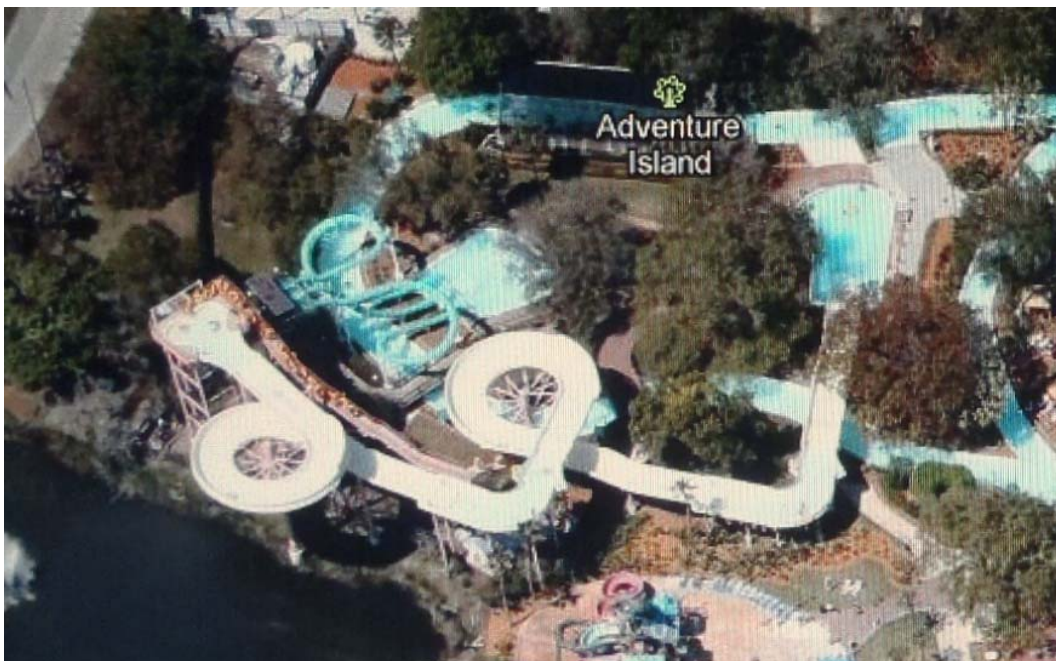


# **ADVENTURE ISLAND**

# **LIGHTNING INCIDENT**

**AN IN-DEPTH REPORT ON THE DEADLY FAILURE OF AN  
EARLY STREAMER EMISSION LIGHTNING ROD**



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## **Introduction**

In March 2012, a student was struck and killed by lightning on a Malaysian university football field while he was within the claimed protection zone of a French-made early streamer emission (ESE) lightning rod (i.e. air terminal).

<http://www.lightningsafetyalliance.com/documents/86700078-Death-at-the-Stadium.pdf>

Following the posting of the incident report, the authors were informed about a similar incident that had occurred recently at the Adventure Island theme park in Tampa, Florida, USA. In that incident, a young lifeguard supervisor of the park was struck and killed by lightning while he was on duty at the Key West Rapids water slide.

A survey of the park revealed that the water slide was located between two French-made ESE lightning rods. This suggests that the fatal incident was located within the claimed ESE protection zones of one or both lightning rods.

### **Cover picture:**

The Key West Rapids water slide at the Adventure Island theme park, Tampa, Florida.  
(Source: Google Map)

## 1. FATAL LIGHTNING INCIDENT REPORT

The Adventure Island theme park is located in the city of Tampa, Florida, in the United States of America (USA). Florida, which has the highest number of annual thunderstorm days, is also considered to be the “Lightning Capital” of the USA.

The Key West Rapids (KWR) water slide (Fig. 1) is a six-story (about 20m high), 700 foot (about 220m long) slide with an entry pool at the top (X) and an exit pool at the bottom (Y). Dozens of guests will line up on the staircase leading to the entry pool before they ride down the looping water slide.



Fig. 1: The Key West Rapids water slide. (Source: Google Map/Satellite view)

According to the news report, the lifeguard supervisor was helping the guests off the KWR water slide when he was struck by lightning. However, the news report made no mention whether he was at the top (X) or bottom (Y) pool when the incident happened.

The water slide was found to be located in between two mast-mounted ESE lightning rods, A and B (Fig. 2). The lightning rod A (Fig. 3) is located besides the Riptide pool while the lightning rod B (Fig. 4) is located besides the parking lot access road.





