Specific systems protection
Introduction

Protecting wind turbines - Wind turbines contain a vast array of electronic systems, including power, control and telecoms, which require transient overvoltage protection.

Protection follows the Lightning Protection Zones (LPZ) concept established in IEC/BS EN 62305 and IEC 61400, with equipment sited in internal zones up to LPZ 2 (see Figure 8 & Table 3 for specific locations).

Power line protection

Lightning current/equipotential bonding SPDs (minimum Type 1) are required at LPZ boundary LPZ 0 to LPZ 1 to counter partial lightning currents resulting from a direct lightning strike. Transient overvoltage SPDs (minimum Type 2) are required at LPZ boundary LPZ 1 to LPZ 2 to protect critical electronic systems.

The SPD selected should be suitable for the voltage of the line. Furse ESP WT Series protectors apply at 690 V with Furse ESP D1 Series or Furse ESP M1 Series protectors covering 230 V/400 V lines (see Table 3).

These power line protectors offer low let-through voltage protection creating a safe area downstream of minimum LPZ 2, meeting the requirements for wind turbines.

SPDs should be installed on the line side, as close as possible to the equipment being protected. Where connected downstream equipment is > 10 m away, a second SPD should be installed at the subsequent equipment (in line with guidance in DD CLC/TS 50539-22:2010).

If the main HV transformer is housed separately from the wind turbine, incoming/outgoing lines from the turbine and the HV transformer should be protected (minimum LPZ 0 to LPZ 1, or where control system electronics are installed LPZ 0 to LPZ 2).

Data/signal/telecoms line protection

SPDs should be installed to protect data, signal and telecoms lines in the wind turbine and where appropriate, the HV transformer. A wide range of Furse SPDs are available for this purpose, including the the ESP SL Series and ESP D, E, H Series protectors (see Table 3 for specific application).

The SPD selected should be compatible with the system to be protected, and offer sufficient protection to reduce overvoltages below the immunity threshold of the protected equipment. The SPD must not impede system performance and must be able to survive repeated transients.

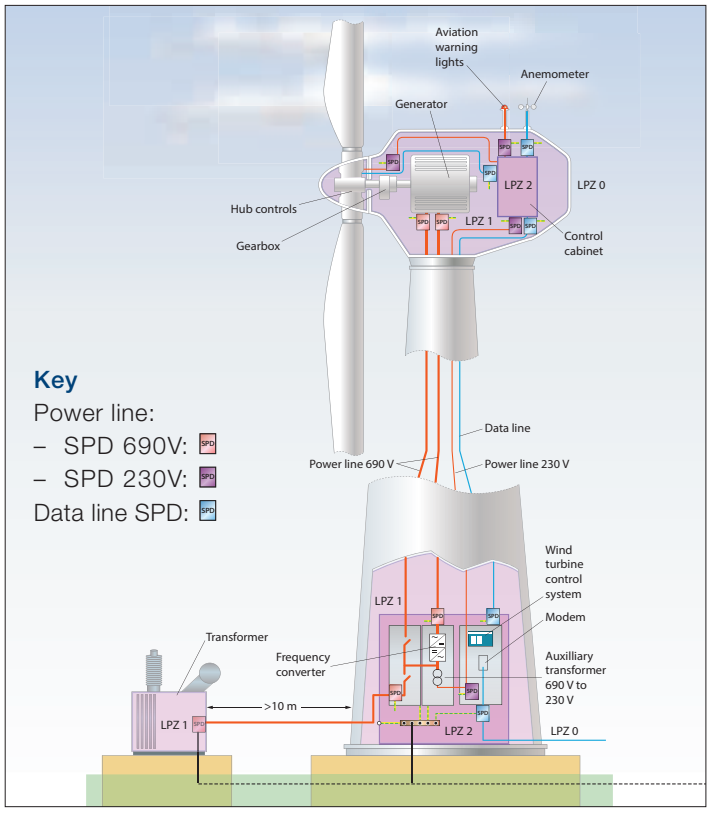
Table 3: SPD requirement according to component to be protected

