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COMPARAISON BETWEEN CONVENTIONNAL PROTECTION & ESE PROTECTION OF AN INDUSTRIAL BUILDING

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Summary :
For most of the specific sites the protection design can be realized with different methods. Therefore the owner and/or the design office shall be confronted to a choice which can be directed by various parameters (technical feasibility, ease of installation, maintenance, financial data, etc…). The solution might be different according to specific aspects of the sites and the owner's request.

The study will present a specific case for which two different solutions have been designed on the request of the owner. After a detailed presentation of the industrial site and its constraints, the results of the Risk analysis according to IEC 62305 – 2 will be explained.
Then a conventional protection and an alternative based on ESE technology will be presented with the same parameters. Advantages and disadvantages of each solution will be examined and the final choice retained by the customer will explained.
Various similar cases will be exposed, to explain that there is not only one solution to be applied in any situations.

Keywords: Conventional Protection, ESE, Price

1 - Project description

The project is based on the lightning protection of an existing industrial site belonging to a customer "A" in the field of aeronotics; The name of the customer shall be preserved due to "secret defense status".
The building dimensions are quite huge 400 m x 200 m x 15 m. Metal sheets are covering the metal framework of the structure.
Unfortunately the owner is unable to give any data regarding earthing arrangement of the building. Nothing has been kept in the maintenance files and nothing is visible.

The roof is protected by steel sheets and tarred waterproofness (asphalt).

2 - Constraints of the existing situation

In addition to the huge dimensions of the structure itself, the main constraints imposed by the customers was that the use of metal frameworks of the structure as air terminaisons was not accepted due to the risk of puncture by a lightning flash;

Furthermore the works shall conducted in such a manner that access and maintenance operations on the roof shall be preserved despite LPS installation during erection works and after;

In addition to that earthing excavations around the building were expected to be very difficult due to the nature of the ground and the accesses.

3 - Risk Management study

Risk Management Study has been made at the early 2011 by a qualified organism (DEKRA) in accordance with NF EN 62 305 – 2; The conclusion of this study was that lightning protection was required.

Furthermore a lightning protection level II was requested considering the various elements of the study.

Upon the end-user's request, 2 types of protections will have to be studied in the technical design:

- SOL 1 : Protection based on Meshed cage;
- SOL 2: Protection based on early streamer emission lightning protection system (ESESystem).

Technical design was then made by Franklin France;

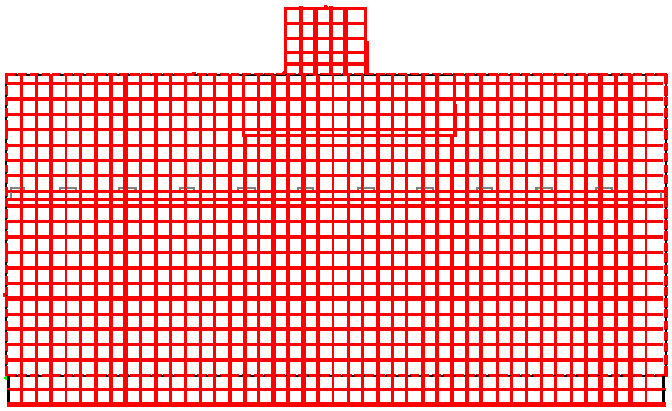
4 – Technical Solution 1: Meshed cage

As per NF EN 62 305 – 2 table 2, when a LPL II is required, then the size of the mesh shall be 10 m x 10 m.

Table 2 – Maximum values of rolling sphere radius, mesh size and protection angle corresponding to the class of LPS

	Protection method		
Class of LPS	Rolling sphere radius r m	Mesh size w_m m	Protection angle $\alpha°$
I	20	5 × 5	See Figure 1 below
II	30	10 × 10	
III	45	15 × 15	
IV	60	20 × 20	

The design has been optimized according to the specifics of the building with respect to 10m x 10 m mesh.



Tin copper tape 30 x 2 mn has been considered as roof and down conductor.

Earthing system was based on both a ring conductor (type B) and earth terminations type A.

A summary of the bill of quantities is as follow:

- Roof conductor: Copper tape 30 x 2 mn: ± 16 500m
- Down conductors: Copper tape 30 x 2 mn: ± 1800m
- Earth terminaisons systems: Type B (ring) : ± 1200 m
- Earth terminaisons systems Type A : 120

While the duration of the works was foreseen to be 7 to 8 months, the cost estimation of the project was 350 k€ shared as follow:

