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Specific lightning protection by ESEAT installations

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***Abstract*—This paper wishes to present specific lightning protection installations where the use of ESEAT (Early Streamer emission Air Terminal) technology has proved to be an asset.**

Most of the cases presented will show than that ESEAT was the only reasonable solution to protect such building or structure due to the fact that either wide external areas were to be covered, or the structure to be protected due to its design was very difficult to protect with a meshed cage.
The aim of this paper is to show when the ESEAT System is the unique/affordable solution to give the required protection due the determined installation's type.

Keywords—ESEAT, External areas, historical monuments

I. SHANGHAI 65 METER RADIO TELESCOPE

The radio telescope is located in Shanghai / Song Jiang district, China.

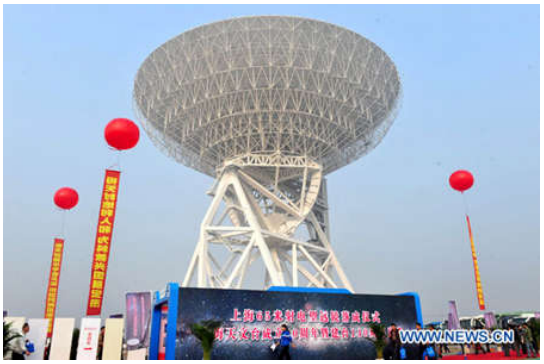


Fig.1. Shanghai Mont Sheshan radiotelescope

The LPS aims to protect the radiotelescope and the adjacent buildings that are installed all around. The radio telescope of Shanghai is a very sensitive equipment and the solution with two ESE enables to:

- ✓ Protect all adjacent technical buildings
- ✓ Protect the radio telescope as if it is rotating around its axle

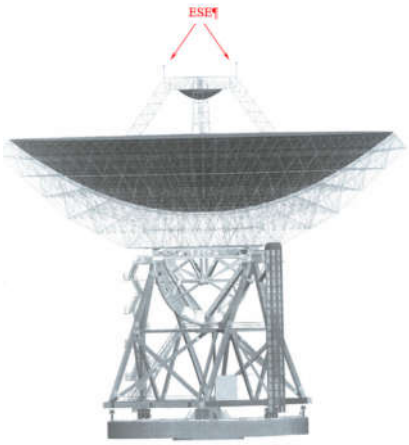


Fig.2. Shanghai Mont Sheshan radiotelescope with LP

Moreover, based on GB50057-94 (this project was designed in 2010, so the standard was the 1995 version), the protection radius of normal Franklin lightning rods is 26m, if the installation height reaches 15 m. Due to the requested protection surface of the radiotelescope, it makes no doubt that the use of E.S.E rods is the best solution to reduce the quantity of the rods which is important to avoid disturbance of the signal.

II. COLORADO STATE UNIVERSITY STADIUM

The stadium is located in Fort Collins, Colorado USA.

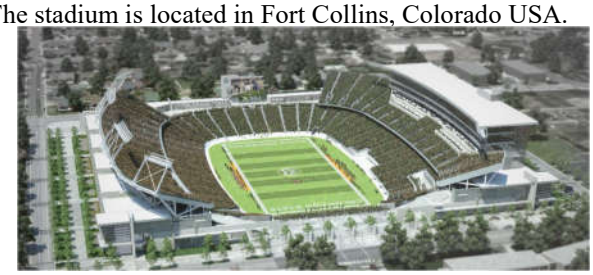


Fig.3. Colorado State University stadium

The lightning protection of an open area as a stadium is a very specific task than can be achieved only using the ESEAT technology when you want to protect not only the stadium bleachers but also the field.
4 ESEAT have been settled on the top roof of the arena with protecting radius covering to total field as displayed in the hereunder drawing.

