Sean Passant – Technical Manager
DEHN UK

- DEHN UK are a wholly owned subsidiary of DEHN & Sohne GmbH.
- Trading in the UK for over 20 years.
- DEHN & Sohne have been trading for nearly 110 years.
- 23 Companies within the group.
- A presence on every continent and in over 70 different countries.
- Invented the world's first surge protection device.
- Developed the world's first High Voltage Insulated down conductor.
- The world's largest manufacturer of isolated lightning protection equipment and surge protection devices.
- Turn over in excess of €250 Million
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition

On average the UK receives around 260,000 lightning strikes to ground per year.

However this number is on the increase, we saw more lightning activity in 2015 than we did in 2014 and again we saw more lightning activity in 2016 than we did 2015.

In fact in just 3 months in 2016 the UK was subjected to over 227,000 strikes to ground (1st June – 31st August) almost the entire annual average in just 92 days, almost 2,500 strikes per day!
Lightning as a Source of Ignition

At around 5.20pm on June 16th 2016 an Anaerobic Digestion plant in Oxfordshire was struck by lightning and burst into flames.

The 45m high flames could be seen for miles around and fortunately no one was injured but the incident was attended by 4 appliances which were on site for over 3 hours.

The incident made the BBC news website later that evening and BBC breakfast news the following morning. This is a rare example of lightning leading to ignition being confirmed and reported on but anecdotal evidence and insurance claims would certainly suggest that our increased levels of lightning activity are leading to increased incidents of lightning related ignition.
Lightning as a Source of Ignition

Why is this a problem?

The current British standard for lightning protection is BSEN 62305:2012 Parts 1-4. Incredibly it only mentions ignition or combustion 6 times in a 477 page document. Two of those mentions actually make reference to ignition not having to be considered*.

ATLAS (the UK trade federation for lightning protection) has a 31 page document on their website offering advice on the technical aspects of lighting protection. It makes no reference what so ever to ignition, fire, combustion or dangerous sparking.

The whole UK lightning protection industry has a dangerously flippant attitude towards lightning as a source of ignition and in applying lightning protection in high risk applications.
As an example here is a quote taken direct from the website of the company which owned the AD site that was struck:

“I am very pleased with the outcome. Our staff performed fantastically, our customers & neighbours are happy and this can now become a great case study demonstrating the resilience of our plants”
Lightning as a Source of Ignition

Pleased with the outcome
A great case study?
Lightning as a Source of Ignition

Lytchett Minster School

Struck Christmas 2012
Lightning as a Source of Ignition

http://www.bournemouthecho.co.uk/news/10131445.VIDEO_Moment_Lytchett_Minster_School_is_struck_by_lightning_caught_on_CCTV/

Sadly we don’t own the copyright to show you this video but please feel free to take down the link and view it at your leisure.

It is a nearly perfect example of lightning acting as a source of ignition.
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition

- Typically a ground mounted PV farm requires just over 5 acres per MW of energy.
- In the UK typically these are 5MW sites and these are around 26 acres in size (we currently have over 230 sites of this size in the UK).
- 26 acres is approximately 10.5 hectares which is 0.105 square kilometres.
- The average ground flash density in the UK is 1.1 flashes to ground per square kilometre per year.
- This means that on typical 20-25 year life span a large ground mounted PV site can expect to see up to 3 direct lightning events.
- Indirect lightning events could be as many as 25-30 events.
- This clearly poses a considerable threat of ignition.
Lightning as a Source of Ignition

BSEN 60079 – Explosive Atmospheres states that:
“Lightning will always lead to ignition, either from thermal rise, flash over, sparking, physical damage to structures or from induced energy leading to faults within localised LV distributions systems and equipment.”

DSEAR Regulations place a duty of care on site owners to manage, mitigate, remove or reduce any potential sources of ignition.

Different standard, different attitude altogether.
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition

50kA 10/350 lightning energy resulting in a 26mm diameter hole in a 0.35mm galvanized steel plate
Lightning as a Source of Ignition

Clearly we can see that lightning presents a very real danger as a source of ignition.

Through flash over, sparking, hot spots, resistive thermal rise, induced energy on local LV equipment.

If you have a site that is DSEAR regulated, stores explosives, contains highly flammable chemicals or has ATEX zones then serious thought, planning and consideration is required in order to offer suitable lightning protection, surge protection and earthing.
Lightning as a Source of Ignition
Lightning as a Source of Ignition

FDB: floor distribution board
MEB: main equipotential bonding
EB: equipotential bonding

ventilation system/air conditioning

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HVI Standard Presentation; TDL 17.07.2013
Lightning as a Source of Ignition

So what’s the answer?

- Isolated Lightning Protection
- Spark Gap Surge Protection Devices
- Comprehensive “Type B” Earthing Arrangement
- BSEN62305 Compliant Risk Assessment
BSEN62305:2012 part 2 is the document that covers risk assessments for lightning protection & surge protection.

