

Advances in Science, Technology and Engineering Systems Journal Vol. 6, No. 1, 1384-1402 (2021)

www.astesj.com

ASTESJ ISSN: 2415-6698

Special Issue on Multidisciplinary Sciences and Engineering

# BrcLightning - Risk Analysis and Scaling for Protection against Atmospheric Discharge - Extender

Biagione Rangel De Araújo\*

BRC – Biagione Rangel Consulting, Natal, 59064-490, Brazil

ARTICLE INFO	ABSTRACT
Article history: Received: 21 December, 2020 Accepted: 09 February, 2021 Online: 28 February, 2021	This manuscript intending to publicize the improvements incorporated in the BrcLightning application, including the Risk Analysis module with the help of a pop-up, which provides the result and assists in the identification of mitigating measures by the professional, which must be defined to reduce the calculated risks. Other points addressed in this extension are
Keywords: Risk Analysis Lps Sizing BrcLightning	the improvements added to the database to meet the corporate demands of companies, referring to the Risk Analysis module. It also incorporates flexibilities to perform the sizing separately, in the design, evaluation and scaling modules of the LPS – Lightning Protection System that using rolling sphere method and Angle Method, incorporating, in some of the modules, the issue of opinions or alerts. These modules use the mathematical approach methodology. In addition to these improvements, this review included the reporting module of facilities in the filter system, which allows the use of the database more selectively for the emission of these documents. This filter has a structure for issuing corporate demands of reports. The results can be obtained quickly and easily, on-screen or printing several reports. The reliability and safety of the results can be assessed through the check with the examples of the standards that define the criteria and methodology, that must be followed to carry out for cases of Risk Analysis or through graphic drawings on AutoCad platform or similar for the sizing modules. Other improvements in this extension are the addition of topics for new modules for which we already have the equations modeled in Excel, although we have not yet coded in the programming language.

## 1. Introduction

This article is an extension of the work originally presented at the Symposium SIPDA XV [1]. In the event, representatives of a large company attended our explanation and reported that the great difficulty they faced was to have the control and traceability of the various Risk Analyses that are performed for each building or structures of the various units of the company. So, considering that our system is structured in the form of a database, we evaluated that, by introducing structural changes in this database, it will be possible to meet this demand.

Concomitantly with this observation, we also identified that other improvements would be required, even to use the various modules of the system in isolation (before having to register a project), either in the database or through an app which may be via mobile phones. These improvements aim to meet specific demands, such as those to evaluate the effectiveness of the volume of protection of a given SPDA concerning the various structures or equipment and facilities that, in principle, are or would be under protection against direct impacts of atmospheric discharges. In this case, the data is not embedded in the database but can be consolidated into a report, with options to be printed or archived.

Regarding the Reporting Module, this extension was less extensive, as it was composed by the improvements of the filters defined to facilitate the selective issuance of Database Reports, with limited coverage of the specificity of each module that make up the current system. However, because it is a database, we intended (in a new version) to provide tools in this module, to enable the data export specifically to the Excel environment, to allow better tools for analyzing historical data.

## 2. Definitions

• <u>Coverage radius (rc)</u>: The distance between the point of the cover margin, of a determined envelopment of an LPS. This distance determines the size of the horizontal projection of the fictitious plane, given by equation (1):

$$rc = [h_1(2R - h_1)]^{1/2} - [h_2(2R - h_2)]^{1/2}$$
(1)  
1384

<sup>\*</sup>Corresponding Author: BRC – Biagione Rangel Consulting, contato.brc@biagione.com.br, +55-84-98723-8753

where:

- rc horizontal protected distance
- h1 height of the higher mast
- R rolling sphere radius
- h2 height of the lower mast:
- <u>Cover margin height (hc)</u>: The dimensions of the height of the nearest point on the envelope over the structure under the protection of the LPS;
- <u>Distance from the critical point (d1)</u>: The distance between the critical point and one metallic element such as rods or wire air-terminations
- <u>Envelopment:</u> Geometric shape that limits the protected volume according to the rolling sphere method;
- <u>Coverage margin (cm)</u>: The shortest distance between a point of the structure under the protection of the LPS and the envelopment of the protective volume. The dimension of the margin corresponds to the perpendicular tangent measurement of the envelopment to the nearest point of the structure under protection. The graphical representations of "cm" are as shown in Figure 1a, Figure 1b, and Figure 1c (all contained in Figure 1):



Figure 1: Examples of coverage margins

- <u>*Fictitious plane (Fp):*</u> Assumed horizontal plane that provides coverage of protection at a given height;
- <u>Hazardous areas</u>: Area surrounding storage facilities or transfer station of flammable liquids or gases, due to the possibility of containing flammable or explosive mixtures. They are defined in: Zone 0 (when the explosive/inflammable mixture is still there or will be for long periods); Zone 1 (likely to occur in normal operating conditions) and Zone 2 (it's unlikely – an abnormal condition of operation);
- <u>Sizing module marks</u>: The marks indicated in the graphs of the sizing and limit variation modules correspond to the extreme points of the structure that should be protected or evaluated on the effectiveness of the coverage by the SPDA protection wrap, as shown in figures 2 and 3 below:



Figure 2: Hazardous areas limiting point figure (see Figure 1b)



Figure 3: Structure limiting point figure (see Figure 1a)

## 3. Software Development

The application is developed in Access, in VBA language, to allow it to run on Windows and on the Internet. We had a project to carry out the migration to an Internet language; however, due to the Covid 19 pandemic, we had to cancel it. Nevertheless, we hope that, considering the problems due to the current situation, we can resume the project in the year 2021.

In this version, the system continues with the same configuration of modules and sections of the previous publication, from which this paper is an extension of (SIPDA XV [1]). Thus, we will focus on detailing the improvements that have been introduced, as described in sequence (items 4 to 7).

## 4. Risk Analysis Module

Risk Analysis consists of 5 sections: 1. Registration Module; 2. Zone Registration Module; 3. The configuration data of the connected lines and Zone.; 4. Risk Analysis Factors Module (typical loss value) and 5. Results Module.

## 4.1. Registration Section

In this section, there are specific data related to design registration that can be common to all modules and all sections, but also, there are important data specific to the Risk Analysis Module. Due to this, we have identified that it will be more effective for these data input to be dismembered in two modules: one for general project registration and another for registration and configuration of the Risk Analysis Module. However, this should only be performed in a new version.