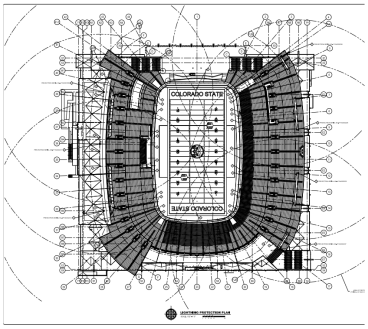


Fig.4. Colorado State University stadium protection radius plan view

III. PK HOSPITAL LAHORE, PAKISTAN

The hospital is located in Lahore Pakistan.

Fig.5. PKLI Hospital - Lahore

The customer request was to protect not only the three buildings but also the gardens… who are situated on the roof of the structure. So, we were facing an open area on top of a structure! No other technical solution allows to realize such protection.
One ESE was installed on the roof of each buildings with a 6 m mast to overtakes the trees.
There were 2 nos. of down conductor with 2 earth pits for each 3 buildings…

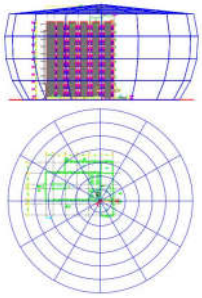


Fig.6. Lahore Hospital Protection radius

IV. UNITED NATIONS OFFICE AT NAIROBI (UNON)

The tower is located in Nairobi, Kenya.

Fig.7. United nations Office- Nairobi

Conventional lightning protection was not easy to be installed and maintained on such building. Four storey building with solar panels on roof were to be protected
The original design was of normal conventional lightning protection system. There were 8 nos.of lighting arrestors, with 8 nos. of down conductors. Copper tape was to run along parapet and in centre of the roof as indicated along the drawing. There were 8 nos. of earth pit.

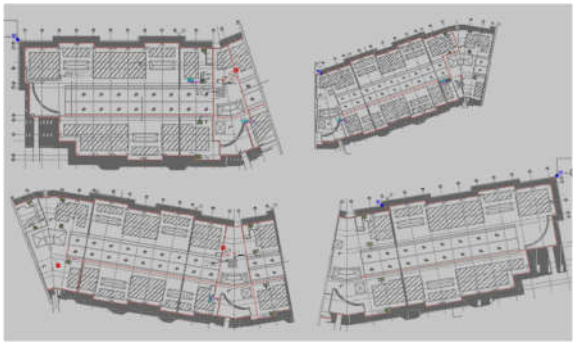


Fig.8. United nations Office- Nairobi – original design

There was no space for running copper tape along the roof floor as per the drawing.
Two Isolated ESE systems have been installed on towers next to buildings. There are 2 nos. of down conductors, one for each.

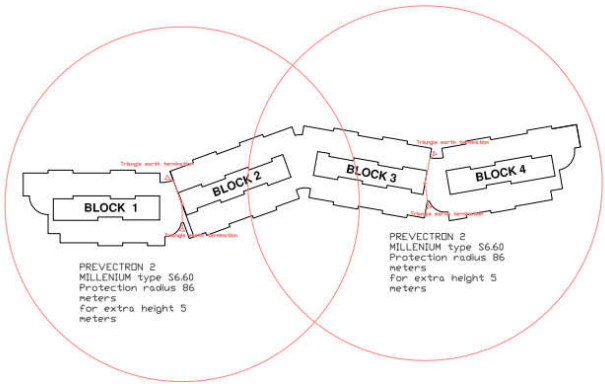
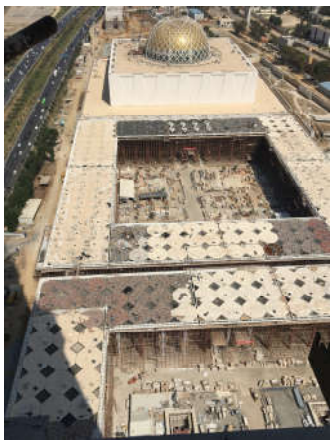


Fig.9. United nations Office- Nairobi – ESEAT Design with protective radius.

This solution was much easier to protect the building and meet the requirement of the customer to have solar panels on the roofs and minimum down conductors around the building.

