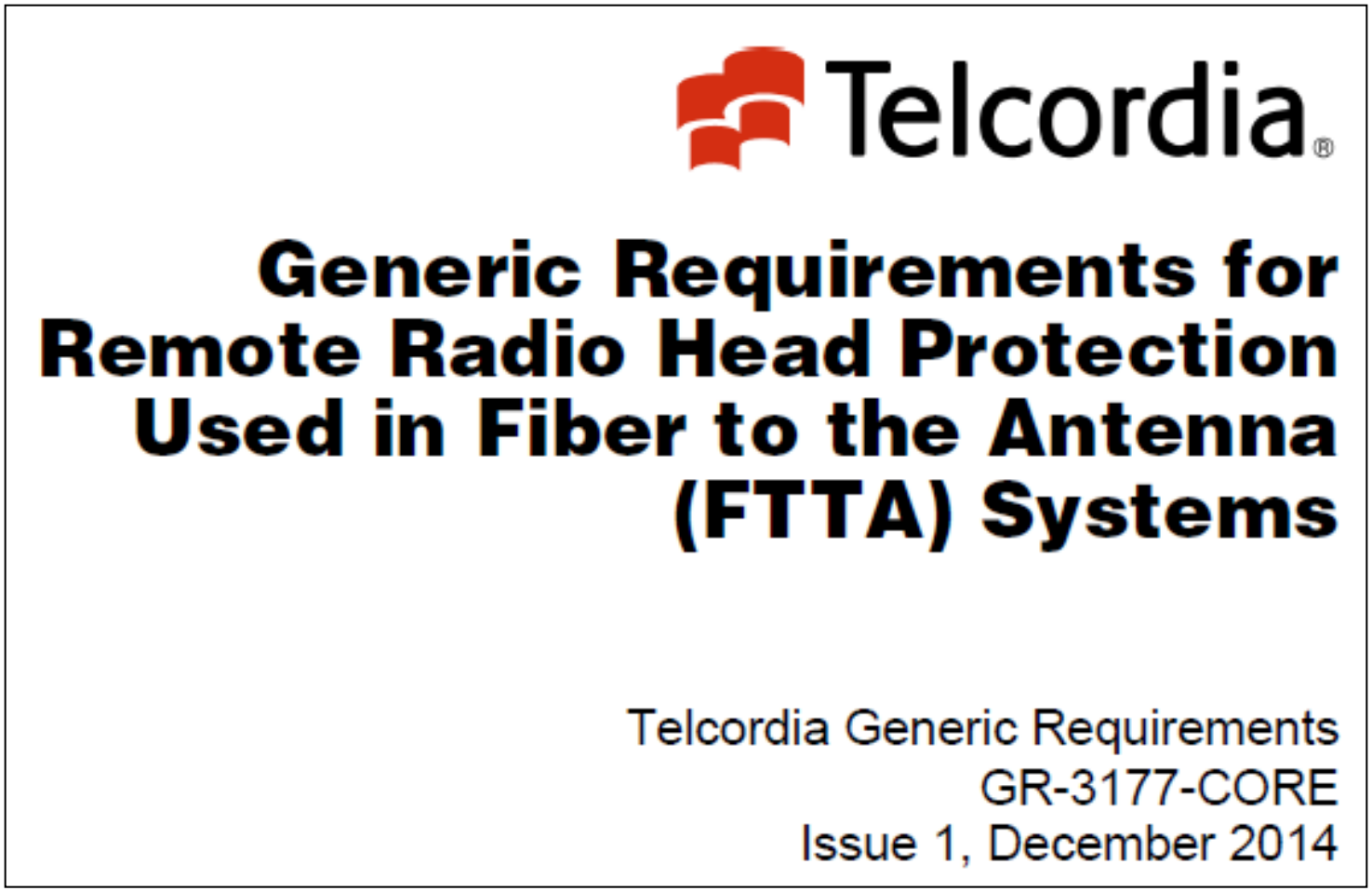
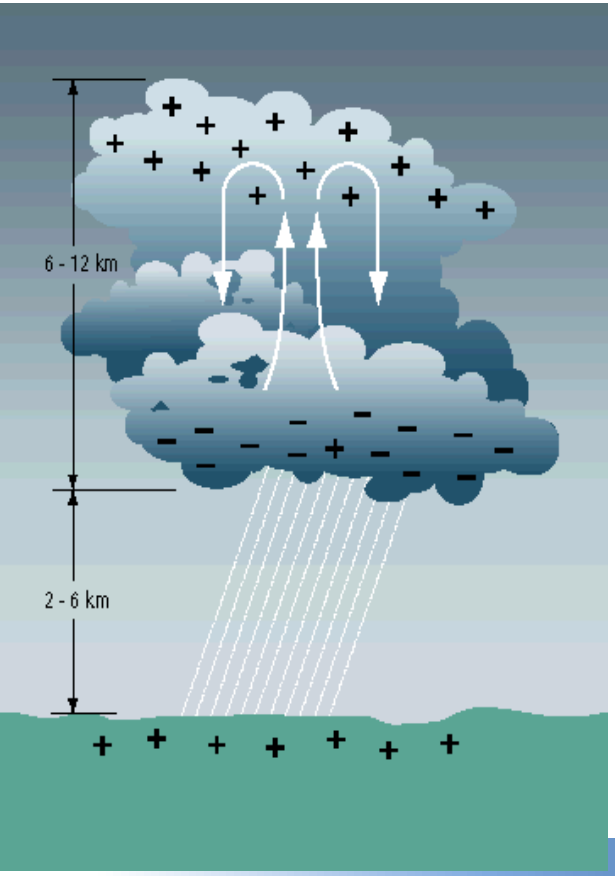
New Telcordia standard for RRH Protection

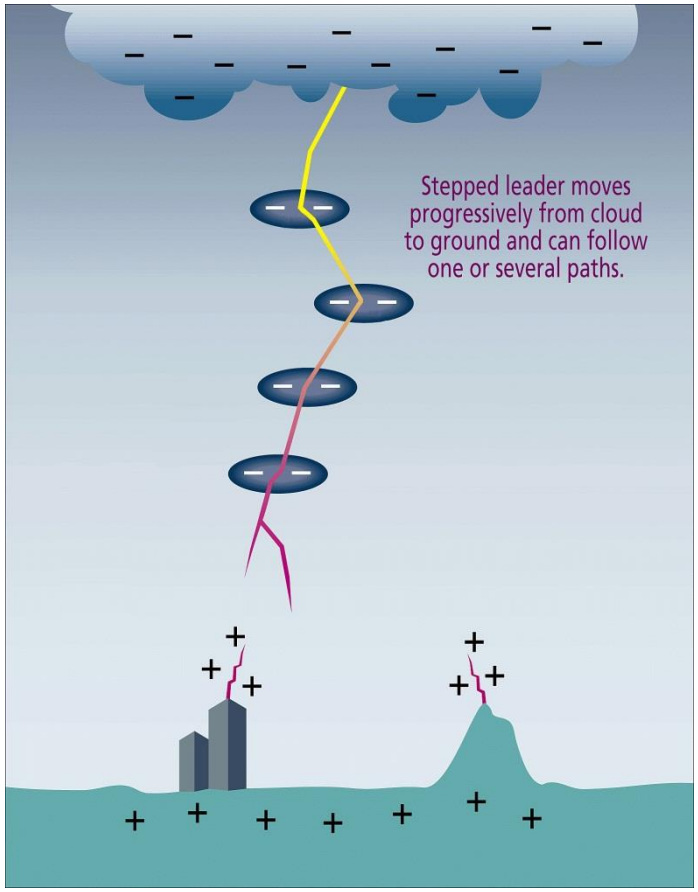


Protection from Lightning and Lightning Surges

How Lightning Forms

Cloud electrification – charge particle separation, quasi static E Field est. between cloud & ground



