

# The « Grand Palais des Beaux-arts » of PARIS

Protection against lightning of a historical monument.

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**Abstract** — The « Grand Palais des Beaux-arts », a historical monument, changes one's image.

In the context of brought into the compliance with standards, of this monument, DUVAL MESSIEN won the contract and intervened to update the directed and undirected lightning protection, in order to consider the human loss and the cultural heritage risk. DUVAL MESSIEN worked again on this monument in 2015 to update all the lightning protection, in order to consider the human loss and the cultural heritage risk.

**Keywords** — Monument; lightning protection; ESE Early Streamer Emission.

## I. INTRODUCTION

« Le Grand Palais des Beaux Arts » has been built in praise of the French art, at the beginning of the last century for the Universal exposition of 1900. This building has been classified Historical Monument in the year 2000. Today, it is dedicated for receiving the biggest official artistic events of the capital and by consequence a large number of important visitors.

This construction was secured against the direct lightning effects in 2006, at the time of the renovation of the facades, and since, only some repairs had been realized.



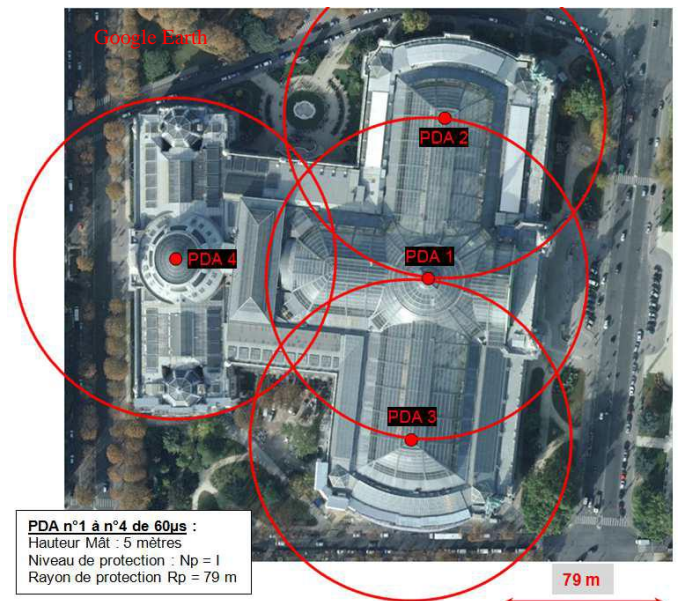
Through this paper, I will present you the different steps of this compliance upgrade and the found solutions in order to comply at best to the technical and architectural obligations, considering the government buildings proximity.

## II. LIGHTNING RISK ANALYSIS AND ENGINEERING STUDY

The Lightning Risk Analysis and engineering study has been realized by an independent engineering office.

According to the probabilistic method, the "Grand Palais" requires a protection level PL = IV against the direct and indirect effects of lightning.

However, for security reasons, a protection level PL = I was imposed, because of the importance of this building, classified "historical monument".



Between the levels I and IV, the number of Early Streamer Emission doesn't increase. Only the protection radius is changed. The protection radius of ESE, depends on its height

(h m) relative to the surface to be protected, its advance device ( $\Delta t$ ) and of the protection level required. It is calculated from the abacus of the NFC 17-102 standard.

In addition, to reduce costs during periodic checks, existing ESE have been replaced by a new generation models with remote test.

The Engineering Office calculated the separation distance  $S = 1.15m$ . To standardize the results to all descents on facade of the building, the separation chosen by the EO is equal to 1 meter. The standardized conductors, placed on the metal roof and the metal structure of the glass canopy, have a distance of zero separation.

The Lightning Risk Analysis also provides the facility of surge protection devices, type I, into the nine TGBT of the site, according to standard NFC 15-100 and the protection of any important security equipment, with type 2 SPD, to the head of the installation into the electrical box which feeds it, or closer to the equipment if the length between the electrical box and the equipment is more than 30 m.