The improvements that we introduced in this section included the fields of input to meet the demand to perform the registration of organizational structures, containing up to 5 levels: Level 1 -Hold Company; Level 2 – The Business Unit, which may or may not cover several other Operating Units; Level 3 - The Operational Unit; Level 4 - The Operational Sector and Level 5 - The installation subject to risk analysis or the one containing Air Terminal. This improvement is only incorporated into the Registration Form of this Section. Therefore, in this version, it has not yet been possible to integrate this organizational structure registration with the other modules, including the Risk Analysis Module itself, regarding the reports. This requires numerous changes in the reports already formatted. The reported modifications are highlighted in green as shown in Figure: 4.

							CON
tro/Record Zonas -	Dados/Zones - Data Dados Téc./1	Fechnical data Fatores da AR/R	A Factors Resultad	los/Results   Metódo ER/RS Me	thod Mét. do Ângulo/A	Angle Method Relat	tórios/Reports
		· · ·					
○ NBR 5419-2	• IEC 62305-2	○ NFPA 780		(AR) Risk A	analysis: O (CL)	) Calculation (	(AC) Risk Analysis/Calculati
Cadastral Data							
Design name:	Risk analysis of the administration l	building Technic	al Expert: Fulano	dos Anzois Pereira	✓ Date: 11.	/02/2021 Risk analy	sis No.: BRAAC2021FDA00001
Country:	Brazil	✓ City:	NATA	L	└iş	ghtning density (Ng):	12,0000000
treet/Avenue:	Central Ave	4	Address complement:	RN	Number:	10 Zip cod	de: 59000-000
Organizational Levels:	5 1 - Hold Company Name:	Cia Hold 1		✓ 2 - Business Unit:	BU 1 -Cia 1		
- Production asset:	Asset 1 - Cia 1 - BU1			4 - Operational Unit:	Uop1 Asset 1 - Cia 1 -	BU1	
- Structure/Building:	Administration building		Manager: Ara	aujo, John P.	Etmoture sumounds	el-management:  Mar	ntenance Manager
dructure type.	Office Building		✓ Su Fat	or de localização da estrutura (CT	Structure surrounde	ed by objects of the sa	me neight or smaller
			rat	or de localização da estrutura (CL	g). princiale surrounde	ed by higher objects	
otection Measures	or Risk Mitigation			Physical Characteristics	of the Structure, Adja	acent Structure and	d Economic Values
Tharacteristics	Structure protected by LPS Class IV	7		Is there Additional Area	? C	ollection area (AD)	): Collection area (AD
of structure (PB):				Yes Not	(r	n²): 4.085	(m²): 1.202
tructure protected by	LPS Class IV				Length (m): L	20	Lj 10
					Width (m):	30	Wj 15
her Characteristics	s of Structure				Height (m): H	7	Hi 4
		· · · · · · · · · · · · · · · · · · ·		The second se	Treight (III).		
iones in Study:	Z3 - Three Zones 💟 Expec	ted total number of persons (nt):	150	Economic values 5	A	D-Cálcular/Calculate	ADj-Cálc./Calculate
	Time	in nours (year) mai persons (ie).	8760	(10*).			
	-		1	1		1	1
	8	Nova AR/New RA	Sal	var / Save	Atualizar/Update	Customiza	r/Customize
		Rua Ministro Mirabeau da	0 1 10 10 1005				
		www.biagion	a cunna Meio, 1925   Ap ie.com.br   contato.brc@t	401   Candelária   Natal-RN   Brasil   C biagione.com.br   cel.: +55-84-98723-83	ep.: 59064-490 753		
		www.biagion	e.com.br   contato.brc@t	401   Candelária   Natal-RN   Brasil   C piagione.com.br   cel.: +55-84-98723-83	ep.: 59064-490 753		
		www.biagion	gure 4: Main	401   Candelária   Natal-RN   Brasil   C piagione.com.br   cel.: +55-84-98723-8; screen of data input	ep :: 59064-490 53		
rcI ightning	<b>Biel:</b> Analysis and S	www.biagion Fig	gure 4: Main	401   Candelária   Natal-RN   Brasil   C Jagione.com.br   cel: +55-84-98723-8; screen of data input	2p.: 59064-490 753		
rcLightning	- Risk Analysis and S	www.biagion	gure 4: Main	401   Candelána   Nata-FNN   Brasil   C jaggione.com.br   cel. + 55-84-98723-81 screen of data input	ep.: 59064-490	Idioma/Langu	1age <b>3</b> 7
rcLightning	- Risk Analysis and S	www.biagon Fig	a cuma Meio, 1925   Ap gure 4: Main n against At	401   Candelána   Mata-FN   Brazil   G jagjone.combr   cel.: +55-84-98723-81 screen of data input	ep.: 59064-490 F33	Idioma/Langu	iage English
rcLightning	- Risk Analysis and S	www.biagon Fig	gure 4: Main	401   Candelána   Mata-FN   Brazil   G jagjone.combr   cel.: +55-84-98723-81 screen of data input	ep.: 59064-490 753	Idioma/Langu	iage © English BIRGONE C
rcLightning	- Risk Analysis and S Dados/Zones - Data   Dados Téc./1	www.biagon	gure 4: Main	401   Candelána   Nata-FN   Brazil   C isagione.combr   cel: +55-84-98723-81 screen of data input	ep.: 59064-490 F3 ge	Idioma/Langu	iage © English English Store of the second
ro/Record Zonas - ]	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7	www.biagon	gure 4: Main n against At	401   Candelána   Natal-HN   Brasil   C júagione.com br   cel: +55-64-98723-87 screen of data input smospheric Dischar istomization - Structure	ер.: 59064-490 53 ge Туре	Idioma/Langu	iage English  English  tórios/Reports  Analyzia/Calculation
ro/Record Zonas - ] • NBR 5419-2	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7 O IEC 62305-2	www.biagon Fig Scaling for Protectio Technical Expert:	gure 4: Main n against At	401   Candelána   Natal-HN   Brasil   G júgione.com br   cel: +55-64-98723-8; screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo	ge Type s Pereira	Idioma/Langu	age • English tórios/Reports • (AC) Risk Analysis/Calculat
ro/Record Zonas - 1 NBR 5419-2 Cadastral Data	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7 O IEC 62305-2	www.biagon Fig caling for Protectio Technical Expert: Customization Languag	gure 4: Main n against At System Cu ge: English	401   Candelána   Natl-HN1   Brasil   6 jaggione.com br   cell. +55-64-98723-81 screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo	ge Type is Pereira pe: [Structure Type	Idioma/Langu	age • English tórios/Reports • (AC) Risk Analysis/Calculat