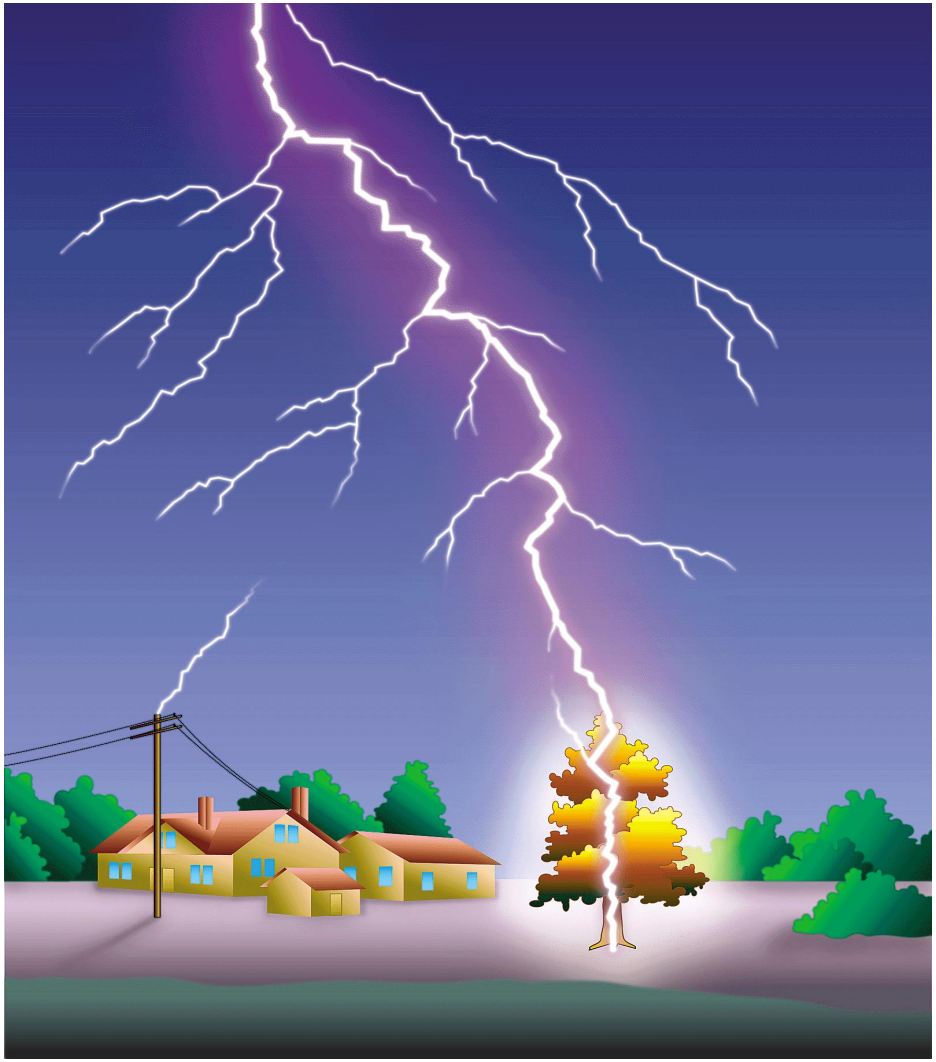


Downleader approaches, E Field increases to point of initiation of upward streamers

Upward leader propagates toward downleader to complete ionised path between cloud & ground

Lightning Attachment

- Competing upward leaders propagate toward the downward leader until one successfully “wins the race”.
- A highly ionised path is formed between the cloud and ground, allowing a large transfer of charge in milliseconds.
- Overall duration of a “flash” is ~ 0.5 s.



Direct Lightning Strike - Exposure

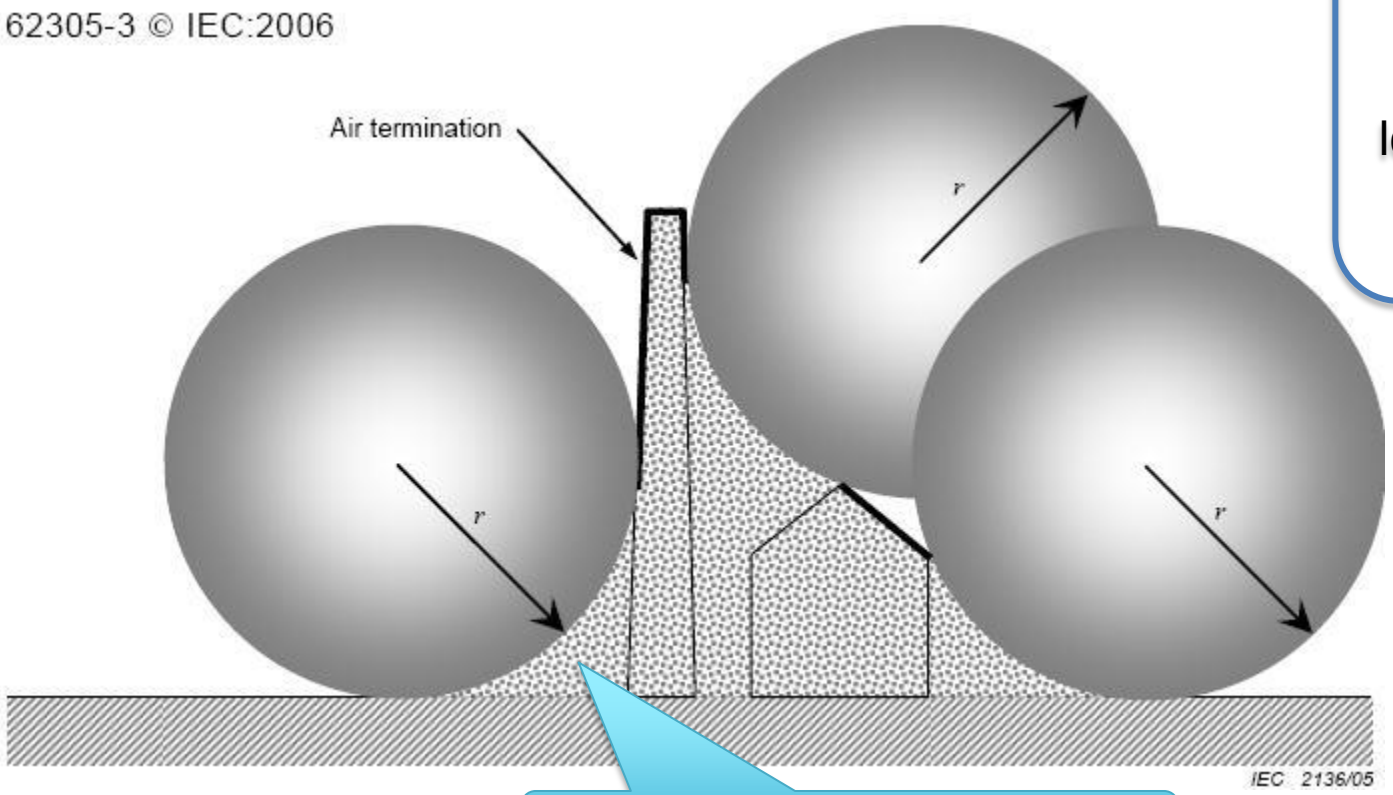
FTTA systems might be installed in a low profile arrangement along the rooftop, or involve a much higher tower arrangement.

