Météorage

Memo for lightning protection professionals

Distribution: Qualifoudre and F2C

Pau, 05/09/2017

Subject: Lightning strike-point density value (N_{SG}) to be used in the lightning risk analysis (LRA)

METEORAGE has been providing statistics based on ground strike points in France, as well as in whole area covered by the network, extending to a large part of Western Europe, since 01/01/2017.

The value obtained (N_{SG}) is calculated directly according to the data from our lightning detection network, with using the formula indicated in the standard that applies a factor of 2 to the N_G.

The choice isn't antinomical to standard NF EN 62858, since it isn't necessary to use a coefficient mentioned in this standard if the ground strike points can be determined directly. This fact is also mentioned in the study[1] used as a reference to justify recourse to this coefficient. The IEC also confirmed this possibility, which will be published in the next edition of 62305-2. These elements were discussed and accepted by the French standardisation committee (TC 81) in December 2016.

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1 Bouquegneau, C., A. Kern, and.A. Rousseau (2012), "Flash Density applied to Lightning Protection Standards", Ground'2012 & 5th LPE, Bonito, Brazil

Annex: details relating to the provision of 'N_{SG}' by METEORAGE

Context:

To address divergent practices worldwide in the way that lightning density is determined, the International Electrotechnical Commission (IEC) deemed it necessary to establish a common standard in order to harmonise said practices.

IEC/NF EN 62858:2016 aims to establish common rules and identify reliable methods for the establishment of lightning statistics that serve as the basis for lightning risk analysis (LRA).

Application of the standard for the provision of the 'Nsg' by METEORAGE:

I) Regarding the lightning detection network's performance:

According to the standard, detection efficiency must be better than 80 % for 'flashes', with an accuracy of 500 metres in the median value and a classification higher than 85 % between cloud-to-ground and intracloud lightning.

The METEORAGE network, as well as EUCLID, the European network which METEORAGE is part of, is the subject of numerous studies concerning the analysis of the network's performance.

Efficiency is currently higher than 96 % for the detection of flashes, with an accuracy of 100 metres in the median value, and a wrong classification rate lower than 10 %.

Numerous articles have been published, for example: [1]

II) Regarding the choice of entity: the 'strike point':

The notion of 'flash' was considered obsolete because it underestimates reality. Taking into account the ground strike points is much closer to the physical reality of the phenomenon because the same flash can have several ground strike points and it is therefore this entity that must be taken into account.

[1] E.g.: Schulz et al. (2015), The European lightning location system Euclid – Part 1. Performance validation, journal of the European Geosciences Union, NHESS.

Given the difficulties faced by certain countries, whose networks still aren't as efficient as in Europe, in particular, the standard suggests using coefficient 2 (based, in particular, on certain international studies[2]).

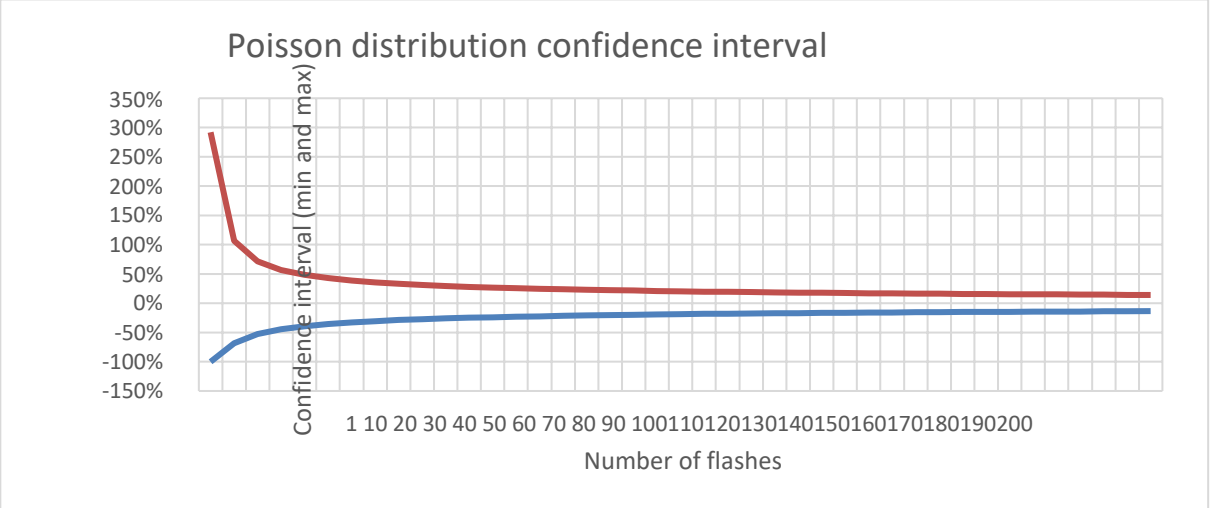
METEORAGE has conducted several studies[3] showing that this simplified formula, which is of course approximate, doesn't have to be used, and is able to provide the strike points directl, without going through this stage.

It should also be noted the IEC specifies, in its current research on Version 3 of 62305- 2, that the strike points can be directly supplied by the lightning detection network operator.

III) Regarding the application of 'Poisson distribution' relating to rare events:

The standard indicates that to reduce uncertainty to less than 20 % with a level of confidence of 90 %, the population of impacts can't be less than 80 elements in the reference area.

METEORAGE has chosen to use a level of confidence of 95 %, which is higher than the 90 % required by the standard. The graph below shows the evolution of the minimum and maximum values of the coefficients that must be applied to the result to obtain framework values. For instance, for a number of flashes equal to 20, the result on the density is between +49 % and -39 %, i.e. an average interval of approximately 45 %.



2 E.g.:

- V.Rakov (2007): "Lightning phenomenology and parameters important for lightning protection" - SIPDA, Brazil
- Bouquegneau, C., A. Kern, and.A. Rousseau (2012), "Flash Density applied to Lightning Protection Standards", Ground'2012 & 5th LPE, Bonito, Brazil.

3 E.g.: S.Pedeboy, W. Schulz (2014): "Validation of a ground strike point identification algorithm based on ground truth data" - ILDC USA.

The formulas that allow us to calculate the limits of the interval are as follows, with N equal to the number of flashes and C_m equal to the margin coefficient according to the table below:

$$N_{max} = \left(\frac{2}{} + \sqrt{}\right)^2$$
$$N_{min} = \left(\frac{}{2} - \sqrt{}\right)^2$$

Confidence rate	Marg. coef.
80%	1.28
85%	1.44
90%	1.645
95%	1.96
96%	2.05
98%	2.33
99%	2.575

IV) <u>On the other provisions:</u>

- The minimum period is 10 years. This provision, which was already used, has been maintained.
- Reference area:

METEORAGE has chosen to base its calculations on the official administrative division of the communes, and not to supply a value stemming from a grid that would make it difficult to obtain a single value for a commune that overlaps with several grids.

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