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The Risk Multilingual 3 Software: Applying the New Trends in Lightning Risk Assessment

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Abstract: This paper introduces the new trends in lightning protection standardization with some comments on the use of an improved software (RISK Multilingual 3) in order to nicely apply the IEC 62305-2 standard on the Risk assessment in Lightning protection (Protection against lightning - part 2: Risk management) in its coming new version (ed. 2, 2011).

Keywords: Lightning protection standard, risk assessment, risk calculation software.

1. EXISTING LIGHTNING PROTECTION STANDARDS

The first edition of the IEC 62305 Lightning Protection international standard was published in January 2006. This standard contains four parts (see reference 1): 1 general principles; 2: risk management; 3: physical damage to structures and life hazard; 4: electrical and electronic systems within structures.

This edition was broadly accepted around the world. It states that a global approach is needed to address the phenomenon in a correct and comprehensive way. All parameters are interconnected through the four parts, especially to enter part 4 related to protection against electromagnetic pulses (LEMP): surge protective devices, shielding, cable routing… Moreover, IEC 61643 standards (from IEC SC37A) are in complete conformity with IEC 62305 (from IEC TC 81).

Part 2 of the IEC 62305 standard (Risk Management, IEC 62305-2, 1st edition 2006-01) is treating the risk management of the lightning protection. Hazards can lead to damage to the structure and to its contents, failure of associated electrical and electronic systems and injury to living beings in or near the structure. Consequential effects of the damages and failures may be extended to the surroundings of the structure or involve the environment. The risk, defined in this standard, is the probable mean annual loss in a structure due to lightning flashes. The lightning risk depends on a lot of parameters (about 70, referring to IEC 62305-2). All four sources of damages (direct strike to the structure, strike to ground near the structure, direct strike to the incoming lines, strike to ground near the incoming lines) need to be addressed and they are clearly shown in the same formulas to calculate the risk.

The lightning risk to different objects and living beings, as well as the possibility of reducing this risk, had been studied by several authors (see for example references 2 and 3). These authors show that the risk assessment method has some limitations; for example economic risk is difficult to apply in practice due to the lack of data to perform the analysis. On the contrary, this risk analysis can be used in other applications; for example to estimate the risk for workers in the construction stage of large structures in several countries The IEC 62305-2 standard resulted from this scientific work.

Several other standards are based on the same risk assessment approach: new risk assessment for electrical installations in buildings (IEC 60364), stress definition coming from direct strikes in low-voltage surge protective devices (IEC 61643-11), lightning protection of wind turbines (IEC 61400-24, a technical report), risk methodology for photo-voltaïcs (PV, see EN 61727)…

In the informative annex J of the standard, a simplified software for risk assessment for structures was first proposed (SIRAC, IEC Risk Assessment Calculator, v.1.0.0) but it failed due to too many limitations: it is a simple tool, only applicable to single-zone structures and does not give results precise enough and will not show up again in the second edition

2. EXISTING SOFTWARES

Then there was a need to use a complete software taking into account all these parameters. This software had to allow the user to introduce any value of each parameter, for example, the soil resistivity or the length of the line entering the structure.

Several softwares already exist in different countries, namely in Germany, France and Italy. However, ours seems much easier to use.

We already presented (see reference 4) a software called "RISK Multilingual", at the IX International Symposium on Lightning Protection (26-30 November 2007, Foz de Iguaçu, Brazil): it is not only the most complete and comprehensive we know at a university level (independent of commercial interests), but it is also available in any language. First designed in English, French and Dutch, it can be translated in another language by simply modifying a specific file containing a given word list. It also includes various maps of ground flash densities in different countries; any one can easily be integrated according to specific national needs.

