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# Embry Riddle University's Lightning Protection System by UL listed ESEAT

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***Abstract*—The Embry Riddle Aeronautical University, (Daytona Beach, Florida USA), called the ''Harvard of the Sky'' is the world largest, fully accredited place, for aeronautic, and aero spatial education. Created in 1929, and training more than 30 000 students yearly.**

**This prestigious site, divided in 150 sites spared in three campus, has required for its project of Union Student Building, the evaluation and design of an External and Internal Lightning Protection System.**

**The keraunic level in the Florida area, added to the high exposure of human risk with a density of population permanently on the site has evidenced the necessity to apply the standards recommendation of IEC 62305-1 to 3 [1 to 3], together with the consultation of NFPA 780 [4] regulations in full force in this area.**

**A lightning risk analysis, followed by technical study have been designed ; According to their results, and the mandatory Underwriter's Laboratory Certification, a solution of protection, under new technology E.S.E. IONIFLASH MACH as per NFC 17-102 standard [5], was proposed**

***Keywords—Lightning Protection System; ESEAT, UL***

## I. INTRODUCTION

This paper is therefore dealing with direct lightning protection of a public/private building, which is the main entrance of the EMBRY-RIDDLE UNIVERSITY ; It is the largest oldest aviation-focused university in the world ; it's students can choose from 40 degrees program ; It is the only school with dozens of instructional aircraft on hand and an organization established for future air traffic controllers ; Their premises and organization expend with an extensive network of more than 150 centers throughout the United States, Canada, Europe, Singapore, and the Middle East, as well as a web-based distance learning program for civilian and military working adults.

*1) Union Student Building of the Embly Riddle University*

## II. CONTEXT OF THE SURVEY

### *A. Limit of the design*

This lightning protection survey and design is presented in full compliance with international standards defined in the instruction of a project of a lightning protection system: IEC 62305:3 Edition 2010.

We draw your attention on the fact that lightning protection standards are based on statistical survey, and scientific experiments, and that, as every natural phenomenon, it cannot be fully mastered and fully protected in its target. It wishes to limit the damages occurring to lightning impacts to human beings and structures according to law and standards:

As in the case with anything related to natural elements, a lightning protection system designed and installed in accordance to this standard "may not, like everything about the natural elements, ensure the absolute protection of structure, people or objects ; however the application of this documents must reduce significantly the risk of damage due to lightning on protected structures. NF EN C 17-102: 2011

‘’The measures of protection specified in IEC 62305-3 and IEC 62305-4 [6] are efficient if the lightning current parameters are in within the level defined by the designer. This is why the efficiency of a measure of protection is supposed equal to the probability for the impulse lightning current parameters are in this field. For the parameters outside this field, a residual damage risk remains. IEC 62305-1.

### *B. Standard in force*

This survey and design is conducted in accordance and respect of the following standards in full force, and shall be updated in compliance with their revision, at the date of realization of the project:

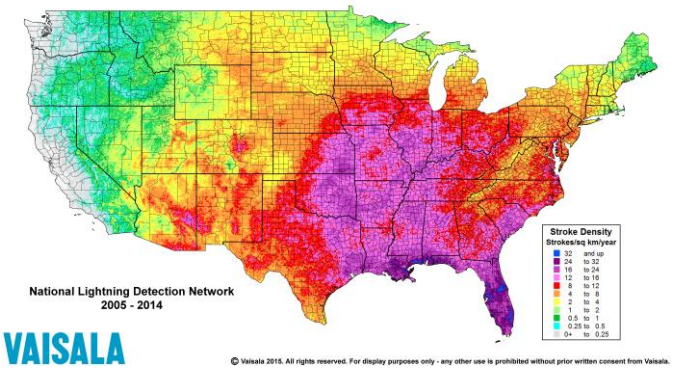
- The 4 parts of the IEC 62305: 2010
- The IEC 61643 -11 and 61643-12 parts [7 to 8]
- The NF EN 17-102: 2011 Early Streamer Emission lighting protection systems.

Since 2016, Underwriter Laboratories (UL) has added a new lightning products certification category. The OVHC. It corresponds to the Early Streamer Emission Air Terminals Certified to NF C 17-102. This paper aims to present an UL listed project with an Early Streamer Emission Air-Terminal (ESEAT) Lightning Protection System.

## III. PARTICULARITIES OF THE SITE

### *A. Local lightning Activity*

According to the Vaisala map, we consider that flash density of State of Florida, is greater than 32.