Fig. 2: Location of the ESE lightning rods, A and B (Source: Google map)



Fig. 3: Location of the ESE lightning rod A (Source: Google map)



Fig. 4: Location of the ESE lightning rod B (Source: Google map)

Photographs of the lightning rods taken from the access road are shown below (Figs. 5 and 6). The masts are estimated to be about 25m high each i.e. higher than the KWR top entry pool. Close-up shots of the lightning rods revealed that they are first-generation Prevelectron ESE lightning rods manufactured by Indelec of France.



Fig. 5: Position of lightning rod A in relation to the KWR water slide.

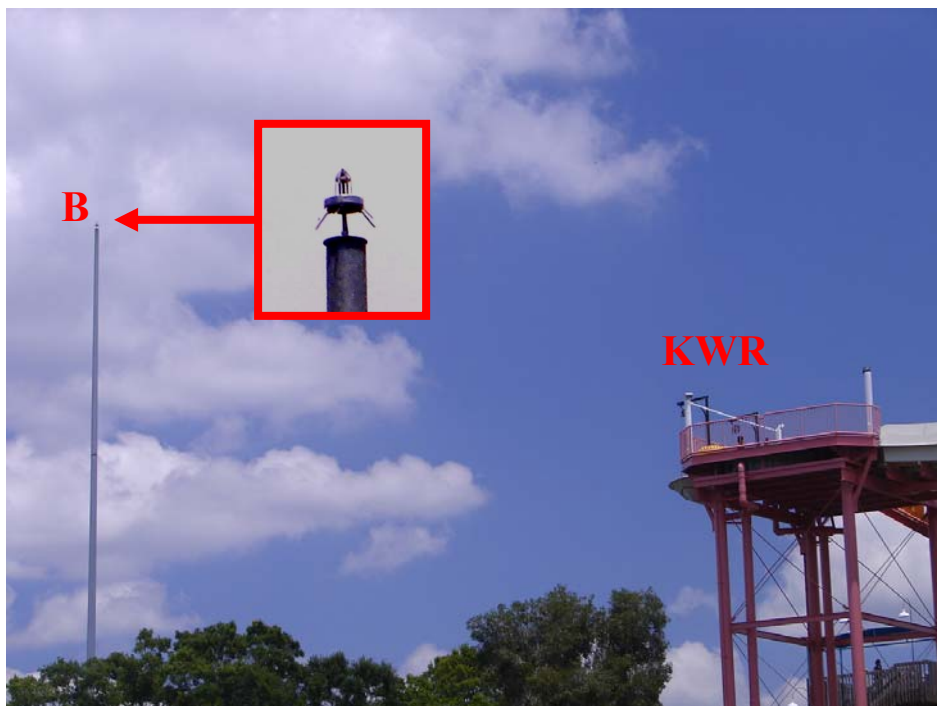


Fig. 6: Position of lightning rod B in relation to the KWR water slide.



An inspection of the masts shows that the Prevectron lightning rods had been bonded to the masts and grounded according to the French ESE standard (Figs. 7 and 8).



Fig. 7: The base of the ESE lightning rod mast at B showing a grounding cable leading towards two grounding points..



Fig. 8: A close-up shot of the bonding terminal on the mast..

## 2. CLAIMED ESE PROTECTION ZONE

The manufacturers of the ESE lightning rods have claimed that their devices can provide a very large protection zone i.e. up to 100 m or more depending on the make and model of the device. According to GIMELEC, an organisation that is affiliated to the French ESE manufacturers, a single ESE lightning rod installed centrally on the roof can provide protection for the entire building and the open area surrounding the building. This is shown in the GIMELEC diagrams below (figs 9 and 10) for a school building and an adjacent playing field.

Source: <http://www.lightningconductor-ese.com/etude1.htm>

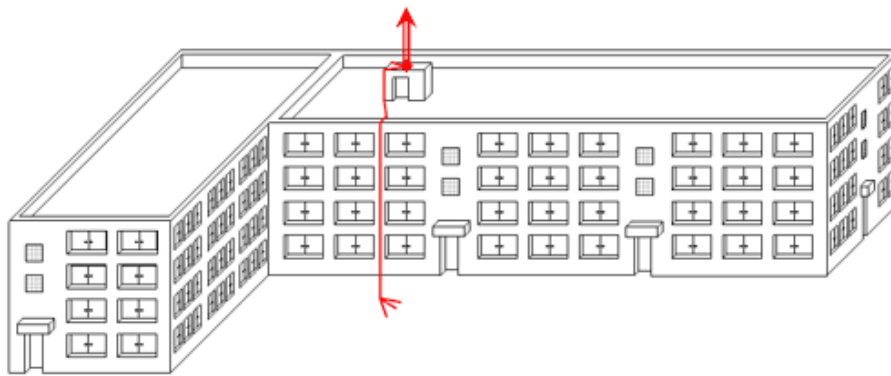


Fig. 9: A school building installed with a single ESE lightning rod at the centre of the roof.  
(Source: GIMELEC)