ro/Record Zonas - ) NBR 5419-2 Cadastral Data lesign name:	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7 O IEC 62305-2	www.biagoon Fig ccaling for Protectio Technical Expert: Customization Languag	gure 4: Main n against At System Cu e: English	401   Candelána   Nata-FNN   Brasil   6 jiagione.com br   cel: +55-64-98723-8: screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo	ge Type is Pereira pe: Structure Type	Idioma/Langu	tórios/Reports (AC) Risk Analysis/Calculat ysis No.: BRAAC2021FDA00001
ro/Record Zonas - 1 NBR 5419-2 adastral Data lesign name: ountry:	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2 Brazil	www.biagoon Fig caling for Protectio Technical Expert: Customization Languag Structure regist	gure 4: Main n against At System Cu ge: English	401   Candelána   Nata-FNN   Brasil   C jiagione.com br   cel: +55-64-98723-87 screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo Customization Ty	ge Type is Pereira pe: Structure Type	Idioma/Langu	tórios/Reports  (AC) Risk Analysis/Calculat ysis No.: BRAAC2021FDA00001
ro/Record Zonas - 1 NBR 5419-2 adastral Data tesign name: ountry: treet/avenue:	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2	Technical Expert: Customization Languag Structure regist Structure type: Pass	gure 4: Main n against At System Cu ge: English tration: senger terminal	401   Candelána   Natl-FNN   Brasil   C jagone.com br   cel: +55-84-98723-81 screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo Customization Ty	ep: 59064-490 53 ge Type is Pereira pe: Structure Type	Idioma/Langu	iage     English       English     English       itórios/Reports     (AC) Risk Analysis/Calculat       ysis No.:     BRAAC2021FDA00001       inde.     Index
ro/Record Zonas - 1 NBR 5419-2 Cadastral Data Design name: ountry: treet/Avenue: brganizational Levels: Dephytica ecori	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2 Brazil I - Hold Company Name:	Technical Expert: Customization Languag Structure regist Structure type: Pase Zone/Structure	gure 4: Main n against At System Cu e: English tration: senger terminal Association:	401   Candelána   Natl-FNN   Brasil   C jagone.com br   cel: +55-84-98723-81 screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo	ge Type is Pereira pe: Structure Type	Idioma/Langu	iage     English       English     English       itórios/Reports     (AC) Risk Analysis/Calculat       ysis No.:     BRAAC2021FDA00001       ode     Image: State
ro/Record Zonas - 1 NBR 5419-2 adastral Data lesign name: ountry: treet/Avenue: rganizational Levels: - Production asset: - Structure? Structure? - Production asset:	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7 O IEC 62305-2 Brazil I - Hold Company Name:	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name:	gure 4: Main n against At System Cu ge: English tration: senger terminal Association: Waiting Room	401   Candelána   Natal-RN   Brasil   G júgione.com br   cel: +55-64-98723-8; screen of data input smospheric Dischar istomization - Structure Fulano dos Anzo	ge Type is Pereira pe: Structure Type	Idioma/Langu	iage     Image I
rcLightning ro/Record Zonas - 1 NBR 5419-2 adastral Data esign name: ountry: treet/Avenue: rganizational Levels: - Production asset: - Structure/Building - Structure/Building	- Risk Analysis and S Dados/Zones - Data   Dados Téc./ O IEC 62305-2 Brazil V 1 - Hold Company Name:	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name:	gure 4: Main n against At System Cu ge: English tration: senger terminal Association: Waiting Room	401   Candelána   Natal-HNI   Brasil   G júggione.com br   cel: +55-64-98723-8; screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo	ge Type is Pereira pe: Structure Type	Idioma/Langu	iage       Image Ima
ro/Record Zonas - 1 NBR 5419-2 Cadastral Data Design name: ountry: treet/Arenue: brganizational Levels: - Production asset: - Structure/Building: tructure/Building:	- Risk Analysis and S Dados/Zones - Data Dados Téc./ O IEC 62305-2	Technical Expert: Customization Languag Structure type: Zone/Structure Zone Name: Can It lose animals?	gure 4: Main n against At System Cu e: English tration: senger terminal Association: Waiting Room () N () Y	401   Candelána   Natal-HN1   Brasil   G jaggione.com br   oel: +55-64-98723-8; screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo V Customization Ty	ge Type is Pereira pe: Structure Type xplosion? • N ()	Idioma/Langu	iage   English  English  ttórios/Reports  (AC) Risk Analysis/Calculat  ysis No.: BRAAC2021FDA00001  de
ro/Record Zonas - 1 NBR 5419-2 Cadastral Data Design name: ountry: treet/Avenue: brganizational Levels: - Production asset: - Structure/Building: tructure/type:	- Risk Analysis and S Dados/Zones - Data   Dados Téc./7 O IEC 62305-2 Brazil	Technical Expert: Customization Languag Structure type: Pass Zone/Structure Zone Name: Can It lose animals?	gure 4: Main n against At System Cu e: English tration: senger terminal Association: Waiting Room N Y rpical loss:	401   Candelána   Natl-FN1   Brasil   G jaggione.com br   oel: +55-64-98723-8; screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo V Customization Ty	ge Type is Pereira pe: Structure Type xplosion? • N • Y	Idioma/Langu	iage   English  English  itórios/Reports  (AC) Risk Analysis/Calculat  ysis No.: [BRAAC2021FDA00001  ode
ro/Record Zonas - 1 • NBR 5419-2 Cadastral Data Design name: Country: treet/Avenue: rrganizational Levels: - Production asset: - Structure/Building: tructure type: - Detection Measures	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name: Can It lose animals? Definition of ty	gure 4: Main n against At System Ct ge: English tration: senger terminal Association: Waiting Room N Y pical loss: Tainay to Errico	401   Candelána   Nata-FNN   Brasil   C jiagione.com br   oel: +55-64-98723-81 screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo V Customization Ty	sp: 59064-490 53 ge Type is Pereira pe: Structure Type xplosion? • N O	Idioma/Langu	lage       Image <ul> <li>English</li> <li>English</li> <li>English</li> </ul> ttórios/Reports       Image         (AC) Risk Analysis/Calculat         ysis No.:       BRAAC2021FDA00001         ode       Image         Image       Image         add Economic Values       Image: Calculate