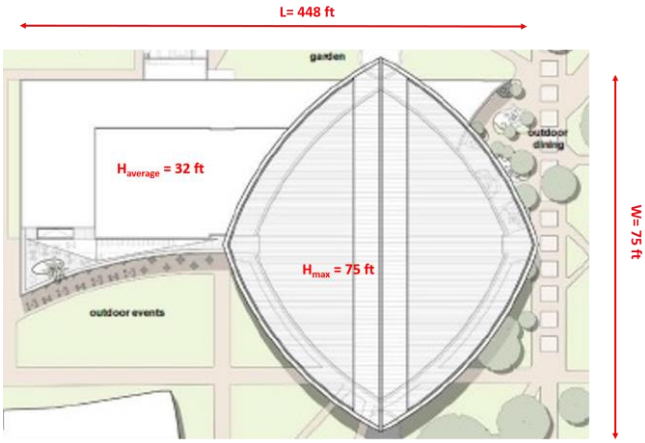

*2) Lightning activities map of the United State of America*

In order to be more precise, local information were obtained, and a lightning stroke density of 35 impacts per year pear km² has been set.

### *B. Dimensions of the Building*

The project of Union student building in the Embry Riddle University presents the following dimensions:

- Length L = 448ft or 137m.
- Width W = 75ft or 98m.
- High standard H = 32ft or 10m.
- Maximum high Hmax = 75ft or 23m.




*3) Dimensions of the Union Student building*

The Union Student building is design with 3 level of roof and with 2 external area where people may be present:

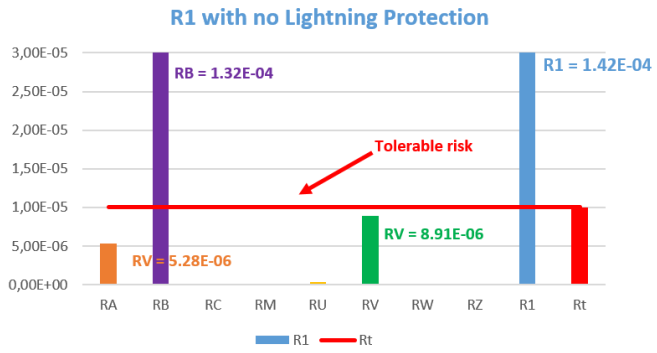
- 1 Area for outdoor dine
- 1 Area for outdoor events


*4) 3 roof levels of the Union Student building*

## IV. LIGHTNING RISK ASSESSMENT

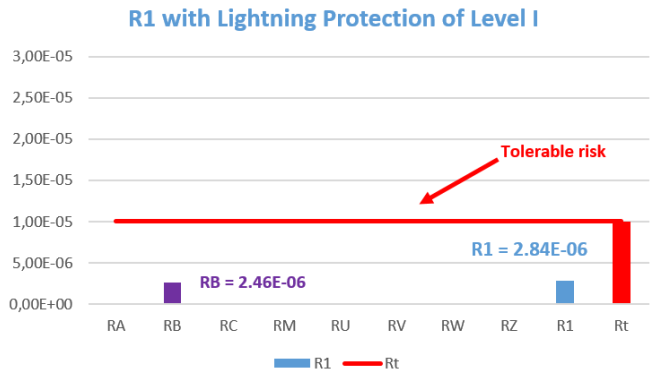
The Analysis has been realized with the Software IONEXPERT 3000 which fulfill and comply with IEC 62305-2:2010.

For this building, study gives a Human loss risk R1 of 1.42E-4 greater than the tolerable RT (1E-5).




*5) R1: Risk of loss of human life in the structure without Lightning Protection*

By applying a lightning protection of level I, the R1 risk reduces below the tolerable risk Rt: R1=2.84E-6




*6) R1: Risk of loss of human life in the structure with Lightning Protection of Level I*

## V. DESIGN OF LIGHTNING PROTECTION SYSTEM

### *A. Air-terminal*

For a level of protection I and according the standard NFC 17-102:2011, an ESE Air terminal with an advance time of 60 µs have a radius protection of 259 ft (79m) for a first reference plane at h = 16ft (5m).

So, for the lightning protection of this building, we recommend the installation of 2 ESE IONIFLASH MACH NG60 UL.

Indeed, 2 ESE were requested to protect the whole building and the outdoor open areas (Outdoor dining and events areas).

The implementation of the ESE technology in the design of the lightning protection system enables to realize an efficient Lightning Protection system economically interesting and preserving for the planet.

Few row material are requested to realize the system.

The first ESE has been installed on the metallic armature of the dome, nearly at the highest part of the building. The ESE rises at least 5m above the roof. From this position it enables the protection of the upper part and of the open area.

The second ESE has been installed on the intermediate roof

### *B. Down-conductors and separation distance*

Each ESE Air Terminal should be connected to at least two down conductor until the earthing system in order to have a good distribution of the lightning current according to the standard NFC 17-102 of September 2011.

