

Lightning protection systems in the yachting industry

How Alewijjnse developed an innovative lightning protection system to protect composite constructed vessels from electro-magnetic fields that result from electro static discharging in the atmosphere.



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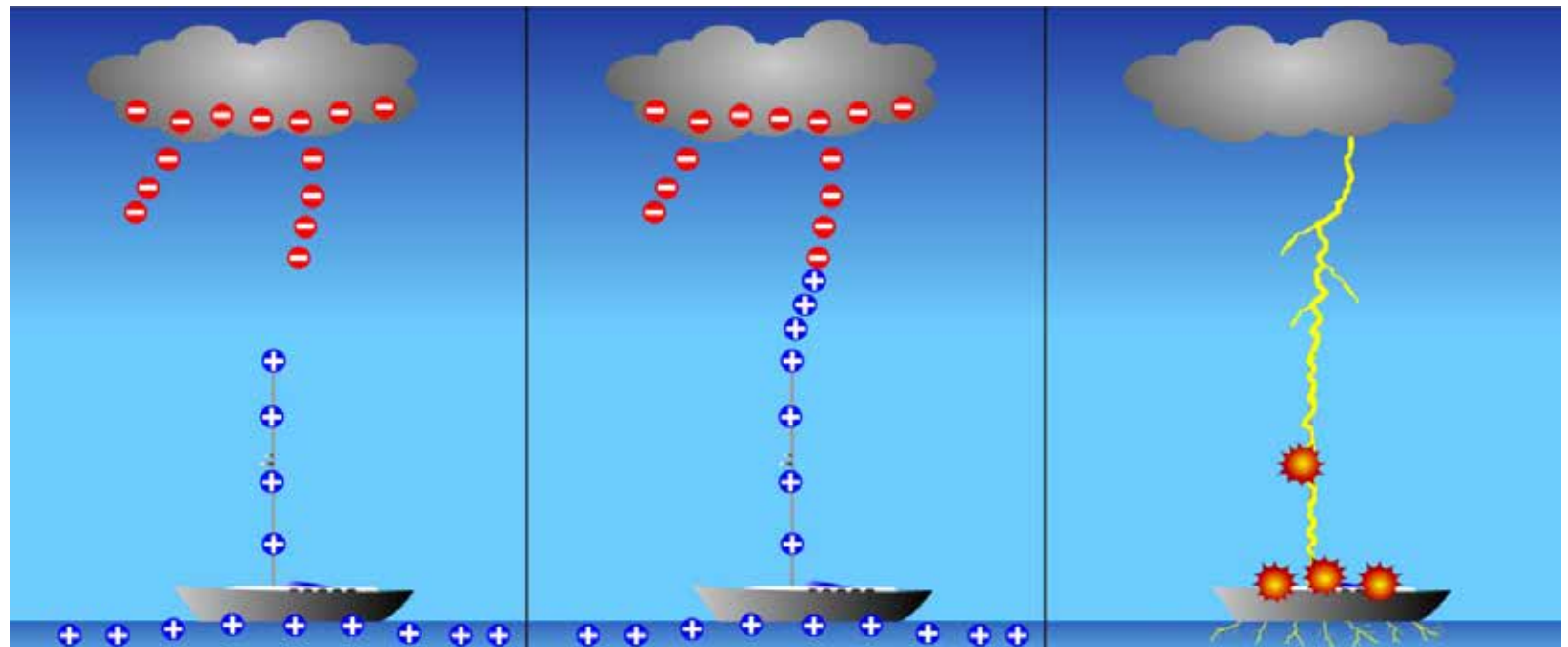
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Composite vessel constructions and lightning protection

One of the recent trends in the yacht building industry has been the introduction of composite materials into the construction process. The use of these materials brings certain advantages that are not present when vessels are made using steel or combine a steel hull with an aluminium superstructure. Therefore, it can be expected that greater numbers of composite / steel yachts will be produced in the future.

Using composites in the construction of a yacht's superstructure makes it non-conductive and therefore protects both the people on board and essential electronic equipment against phenomena such as the electromagnetic fields that result from electrostatic discharge in the atmosphere.

From a technical point of view and to comply with class requirements, in this situation it is mandatory for the yacht to install additional components to protect the electrical systems on board composite / steel vessels. According to *Lloyd's requirements for the Special Service Craft, Part 16 Control and Electrical Engineering – Chapter 2 –Section 1*: "General requirements, the essential electronic equipment must be protected from secondary effects of electrostatic discharging in the atmosphere". In the domain of power quality, this event is defined as a transient effect in the electrical network system.



Transient overvoltage

This event is called cloud to cloud electrostatic discharge. It can reach a magnitude of 8,000 volts in a well-insulated power distribution system. This is over eight times the level tolerated by many electronic systems. Its secondary effects can cause transient overvoltage due to:

- Electromagnetic pick-up (inductive coupling);
- Differences in potential between two connected earths (resistive coupling between the superstructure, equipment and the steel hull).

