Lightning and Surge Protection Device - Selection Criteria

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Any product selection is based on design parameters. The technical specifications help in identifying technically suitable product at optimum cost. For a safety product like an SPD, over specification will lead to higher cost and lower specification will lead to equipment failure even after the installation of protection devices. Selecting suitable products for the whole industry is a specialist's job. Risk management companies like Cholamandalam Risk Management Services, Chennai; and LPCI-Lightning Protection Consultants International, Chennai have rich experience in this specialized activity based on risk assessment techniques. Risk assessment helps first in determining whether a particular protection is required for a specific application or not and if required up to what level and the type of protectors that are required.

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There are different types of protection devices, each catering to a specific application. Most of them fall under the two broad categories of series and parallel type of connection in the circuit. MCB is a series component and hence, its current rating is the most important parameter. SPD- surge protection device is a parallel component and hence, the current rating of the load has no significance in the selection of the SPD. For any new product or concept we can get the best guidance from the international or national standard. IEC - International Electro Technical Commission is a handy tool that guides us in the selection of SPDs. IEC is in existence for the past several decades and a new standard is introduced only when a need is absolutely felt. The present IEC 62305 - protection against lightning, released in 2006 has four parts. Part 4 - electrical and electronic systems with in structure, contains in its introduction a profound statement, "The need for this International Standard has arisen due to the increasing cost of failure of electrical and electronic systems, caused by electromagnetic effects of lightning." To avoid failures of electronic equipment that are based on rapid development of IC designs of VLSI and so on, the need for detailed and comprehensive protection measures have been discussed in great detail in IEC 62305. When a new standard is introduced, it is customary to follow any one of the following options for the old standards. The old standard can be reconfirmed/withdrawn/replaced by revised edition or amended. IEC 62305 replaces the following old standards.

- IEC 62305-1 (general principles) replaces IEC 61024-1-1 & IEC 61024-1-2
- EC 62305-2 (risk management) replaces IEC 61662
- IEC 62305-3 (physical damage to structures and life hazard) replaces IEC 61024-1
- IEC 62305-4 (electrical and electronic equipments systems within structure) replaces IEC 61312- 1, IEC 61312-2, IEC 61312-3, and IEC 61312-4.

The scope of this article is focused on protection of electrical and electronic equipments within structure. IEC 62305-4, Annexure D discuss about selection of SPD strictly in the following order of preference:

- Selection with regard to voltage protection level **(U_p)**
- Selection with regard to location and to discharge current

Selection with regard to Voltage

Protection level: (U_p) Selection is mainly dependent upon the voltage withstanding capacity of equipment that needs protection. As per IEC 60441: insulation co-ordination for equipment within low voltage systems, Part 1: principles, requirements and tests, table F depicts the rated impulse voltage for equipment energized directly from the low voltage mains – equipment that come in main DB have overvoltage category of 4000 V and the equipments at last level- i.e. computers etc. come under the overvoltage category of 1500 V.

For the main DB equipment this 4000V is the total voltage that includes the voltage protection level of SPD between L-N, voltage protection level of SPD between N-PE and the inductive voltage drop on the bonding conductors.

To ensure that the total voltage available across the equipment that needs protection never exceeds 4000V, the voltage protection level of SPD type 1 (class B) shall not exceed 2.5 kV which includes L-N and N-PE arrestor voltage protection level so that practically, there is a margin of 1500V for the inductive voltage drop on the bonding conductors.

Selection with regard to location and to discharge current: SPDs should be able to withstand the discharge current expected at their installation point. Severe lightning current is expected because of *surges due to flashes to services*. The magnitude of this current again depends on the factor called LPL- Lightning Protection Level. LPL is a number (I, II, III, and IV) related to a set of lightning current parameter values relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning. LPL is used to design protection measures according to relevant set of lightning current parameters namely minimum & maximum levels.

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In a typical low voltage system (up to 1000V AC), considering the worst threat of LPL – I , the maximum current due to direct flash on the service line is 10 kA of impulse current (10/350 uS) at the boundary of LPZ- Lightning Protection Zone, i.e. at the main DB). This is explained in IEC 62305-1, Annexure E, Table 2 "expected surge over currents due to lightning flash."

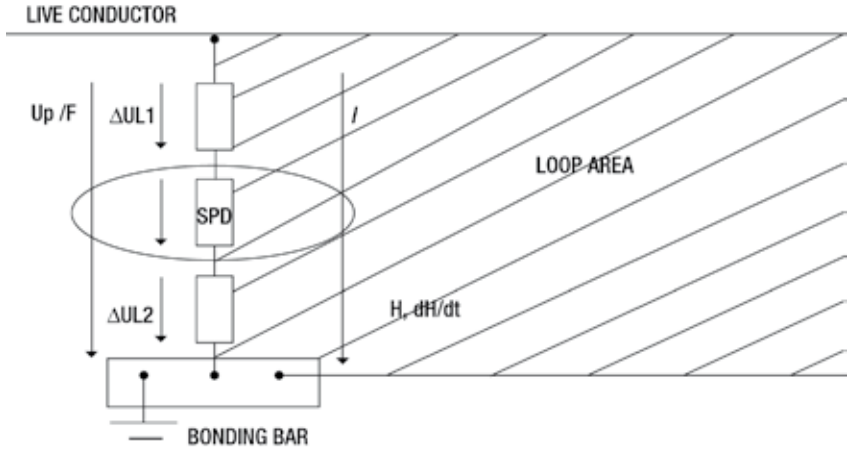
Considering the partitioning of lightning current in both directions of the service and the number of conductors - line, neutral and earth, this current will be significantly low.

On evaluation of both the above parameters – vis-à-vis voltage protection level and selection with regard to location and to discharge current. Type 1+2 (class B+C) of model V25 B+C will serve the purpose in almost all installations. IEC 62305-2 risk management very clearly states the following:

"In most cases, switching over voltages is less damaging than lightning ones and the means of protection (namely SPDs) effective to protect against lightning surges also protect efficiently against switching surges. Therefore, the decision to protect equipment against lightning surges covers in general the question of the need of protection against switching surges."

It is very clear from above statement that, even though lightning surge is not expected in a particular location, a product which is designed for lightning surges can withstand switching surges effortlessly. The only other important parameter to be taken care of is the voltage protection level. ■

SURGE VOLTAGE BETWEEN LIVE CONDUCTOR AND BONDING BAR



Key

I	Partial lightning current
Up/f = Up+ΔU	Surge voltage between live conductor and bonding bar
Up	Voltage Protection Level / Limiting voltage of SPD
ΔU = ΔUL1+ΔUL2	Inductive voltage drop on the bonding conductors
H, dH/dt	Magnetic field and its time derivative