Direct Lightning Strike - Exposure

- The RRH, antennas, and their supporting structures should ideally not be vulnerable to direct lightning strikes. This often runs counter to the requirement that these systems be placed high up to achieve good signal coverage!
- The support structure should protrude higher than the Antenna and RRH if possible.
- Guidance on protection from lightning can be found in:
  - NFPA 780, Standard for the Installation of Lightning Protection Systems
  - UL 96A, Installation Requirements for Lightning Protection Systems.
- With reference to these standards, the Antenna and RRH should be located within a Zone of Protection, and thus be relatively immune from a direct strike wherever possible.

Lightning Protection - Rolling Sphere Method

Used in NFPA780, UL96A and other Standards



The Antennas and RRH should be located within a Zone of Protection

Zone of Protection

Direct Lightning Strike - Exposure

Lightning can strike at many places, including:

- The tower or support structure
- The antenna,
- The base station enclosure,
- The rooftop,
- The incoming AC power infrastructure supplying the system
- Nearby

Worst case scenario

Potential SPD Locations

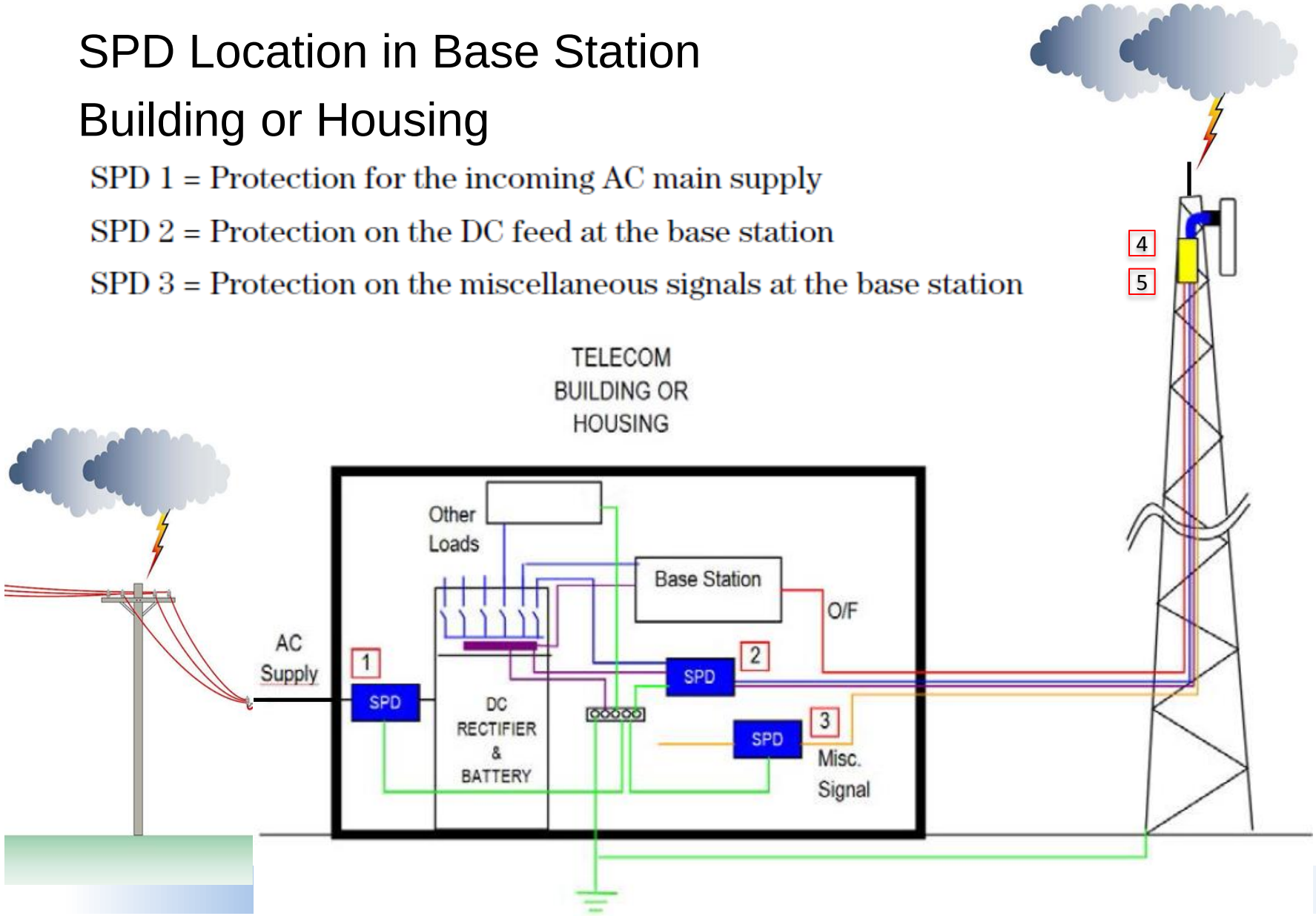
SPD Location in Base Station

Building or Housing

SPD 1 = Protection for the incoming AC main supply

SPD 2 = Protection on the DC feed at the base station

SPD 3 = Protection on the miscellaneous signals at the base station

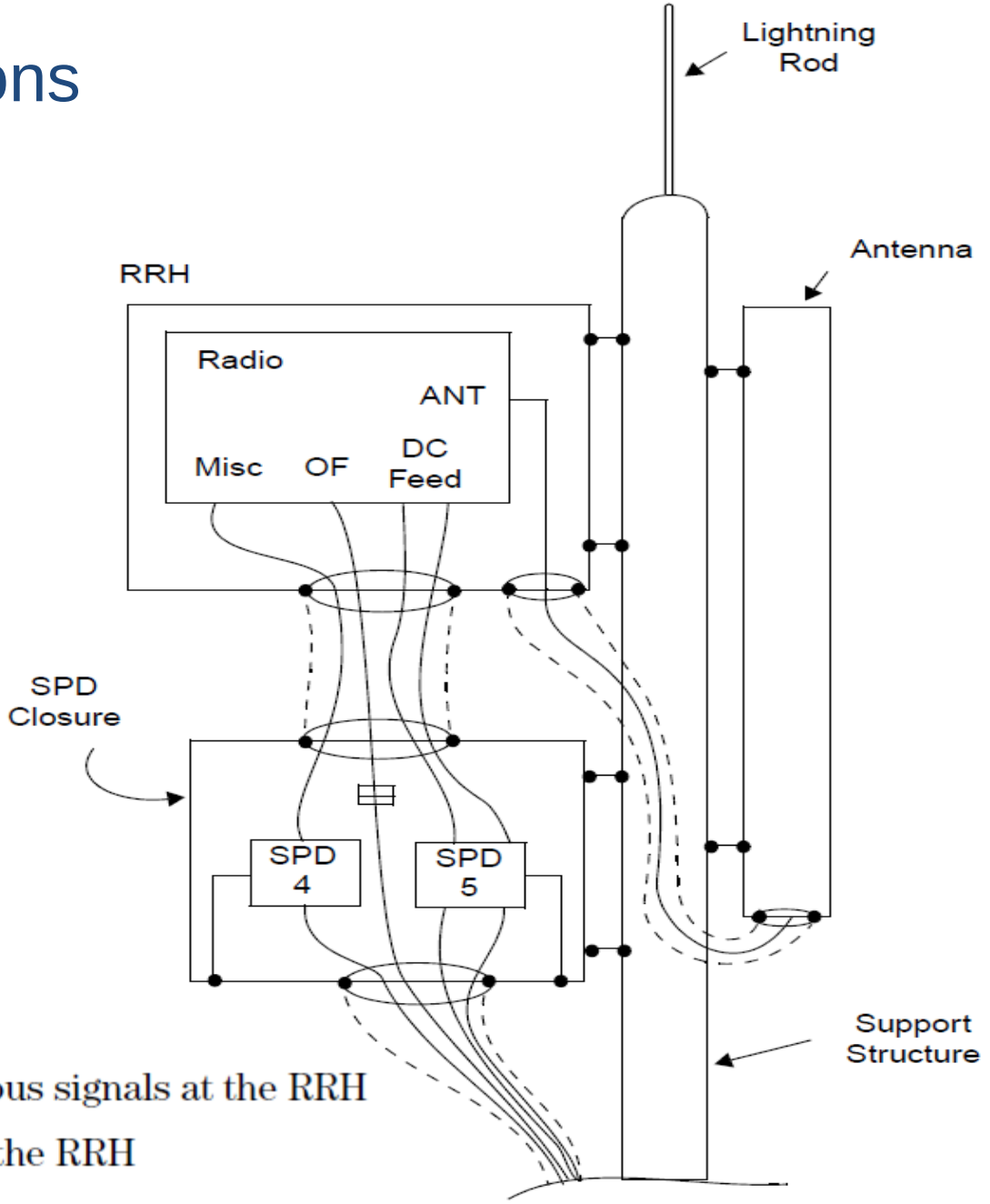


Potential SPD Locations

SPD Location in the RRH

It is acceptable for an integrated design to be employed whereby the SPDs are included inside the same closure as the RRH.

Also, the optical fiber is shown passing through this separate SPD closure, as it may provide a convenient interconnection point. However, the optical fiber may bypass the SPD closure if desired.



SPD 4 = Protection on the miscellaneous signals at the RRH

SPD 5 = Protection on the DC feed at the RRH

Potential SPD Locations

SPD 1 = Protection for the incoming AC main supply

A regular AC Point of Entry SPD

SPD 2 = Protection on the DC feed at the base station

SPD 5 = Protection on the DC feed at the RRH

These are really identical SPDs – purpose designed

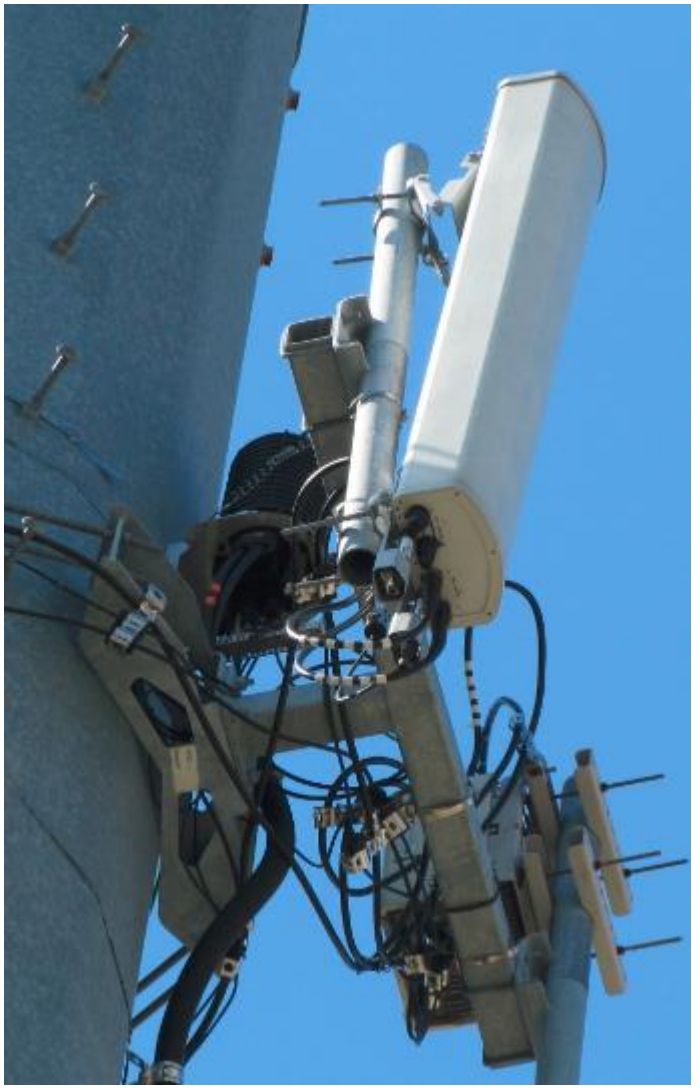
SPD 3 = Protection on the miscellaneous signals at the base station