Another source of transient overvoltage can be the switching of high inductive loads (transformers, AC motors, etc.). However, this will not be further discussed in this article. Also, it is important to note that it is not necessarily lightning that has to strike an object, such as a vessel, in order to cause destructive transient overvoltage.

In short, it is important to prevent large transient overvoltage from happening on yachts and other vessels. In order to achieve this, primary and secondary lightning protection systems need to be implemented. Alewijnse has proposed a new concept design that includes these systems, based on a technical solution that additionally addresses steel hull / aluminium superstructure / composite mast vessels (which is already being implemented and includes both lightning protection systems).

The concept design takes the IEC standards and Lloyd's requirements as its reference and uses 3-D simulation modelling to visualize the lightning safety protection area.



Figure 1: Transient overvoltage

Lightning protection systems

The primary protection system protects vessels from a direct lightning strike. For the concept design a 3-D model is used to visualize the lightning safety protection area.

Figure 2 shows the results of the 3-D simulation and the lightning protection safety zone (see blue area).

The secondary lightning protection system protects the Control and Electrical power distribution systems (specified by Lloyd's as essential electronic equipment), plus any customer-specified equipment, from transient overvoltage effects on board the yacht.

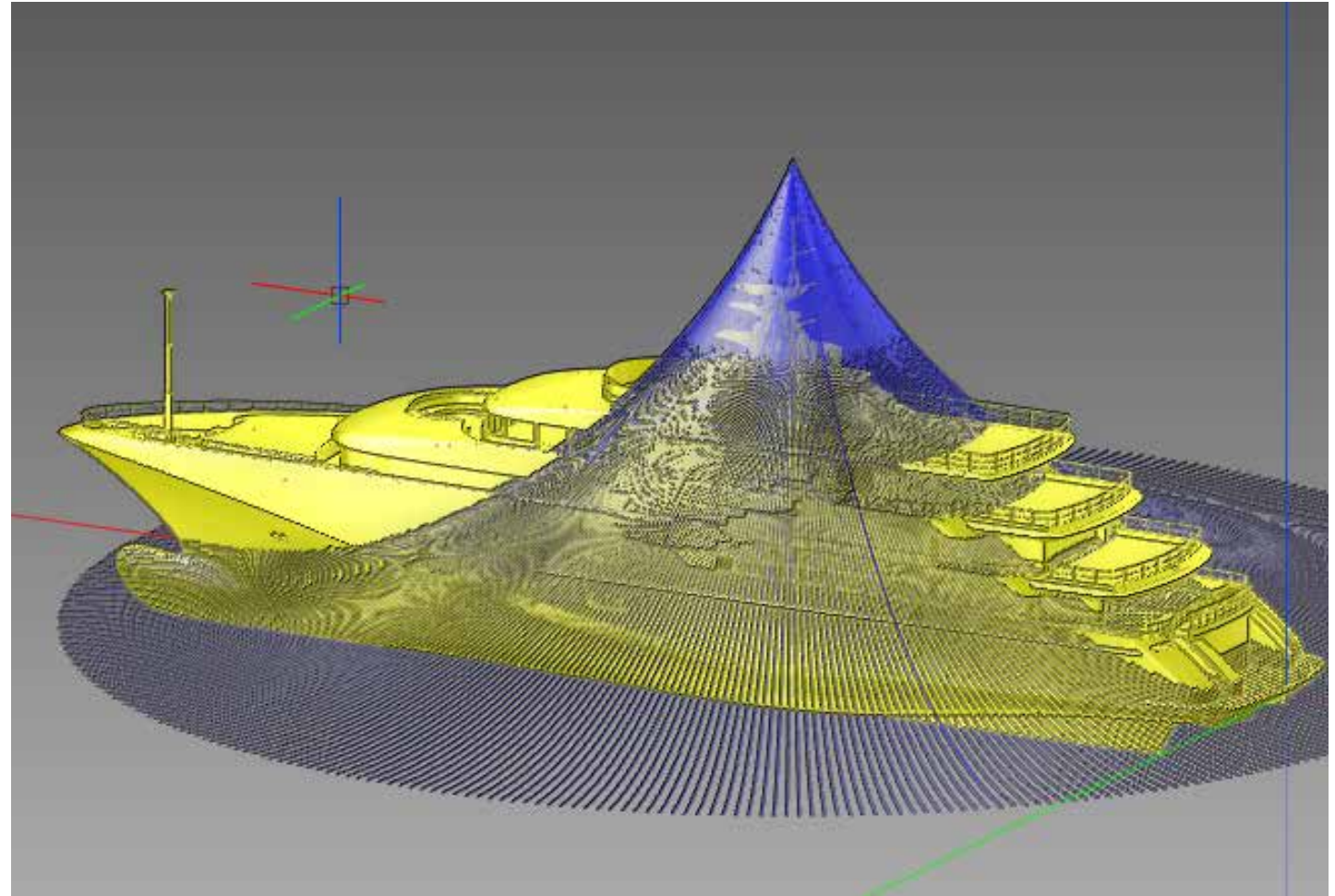


Figure 2: 3-D model- Lightning protection safety zone

There is no obligation to protect the customer-specified equipment (it is classed by Lloyd's as non-essential), but it is to be recommended and is included in the concept design. The selection criteria and location of the surge protection components (SPCs) is also specified in the concept design document.