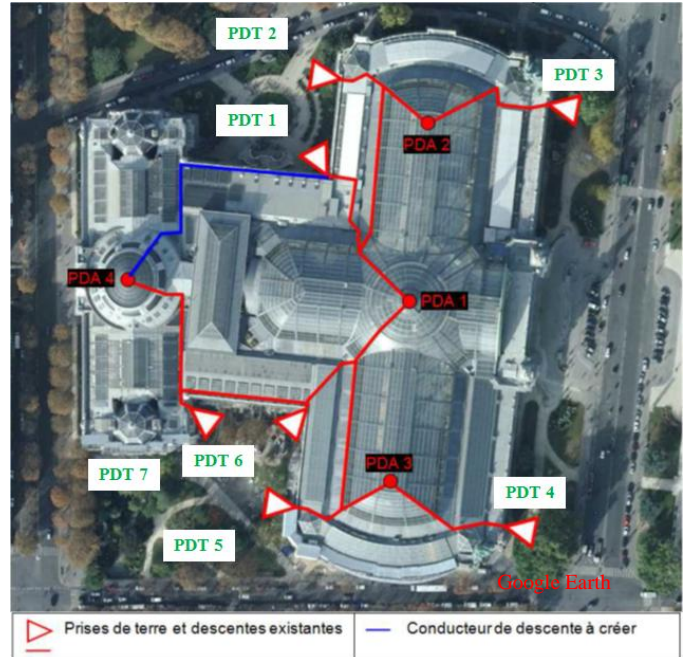
Following this Lightning Risk Analysis and the engineering study, DUVAL MESSIEN was intervened to bring it into line, the direct and indirect lightning protection of the building. The work was carried out between 07/20/2015 and 10/16/2015 by our installation teams.

### III. EXECUTION OF THE WORKS

We have replaced, 3 ESE in stainless steel material (advance time :  $\Delta T = 60$  microseconds) remoted, "Satelit 3-60™", brand "Duval-Messien", mounted on stainless steel masts and installed to extend at least 2 meters more than the highest point of the building.



From the Early Streamer Emission (PDA 4), to the nearest down conductor (connected to the grounding earthing system nbr.1), we have installed a new external down conductor on the roof of the building, in copper material, 30x2 mm.



Because this location receive lot of visitor, in conformity to the standard NF EN 62305-3, we have installed specific conductors, of type « Conductors CUI® » (the insulation is to 100kV under 1.2/50  $\mu s$  wave form and with 3 mm tickiness of crosslinked polyethylene), at the bottom of each down conductor (existing and new), avoiding risks against voltage contacts on the down conductors and also to protect the bottom, against mechanical choc risks .

Finally, we wave installed some Surge Protection Device adapted to the earthing systems, associated with protective devices (fuses), including any subjection of installation and connections, in all the low voltage distribution board, the Fire Safety Systems, elevator and computer bay.

### IV. THE CONSTRAINTS

We met some organizational difficulties because the entry and movement into the exhibition building, during opening hours to the public, were dependent upon of the possession of a valid entry permit areas:

- Pass issued by an authority
- Permanent or temporary badge issued by the "Grand Palais" or an authority. This access title should be presented at any time.

Furthermore the roof access was strictly regulated because of the close proximity of the Elysée Palace (500m), every day our installation teams had to be register to the Paris authorities for permission to ride roof. They were monitored continuously.

This monument is largely made of glass, it was necessary to take extreme caution to go up to the roof to avoid damaging it.



Finally, to achieve the installation of surge protection devices on the low voltage distribution board, it was necessary to plan night interventions to avoid disturbing the activity of the "Grand Palais" in the day.

The ESE number 1 being placed on top of the mast flagship was inaccessible with conventional nacelle, we had to ask to our rope access technicians to do the removal of the old ESE and installing the new one.

## V. CONCLUSION

Despite all technical and management difficulties during this compliance, a good organization with suitable and competent staff allowed us to succeed in this project.

We thank the National Museums and the "Grand Palais des Champs Elysées" for their collaboration, the engineering office BCM, that conducted the Lightning Risk Analysis and the engineering study and also Romain COHU and Jean-Rémy GAILLARD from DUVAL MESSIEN company, who have passed on all necessary information for the realization of this document.



In agreement with the management of the building and technical resources, because of the lack secure access to replace the ESE (fragile glass), the work could not be realized with the rope. Due to the configuration of the place, the implementation of a nacelle on truck was not a solution (even with a machine with a large working height). This work will be done out during the repair of the glass canopy to be held current 2016.