E C H E 2013 BERNE
5th European Conference on Hospital Technology

LIGHTNING PROTECTION FOR HOSPITALS

Direct lightning protection with ESE: ILLUSION OR RELIABLE ALTERNATIVE FOR HOSPITALS?

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ABSTRACT

This document takes stock of the overall protection concept for buildings and structures which are equipped with electrical and electronic systems to counteract the effects of the electromagnetic impulse generated by lightning in compliance with standard CEI 62305-4 for hospitals and in particular with an unconventional lightning protection device (ESE: *Early Streamer Emission* – lightning conductor), which has been distributed since 1986 by some French companies; this is the second generation following the radioactive devices that were offered in the 1940s.

After outlining the development of the ESE, this article describes a method for optimization of the effectiveness of this unconventional device by the improvement of on-site verifications, laboratory tests under natural conditions and, above all, greater investment in experience feedback.

Although most manufacturers (French, Spanish, Polish, Australian etc.) are satisfied with this state of the art, this alternative solution may perhaps be better accepted by the scientific community as a whole.

1 INTRODUCTION

The damage caused by lightning to hospital sites is undoubtedly a major problem. The damage occasioned by the non-availability of electronic equipment, energy production and service loss and data destruction is admittedly often much greater than the material damage to the facility concerned.

Many factors may explain a situation of this kind, non-conformity being one of the main concerns:

- firstly, the contractor must ensure that his service is free from defects. Conformity with the acknowledged rules of the engineering art is a key starting point for impeccable work and service. However, the roles are often reversed here and studies are performed by the companies themselves who sell the lightning protection system.
- The main lightning protection facilities installed on the roofs of most hospitals are rarely, if ever, checked (active part of the device head).
- In addition, the L1 + L2 minimum length rule is seldom respected; this rule applies to lightning conductors which should be systematically fitted on the control cabinets! See

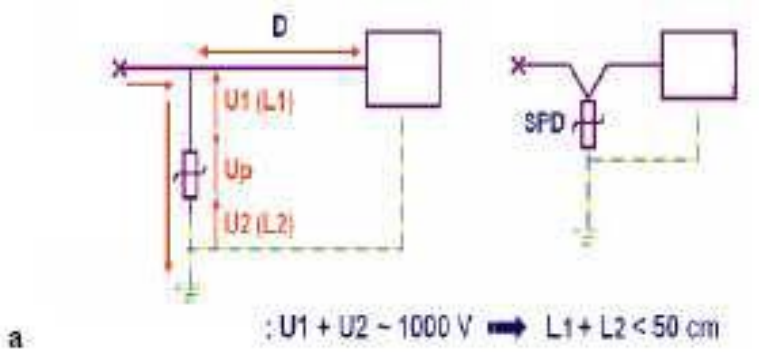

Fig. 1: A voltage surge conductor
Ausrustung = equipment. Netz = mains. Uberspannungsstrom = voltage surge current
For 1 metre cable

In France, Portugal and Spain, protection is generally of the PDA (or ESE) type and these systems are regarded as standardized by most members of the international scientific committee.

In the past, these companies endeavored to improve the "effectiveness" of the conventional lightning conductor by means of a simple rod, i.e. its protection zone. Some decades ago, people hit upon the idea that radioactive lightning conductors would afford better lightning protection than conventional conductors of the same height.
In recent years, many alternative conceptual methods have been proposed to enlarge the protection zone provided by a lightning conductor.

The PDA lightning protection (or ESA) is the subject of controversy, largely because of the lack of literature from the public sector to demonstrate that the performance of the PDA (or ESE) type devices were tested under natural lightning conditions.

This controversy stems from the working bodies which deal with the various aspects of the physics and effects of lightning including the so-called unconventional lightning protection systems and in particular the PDA (or ESE).

This study confirms that the PDA (or ESE) is theoretically based on incoherent scientific hypotheses and goes on to assert that "the premature ignition of tracers by the PDA (or ESA) which was observed in the laboratory cannot take place under natural conditions."

2 ORIGIN OF THE PDA (or ESE),

Some years after the discovery of radioactivity by M. Curie, a Hungarian physicist called Szillard proposed in 1914 a device which was supposed to prevent lightning discharges.
In principle, one thousand curies are not sufficient to confirm this hypothesis. However, in the 1960s some manufacturers confirmed the possibility that gamma rays are able to change the route followed by the lightning towards a particular lightning conductor.


Photos 1 and 2 Radioactive sources Helita (one of the two is positioned below an antenna fitted on the roof of a hospital!)

2.1 Overview

2.1.1 Radioactive sources before 1986

Between the years 1960 and 1986, after the realization had been gained that the device is not effective and the risk of a potential dispersion into the environment exists, the manufacture of this type of device using radioactive sources (Radium 226 or Americium 241) was halted by a ministerial decree.

Today there are still thousands of devices (some 50,000) which are still placed on roofs without any verification whatsoever. The French Agency for Radioactive Substances (ANDRA) has only dismantled 500 heads per year. At this rate, it would take a century for the installed units to be removed and the main problem is that the owner does not know that his facility is not protected.

Some Radium 326 elements have been found in hospitals, kindergartens, bags and rubbish bins of destroyed buildings without any possibility of tracing their origin.