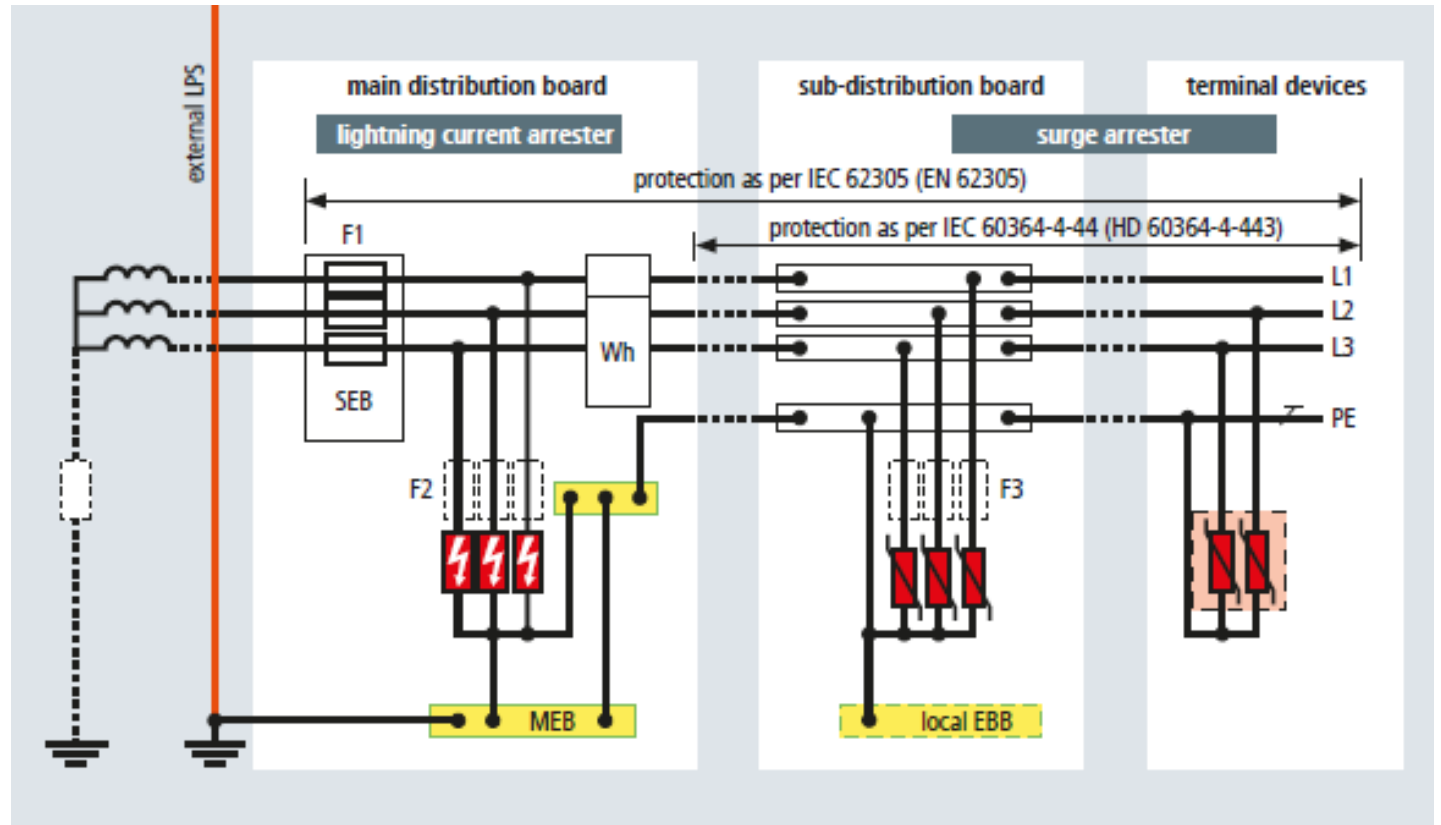
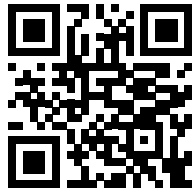


Figure 3: Principle connection SPD's in electrical power plant - example



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