone and instrumentation cabling is not quoted as a service
The total lightning current flowing through a cable is given by:

$$i_c = i_{SERc}/k$$

where:

i_{SERc} : the total current enters through a group of cables, belong to the same service.

k : the number of cables of the same service.

For shielded cables it is assumed that the 90% of the lightning current ***ic*** is flowing through armour, whereas the rest 10% is flowing through the cable core.

4.4 BONDING AND SHIELDING

4.4.1 GENERAL REQUIREMENTS

In general mesh configuration type of bonding shall be used where all metal components of the system are bonded to the common earthing system.

Each Lightning Protection Zone (LPZ 0_B , LPZ 1 etc.) should have an equipotential point where all metallic parts should be bonded at the point of their penetration into the subjected zone.

Such equipotential points should be the bonding bars having minimum cross section of 50 mm^2.
When several bonding bars needed to be installed at the same zone these should be connected with a copper conductor of minimum cross section of 50mm^2.

For building installations this conductor shall be of tape form installed on wall. For outdoor-industrial installations it may be stranded tinned copper conductor installed underground.

Metal structures and or concrete reinforcement should also be connected to these equipotential bars.

Especially for building installations, concrete reinforcement of walls where an external lightning protection system exists should be connected to the earthing system at internals not exceeding the length of five (5) m.

Equipotential bars, which belong to subsequent zones, shall be interconnected by copper conductor of minimum cross section of 50 mm^2 according to the principle implied by **FIGURE 1.**

4.4.2 BONDING OF CABLES AND CABLE WAYS

Cables running between separate structures shall have their sheath bonded at both ends.
The same implies for cables installed between different lightning protection zones. Cable trays, metallic conduits, or reinforcement of cable concrete channels should also be connected at least to earth at both ends of their installation.
Such a bonding of cable trays or metallic conduits shall be performed by bare copper conductors of minimum cross-section of 16 mm^2.

4.5 PROTECTION AGAINST LIGHTNING OF THE ELECTRICAL AND ELECTRONIC SYSTEMS

The information for the design, installation, inspection, maintenance and testing of a Lightning Electromagnetic Impulse (LEMP) Protection Measures System (LPMS) for electrical and electronic systems within a structure, able to reduce the risk of permanent failures due to LEMP, is covered in the standard EN 62305-4.
The standard EN 62305-4 provides guidelines for cooperation between the designer of the electrical and electronic system, and the designer of the protection measures, in an attempt to achieve optimum protection effectiveness.
Protection measures against electromagnetic interference due to lightning that may cause malfunctioning of electronic systems are covered in IEC 60364-4-44 and in the IEC 61000 series. The information reported in Annex A of EN 62305-4 can also be useful to evaluate such disturbances.

5.0 SELECTION OF MATERIALS FOR EARTHING AND BONDING

Materials used for earthing and bonding of an internal LPS shall be in conformance with **Job Spec. No. 710/1** and **783/2,** with the additional requirement that copper conductors used for bonding shall have strands with minimum cross section of 1.5 mm^2.

6.0 ELECTRICAL POWER SYSTEM CHARACTERISTICS

6.1 20 kV M.V. MAIN POWER SUPPLY SYSTEM

Nominal System Operating Voltage	Un 20 kV
Maximum System Voltage	Um 24 kV
Nominal Frequency f	50 Hz
Normal Voltage Spread (maximum value)	+5% of Un
Normal Voltage Spread (minimum value)	-5% of Un
Exceptional Voltage Spread (maximum value)	+10% of Un
Exceptional Voltage Spread (minimum value)	-10% of Un
Frequency Variation (% upon nominal)	±2%

6.2 6.3 kV M.V. POWER DISTRIBUTION SYSTEM

Nominal System Operating Voltage	Un 6.3kV
Maximum System Voltage Um	7.2kV

Nominal Frequency f	50 Hz
Normal Voltage Spread (maximum value)	+5% of Un
Normal Voltage Spread (minimum value)	-5% of Un
Exceptional Voltage Spread (maximum value)	+ 10% of Un
Frequency Variation (% upon nominal)	±2%