ro/Record Zonas - 1 • NBR 5419-2 Cadastral Data Design name: Country: treet/Avenue: ryganizational Levels: - Production asset: - Structure/Building: tructure type: - otection Measures haracteristics	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name: Can It lose animals? Definition of ty Type of damage:	gure 4: Main n against At System Cu ge: English tration: senger terminal Association: Waiting Room	401   Candelána   Natal-FN   Brasil   C jiagione.com br   cel: +55-64-98723-81 screen of data input mospheric Dischar Istomization - Structure Fulano dos Anzo Customization Ty Is there a risk of e beings by electric shock.	ge Type is Pereira pe: Structure Type xplosion? • N O	Idioma/Langu	alage Temperature English Electrone English Electrone English Electrone English (Calculat troiros/Reports) (AC) Risk Analysis/Calculat ysis No.: BRAAC2021FDA00001 ode ad Economic Values );
ro/Record Zonas - 1 • NBR 5419-2 Cadastral Data Design name: country: treet/Avenue: Production asset: - Production asset: - Structure/Building: tructure type: control Measures characteristics f structure (PB);	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2 Brazil I - Hold Company Name:	Technical Expert: Customization Languag Structure regist Structure type: Pase Zone/Structure Zone Name: Can It lose animals? Definition of ty Type of damage: Types of loss:	gure 4: Main n against At System Cu ge: English tration: senger terminal Association: Waiting Room	401   Candelána   Natl-FN1   Brasil   C jaggone.com br   cel: +55-64-98723-81 screen of data input mospheric Dischar Istomization - Structure Fulano dos Anzo Customization Ty Is there a risk of e beings by electric shock, life (including permanent injury	sp: 59064-490 53 ge Type is Pereira pe: Structure Type xplosion? • N O Y	Idioma/Langu Portuonês kela v naly ig: 2 2 2 2 2 2 2 2 2 2 2 2 2	Iage       English            • English       English         stórios/Reports              • (AC) Risk Analysis/Calculat         ysis No.:       BRAAC2021FDA00001            • de            • ad Economic Values
rcLightning ro/Record Zonas - J NBR 5419-2 Cadastral Data Design name: iountry: treet/Avenue: Prganizational Levels: - Production asset: - Structure/Building: tructure type: btection Measures haracteristics f structure (PB):	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2 Brazil I - Hold Company Name: Or Risk Mitigation	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name: Can It lose animals? Definition of ty Type of damage: Types of loss: Types of loss:	gure 4: Main n against At System Cu e: English tration: senger terminal Association: Waiting Room N Y rpical loss: Injury to living Loss of human Loss due to injury	401   Candelána   Natl-HNI   Brasil   G jaigione.com br   cel: +55-64-98723-8; screen of data input mospheric Dischar Istomization - Structure Fulano dos Anzo Customization Ty Is there a risk of e beings by electric shock, life (including permanent injury ury by electric shock	ge Type is Pereira pe: Structure Type xplosion?  NON	Idioma/Langu Portuenės Rela ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) (	tage       English         • English       English         stórios/Reports       • (AC) Risk Analysis/Calculat
rcLightning ro/Record Zonas - 1 NBR 5419-2 Cadastral Data resign name: ountry: treef Avenue: brganizational Levels: - Production asset: - Production asset: - Structure/Building: tructure type: btcction Measures haracteristics f structure (PB):	- Risk Analysis and S Dados/Zones - Data Dados Téc./7 O IEC 62305-2 Brazil I - Hold Company Name: Or Risk Mitigation	Technical Expert: Customization Languag Structure regist Structure type: Pase Zone/Structure Zone Name: Can It lose animals? Definition of ty Type of damage: Types of loss: Types of loss: Types of loss: Type of structure:	gure 4: Main n against At System Cu e: English tration: senger terminal Association: Waiting Room N O Y rpical loss: Injury to living Loss of human Loss due to inji Risk of explosio	401   Candelána   Matl-HNI   Brasil   G jagione.com br   cel: +55-64-98723-8; screen of data input mospheric Dischar istomization - Structure Fulano dos Anzo Customization Ty Is there a risk of e beings by electric shock, life (including permanent injury ury by electric shock on	ge Type is Pereira pe: Structure Type xplosion?  NOY	Idioma/Langu O Portuenês Rela ig): ig): ig): ig): ig): ig): ig): ig):	age English EFGCONE
rcLightning ro/Record Zonas - 1 NBR 5419-2 2adastral Data Wesign name: ountry: treet/Avenue: brganizational Levels: - Production asset: - Structure/Building: tructure type: baracteristics f structure (PB):	- Risk Analysis and S Dados/Zones - Data   Dados Téc./1 O IEC 62305-2 Brazil I - Hold Company Name: or Risk Mitigation	Technical Expert: Customization Languag Structure regist Structure type: Pass Zone/Structure Zone Name: Can It lose animals? Definition of ty Type of damage: Types of loss: Types of loss: Type of structure: Typical loss value:	gure 4: Main n against At System Cu ge: English tration: senger terminal Association: Waiting Room N O Y pical loss: Injury to living Loss of human Loss due to inji Risk of explosie 0,01	401   Candelána   Natl-FNI   Brasil   G jaggione.com br   oel: +55-64-98723-8; screen of data input <b>scroospheric Dischar</b> <b>istomization - Structure</b> Fulano dos Anzo Customization Ty Is there a risk of e beings by electric shock, life (including permanent injury ury by electric shock on	ge Type is Pereira pe: Structure Type xplosion? N N N	Idioma/Langu Portneuês kela ig):	age English English (AC) Risk Analysis/Calculat (AC) Risk Analysis/Calcul