V. DJAMAA EL DJAZAIR, ALGIER MOSQUE

Djamaa el Djazair Mosque is located in Alger Algeria. It is the 3rd biggest Mosque in the world and the biggest in Africa. The minaret is 270 m high and it has a 120 000 visitors capacity with a parking lot for 6000 cars.



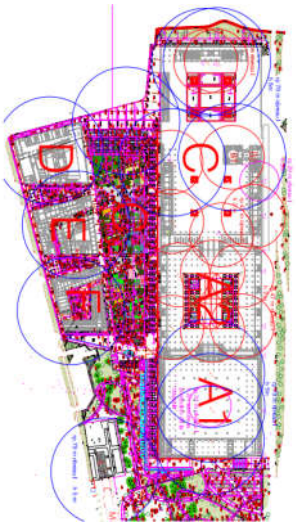


Fig.10. Mosque Djamaa el Djazair

The original design was based on isolated meshed cage with insulated cable.

Due to the necessity to protect wide open areas (external prayer areas for worshippers, parking, etc…) and due the architectural desire of the owner to avoid cable and multiple rods on the wide dome, an alternative had to be proposed.

Twenty ESEAT were successfully installed with related earth pits. The number of ESEAT on the main building was increased by the fact that the architect didn't want them to rise to high over the building.

One of these ESEAT including storm detection device and smart lightning counter had been incorporated together with an ornamental crescent. Both Crescent and ESEAT have been gold covered to fit well in the décor.

The minaret has been protected with 2 ESEAT fixed on the roof and 4 along the side of the structure.

With the original design the dome would have looked like a hedgehog which was not an option for the Muslim council.

VI. POPE FRANÇOIS MASS CELEBRATION IN MEXICO

This specific lightning protection has been designed for the visit to Mexico by Pope François in 2016. Two venues (San Cristobal de las Casas and Tuxtla Gutiérrez both in Chiapas) where Pope François officiated masses during his visit have been protected against lightning.

Fig.11. Pope François celebration in Mexico

This raised the problem of temporary event management: How to protect such a critical event with an exceptional crowd (more than 1 million believers attended the mass) during a short period of time?

Only an ESEAT solution was able to meet the specification. Reliable protection, easy installation in a short time... and cost effective.

An efficient complement could have been to associate the protection to a storm detection device.

VII. FLOATING STORAGE PRODUCTION IN NIGERIA

The Floating Storage Production unity (FSO Unity) ship is an Offshore service barge (Oil storage) located in the atlantic ocean off the coast of Nigeria.

The vessel is linked to a field via a 38 km pipeline.

Fig.12. FSO unity

The lightning protection of this very specific site is achieved by 2 ESEAT directly installed on the top of the telecommunication tower and on the top of an elevated structure on the rear deck of the ship

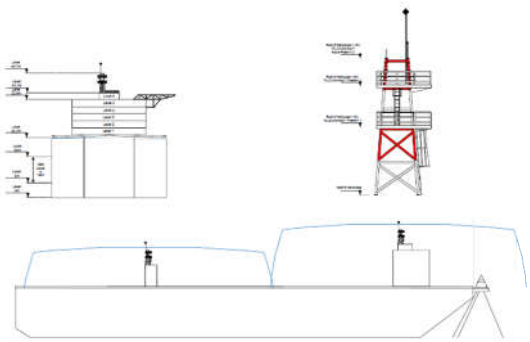


Fig.13. Lightning Protection system side View

Indeed, the ESE technology enables to protect the telecommunication tower, the equipment of the tower, the helideck and a large part of the open area of the platform. This global protection can only be achieved by using the ESE technology.

VIII. MILAD TOWER IN TEHERAN

The tower is located in Teheran, Iran.

Fig.14. Milad Tower city view- Teheran

This high-rise structure is 435 m height and the lightning protection was designed after the construction.

The solution adopted was a protection by multiple ESEAT along the side of the tower and on the top of the structure. The cost prevented to implement any other type of protection.