SPD 4 = Protection on the miscellaneous signals at the RRH

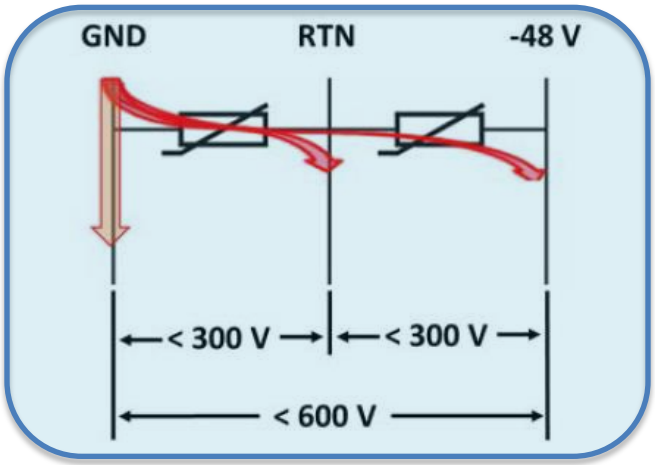
Regular signal SPDs, dependent on the type of signaling circuit

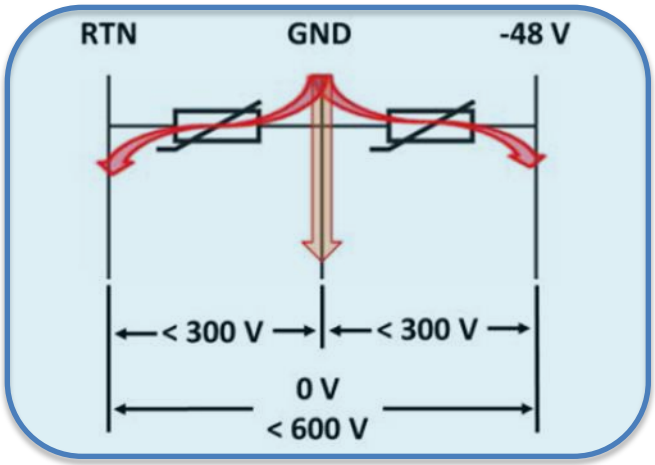
The focus for the Standard is on the DC Protectors (2 and 5)