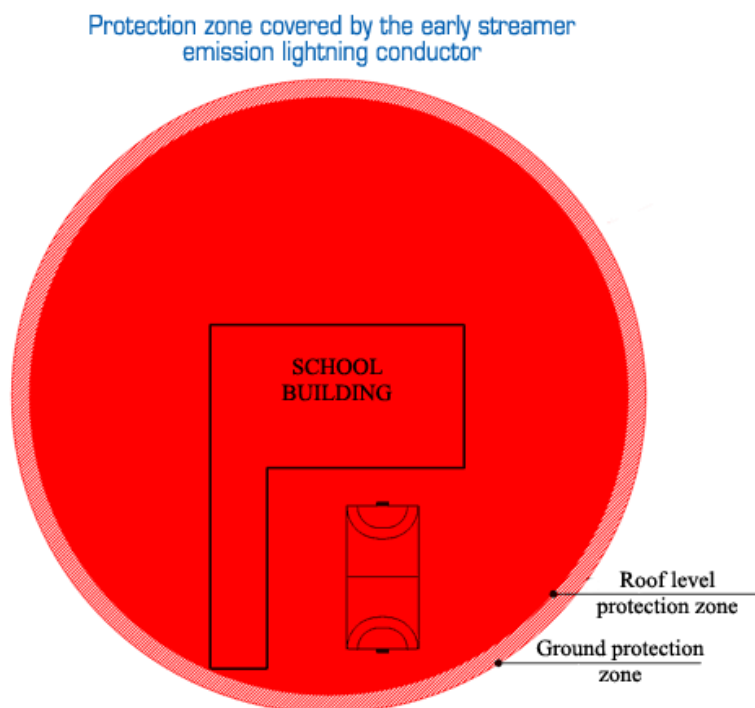


Fig. 10: The claimed protection zone provided by the single ESE lightning rod for the school building and surrounding area (including the playing field). (Source: GIMELEC)

In order to convince the public that the claimed ESE protection zone is bigger than the conventional ones, GIMELEC also posted several diagrams (Fig. 11) to show the smaller protection zones provided by the conventional lightning protection systems. Note that the playing field is only partially included within the conventional protection zones. This suggests that the ESE lightning rod is used to protect open areas and playing fields as well.