6.3 0.4 kV L.V. POWER DISTRIBUTION SYSTEM

Nominal System Operating Voltage	Un 0.4 kV
Rated Voltage Ur	0.6kV
Nominal Frequency f	50 Hz
Normal Voltage Spread (maximum value)	+5% of Un
Normal Voltage Spread (minimum value)	-5% of Un
Exceptional Voltage Spread (maximum value)	+ 10% of Un
Exceptional Voltage Spread (maximum value)	-20% of Un
Frequency Variation (% of nominal)	±2%

6.4 INSULATION LEVEL CHARACTERISTICS

6.4.1 20 kV M.V. MAIN POWER SUPPLY SYSTEM

Insulation Level	24 kV (rms value)
Power Frequency Withstand Voltage	50 kV (rms value)
Basic Lightning Withstand Voltage	125 kV (peak value)

6.4.2 6.3 kV M.V. POWER DISTRIBUTION SYSTEM

Insulation Level	7,2 kV (rms value)
Power Frequency Withstand Voltage	22 kV (rms value)
Basic Lightning Withstand Voltage	60 kV (peak value)

6.4.3 0.4 kV L.V. POWER DISTRIBUTION SYSTEM

Insulation Level	1,1 kV (rms value)
Power Frequency Withstand Voltage	2,5 kV (rms value)

6.5 ELECTRICAL SYSTEM GROUNDING METHOD

6.5.1 20 kV M.V. MAIN POWER SUPPLY SYSTEM

Low Ohmic grounded at PPC remote supply.
Ungrounded at service entrance.

6.5.2 6.3 kV M.V. POWER DISTRIBUTION SYSTEM

Impedance grounded at supply (12 Ω).
Ungrounded at distribution.

6.5.3 0.4 kV L.V. POWER DISTRIBUTION SYSTEM

Solid grounded at supply.
Grounding Method TN.

7.0 SURGE ARRESTER APPLICATION AT 20 kV AND 6.3 kV APPLICATIONS

Surge Arresters used for protection of equipment at 20 kV and 6.3 kV Medium Voltage networks shall be gapless Metal Oxide type according **ELOT EN 60099-4.**

The mode of protection of equipment is with surge arrester connection phase to earth. If other modes of protection shall be required for special cases, these should be performed according to **ELOT EN 60099-5.**

7.1 OVERVOLTAGES TO BE CONSIDERED FOR SURGE ARRESTERS APPLICATION

For Electrical Power Supply and Distribution System at Medium Voltage Level described on **para 6.0,** the following overvoltages shall be quoted for insulation coordination and protection purposes:

7.1.1 CONTINUOUS

Voltages occurring at the system under normal conditions of service, having frequency f = 50Hz. For insulation coordination purposes the highest system voltage Um, should be considered.

7.1.2 TEMPORARY

Voltages occurring at the system under abnormal conditions. The standard power frequency (t = 1 min) shape of power frequency voltage shall be used for coordination purposes.

7.1.3 FAST - FRONT OVERVOLTAGES

Voltages occurred by lightning. The standard full lightning impulse wave shall be used for coordination purposes.

Slow front overvoltages at these voltage levels would not be considered except the case of switching off rotating machines while starting and capacitor banks. Insulation Coordination for the type of overvoltages listed above shall be in full-accordance with **ELOT EN 60071-2.**

7.2 SURGE ARRESTERS CHARACTERISTICS

7.2.1 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

The Maximum Continuous Operating Voltage (MCOV) should be selected according to:

For solidly earthed system and/or with automatic earth fault clearing equal to the highest operating phase voltage.

In resonant earthed systems or systems with isolated neutral equal to or higher than the highest line value of system voltage.

In any case a safety factor of 5% should be added in the calculation of MCOV in order to take into account system harmonics.

7.2.2 RATED VOLTAGE

Surge arrester should have a voltage versus time characteristic such as to be at higher level than the temporary overvoltage versus time characteristic of the system.

The rated voltage of the surge arrester should be evaluated with respect to temporary overvoltages which may occur at the system, according to **ELOT EN 60099-5**, with particular emphasis to overvoltages occurring during single line to ground faults. Determination of the voltage rise at the two (2) "healthy" phases during a phase to ground fault shall be made in accordance to the estimated earth fault factor *k* at the point of surge arrester installation and with a procedure as implied by **ELOT EN 60099-5.**

For the determination of the duration of such an overvoltage the total time of earth fault protection (including circuit breaker operating time) must be consulted. Insulation coordination with respect to equipment shall be done by introducing a safety factor of 15% in order to take into account insulation aging.