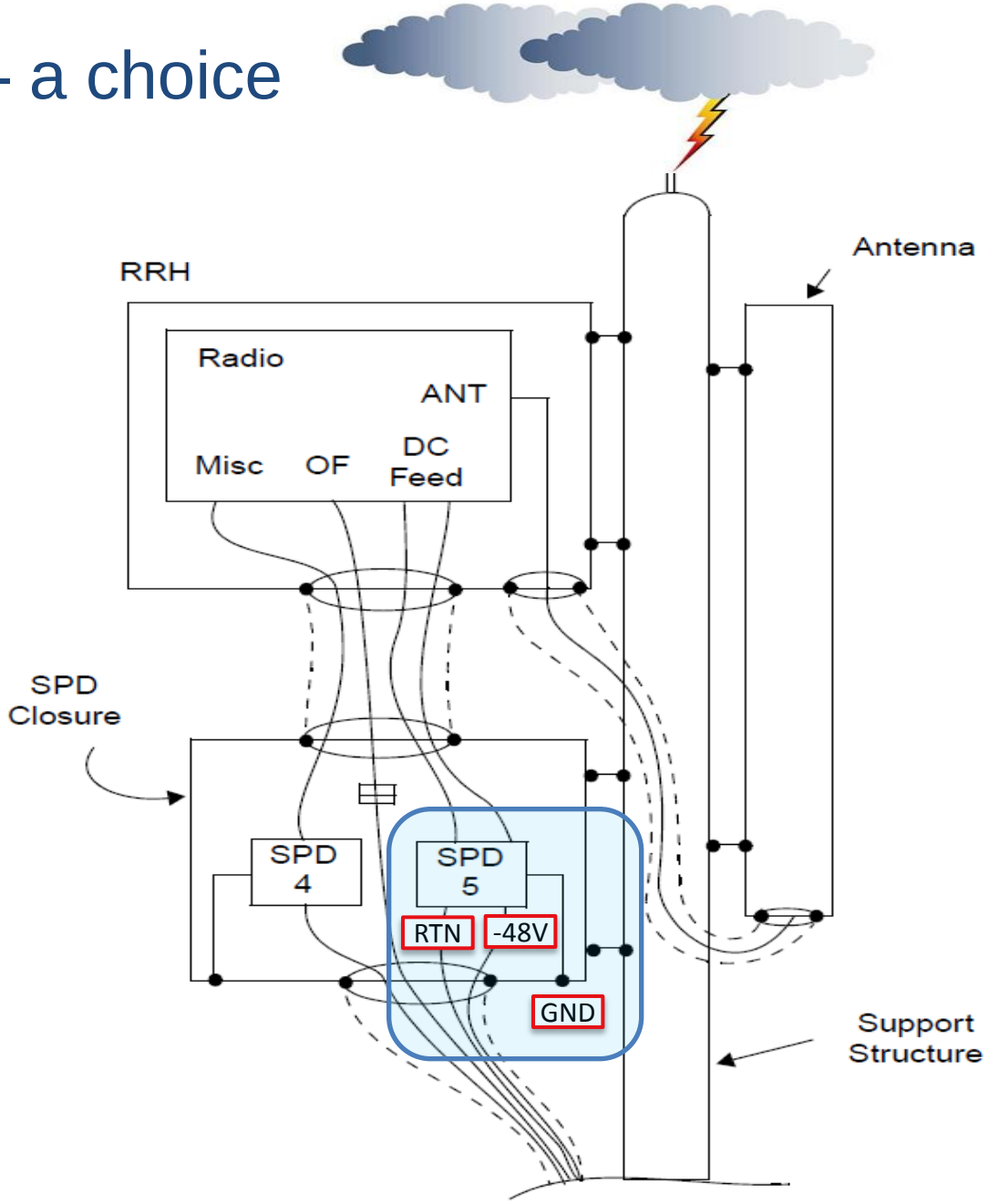
Tower Equipment Example



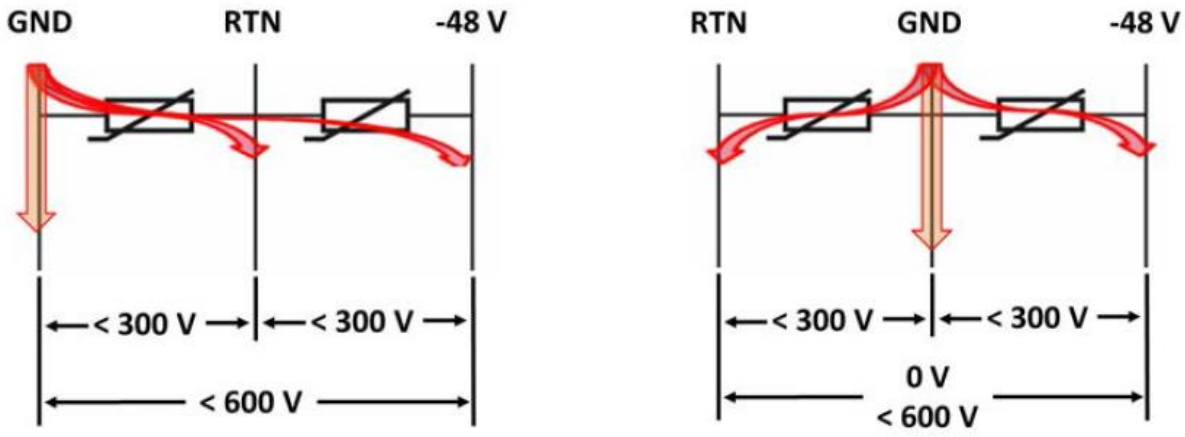
Modes of Protection – a choice

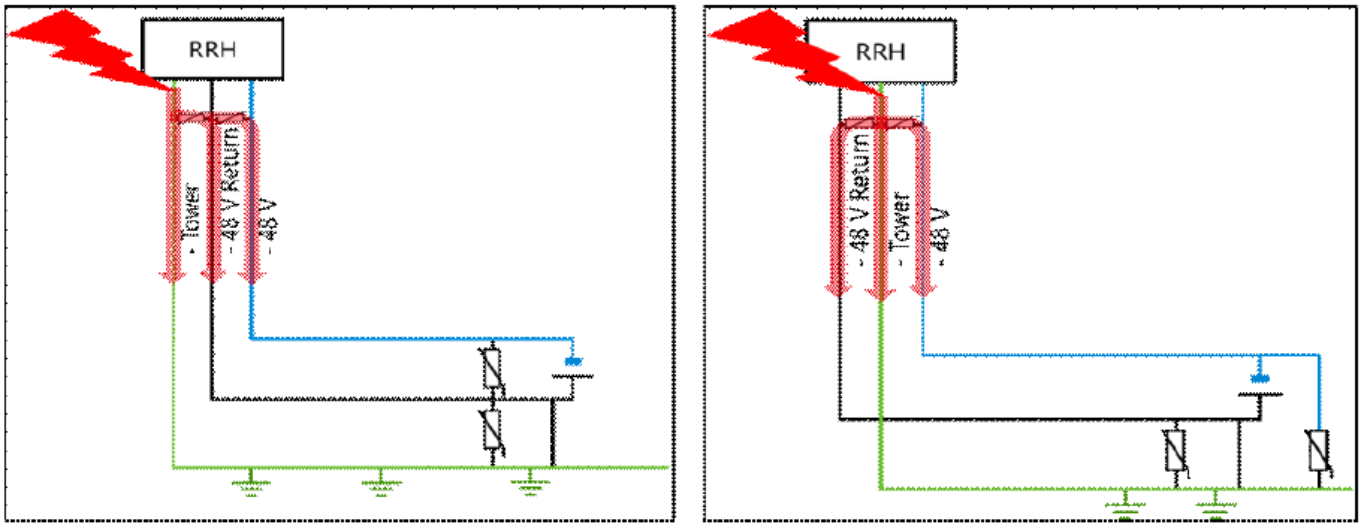






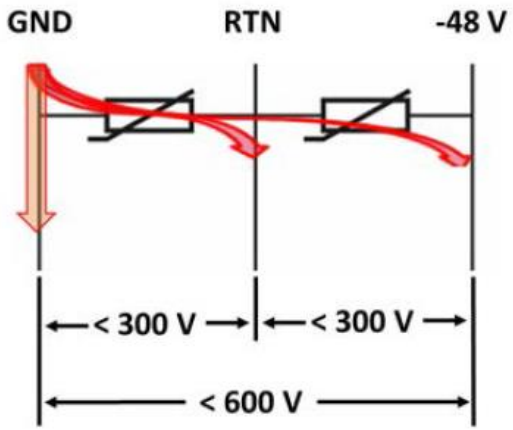
Modes of Protection

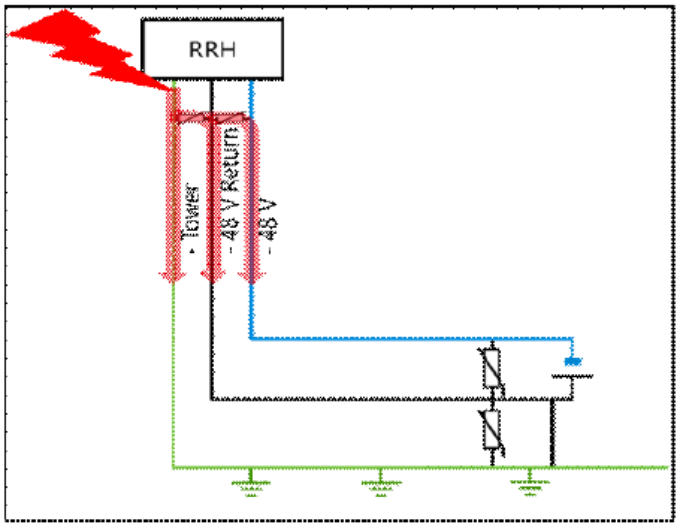




A B

Modes of Protection





A

a) The voltage across the equipment to be protected (from -48V to RTN) is directly clamped by a dedicated SPD, and so good control of this voltage is achieved.

b) However, the surge currents for both power wires travel through the RTN to GND mode, meaning the SPD from RTN to GND should have a higher surge rating (perhaps a factor of two).

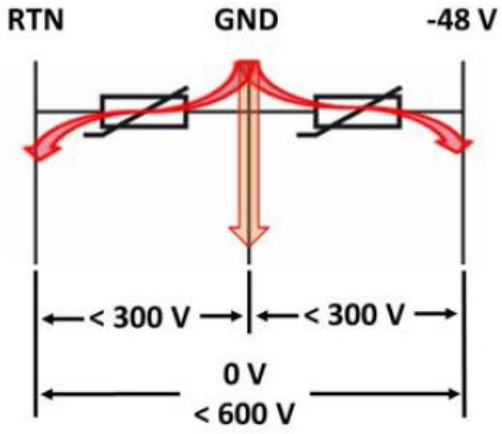
c) Note that the immunity level of the equipment is much higher between the DC power lines and the ground (L-G) than it is between -48 Vdc and RTN (L-L).