Rua Ministro Mirabeau da Cunha Melo, 1925 | Ap 401 | Candelária | Natal-RN | Brasil | Cep.: 59064-490 www.biagione.com.br | contato.bro@biagione.com.br | cel.: +55-84-98723-8753

Salvar / Save

Atualizar/Update

Figure 5: Screen for customizing structure and zones)

8

Nova AR/New RA

Customizar/Customize

## 4.2. Zone registration module

The System was engineered to cover up to 5 Zones (NBR-5419-2 [2] and IEC 62305-2 [3] do not establish limits, but provide examples of up to 5 Zones), as we observe that this is a practice used and that already surpasses the examples provided by the standards cited. The number of Zones is selected as shown in Figure 4 (Zone in Study).

The System already makes several types of structures available, which were understood as necessary and sufficient to meet the range of facilities and buildings that must be studied and related to each of them, the different types of Zones. However, the Designer can insert new structures and new zones, but he or she must proceed to register them. To do so, it will be necessary to customize them and make the association with the loss factors, as shown in Figure 5.

In this Section, the designer inserts the data for each zone that is defined for Risk Analysis, according to Section One of the Register, as shown in Figure 4. In this section, no improvement has been introduced, as show in Figure 6. For more details see SIPDA XV [1].

	sis and Star	0	8	-		Brci	ightning-2020.00	○ Portu	iguês	• Engl	lish	BIAGIO	
lastro/Record    Zonas - Dados/Zones - Data	Dados Téc./Techn	ucal data   Fatores da AR	VRA Factors Resulta	dos/Results   Metód	o ER/RS Me	thod Mét.	do Ângulo/Ang	gle Method	l Relate	órios/Repo	rts		
	·····												
71. Estemal Asso		la unta u	72 055-00										
Liternal Area	Z2  Computer C	enter	Z3  Offices										
Is it considered for analysis?	Is it considered in	or analysis?	Is it considered to	r analysis?									
Is it part of the main structure? <u>Y N</u>	Is it part of the m	nain structure? OY ON	Is it part of the ma	in structure? OY	ON								
Total people in Z1 (nz): 0	Total people in Z	(2 (nz): 10	Total people in Z3	(nz): 140	)								
Time persons in Z1 (tz): 8760	Time persons in 2	Z2 (tz): 8760	Time persons in Z	3 (tz): 876	0								
Pick Amount of rick (rf):	Risk Amount of	(rt) Linoleum	Pick Amount of	t) [Ceramic	~								
Explosion or fire (None)	Fire (Low)	т нэк (н).	Fire (Ordinary)	115K (11).	~								
Partitioning REI?	Partitioning REI2		Partitioning REI2	OV	•N								
Factor of increase of the relative of loss (h	) Factor of increas	e of the relative of loss (h	<ul> <li>z) Factor of increase</li> </ul>	of the relative of los	(hz)								
No special bazard	No special hazard	d	Low level of panic	c (e.g. a structure	s (112)								
	ivo special liazaro	u v	limited to 2 floors	s and less than 100	~								
Total Z1: R\$ 1 <sup>6</sup> 0,00	Total Z2:	R\$ 1 <sup>6</sup> 0,00	Total Z3:	R\$ 1 <sup>6</sup> 0,0	)								
Cultural haritage (Cz)- D\$ 1.6		Γ	-1		_								
Animals (Ca): R\$ 1 6	-		-		_								
Building (Cb): R\$ 1 6	-		-		_								
Content (Cc): R\$ 1 6	-		-		_								
Internal systems (Cs): R\$ 1 6	-	,	-	, 									
		J	Sal	van / Sava									
			Sai	var / Save									
Ticktning Diels Analysi	Figure	e 6: Screen of the	e setting modul	e of the Zones	s (structu	ire with a	all 3 Zone	s)					
cLightning - Risk Analys //Record   Zonas - Dados/Zones - Data    I tive measures due to touch and step	Figure	e 6: Screen of the ag for Protectio	e setting modul n against Atn A Factors Resultado	e of the Zones nospheric Di <sup>95/Results</sup> Metódo	s (structu scharge ER/RS Meth	Brotig Brotig	all 3 Zone	s) Idioma/L: O Portuge	anguaş nês Relatór	ge Engli rios/Report	sh	BIRGION	
cLightning - Risk Analys o/Record Zonas - Dados/Zones - Data    I ctive measures due to touch and step    Z1 - External Area	Figure s and Scalin Dados Téc./Technica voltage and other	e 6: Screen of the ag for Protectio	e setting modul n against Atn A Factors Resultado sult of the risk analysis	e of the Zones nospheric Di <sup>0s/Results</sup> Metódo	s (structu scharge ER/RS Meth	BrcLig	all 3 Zone	s) Idioma/L: O Portugu e Method	anguaş uês Relatór	ge Engli rios/Report	sh		RC
cLightning - Risk Analys o'Record   Zonas - Dados'/Zones - Data    I stive measures due to touch and step    Z1 - External Area    wml Z1: [  8,333    y	Figure s and Scalin Dados Téc./Technice voltage and other rm2 Z1: 8,333	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mca Z2 - Computer C 8,333	e setting modul n against Atn (A Factors Resultado esult of the risk analysis	e of the Zones nospheric Di s/Results   Metódo   Atualizar/Up	s (structu scharge ER/RS Meth	Bredig Bredig Mét. do	all 3 Zone	s) Idioma/La ○Portugu ≥ Method	anguag nuês Relatón Zone	ge Engli rios/Report	sh	BIRGION	
cLightning - Risk Analys /Record Zonas - Dados/Zones - Data II tive measures due to touch and step Z1 - External Area wmI Z1: 8,333 v nal measure (PTA): No protection measure	Figure s and Scalin Dados Téc./Technica voltage and other m2 Z1: 8,333	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mca Z2 - Computer Ce wml Z2: 8,333 No protection me	e setting modul n against Atn A Factors Resultado esult of the risk analysis	e of the Zones nospheric Di s/Results   Metódo   Atualizar/Up 5,176	s (structu scharge ER/RS Meth	arclig arclig and Mét. do tisks @ R1	all 3 Zone	S) Idioma/L: OPortuge 2 Method	anguag uês Relatór Zone	ge Engli trios/Report	sh sh	BIRGION	
cLightning - Risk Analys vRecord Zonas - Dados/Zones - Data II tive measures due to touch and step Z1 - External Area wm Z1: 8,333 v nal measure (PTA): No protection measure	Figure s and Scalin Dados Téc./Technica voltage and other m2 Z1: 8,333	e 6: Screen of the ng for Protectio al data Fatores da AR/R mitigating mca Z2 - Computer C WNI Z2: 8,333 No protection me No protection me	e setting modul n against Atn A Factors Resultado sult of the risk analysis	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176	s (structu scharge ER/RS Meth	are with a arclig tisks () R1 R	all 3 Zone	S) Idioma/L: OPortuge Method	anguag nuês Relatón Zone	ge Engli rios/Report	sh ss	Bingion	
cLightning - Risk Analys /Record Zonas - Dados/Zones - Data 1 tive measures due to touch and step Z1 - External Area wm1 Z1: 8,333 v nal measure (PTUA): No protection measure ion measure (PTUA): No protection measures ion measure (PTUA): No protection measures	Figure as and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea Tel: No protection measure No pr	e setting modul n against Atn LA Factors Resultado sult of the risk analysis is al R (10 <sup>5</sup> ) al in the Zon % de R	e of the Zones nospheric Di %Results Metódo Atualizar/Up 5,176 RA 2 RU	s (structu scharge ER/RS Meth late R 1 ? R	are with a arcling with a arcling with a arcling with a second with a second se	all 3 Zone htring-2020.00 2 Ångulo/Angle RV 2	s) Idioma/L: O Portugu 2: Method Rethod	anguas nuês Zone 2 Z	ge e Engli rios/Report 21 e Z2 M ?	sh s Z3 RW		RZ