The standard formula to convert any temporary overvoltage with a duration T_t and an amplitude U_t to an equivalent amplitude U_{eq} having a duration of t = 10s and thus to check with surge arrested capability during operating duty test is:

$$U_{eq} = U_t (T_t/10)^{0.02}$$

7.2.3 NOMINAL DISCHARGE CURRENT

The nominal discharge current of a surge arrester should be selected according to the expected lightning current through the point of its installation and with **para 5.3;** being not less than the value of 10 (kA) at 8/20 us wave-form. For unshielded substations higher value may be required.

7.2.4 DISCHARGE VOLTAGE

The discharge voltage should be coordinated with the Basic Insulation Level of the protected equipment, if at the later 15% margin is added in order to take into account insulation aging according to the formula:

$$PM = (BIL/LPL - 1)X\ 100$$

where:

LPL = The Lightning Protective Level of the surge arrester to be selected, specified at nominal discharge current.

BIL = The Basic Insulation Level of the equipment to be protected including insulation aging and pollution effects.

7.2.5 SEPARATION DISTANCE

Surge Arrester Protection is valid only at the point of its installation. In order to check its protective distance from the protected equipment, as well as to verify if additional protection is required at a remote second location / equipment being operated at the same voltage level the following formula may be used as an

$$U_{rp} = U_{pl} + 2SL/C \quad \text{if } U_{pl} \geq 2SL/C$$

and

$$U_{rp} = 2U_{pl} \quad \text{if } U_{pl} < 2SL/C$$

U_{rp} = Amplitude of the overvoltage at remote location.
U_{pl} = Lightning Protection Level of the Arrester.

S = Surge Steepness (Table 1).
C = 300 m/μs
L = $a_1 + a_2 + a_3 + a_4$.
a_1 = Length of lead connecting arrester to mains.
a_2 = Length of lead connecting arrester to earth.
a_3 = Length of arrester body.
a_4 = Length of arrester point of connection to considered protected equipment.

7.2.6 SUBSTATIONS CONNECTED TO OVERHEAD LINE THROUGH POLE

At this case the protected zone of a surge arrester installed at overhead line termination should be evaluated according to:

$$Lp = N/A[(Urw/1.15-Upl)] (Lsp + Lf)$$

where:

Lp = Protective zone of the surge arrester.
N = Number of lines connected to the substation.
Urw = Rated Lightning Impulse withstand voltage.
Upl = Surge Arrester Protection Level.
Lsp = Span length of transmission line.
Lf = Overhead line length equal to the accepted failure rate of equipment.
A = 900 kV for distribution line with earthed cross-arms.
2700 kV for wood pole distribution lines.

Protection is needed for equipment and/or substations at the same voltage level being connected through cabling to the primary substation with length five times greater than the one determined as above.

7.2.7 LINE DISCHARGE CLASS

Unless otherwise noted in M.R. surge arresters of line discharge class 2 as per **ELOT EN 60099-4** is sufficient for 20 kV and 6.3 kV systems.

Particular consideration should be given when surge arresters are placed to protect capacitor banks.

For that case the required energy absorption capability of a surge arrester shall not be less than the value obtained as follows:

where: $$W = ½* C[(3Uo)^2 - (\sqrt{2}\, Ur)^2)]$$

Uo = The peak value of the operating voltage.
Ur = The rms value of the arrester rated voltage.
C = Capacitance of the capacitor bank.

The next available arrester class should be selected according to **ELOT EN 60099-4.**

8.0 SURGE ARRESTER APPLICATION AT 0.4/0.24 kV LOW VOLTAGE SYSTEM

Surge Arresters used for protection of equipment at 0.4/0.24 kV Low Voltage distribution network shall be metal Oxide gapless type in conformance with **ELOT EN 60099-4** and **ELOT EN 61643-11.**

8.1 OVERVOLTAGES TO BE CONSIDERED

Protection of equipment at Low Voltage Level shall take into account the following overvoltages, upon selection of the proper type of surge arrester to be used and the method of protection to be applied:

- Transient Overvoltages inherent to the system.
- Lightning Overvoltages.
- Temporary Overvoltages.

8.2 PROTECTION AT MAIN SERVICE ENTRANCE POWER SUPPLY SYSTEM

Protection with surge arresters at main service entrance is always required.