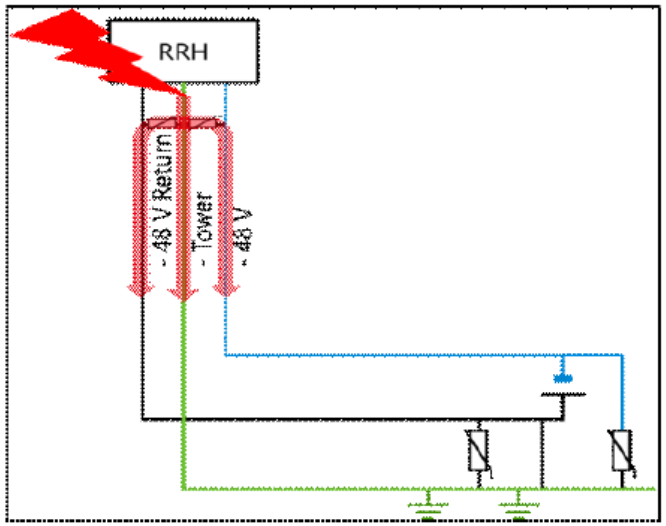
Modes of Protection

a) Each equipment line is clamped independently to ground, and thus will have the same clamping level wrt ground. IF the whole system is well balanced (SPDs, wiring, loops, etc), the L-L voltage across the equipment can be quite low.

b) Both SPDs will handle the same surge current magnitudes, and can be equally sized.

c) Note that the immunity level of the equipment is much higher between the DC power lines and the ground (L-G) than it is between -48 Vdc and RTN (L-L).

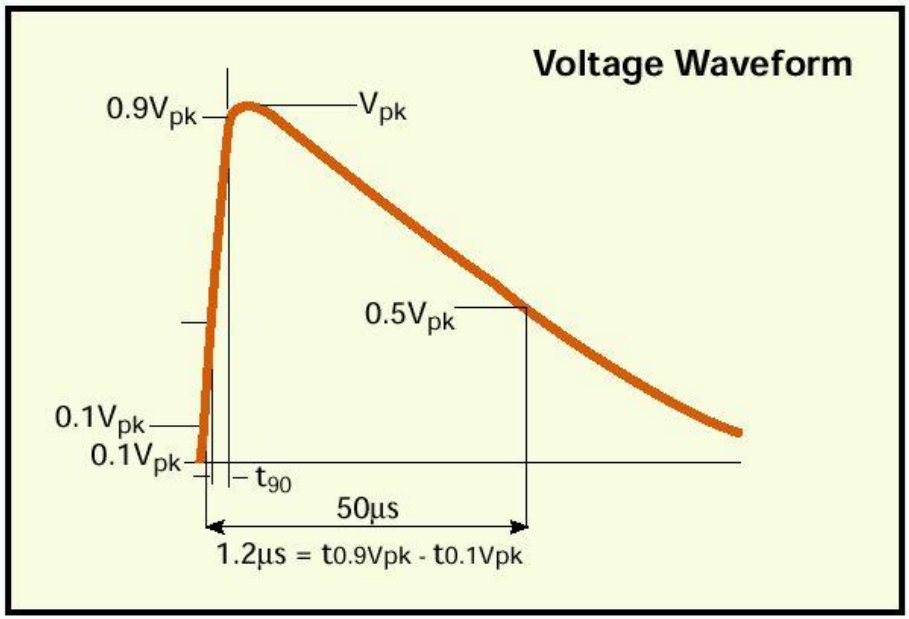




B

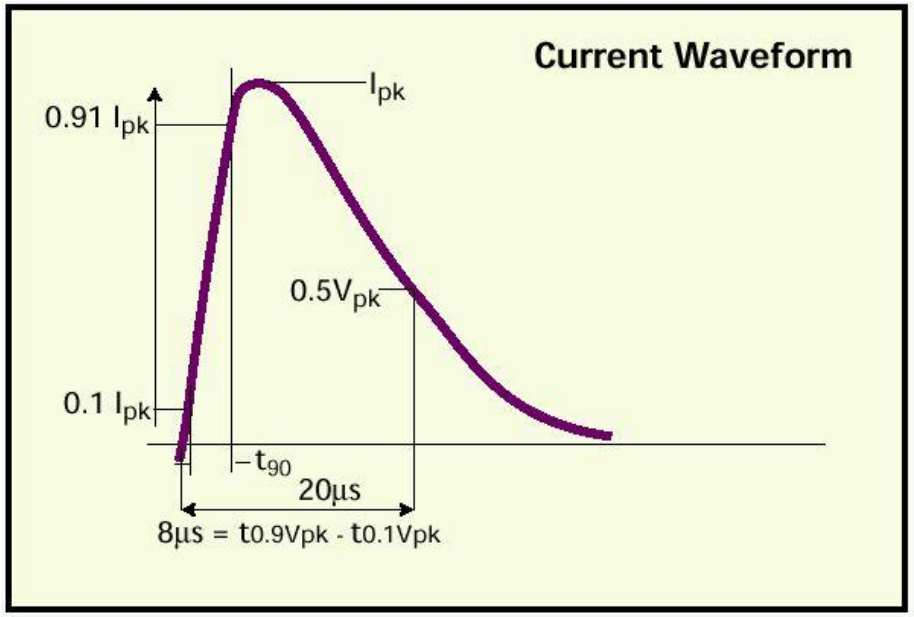
SPD Ratings

Surge Testing Waveforms

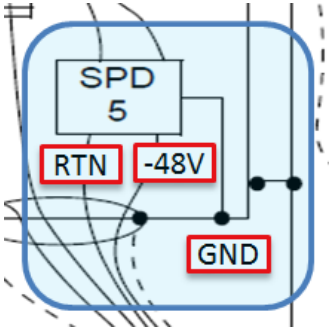


e.g. 6kV (1.2/50us)

e.g. 3kA (8/20us)



SPD Ratings (DC Feed Protectors)



DC Feed Protectors (SPDs 2 and 5)

Clamping voltage:

- < 300V (6kV/3kA combination generator).

Surge rating:

- Single shot: at least 40kA 8/20us
- 15 shots: at least 20kA 8/20us

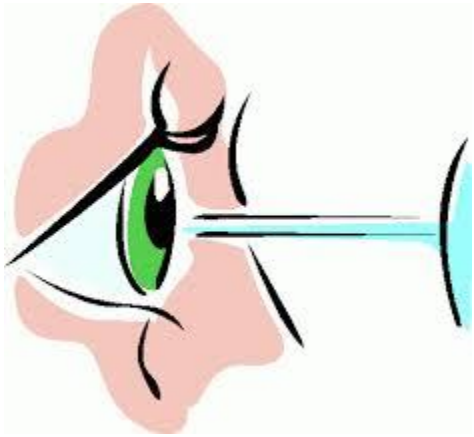
Maximum Continuous Over Voltage (MCOV):