cLightning - Risk Analys vRecord Zonas - Dados/Zones - Data    1 tive measures due to touch and step Z1 - External Area wm1 Z1: [8,333] v nal measure (PTU/P): No protection measures ion measure (PTU/P): No protection measures	Figure s and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333 es v p	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea Z2 - Computer Cd wm1 Z2: 8,333 No protection meast No protection meast N	e setting modul n against Atn KA Factors Resultado sult of the risk analysis B al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8%	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RU 0,000	s (structu scharge ER/RS Meth date R 1 2 R 0,000	are with a           Brckg           isks	all 3 Zone htmp:2020.00 o Ångulo/Angle RV 2 0.006	S) Idioma/La O Portugu 2: Method Rether RC	Anguas nuês Relatón Zone ? Ri	ge Engli rios/Report 21	sh s Z3 RW		RZ
cLightning - Risk Analys o/Record Zonas - Dados/Zones - Data    1 tive measures due to touch and step [Z1 - External Area wm1 Z1: [8,333] v nal measure (PTU/P): No protection measures ion measure (PTU/P): No protection measures spd(P) No coordinated SPD syst external area	Figure s and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333 es p m2 Z1: 8,333	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Representation mease No protection	e setting modul n against Atn A Factors Resultado sult of the risk analysis is al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8% % R)	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA ? RU 0,000	s (structu scharge ER/RS Meth iate R 0,000 0,0%	BrcLip           BrcLip           BrcLip           BrcLip           0.001           0,001           0,0%	all 3 Zone htming-2020.00 Ångulo/Angle RV ? 0.006 0.2%	S) Idioma/L: O Portuge Rethod RC	Anguas Relatón Zone ? Ri	ge © Engli trios/Report 2.1 © Z2 M ?] 2.414 99.7%	sh s Z3 RW		RZ
cLightning - Risk Analys /Record Zonas - Dados/Zones - Data    1 tive measures due to touch and step ZI - External Area wm1 Z1: [8,333] v nal measure (PTU/): No protection measure ion measure (PTU/): No protection measures spd/P) No coordinated SPD syst spd/P) No coordinated SPD syst hybrid coordinated SPD syst	Figure s and Scalin Dados Téc./Technica voltage and other rm2 Z1: 8,333 es v p em v p em v p	e 6: Screen of the ag for Protectio	e setting modul n against Atn A Factors Resultado sult of the risk analysis al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8% % RX/RTotal	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA <u>?</u> RU 0,000	s (structu scharge ER/RS Meth date R 0,000 0 0,0% 0	arclip           BrcLip           (isks)           (i	all 3 Zone           htmm-2020.00           Ångulo/Angle           0.006           0.2%           0.1%	s) Idioma/L: OPortuge Rethod RC	Anguaş tuês Zone OZ ? R	ge e Engli rios/Report 21 e Z2 M ? 2,414 99,7% 46,6%	sh s		RZ
cLightning - Risk Analys vRecord Zonas - Dados/Zones - Data [1] tive measures due to touch and step Z1 - External Area wm1 Z1: 8,333 v nal measure (PTU/P): No protection measures ion measure (PTU/P): No protection measures spd/P) No coordinated SPD syst uction factor (rp): No provisions	Figure s and Scalin Dados Téc./Technice voltage and other vm2 z1: 8,333 es v p em v p em v p	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mca Z2 - Computer C Way 22 [8,333 No protection meas No protection meas No protection meas No coordinated SPD No coordinated SPD No provisions	e setting modul n against Atn A Factors Resultado esult of the risk analysis al R (10 <sup>5</sup> ; al in the Zon % de R 2,421 46,8% % RX/RTotal	e of the Zones nospheric Di ps/Results Metódo : Atualizar/Up 5,176 RA 2 RU 0,000	s (structu scharge ER/RS Meth iate R 0,000 0,0%	arclip           BrcLip           isks           Isks           Isks           Isks           Isks           Isks           Isks           Isks           Isks	all 3 Zone           htmmg-2020.00           > Angulo/Angle           RV 2           0.006           0.2%           0.1%	s) Idioma/L.i O Portuga 2 Method R4 RC	anguag auês Relatón ? R	ge Engli rios/Report 21        © Z2 M        2 2,414 99,7% 46,6%	sh sh s		RZ
cLightning - Risk Analys y'Record Zonas - Dados/Zones - Data 1 tive measures due to touch and step Z1 - External Area wm1 Z1: 8,333 v nal measure (PTA): No protection measure ion measure (PTU/P): No protection measures spd(P) No coordinated SPD syst spd(P) No coordinated SPD syst spd(P) No provisions	Figure s and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mca Z2 - Computer Co wm1 Z2; 8,333 No protection measure No protection measure No protection measure No protection measure No coordinated SPD No provisions Atuali	e setting modul n against Atn tA Factors Resultado esult of the risk analysis fie al R (10 <sup>5</sup> ; al in the Zon % de R 2,421 46.8% % R % R % RX/RTotal	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA ? RU 0,000	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0%	B         ?           0.001         0.001           0.005         0.006	all 3 Zone           htming-2020.00           > Ångulo/Angle           0.006           0.2%           0.1%	s) Idioma/L: O Portuge Rethod RC	Anguaş nuês Zone ? R	ge e Engli rios/Report 2.1 e Z2 M 2 2.414 99.7% 46.6%	sh si		RZ
cLightning - Risk Analys vRecord Zonas - Dados/Zones - Data [1] tive measures due to touch and step [21 - External Area wml Z1: [8,333] v nal measure (PTA): No protection measure ion measure (PTU/P): No protection measures spd(P) No coordinated SPD syst uction factor (rp): No provisions ate of Connected Power Line	Figure s and Scalin Dados Téc./Technice voltage and other mn2 Z1: 8,333 es em em em per em p	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Z2 - Computer Cd wm1 Z2: 8,333 No protection meas No protection meas No protection meas No protection meas No coordinated SPD No coordinated SPD No provisions Atuali	e setting modul n against Atn KA Factors Resultado sult of the risk analysis al n (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8% % RX/RTotal	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RU 0,000 G 1 Attribute of Con	s (structu scharge ER/RS Meth date R 0,000 0,0% 0,0%	are with a           Brdlg           od           Mét. do           tisks           (a) R1           B         ?           0,001           0,0%           0,0%	all 3 Zone           htmm: 2020.00           o Ångulo/Angle           RV         2           0.006           0.2%           0.1%	s) Idioma/L: O Portugn Rethod R4 RC	anguag nuês Zone ? R	ge ● Engli rios/Report 21 ● Z2 M ? 2,414 99,7% 46,6%	sh s s Z3 RW	2 2	RZ