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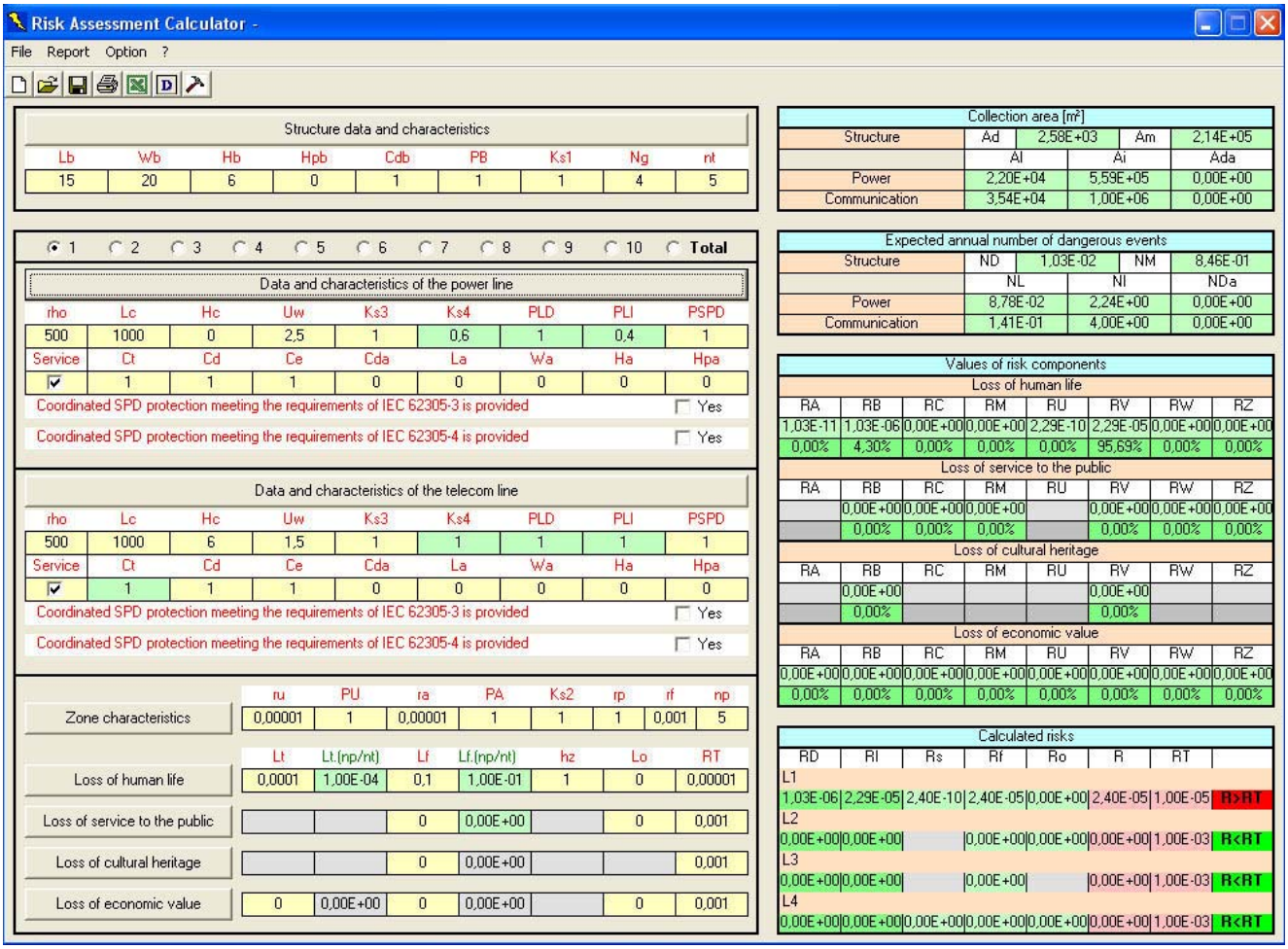

Fig. (1). Typical spreadsheet related to the risk multilingual 1 software (edition 1).

Our software interface was designed to show, on a single screen, values of all parameters, all risk components and their relative importance, so that users can immediately evaluate the type and level of protection to be applied in order to guarantee a total risk smaller than the tolerable risk imposed. Speech bubbles are provided to define each parameter introduced. Windows can also be opened to change any value of these parameters, either in the window or on the full screen. The RISK Multilingual software can relate up to ten zones per structure. At any time, the user can visualize the whole results by shifting from one zone to another on the same screen. These results are transferred to an Excel spreadsheet used as a basis to add risk components, compare the sum to the tolerable risk and even write a final report on the lightning risk analysis of the given structure (as an example, see the spreadsheet in Fig. **1**).

In the China International Forum on Lightning Protection and Disaster Mitigation (CLPDM 2009, 8-10 September 2009, Chongqing), we introduced an improved issue of this software (see reference 5), called "RISK Multilingual 2", taking into account not only all the relevant comments on the "RISK Multilingual (1)" software we received in the mean time from all over the world, but also adding hints to choose the most reasonable lightning protection measures among those appearing from the crude calculations of risk components in the initial issue (see Fig. **2**).

3. NEW TRENDS IN THE LIGHTNING PROTECTION INTERNATIONAL STANDARD

The international IEC 62305-2 standard was under revision for four years so far and a second edition will be published in less than one year. The complete text of the first edition was improved for clarity sake and the some equations were largely simplified. Parts related directly to services have been removed. A new minimum value of the withstand voltage has been chosen: 1 kV instead of 1.5 kV. Collection areas have been refined and simplified (drawings with a width of 40 m and a width of 4000 m).