Location	LPZ	SPD required
Generator (690 V)	LPZ 0 to LPZ 1	ESP WT Series protector
Frequency converter (690 V)	LPZ 0 to LPZ 2	ESP WT Series protector
Transformer (690 V)	LPZ 0 to LPZ 1*	ESP WT Series protector
Control system (230 V)	LPZ 0 to LPZ 1	ESP 240 D1 or ESP 240 M1
Aviation warning light (230 V)	LPZ 0 to LPZ 1	ESP 240 D1 or ESP 240 M1
Hub control: – (230 V)	LPZ 0 to LPZ 1	ESP 240 D1 or ESP 240 M1
– (4-20 mA loop)	LPZ 0 to LPZ 1	ESP SL RS485
– (RS 485 line)	LPZ 0 to LPZ 1	ESP SL RS485
Anemometer (24 V)	LPZ 0 to LPZ 1	ESP SL30
Modem	LPZ 0 to LPZ 1	ESP TN or ESP SL TN

*Where the transformer includes process control/data lines, protect to LPZ 2

The SPD should be installed as close as possible to the point of entry/exit of the incoming/outgoing line. Where connected equipment is > 10 m from the incoming/outgoing line, a second SPD should be installed at any subsequent connected equipment.

Application of SPDs within a typical wind turbine environment



Specific systems protection
Introduction

Table 4: SPD requirement according to structural LPS configuration

Status of Structural LPS	DC side, distance PV array to inverter		AC side of inverter
	< 10 m	> 10 m	
No structural LPS	ESP PV Series protector (min. Type 2 performance)	ESP PV Series protector (min. Type 2 performance)	ESP AC mains power protector (min. Type 2 performance)
Structural LPS (separation distance kept)	ESP PV Series protector (min. Type 2 performance)	ESP WT Series protector (min. Type 2 performance)	ESP AC mains power protector (min. Type 2 performance - inverter) (min. Type 1 performance - MDB)
Structural LPS (separation distance not kept)	ESP PV Series protector (min. Type 1 performance)	ESP PV Series protector (min. Type 1 performance)	ESP AC mains power protector (min. Type 1 performance)

Photovoltaic (PV) systems are at risk from transient overvoltages which may enter the system following a direct lightning strike to a structural LPS, or via the wider electrical network.

Protection against transient overvoltages is achieved through installation of appropriate SPDs on the DC and AC side of the DC-AC inverter in the PV system. Installation should follow the guidance provided in Technical Specification DD CLC/TS 50539-12.

Installation on the DC side of the DC-AC inverter

An SPD specifically designed for use on the DC side of a PV system should be installed. Where the distance between the PV array and the inverter is < 10 m, a single SPD suffices, mounted as close as possible to the inverter. Where the distance > 10 m, two SPDs should be installed, one close to the inverter and the other close to the PV array. The minimum Type of SPD is dependent on presence of structural LPS/ separation distance (see Table 4).

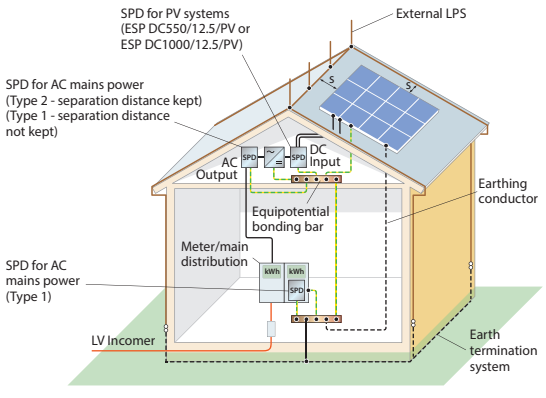
Installation on the AC side of the DC-AC inverter

The presence (or lack) of a structural LPS, plus whether sufficient separation distance has been kept between the LPS and the PV array, defines the SPD requirement on the AC side of the inverter (see Table 4). Where the distance between service entrance (Main Distribution Board (MDB)) and inverter is < 10 m, a single SPD should be installed at the service entrance (MDB). Where > 10 m, two SPDs should be installed, one at the MDB and the other close to the inverter.

Furse Combined Type SPDs for AC mains power circuits are applicable here. The SPD to be installed will be dependent on the Class of LPS around the structure, and the location of the metallic services connected to it (i.e. underground/ exposed overhead supply).