cLightning - Risk Analys /Record Zonas - Dados/Zones - Data [] trive measures due to touch and step Z1 - External Area wm1 Z1: [8,333] v nal measure (PTU/P): No protection measure ion measure (PTU/P): No protection measures spdP) No coordinated SPD syst spdT): No protection measures spdP) No coordinated SPD syst function factor (rp): No provisions ute of Connected Power Line ground. and isolation (CLD/CLI): [Shielded	Figure s and Scalin Pados Téc./Technice voltage and other vm2 Z1: 8,333 es p em p em p em p p em p p	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Kalon Protection mease No protection mease No protection mease No protection mease No protection mease No coordinated SPD No provisions Atuali 2 ? Comm	e setting modul n against Atn A Factors Resultado sult of the risk analysis § al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8% % RX/RTotal ected shield	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA ? RL 0,000 C Attribute of Con Shield, ground and	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0% nected Tele isolation (CL	are with a           BrcLig           BrcLig           (isks           (isks)           (isks) <td< td=""><td>all 3 Zone           htming-2020.00           Ångulo/Angle           RV ?           0.0006           0.2%           0.1%</td><td>s) Idioma/L: Portuge Portuge R4 RC</td><td>Anguag nuês Zone ? R</td><td>ge © Engli rios/Report 21 © Z2 M ? 2,414 99,7% 46,6% V ?</td><td>Connecta</td><td></td><td>RZ RZ</td></td<>	all 3 Zone           htming-2020.00           Ångulo/Angle           RV ?           0.0006           0.2%           0.1%	s) Idioma/L: Portuge Portuge R4 RC	Anguag nuês Zone ? R	ge © Engli rios/Report 21 © Z2 M ? 2,414 99,7% 46,6% V ?	Connecta		RZ RZ
cLightning - Risk Analys /Record Zonas - Dados/Zones - Data [] 1 trive measures due to touch and step ZI - External Area wm1 Z1: [8,333] V nal measure (PTA): No protection measure ion measure (PTU/I): No protection measures spd/P) No coordinated SPD sys spd/T): No provisions tue of Connected Power Line ground. and isolation (CLD/CLI): [Shielded length? Length LL (m):	Figure s and Scalin Dados Téc./Technice voltage and other rm2 Z1: 8,333 es es es em prime prim prime prime prim prim prime prim prime prim prime prim pri pr	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Relation mease No protection mease No protection mease No protection mease No protection mease No coordinated SPD No provisions Atuali	e setting modul n against Atn A Factors Resultado sult of the risk analysis al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46,8% % RX/RTotal setted shield near line: Al (m <sup>2</sup> )	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RL 0,000 Q Atualizar/Up 5,176 RA 2 RL 0,000 Q 5,176 Atualizar/Up 5,176 Atualizar/Up 5,176 RA 2 RL 0,000 Q 5,176 Atualizar/Up 5,176 Atualizar/Di 5,176 Atualizar/Di 5,176 Atualiz	s (structu scharge ER/RS Meth date R 0.000 0 0.0% 0 0.0% 0 0.0% 0	BrcLig           BrcLig           (isks           (isks)           (is	all 3 Zone           htning-2020.00           Ångulo/Angle           Q.0006           0.2%6           0.1%6           elded buried lin           n): Årea AL (n	s) Idioma/L: Portuge Rethod Ret	Anguag Relatór Zone ? R ? R for flash	ge Engli rios/Report 1   Z2 M   2 2,414 99,7% 46,6% 46,6% 2 we near?	Connectu	2 ed shield	RZ I (m²)
cLightning - Risk Analys p/Record Zonas - Dados/Zones - Data [1] trive measures due to touch and step Z1 - External Area wm1 Z1: [8,333] nal measure (PTU/): No protection measure ion measure (PTU/): No protection measures spd/P) No coordinated SPD syst huction factor (rp): No protections spd/T): No coordinated SPD syst huction factor (rp): No provisions ute of Connected Power Line ground. and isolation (CLD/CLD): [Shielded length? Length LL (m); es _ Not _ ? 500	Figure s and Scalin Dados Téc./Technica voltage and other ym2 Z1: 8,333 es v p em v p	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Test Market State No protection meas No protection meas No protection meas No protection meas No coordinated SPD No provisions Atuali Yes in Not 2.00000 2.0000 2.000000 2.00000 2.00000 2.00000 2.00000 2.000000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.00000 2.000000 2.000000 2.00000000 2.0000000 2.0000000000	e setting modul n against Atn A Factors Resultado sult of the risk analysis \$* al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46,8% % RX/RTotal ** ** RX/RTotal ** ** RX/RTotal ***	e of the Zones nospheric Di s/Results Metódo : Atualizar/Up 5,176 RA <u>2</u> RU 0,000 C Attribute of Con Shield, ground. and Known length? ÝYes No	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0% 0,0% 1 0 0 0,0% 10,0% 10,0	B         ?           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,001         0,0%           0,003         0,0%	all 3 Zone           htmmg-2020.00           Ångulo/Angle           0.006           0.2%           0.1%	s) Idioma/L1 ○ Portugu ○ Portugu ○ R4 RC □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	anguag ues Relatór 2 R 2 R 4 6 or flash	ge Engli rios/Report 2.1	Sh S	2 ed shield r line: A 4.000.00	RZ
cLightning - Risk Analys         o/Record Zonas - Dados/Zones - Data [1]         tive measures due to touch and step         Z1 - External Area wml Z1: [8,333]         mal measure (PTA):         No protection measure iton measure (PTU/P): No protection measure stypd(P)         No coordinated SPD syst sysd(P)         No coordinated SPD syst sysd(P)         No coordinated SPD syst duction factor (rp):         No provisions         atte of Connected Power Line ground, and isolation (CLD/CLI): [Shielded length?         rength L1 (m) es Not 500 tor Installation Factor (Cl): [Buried	Figure s and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333 es prm2 Z1: 8,333 es prm2 Z1: 8,333 v prm2 Z1: 8,334 v prm2 Z1: 8,334 v prm2 Z1: 8,334 v prm2 Z1: 8,344 v prm2 Z1: 8,344 v prm2 Z1: 8,344 v prm2 Z1: 8,344 v prm2 Z1: 8,344 v prm2 Z1: 8,344 v prm2 Z1: 8,444 v prm2 Z1: 8,444 v	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea T22 - Computer C4 wm1 Z2: 8,333 No protection meast No protection meast No protection meast No coordinated SPD No provisions Atuali x provisions Atuali x protection meast No coordinated SPD No provisions Atuali x protection meast No coordinated SPD No provisions Atuali x protection meast No coordinated SPD No provisions Atuali x protection meast x protection me	e setting modul n against Atn tA Factors Resultado suit of the risk analysis to al R (10 <sup>5</sup> ; al in the Zon % de R 2,421 46,8% % RX/RTotal mear line: Al (m <sup>2</sup> ) 0,000	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RU 0,000 C 0,000 C 0,000	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0% 0,0% 1 enceted Tele isolation (CL t 2 m Factor (Ci	B         ?           0.001         Mét. do           (isks)         (isks)	all 3 Zone           htring-2020.00           Ó Ângulo/Angli           0.006           0.22%           0.19%           elded buried lin           n). Área AL (n           1	s) Idioma/L: Portugn R4 RC () () () () () () () () () () () () ()	anguag Relatór Zone ? Ri ? Ri for flash	ge ● Engli rios/Report 2.1 ● Z2 M ? 2.414 99,7% 46,6% ↓ ↓ ↓ Not ↓	Connectu	2 2 2 4 4 4 4 4 4 4 4 4 4 4 4 4	RZ (m <sup>2</sup> ) 0