Every single project should be risk assessed to ensure the correct level of protection is applied. There are four levels of lightning protection, with level I being the most onerous and level IV the least.

COMAH regulations require that all applicable sites MUST have a risk assessment carried out to determine if protection is required. Furthermore it states that if the site is also DSEAR regulated then in the event that protection is required then the default minimum level MUST be level II.

DEHNsupport is a bespoke risk assessment software package that provides all the information and details required for a fully compliant risk assessment.
Lightning as a Source of Ignition

Type ‘B’ Earthing Arrangement:

BSEN62305:2012 Part 3 D.3.3 states:
“A type B earthing arrangement is preferred for all structures with danger of explosion. The earth resistance shall be as low as possible and never greater than 10 Ohms”

A type B earthing system is a buried ring conductor around the structure with a minimum cross sectional area of 50mm. This conductor should be buried to a depth of at least 500mm and a minimum of 80% of the length of conductor must be below ground level.

The use of interlinked foundations, piles or similar can also be utilised to form a type ‘B’ arrangement.
Lightning as a Source of Ignition
Lightning as a Source of Ignition

Spark Gap based Surge Protection Devices

Structural lightning protection is only half the story. In addition to this it is a requirement of BSEN62305 that you MUST install entry point type 1 SPD’s.

It is further a requirement of BS7671 that SPD’s MUST be installed if the structure in question falls into the following categories:

1) There is a risk of significant loss of life
2) The structure provides a public service
3) The structure is involved in commercial or industrial activities
4) The structure houses large numbers of individuals
5) The structure is supplied via an overhead cable

These SPD’s are required even if there is no structural lightning protection.
Lightning as a Source of Ignition

Wiring tested with an impulse current 40 kA (8/20 µs)
Lightning as a Source of Ignition

Type 1 SPD’s are more correctly described as “lightning arrestors” they are specifically designed to be able to cope with the large quantities of 10/350 lightning energy associated with a lightning strike.

They are robust, sturdy and capable of resisting repeated lightning events. They prevent dangerous sparking, provide equipotential bonding, reduce the risk of fire and help to save lives.

But why do we say they should be Spark Gap based?

Spark gaps offer true isolation, they are more robust in nature than the equivalent Metal Oxide Varistors (MOV) and it is easier to ensure energy co-ordination.
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition

Isolated Lightning Protection

What is “isolated lighting protection”?

BSEN62305 part 3 Annex E defines isolated lightning protection as “An LPS that is connected to structural conductive elements & the equipotential bonding system at ground level ONLY”

It is achieved by deliberately maintaining the separation distance between the LPS and conductive elements within the structure by either installing a system of air rods, adjacent masts or a suspended catenary wire system.
Lightning as a Source of Ignition

Putting it into simple terms, with an isolated lightning protection system you deliberately **do not** bond all the conductive/metallic items that you might normally expect to see bonded in a conventional LPS. Air handling plant, aerials & antennae, handrails, trunking, conduit etc

Instead you maintain the separation distance between these items and the LPS. The separation distance is the minimum safe distance between conductive elements where lightning energy will not flash over. In order to do this we need to carry out a separation distance calculation because no two structures and lightning protection systems are the same.

The requirements of the separation distance calculation are set out in BSEN 62305:2012, 6.3.1 tables 10-12
So what options do we have?

Isolated lightning protection can be achieved by using:

1) Free standing masts
2) Suspended catenary wires
3) Stand off non conductive holdfast products
4) High Voltage Insulated down conductor products
Lightning as a Source of Ignition

Free standing

Catenary wire

Off set conductors

HVI
Lightning as a Source of Ignition

\[ s = k_i \times \frac{k_c}{k_m} \times l \ [m] \]

- \( s \): Distance
- \( k_i \): Dependent on protection class LPL (e.g., LPL III = 0.04)
- \( k_c \): Coefficient
- \( k_m \): Coefficient
- \( l \): Length

 MDB: main distribution board
SPD: surge protective device

Ref.: IEC 62305-3:2010; Annex E, Figure E.38 modified
Lightning as a Source of Ignition

Options
What options do we have?
• HVI
• High Voltage Insulated cable
• Unique to DEHN
• Over 10,000 Km installed world wide
• Full range of air rods & fixings
• Creates its own separation distance
Lightning as a Source of Ignition

Cable

HVI® Conductor

inner conductor

proximity to earthed metal parts

insulation

proximity to earthed metal parts

insulation (semi conductive)

connection to the equipotential bonding via earthing clamp
Lightning as a Source of Ignition
Lightning as a Source of Ignition

class of LPS II

max. total length ≤ 15 m
max. length of the HVI Conductor ≤ 12.5 m
max. free length ≤ 8.5 m
R 30 m

sag of the rolling sphere (radius of 30 m)

Ex-Zone 2
Lightning as a Source of Ignition

class of LPS II
r = 30 m
Lightning as a Source of Ignition
Lightning as a Source of Ignition
Lightning as a Source of Ignition

Any questions?

Many thanks for your time and attention