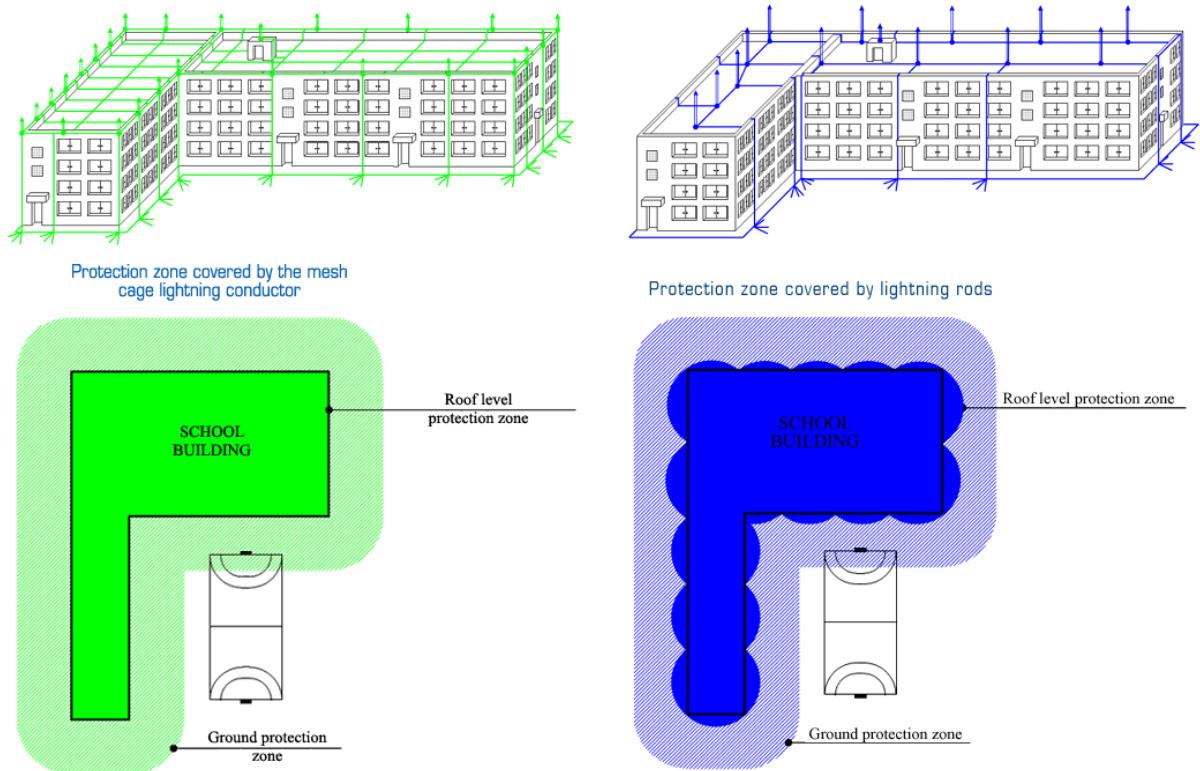


Fig. 11: The protection zones provided by the mesh system (above left) and the pole-type lightning rods (above right). (Source: GIMELEC)

According to Indelec, the lightning rod has a claimed protection radius (i.e. zone) of up to 109 meters. This protection zone is in accordance with the French ESE standard, NFC 17-102. (<http://www.indelec.com/>)

Using the distance scale provided by Google Map, it was found that both the pools X and Y were located within the claimed ESE protection zones (Fig. 12). The upper entry pool X was located within 50 m of the Prevectron lightning rod at location B while the lower entry pool Y was located within 100 m of both Prevectron lightning rods at locations A and B.

Since the victim was reportedly struck by lightning while he was on duty on one of the two entry pools, this incident provides firm evidence that the actual ESE protection zone is very much smaller than is claimed.