Surge arresters to be installed, shall be considered in order to protect equipment at least of overvoltage Category II. For the sake of coordination all overvoltages according to **para 8.1** should be considered.

8.3 PROTECTION OF BUILDINGS

Protection with surge arresters at main service supply of buildings is always required. Provision for protection at main service entrance of buildings in order to take into account the induced effects by a direct lightning stroke to a building shall be done according to **para 4.3.**

When lightning zones boundaries have been defined, protection by surge arresters shall be provided at each equipment electrically connected to equipment of other zone and of different insulation level.
For transition form zone 0 to zone 1, surge arresters of Class II test and with discharge current 10 kA shall be provided.
Discharge voltage of selected surge arresters shall be such as to ensure 15% margin from protected equipment impulse insulation level (Uimp).

8.4 INSTALLATIONS OF SURGE ARRESTERS AT INDUSTRIAL AREAS CLASSIFIED AS HAZARDOUS

Installation of surge arresters at industrial areas, which are classified as hazardous to explosion, shall be made according to the general provision of electrical equipment installation in such areas according to **Job Spec. No 700/5.** Only gapless metal oxide surge arresters may be used, with minimum discharge current In = 10 [kA], specified at 8/20 waveform at least for a number of ten (10) operations.

8.5 INSTALLATIONS OF SURGE ARRESTERS AT INDUSTRIAL AREAS

Installations of surge arresters at industrial areas, other then substations, if required should be done according to provisions of **para 8.3** and **8.4.**

9.0 ENVIRONMENTAL CONDITIONS

Depending on the application, creepage distances between surge arresters, safety margin used for insulation coordination shall take into account the pollution degree level of the relevant area.

10.0 ARRESTER CLASSIFICATION AND TEST REQUIREMENTS

10.1 FOR MEDIUM VOLTAGE SURGE ARRESTERS

Surge arresters shall be tested and meet the requirements as imposed by **ELOT EN 60099-4.**

10.1.1 TYPE TESTS

- Insulation withstands test under dry and wet conditions.
- Residual voltage test where residual voltages shall be demonstrated under the following tests:
  - Steep current impulse test
  - Lightning impulse test
  - Switching impulse test (not required for surge arresters of discharge current of 5 kA and 2,5 kA.
- Long duration current impulse withstands test.
- Operating duty test:
  - High current impulse operating tests (nor required for surge arresters of discharge current of 20 kA).
  - Switching surge operating duty test.
- Power frequency voltage versus time curve.
- Pressure relief test (if pressure relief device is fitted). (Not required for surge arresters of discharge current equal to 2,5 kA).
- Arrester disconnector test (if disconnector is fitted).
- Artificial pollution test (for porcelain - housed surge arresters).
- Partial discharge tests.

- Routine Tests.
- Acceptance Tests.

10.2 FOR LOW VOLTAGE SURGE ARRESTERS

Surge Arresters shall be tested and meet the requirements as imposed by **ELOT EN 61643-11.**

10.2.1 TYPE TESTS

- Impulse current test for Class I surge arresters.
- Nominal discharge current test for Class I and Class II surge arresters.
- Voltage impulse test for Class I and Class II surge arresters.
- Class III combination wave test.
- Tests for terminal and connections.
- Tests for protection against direct Contact.
- Measured limiting voltage tests.
- Operating duty tests
- Tests for disconnectors and safety performance during over stressing.
- Test for percentage voltage regulation (for one and two part SPD).
- Rated load current test.
- Additional test **(ELOT EN 61643-11).**
- Routine tests.
- Acceptance tests.

11.0 ARRESTER IDENTIFICATION

11.1 FOR MEDIUM VOLTAGE SURGE ARRESTERS

Unless otherwise noted in Material Requisition the following information shall be marked on surge arrester permanently attached nameplate:

- Continuous operating voltage.
- Rated voltage.
- Rated frequency.
- Nominal discharge current.
- Pressure relief rated current in kA rms (if pressure relief device is fitted).
- Manufacturer's name -trademark - arrester type and identification.
- Year of manufacture.
- Serial number.