Another important change concerns the explosive areas (annex D of the IEC 62305-3 standard will now be *normative* instead of informative): explosive zones 1, 2 and 21, 22 will be used in the risk calculation, experiencing higher risks than before.

There is a newcomer: *isolated interfaces* which are capable to reduce conducted surges on lines entering the LPZ (lightning protection zones); these include isolation transformers with earthed screen between windings, metal-free fibre optic cables and opto-isolators.

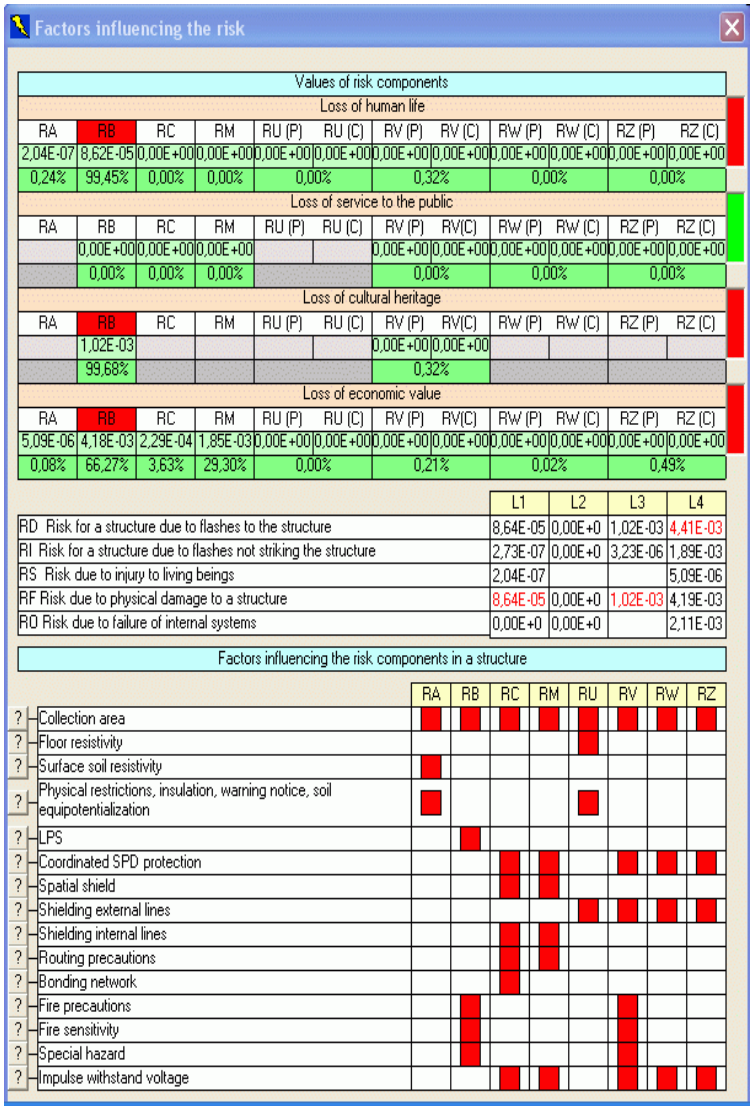

Fig. (2). Part of a typical spreadsheet related to the risk multilingual 2 software. Helping the user to select the best measures of protection against lightning.

In part 4 (Electrical and electronic systems within structures), a new generic term appears: ESP stands for electrical and electronic system protection (internal protection), similarly to LPS for external protection.

As for Part 2 (Risk management), the environmental impact and the *risk* on the structure itself have been split into two different risk terms, namely because the multiplication factor taking the environmental conditions into consideration had to be replaced (indeed, when the structure risk was very low, i.e. when a limited number of people were present inside the structure, the calculated resulting risk was much too low); a new calculation of the corresponding losses is obtained by adding the loss concerned to the loss due to physical damages outside the structure. The splitting in *environmental impact* and *facility risk* results in a new and more realistic approach, i.e. the replacement of a multiplication factor by an addition of two losses:

$$L_{XT} = L_X + L_E \quad (1)$$

with

$$L_E = L_{tE}.\ t_e/8760 \quad (2)$$

where

L_{tE} is the loss due to physical damage outside the structure,

t_e is the time of presence of people in dangerous places outside the structure (Note: when this time is unknown, L_E is chosen equal to 1).

Another improvement stands in the new loss calculations taking into account the ratio of the number of people effectively staying for a given time duration (in hours) in a particular zone with respect to the total number of people present inside the structure. Loss calculations deeply change with the ratio of the number n_z of people staying in a particular zone divided by the total number n_t of people in the structure:

$$L_C = L_M = L_W = L_Z = L_o.\ (n_z/n_t).\ (t_z/8760). \quad (3)$$

Finally, the minimum value of the tolerable risk for cultural heritage, is now 10^{-4} instead of 10^{-3}.