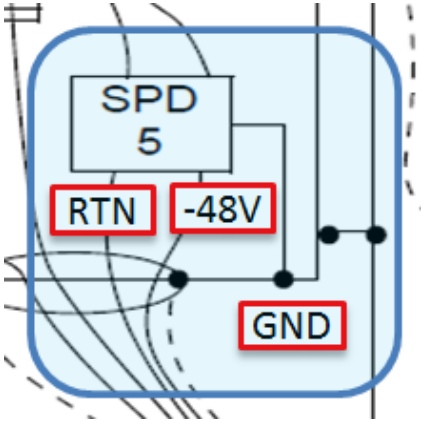
- at least 65Vdc for 48Vdc systems
- at least 35Vdc for 24Vdc systems

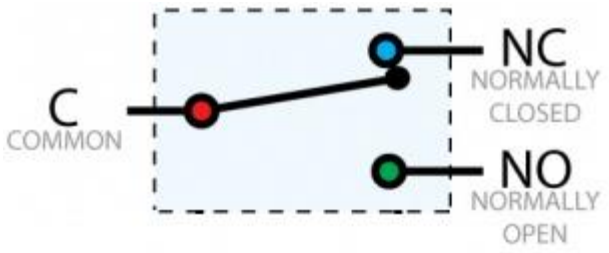
SPD Features (DC Feed Protectors)

SPDs need to provide:

1. Visible status indication
2. Remote protection status monitoring capability (NO/NC contacts)



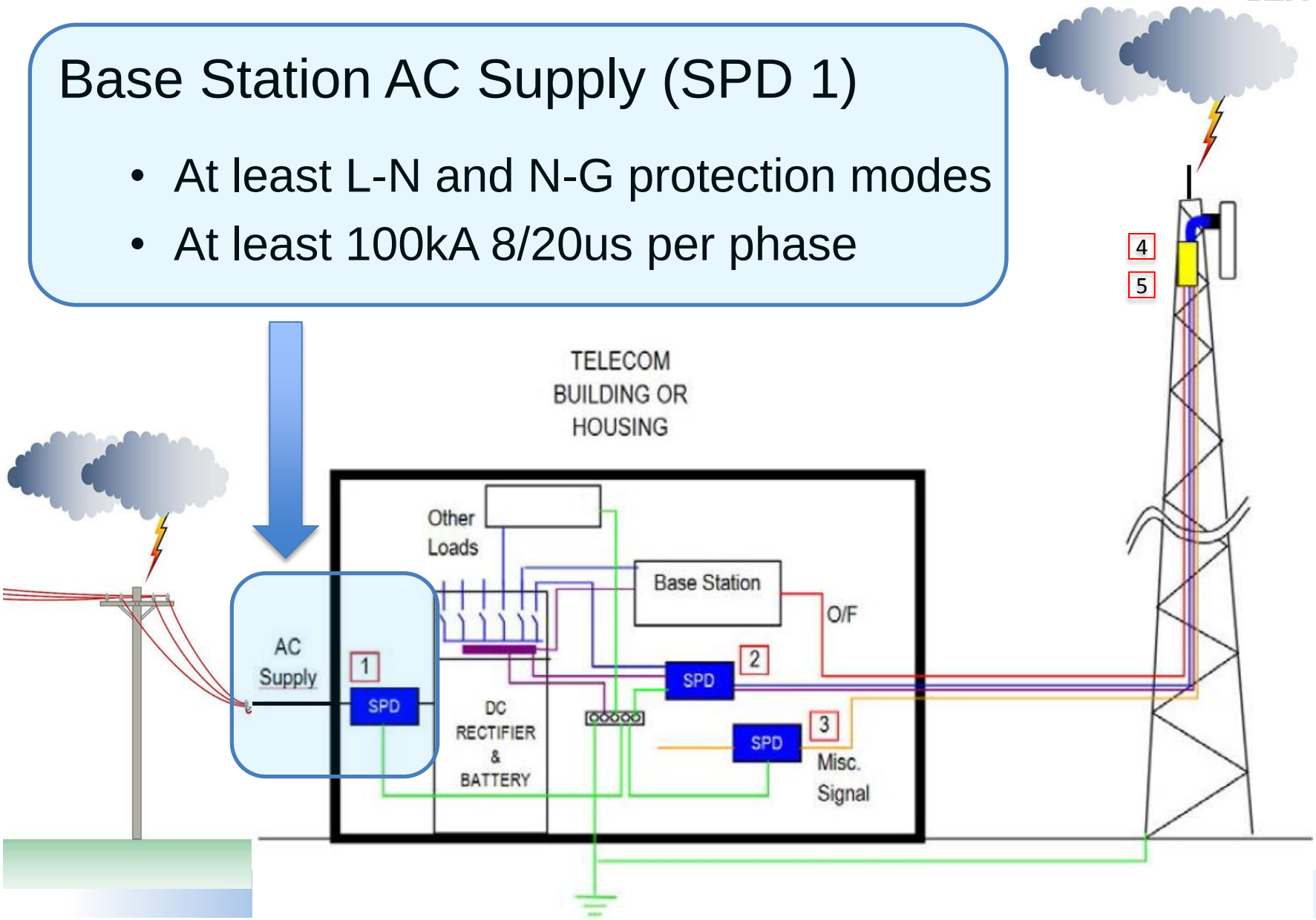




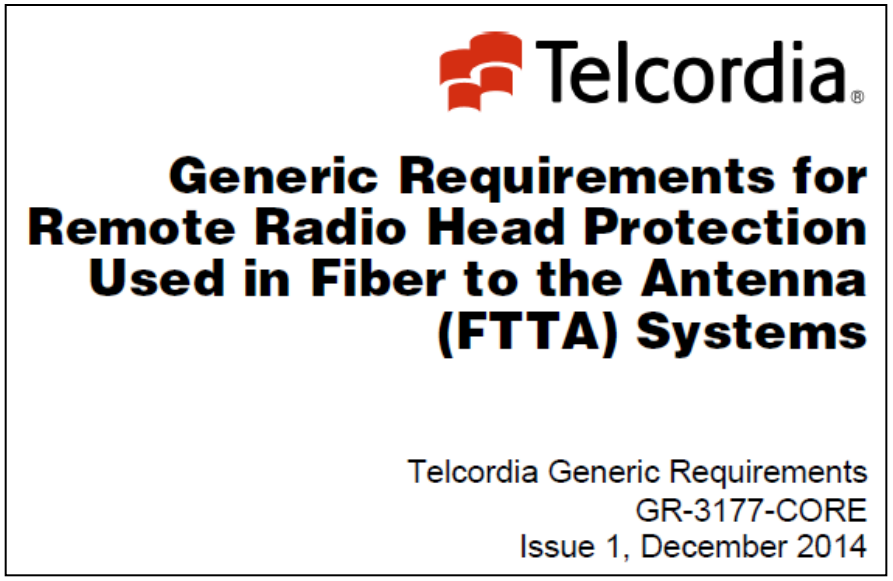
AC Supply SPD

Base Station AC Supply (SPD 1)

- At least L-N and N-G protection modes
- At least 100kA 8/20us per phase



New Telcordia standard for RRH Protection



Questions?