11.2 FOR LOW VOLTAGE SURGE ARRESTERS

- Manufacturer's name.
- Model number
- Maximum continuous operating voltage and nominal / rated frequency.
- Test classification and discharge parameters according to arrester Class I, II or III.
- Voltage protection level Up.
- IP Code.
- Maximum recommended routings of back-up protection.
- Terminal identification.
- Type of current AC, DC or both.

12.0 ARRESTERS CLASSIFICATION

12.1 MEDIUM VOLTAGE SURGE ARRESTERS

Medium voltage surge arresters shall be classified according to their nominal discharge current.

12.2 LOW VOLTAGE SURGE ARRESTERS

Low voltage surge arresters shall be classified and compared according to their discharge parameters, as follows:

- For Class I surge arresters test Iimp (impulse current).
- For Class II surge arresters test Imax (maximum discharge current).
- For Class III surge arresters test Doc (open circuit voltage).
- For both Classes I and II, according to nominal discharge current.

13.0 INFORMATION TENDER GIVEN BY MANUFACTURER

13.1 MEDIUM FOR MEDIUM VOLTAGE SURGE ARRESTERS

- Continuous Operating Voltage.
- Rated Voltage.
- Steep current impulse residual voltage.
- Nominal discharge current and residual voltages.
- Switching current impulses and residual voltages.
- For 10 kA and 20 kA arresters the long duration discharge class.
- Short circuit current capability.
- Length and creepage distance of arrester housing.
- Reference current and voltage at ambient temperature.

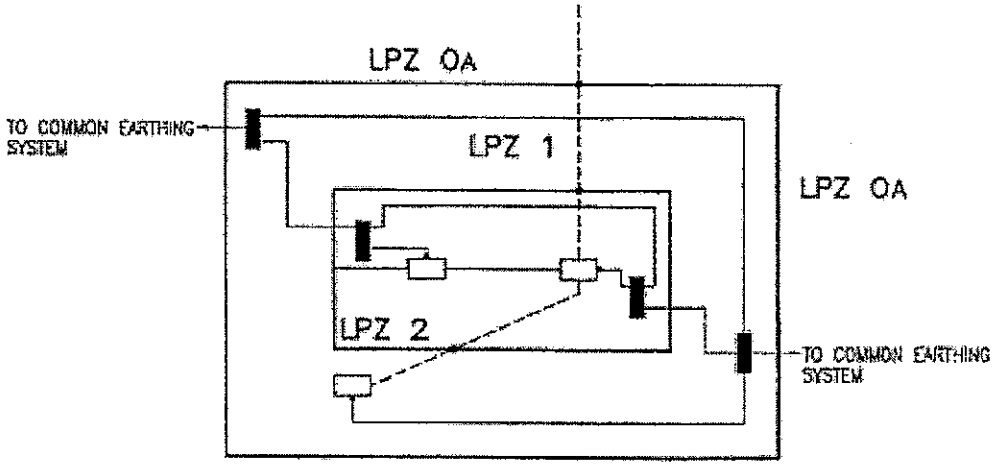
- Power frequency versus time characteristic (with and without preloading of surge arrester).
- Lightning impulse residual voltage at 0,5, 1 and 2 times the nominal discharge current.
- Clearances, mounting specifications.
- Pressure Relief function.
- Mounting method and mounting details.
- Permissible conductor size.
- Dimensions and weights.
- Cantilever length.
- Mechanical Protection Degree (IP Code)
- Insulation Medium.

13.2 FOR LOW VOLTAGE SURGE ARRESTERS

- Manufacturer's name and Model number.
- Number of parts.
- Method of mounting.
- Maximum continuous operating voltage, nominal and rated frequency.
- Test classification and related discharge parameters.
- Nominal discharge current (not for Class III surge arresters).
- Voltage Protection Level.
- Rated load current.
- Mechanical Protection Degree (IP Code).
- Short circuit withstand.
- Maximum recommended routings of back-up overcurrent protection.
- Indication of disconnector operation.
- Identification of terminals.
- Installation instructions.
- Type of current.
- Specific energy W/R for Class I surge arresters only.
- Creepage distances (recommended).
-Temperature range.

FIGURE 1

PRINCIPLE OF EARTHING BETWEEN ADJACENT LIGHTNING PROTECTION ZONES



EQUIPOTENTIAL BONDING BUSBAR

ELECTRICAL USER DEVICE

ELECTRICAL CONDUCTIVE PATH

BONDING POINT

GROUNDING CONDUCTOR