These are only some major changes in the second edition of the IEC 62305-2. The new "Risk Multilingual 3" software

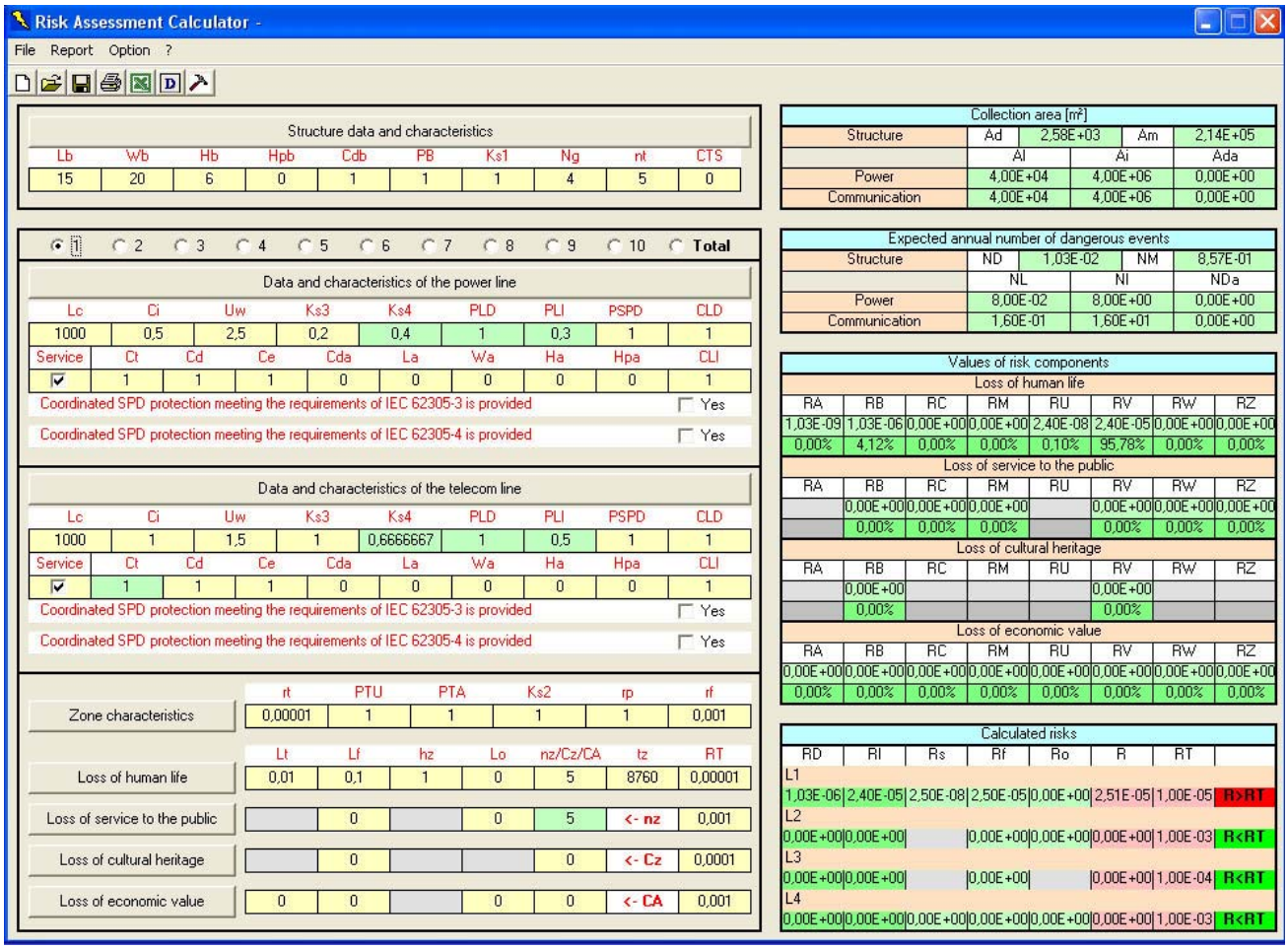

Fig. (3). Typical spreadsheet related to the new risk multilingual3 software.

takes all these changes (major or minor) into account (see Fig. **3**).

CONCLUSION

Though the second edition of the IEC 62305 international standard on Lightning Protection is not published yet, we designed a complete software to strictly apply the IEC 62305-2 (Risk management) in its new coming version. This software has already been successfully tested to several structures of different types in our country.

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CONFLICT OF INTEREST

Declared none.

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