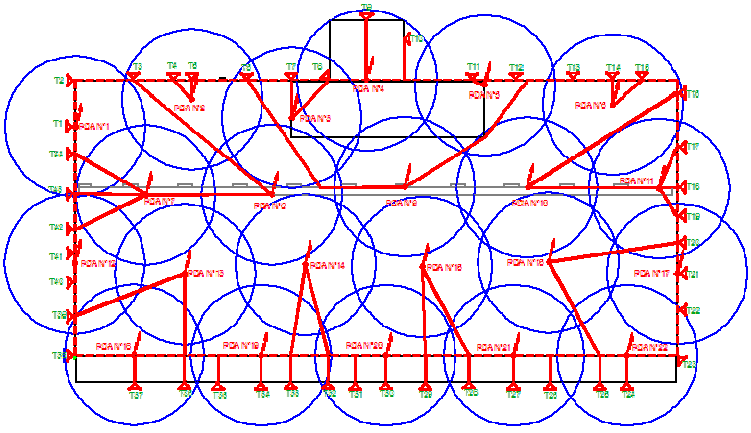
Material: 200 000 €
Manpower: 150 000 €
Duration of the works: 7 to 8 months

5 - Technical Solution 2: ESESystems

The protection was designed according to NF C 17-102, dated 01- 2009.

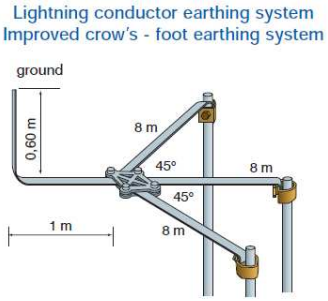
A reduction of 40% is applicable on ESE radius of protection (whatever the level of protection) in the case of structures where the h factor is equal to 20 (danger for environment) or to 50 (contamination of the environment).
h being the factor increasing the relative amount of the losses in presence of a particular danger (CS table in NF EN 62 305-2 standard)
As well for ICPE sites (sites including risk for environment), French regulation (circular of April 24th 2008 relative to decree of January 15th 2008 - Lightning protection of classified installations, amended by the decree of July 19th 2011 requires a reduction of 40% minimum of the ESE zone of protection in any cases.

We had thus to reduce the protection radii by 40% and, in order to protect the structure 22 early streamer emission air terminal (ESEAT) had to be implemented on the roof on 5 m masts.



They were Activ2D 60 µs models with a protection radius: 52 m (86 m x 40%).

According to NFC 17-102 issued 01 2009, each ESEAT shall be connected to at least two down conductors. Therefore 44 down conductors and earth terminations systems (improved crow's foot) have been implemented.



In order to make maintenance easiest and considering the access constraints two specific elements have added:

1. ESEAT will be remotely testable and remote testers will be provided
2. Lightning strike counters (as per IEC 62561 – 6 / NF C17-106) will be installed on each 44 down conductors.

Duration of the works was foreseen to be 2 months and project cost estimation was 150 k€ shared as follow:
Material: 100 000 €
Manpower: 50 000 €

6 – Preferred solution

Both options have been presented to the owner and discussed in detail.
Two points were in favour of Solution 1: current dissipation and separation distance optimization. Indeed the greeter quantity conductor and particularly of down conductors will be an asset for current spreading.

Four points were in favour of Solution 2: Less earthing excavations, less material on the roof meet the site constraints. And of course Project cost and duration of the works were key factors for the decision of the owner.
The ESEAT solution was more in adequacy with the owner's request and therefore was given the preference.

7 - Technical Solution 3: ESESystems with new standard

If we look at the technical study according to NF C 17-102, issued in September 2011, we could improve the project cost significantly.

22 early streamer emission air terminal (ESEAT) Activ2D 60 µs including remote testers are still needed to protect the structure.

Each ESEAT shall be connected to at least two down conductors and at least one of them must be a specific down conductor complying with EN 50164-2, since natural components may be modified or removed without taking into account the fact that they belong to a lightning protection system.
However considering the possibility offered in the standard NF C 17-102 09/2011 paragraph 5.3.2 to mutualize the down conductors.
To use less than 44 down conductors is only possible if the calculated separation distance for the whole system is allowing that number.
Therefore we could have 22 down conductors and earth terminations systems and of course 22 lightning counters (as per IEC 62561 – 6 / NF C17-106). Some additional bonding and earthing has to be foreseen to compensate the increase of the separation distance.

The project Cost estimation is then ± 125 k€ shared as follow:
Material: 90 000 €
Manpower: 35 000 €

The duration of the works is reduce to 1,5 months

This third solution is as safe as the solution 2, since this mutualization of the down conductors was already foreseen in NF EN 62305 for single rod.

8 - Other cases
This doesn't imply that ESESystem is always the best solution. It depends on the site constraints and the owner's request.
For example the following cases might lead to another preferred solution:

- Data Centers: Meshed case could be preferable due to current dissipation (EMC);
- Pyrotechnics storage: Stranded wire is often installed to protect a small building (6 x 2m) in order to increase the distance between explosive material and lightning protection system;
- Fuel storage tank with 4 mm steel thickness : The structure itself can be used as air termination system and down conductor;
- Telecommunication Tower: A single rod as been preferred to protect antennas and the metallic structure has been as down conductor.

9 - Conclusion
The choice of the protection shall not be philosophical one! It shall guided by technical and economical reasons between standardized and well known technologies.

References

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