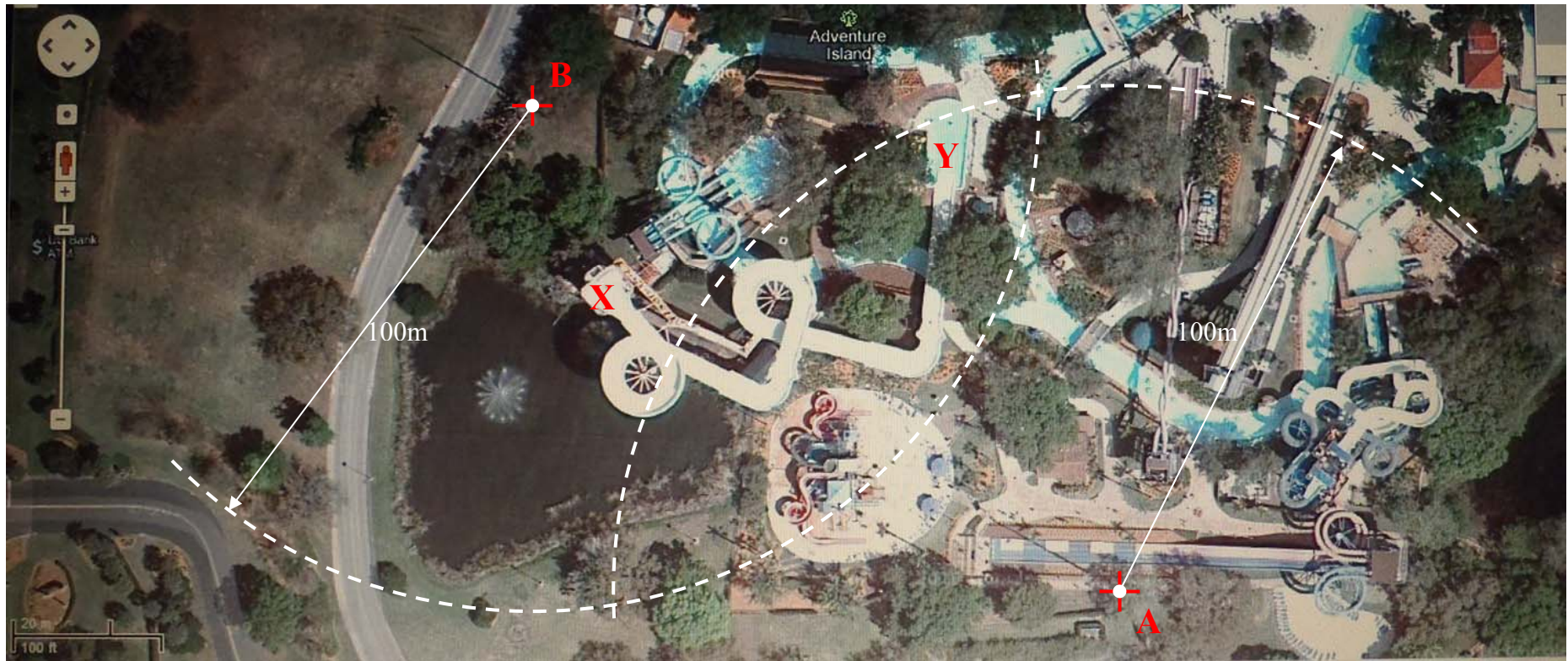


Fig. 12: The positions of the entry pool X and exit pool Y in relation to the Prevelectron lightning rods A and B. (Source: Google map)

### 3. DISCUSSIONS

The Prevector lightning rods have been used in Malaysia for more than a decade. Although their number is small when compared with other brands of ESE lightning rods, their failure rate is about the same since most of the tall buildings that used them had displayed the characteristic bypasses i.e. lightning caused damages.

The failures of the ESE lightning rods to attract lightning have been highlighted by the authors in several technical reports and conference/seminar papers since 1995. In their latest conference paper presented in 2011, the authors have highlighted the fact that lightning can strike within 10 m of the ESE lightning rod. (Z. A. Hartono and I. Robiah, “Close proximity bypasses to ESE and CVM air terminals”, Asia Pacific International Conference on Lightning, Chengdu, China, 2011).

<http://www.mikeholt.com/download.php?file=PDF/CloseProximityBypasses.pdf>

Examples of bypasses near second-generation Prevector lightning rods are shown below (Figs. 13 and 14). A Prevector lightning rod failure can also be inferred when another ESE lightning rod is installed next to it but with a higher rod tip location (Fig. 15). More cases like this can be found in our paper “ESE: The device for a modern answer to lightning protection?”

<http://www.mikeholt.com/newsletters.php?action=display&letterID=823>



Fig. 13: The lightning damaged TNB building in Johor Baru, Malaysia.



Fig. 14: The lightning damaged Sri Kota apartment in Kuala Lumpur, Malaysia.