Fig.15. Milad Tower – Teheran

IX. PHOTOVOLTAIC PLANT 250 MW

The 250 MW Photovoltaic plant is located in Rewa Madhya Pradesh, India. It is extended over a surface of 700 ha.
202 units of ESEAT 60 µs have been needed to protect the whole surface.

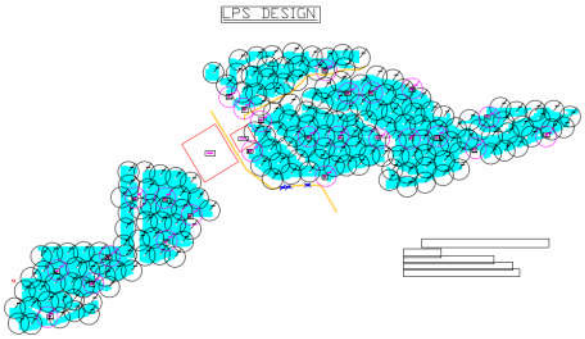


Fig.16. Rewa Photovoltaic plant LP plan view

Due the size of the project, installing conventional system would:
- Decrease the profit by increasing the payback time due to the fact that the numbers of rods requested to be installed in a passive solution will generate shadows that would decrease the efficiency of the solar modules.
- Increase cost of the lightning protection. Due to the fact that a non-isolated system required at least one down-conductor based on IEC 62305 the cost would be much higher than within the ESEAT.

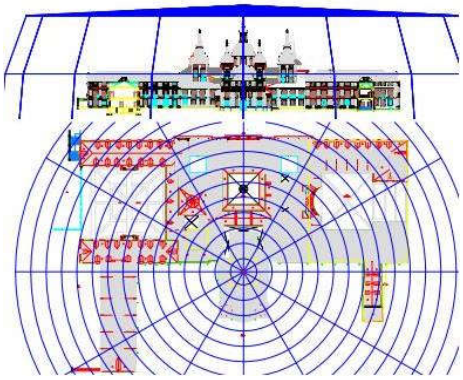
X. LA GRANJA PALACIO, SEGOVIA, SPAIN

The grand palace is in Segovia, in the close vicinity of Madrid.

Fig.17. La Granja Palacio Segovia

The Palace is a highly touristic structure with large gardens and several inner courtyards.
Therefore, the key point is to protect not only the palace itself but also the numerous open areas where tourists are wandering.

Only one ESEAT was enough to protect the whole palace and part of the surroundings.
An alternative based on meshed cage would be very costly, difficult to install, too visible for architectural purpose and would not protect the open areas.



XI. SOLAR FARM IN CHINA

The Yun nan shi lin photovoltaic power generation station is located in Shi Lin, Yunnan province, China.

This 100 MW power station undergoes almost 60 stormy days a year.

Fig.18. Yun nan shi lin Solar Farm

The request of the owner of the farm was to meet the lightning protection requirement while avoiding to reduce efficiency of the solar panels due the shadow from any lightning rods.
An innovative solution has been developed so that the ESEAT was installed on retractable masts and associated to a Stormdetec device. When a storm arrives on site the ESEAT is rising thus the telescopic mast and protecting the solar panel…

Fig.19. Yun nan shi lin Solar Farm telescopic mast

XII. WATER TREATMENT PLANT, SPAIN

The Consorci Aigües Tarragona, Water treatment plant is located in L'Ampolla, Catalunya, Spain
Water treatment plants usually are settled in a wide area where you have constantly workers around and due the volume of water existent on those areas are preferential impact spots for the lighting strikes.
So due the requirement to protect people in open areas the passive system would not be suitable.

Fig.20. Consorci Aigües Tarragona, Water treatment plant

7 units of ESEAT have been installed to cover the area with relevant Earth Pits and down conductors.

XIII. CONCLUSIONS

When wide open areas are to be protected, when architectural constraints arise, when the structure is not permanent or when cost is an issue, Early Streamer Emission Air Terminal shows the only reasonable solution if any.
This technology enables to protect structures which would not have had access to protection otherwise.

Installation shall of course be done according to the standards (NFC 17 102, UNE 21186, etc…) to be effective.

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