The manufacturers and the Ministry of the Environment failed to take this problem seriously, as was done in England and Spain in the 2000s.
Today, the French governmental authorities require the owners to arrange for the equipment to be removed by the year 2012 by specialist companies with an ASN certificate (at the price of 2000 euros per head). But once again it is too late because the period of four years is too short.

2.1.2 Transition: 1986

French companies lost no time in finding substitutes for this market after the first French decree which prohibited them from continuing to manufacture and market systems of this kind.

When the PDA (or ESE), which is designated as unconventional today, first made its appearance all the technologies were available: piezoelectric/aeolian (see photos above), spark gap, voltaic system etc). Originally, the protection radius was roughly one hundred metres.

In 1998, some engineering studies proposed putting an end to this inflation by a reduction of this uncontrolled radius and the Environmental Ministry proposed that the radius of the PDA (or ESE) should be reduced by 40% at risk sites (of the SEVESO type, representing some 10% of French industry). Other problems emerged with the laboratory tests selected by the manufacturers and no tests were performed under natural conditions (temperature between -20° and 40°, wind, dust … and EMC).

The main drawback, however, resided in the impossibility of testing the electronic heads with simple and lightweight second-generation systems. Years later, thousands of PDAs (or ESE) had still not been tested and are surely obsolete.

Some manufacturers (FRANKLIN France, INDELEC, PIORTEH etc) have developed a new remote control system, but this involves the problem of batteries and the number of remote controls per PDA (or ESE); a system with personal codes is also available…

On the other hand, PDA heads have been dismantled and sent for examination to the manufacturer's laboratory with the problem of reliability, loss of time and loss of protection during the operation.

Photos 1 and 2: example of modern PDAs (Indelec and Franklin France)

Some of the systems based on piezoelectric/aeolian technology which have never been tested under natural conditions are still available on the market today without any possibility whatsoever of testing them.

3 OPPONENTS AT CEI 81

After all these hesitations and improvisations arising from the fact that the French market is controlled by the manufacturers and because of the importance of export sales to Asia and a French **Standard NF C 17-102:** *Lightning protection for roofed structures and zones by means of lightning conductors with an ignition device (1995)* together with the fact that most risk analyses were performed by the same persons who sell the product, thousands of PDAs were installed without any question whatsoever being asked about the verification of the electronic head which is often located in a critical position (see photos 2 and 3).

The PDAs were installed in large numbers on the roofs of many hospitals or in grain silos where it is not uncommon for explosive zones to be located right next to the device. These piezoelectric devices are also encountered with the widespread installation of antennas (GSM network) in the years 2000 and in particular on the roofs of hospitals, because of their size and high level positioning.

Photo 3: PDA close to ATEX zones

Photo 5: Verification of a PDA installed on top of a building (Indelec)

The French standardized verification procedure is ambiguous and open to interpretation (length of the simple rod and form of the end piece). The existence of vague definitions in a national standard must inevitably raise questions about the effectiveness of that standard.

The choice which consists in assessing the protection zone of a device of the PDA type by comparison with the shape of a bar-type lightning conductor can influence the calculation of the result.

It has been shown that the bar-type lightning conductors of radically different shapes (pointed or rounded) generate varying average values in respect of the operating times before a breakdown.

4 PDA: CREDIBLE ALTERNATIVE OR NEED TO IMPROVE THE TESTS?

PDAs cannot be rejected out of hand, if improvements are made by the manufacturers which take account of the following recommendations:
- testing under natural conditions,
- serious improvement of experience feedback without counting worldwide PDA sales figures,
- progress with on-site testing of heads annually, even by radio,
- call for a 40% reduction of the radius each time not only for hazardous facilities (ICLP, SEVESO etc),
- estimates or even technical studies must not necessarily be made by the manufacturers,
- prefer mixed protection with PDA (and networking) but systematic preference for protection against voltage surges.

Qualifoudre: verification studies, companies which perform verifications; this more recent certificate made no difference. Some companies which signed big lightning protection contracts as they have ISO 9001 certification, but without any reference in the lightning field, are the challengers. Others have thousands of references.

Photo 6: How a petrol tank head and a launch ramp can be protected

However, a report by INERIS (Gruet report) dating from October 2001 called **the discharge model directly into question; the calculations of the protection radius guaranteed by the PDA are based on that model.**

Following this report, the Ministry and the UTE published two interpretation documents of standard NF C 17-102 with a definition of the different measures to be taken for the design of a protection system based on PDAs.

The first document stated that for the ICPE (in the case of facilities classified for environmental protection), if the risk analysis of a facility shows a value of 10 for the coefficient C5 (see Section 7.4) the protection radius of the PDA is reduced by 40% (safety margin) compared to the original value according to standard NF C 17-102.

The second document interpreting standard NF C 17-102 applied solely to PDAs, for which the value of the advance on ignition (ΔT) is not greater than 60 µs.

5 CONCLUSION

Despite the progress made by most leading French PDA manufacturers in an endeavor to implement this system, the PDA principle remains so far a utopia.

Most hospitals are protected today by these systems and the question as to the electrical continuity which remains the main concern cannot be based on such systems without first resolving the problem of voltage surge protection (95% of all accidents caused by lightning are the result of a voltage surge.

However, if all of the above remarks are followed (test under natural conditions in the open air, on site, simplified verification procedure by radio etc.) and if mixed protection is regarded as the solution, the scientific community may possibly accept this unconventional protection mode.

Photo 7: Eiffel tower and an ascendant lightning flash

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