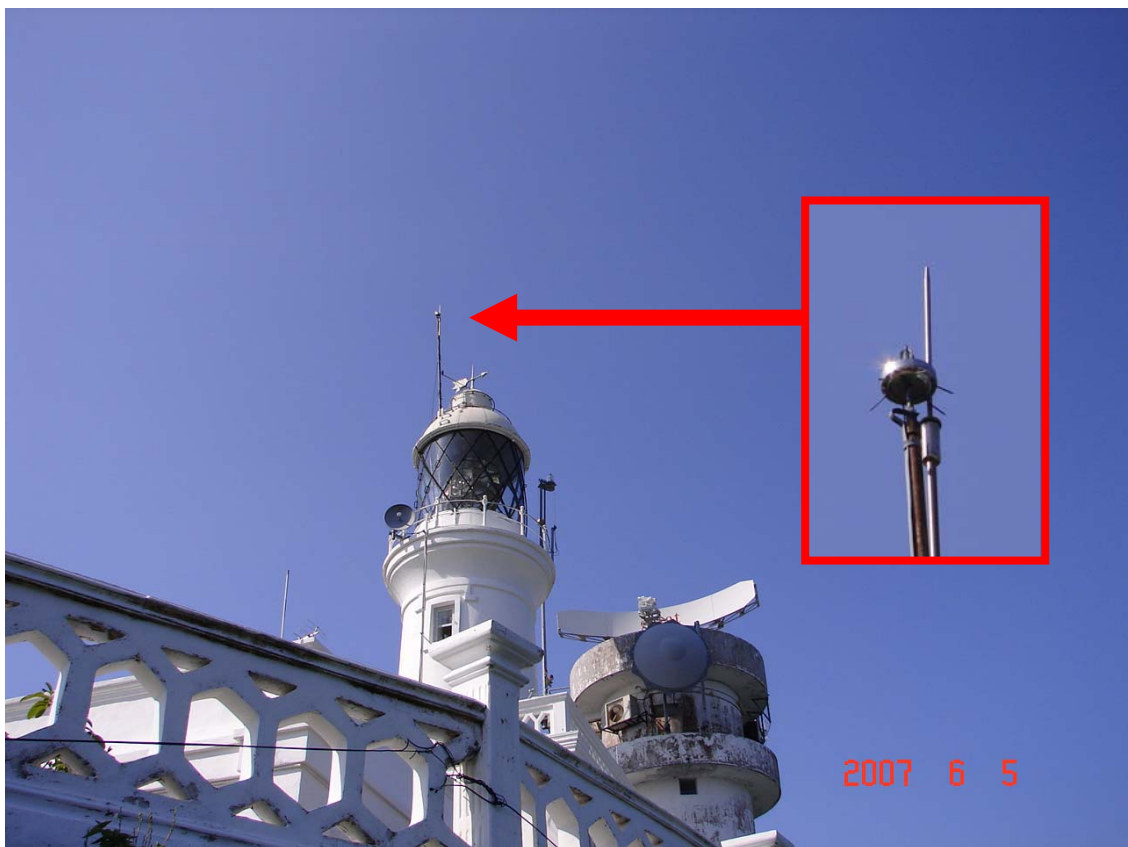


Fig. 15: A Prevector lightning rod (left) and a Pulsar lightning rod (right) at the Cape Rachado lighthouse, Malaysia. Both lightning rods are made to NFC 17-102 standard.



The failures of the ESE lightning rods have been reported not only in high thunderstorm activity areas like Malaysia and Florida but also in France where the thunderstorm activity is very much lower. In the scenic town of Sigolsheim, a stone cross which is located barely seven meters away from a Pulsar ESE lightning rod was struck and damaged by lightning (Fig. 16).



Fig. 16: The bell tower with the (missing) damaged stone cross (left) and the new stone cross installed a year later (right). The ESE lightning rod is installed on the opposite side of the roof.

Since the ESE lightning rod system had been inspected and confirmed to be in working order by independent French technical experts, this suggests that the French ESE standard and the claimed ESE protection zone must be technically unsound. (Reference: Z. A. Hartono and I. Robiah, “The Bell Tower Incident at Sigolsheim”, 2010)

<http://www.lightning.org/document/belltower-sigolsheim-france>

#### 4. SUMMARY

The failure of two ESE lightning rods to protect the Key West Rapids water slide from lightning strike is not surprising. A study conducted by the University of Florida nearly a decade ago had revealed that the ESE lightning protection technology is not supported by scientific theory or field data. (Reference: MA Uman and VA Rakov, “A critical review of non-conventional approaches to lightning protection”, Bulletin of the American Meteorological Society, December 2002.)

<http://www.lightning.ece.ufl.edu/PDF/umanrakov.pdf>

In 2005, the United States District Court for Arizona issued a permanent injunction, which prohibits the vendors of the ESE lightning rods from claiming that their gadgets have been proven to significantly extend the maximum range of protection against lightning damage beyond that afforded by NFPA 780 requirements. The Order was issued pursuant to provisions of the Lanham Act, which prohibit false advertising.

<http://www.lightningsafetyalliance.com/documents/finalinjunction.pdf>

The opposition to the ESE lightning protection technology can also be found among CIGRE lightning experts. For the past two decades, these experts could not find any scientific evidence to support the ESE technology. In their latest study, they found that the ESE lightning rods do not work under natural lightning conditions and that there is no justification to assume that ESE lightning rods perform better than Franklin rods. (V Cooray et al, “Non-conventional lightning protection systems”, CIGRE WG C4.405 Report, Elektra No. 258, October 2011.)

<http://www.iclp-centre.org/pdf/Cooray-CIGRE-2011.pdf>

The failure of the ESE lightning rods to protect buildings and structures from direct lightning strikes has been widely known for the past two decades. Hence the ESE lightning rods are also ineffective for the protection of open areas like theme parks, stadiums and other recreational grounds.

In order to avoid further lightning casualties, it is highly recommended that theme parks be installed with NFPA780 compliant lightning protection systems and implement proven lightning safety rules.