The ESE N°1 (lower roof) is directly connected to 2 specific down-conductors. The ESE N°2 (higher roof) is connected to one specific down-conductor and is connected to the 2 down-conductors of the first ESE via an interconnection link on the roof. Morevover, division of the current is increased with implementation of direct bonding of the 2 ESE to the metallic structure of the Union Student Building.

At least, according to standard calculation (NFC 17-102:2011) and structural design (more than 10 natural down-conductors and 3 specific down-conductors), the separation distance is negligible for this project.

### *C. Earthing system*

According to the ESEAT technology's requirements, resistance of this earthing system should be inferior to 10 Ohms.

Paper from Troubat & all [9] describes the influence of the earthing value on the magnetic field radiated around the down-conductor and on residual current that exists in the soil. Conclusion of this paper was that the lower is the value of the earthing system, the lower will be the radiated field and the lower will be the lightning current in the soil.

So, it is scientifically advisable and recognized that the better the earthing system is, the lower lightning parasites may occurs.

In this project, the earthing system has been realized with 3 Type A (crow's foot) earthing system, with stainless steel earth rods. The linked conductor has to be a 30 x 2 mm tinned copper plate. Moreover, for each earthing system, an eathing disconnection in inspection pit, to link the electric earthing system has been implemented.

The final measurement of the earthing system has been performed according to the 62% method.

The measurement results are given in the table I below.

TABLE I. VALIDATION OF THE EARTHING SYSTEMS

| Earthing System | Value below 10Ω |
|---|---|
| N°1-1 | Yes |
| N°1-2 | Yes |
| N°2-1 | Yes |

*D. Reduction of hazard by complementary solution*

The frequency of university crossing in the playground is high, so we recommend the establishment of a protective measure on the down conductors against contact tensions.

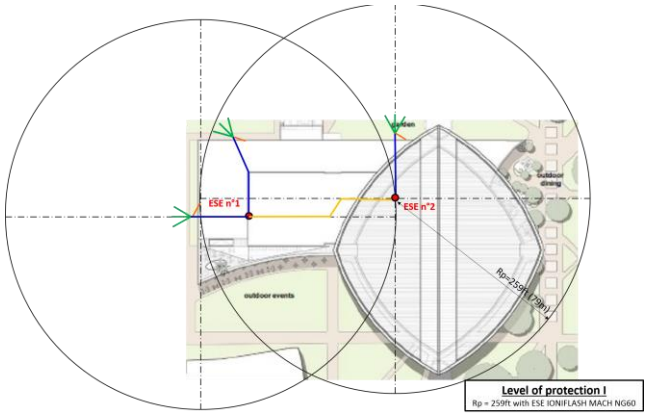
It has been requested to set up informative poster that warning risks and hazards around the down-conductors in stormy period.

*E. Equipotentialization*

A class I Surge Protective Device (SPD) is requested in order to harmonize the potential differences that may occurs after a lightning strike. A SPD with at least 12,5kA for the Impulse current withstand is sufficient to protect and to realize the equipotentialization.

*F. Lightning Protection System Design*

Below, the location of the 2 ESE IONIFLASH MACH NG60 UL, down conductors and earthing systems:




*7) Design of the ESE Lightning Protection System*

## VI. Installation of the 2 ESE air-terminal

The project is now in final phase of construction. The two ESE IONIFLASH MACH NG 60 UL have been recently installed on the building (July 2018).

A picture of the realized building is available below.


*8) Building with the Lightning Protection System*

## VII. Conclusion

In Conclusion this paper presents an UL listed installation with an Early Streamer Emission Air-Terminal System (ESEAT). The main entrance building of the Embry Riddle University is protected by two IONIFLASH MACH NG60 which enable to protect.

The installation of the Lightning Protection System (LPS) has just been finished in July 2018 and is totally in respect wit hthe NFC 17-102 standard.

The LPS is composed of two ESE, 3 specific down-conductors, 3 earthing systems interconnected to the main earthing bar. The reduction of hazard to people has also been taken in consideration by the implementation of warning poster and by reducing the possibility of presence of people in the earthing system areas.

## References

[1] IEC 62305-1 : 2010: General Principles

[2] IEC 62305-2 : 2010 : Part 2: Risk Assessments

[3] IEC 62305-3 : 2010 : Part 3: Physical damages to structures and life hazard

[4] NFPA 780 : Standard for the Installation of Lightning Protection Systems

[5] NF EN 17-102: 2011 Early Streamer Emission lighting protection systems

[6] IEC 62305-4 : 2010 : Part 4: Electrical and electronic systems within structures

[7] NF EN C 61643 -11 :2011 Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods

[8] NF EN C 61643 -12 : 2008 Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles

[9] Troubat M., Barriere F., Perrin E., Reduction and mastering of electromagnetic field due to lightning in a structure. International Conference on Lightning Protection (ICLP), Vienna, Austria, 2012