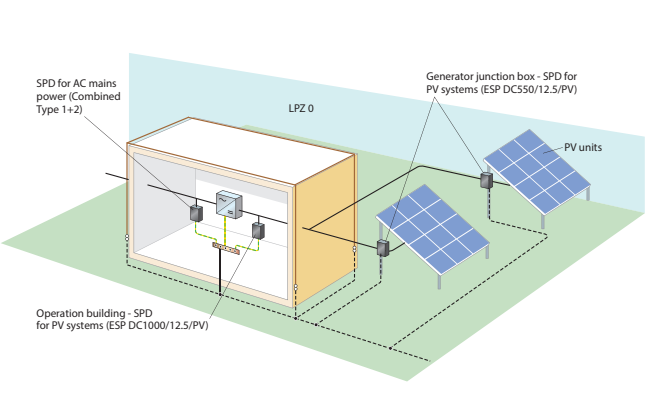
IMPORTANT: This page refers to protection of PV power circuits only. Ensure any data/signal/ telecoms lines connected to the PV system are also appropriately protected.
NOTE: Furse ESP PV Series SPDs offer combined Type 1+2 protection, and therefore apply across all scenarios.

Roof mounted PV array, with external LPS



s = separation distance. This installation shows the separation distance is kept. Where the separation distance is not kept, the PV array should be bonded directly to the external LPS.

Protection of solar park/PV array



Transient overvoltage protection for rail networks

Location	Requirement	Protection measure (SPD)
Main terminals & stations	Protect 3-phase & 1-phase power supplies	ESP M1 Series ESP D1 Series ESP M2/M4 Series ESP 415/XXX Series
	Protect critical systems (e.g. fire fighting equipment)	ESP 5A/BX & ESP 16A/BX Series
	Protect telecoms systems	ESP D, E, H Series ESP SL Series
Trackside location Cabinets (LOCS)	Protect trackside signalling equipment (SSI systems) & radio network	ESP SSI/M & ESP SSI/B ESP RF Series
	Protect power supplies	SSI/120AC & ESP SSI/140AC ESP M1 Series ESP D1 Series
	Maintain TFMs/SSI datalinks	ESP PTE002 Tester
Level crossings	Protect CCTV systems	ESP 5A/BX & ESP 16A/BX Series ESP CCTV Series ESP D Series
	Signalling equipment & radio network	ESP SSI Series ESP RF Series

Note: list of Surge Protection Measures shown above is not exhaustive. Additional electronic systems may require transient overvoltage protection on a case-by-case basis
Please contact us to discuss particular project requirements

Safety, reliability and availability of service are essential prerequisites for a rail network.

For all types of network, from mass transit systems and mainline services to metros, airport links and light rail, this has clear implications for the sensitive and critical electronic systems installed throughout.

These systems manage network performance, and ensure its continuous safe and practical operation. Yet they can easily be damaged or degraded by transient overvoltages, caused by:

- Partial lightning currents entering an electrical system following a direct lightning strike to a network location
- Indirect lightning (nearby lightning strikes) to the rail network, leading to transient overvoltages entering an electrical system via a local earthing arrangement (resistive coupling), or via overhead metallic service lines (inductive coupling)

Outright damage to electronic systems causes service interruptions and network downtime leading to customer dissatisfaction and maintenance costs.

Degradation leads to reduced equipment reliability and lower equipment lifetimes, risking sudden, unpredictable or intermittent failures.

Installing protection against transient overvoltages throughout the network is therefore critical. Transient overvoltage protection should be applied on (but not limited to):

- Power supplies throughout the network, including trackside cabinets, level crossings and at stations and terminals
- Signalling networks including trackside Solid State Interlocking (SSI) systems
- Telecommunications equipment and trackside telephones
- CCTV monitoring systems
- Passenger information systems, ticketing and gating operations
- Security systems and critical safety equipment such as fire detection and fire alarm systems

Effective, repeat protection against transient overvoltages can be achieved through installation of Furse Surge Protective Devices as part of an overall Lightning Protection System to IEC/BS EN 62305.

Key protection locations together with the appropriate Furse SPD are shown in the table below. Many of these SPDs have Network Rail approval (see individual product pages for further reference).