cLightning - Risk Analys. p/Record Zonas - Dados/Zones - Data [1] tive measures due to touch and step [21 - External Area wm1 Z1: [8,333] nal measure (PTA): No protection measure ion measure (PTU/P): No protection measures ispd P) No coordinated SPD syst spd T): No coordinated SPD syst huction factor (rp): No provisions ute of Connected Power Line ground. and isolation (CLD/CLI): [Shielded length? Length LL (m); es Not? 500 tor Installation Factor (Ci): [Buried mental Factor (Ce): [Shurban	Figure s and Scalin Pados Téc./Technice voltage and other m2 Z1: 8,333 es es em per em per em per per puried line (bonded) Area AL (m <sup>2</sup> ): Area 20.000	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea Z2 - Computer C4 wm1 Z2: 8,333 No protection meas No protection meas No protection meas No protection meas No coordinated SPD No provisions Atuali Yes $\bigtriangledown$ Not 2.000 tand voltage (UW in kV)-J	e setting modul n against Atn EA Factors Resultado sult of the risk analysis al n (10 <sup>5</sup> ) al n the Zon % de R 2,421 46,8% % RX/RTotal ected shield near line: A1 (m <sup>2</sup> ) 0,000 PLI: 2,50 ? ?	e of the Zones nospheric Di s/Results Metódo Atualizar/Upa 5,176 RA ? RU 0,000 Conductor Installati Environmental Factor	s (structu scharge ER/RS Meth date R 0,000 0,0% 0,0% 0,0% 0,0% 1 mected Tele isolation (CL t ? ) on Factor (Ci tr (Ce): Sb	are with a           B           (a) Mét. da           (b) Mét. da           (a) Mét. da           (b) Mét. da           (c) Mét. da	all 3 Zone           htmmp-2020.00           Ó Ângulo/Angle           0.0006           0.2%           0.1%           elded buried lim           n). Area AL (n           12.0001	s) Idioma/L: Portuge R4 RC  c (bonded)  r <sup>2</sup> : Area f  v Withsta	Anguage Relator Zone 2 R 7 R 6 or flash for flash and volt	ge ● Engli rios/Report 2.1 ● Z2 M ? 2.414 99.7% 46.6% × ? Not	sh s s RW	2 ed shield r line: A 4.000.000	
cLightning - Risk Analys         o/Record Zonas - Dados/Zones - Data []         stive measures due to touch and step         Z1 - External Area wm1 Z1: [ 8,333 ']         nal measure (PTA):         No protection measures         tion measure (PTU/P):         No coordinated SPD syst         shactor (rp):         No protection measures         spd(P)         No coordinated SPD syst         shactor factor (rp):         No provisions         att of Connected Power Line         .ground. and isolation (CLD/CLI):         [store Installation Factor (Ci):         Buried mmental Factor (Cc):         Buried mental Factor (Cc):         Suburban         pe Factor (Ci):	Figure s and Scalin Pados Téc./Technice voltage and other ym2 Z1: 8,333 es ym2 Z1: 8,333 es ym2 Z1: 8,333 es ym2 Z1: 8,333 es ym2 Z1: 8,333 es ym2 Z1: 8,333 ym2 Z1: 7,743 ym2 Z1: 7,743	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Help re Z2 - Computer C4 wm1 Z2: 8,333 No protection meas No protection meas No protection meas No protection meas No coordinated SPD No provisions Atuali ? Comm a for flashes near? Area Yes $\supseteq$ Not 22.000 tand voltage (UW in kV)-1 dresistance (RS): RS < 10	e setting modul n against Atn CA Factors Resultado sult of the risk analysis §19 al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46.8% % RX/RTotal ected shield near line: Al (m <sup>2</sup> ) 0.000 PLI: 2,50 ¥ 2 2/km ¥	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA ? RU 0,000 Conductor Installation Environmental Factor Line Type Factor (C	s (structu scharge ER/RS Meth late R 0,000 0,0%	BrcLip           BrcLip           BrcLip           (isks           (isks           (isks           (isks)           (isks	all 3 Zone           htming-2020.00           Ångulo/Angle           Q.0006           0.2%           0.1%           elded buried lim           n): Årea AL (n           12.000 l           ation or data lin	s) Idioma/L: Portugn Portugn R4 RC (bonded) S (V) S (V	anguag auês Relatôr 2 Re 2 Re 2 Re 2 Re 2 Re 4 Conce 5 Conce 5 Conce 7 Re 5 Conce 7 Re 5 Conce 7 Re 5 Conce 7 Re 5 Conce 7 Re 5 Conce 7 Conce	ge © Engli rios/Report 21 © Z2 M ? 2,414 99,7% 46,6% (C) (C) (C) (C) (C) (C) (C) (C) (C) (C)	Sh S	2 ed shield r line: Α 4.000.00	RZ
cLightning - Risk Analys         o/Record       Zonas - Dados/Zones - Data         j/Record       Zonas - Dados/Zones - Data         ittive measures due to touch and step         ZI - External Area         wm1 Z1:       8,333         inal measure (PTA):       No protection measure         iton measure (PTU/P):       No protection measures         iton measure (PTU/T):       No coordinated SPD syst         spd/P)       No coordinated SPD syst         spd/T):       No protection measure         spd/T):       No coordinated SPD syst         spd/T):       No coordinated SPD syst         spd/T):       No provisions         utetion factor (rp):       No provisions         ute of Connected Power Line	Figure s and Scalin Dados Téc./Technice voltage and other rm2 Z1: 8,333 es es es em em em figure puried line (bonded) Area AL (m <sup>2</sup> ): Area 20.000	e 6: Screen of the ag for Protectio al data Fatores da AR/R mitigating mea Relation measure No protection mea	e setting modul n against Atn A Factors Resultado sult of the risk analysis al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46,8% % RX/RTotal sected shield near line: Al (m <sup>2</sup> ) 0.000 PLI: 2,50 2 ? //km	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RU 0,000 Q Atualizar/Up 5,176 RA 2 RU 0,000 Q Atualizar/Up Shield, ground, and Known length? Yes No Conductor Installatic Environmental Factor Line Type Factor (CC SPD (PEB):	s (structu scharge ER/RS Meth date R 0.000 0.0% 0.0% 0.0% 0.0% 0.0% 0.0% 0.	Brclig           Brclig           isks           Itisks           Itis	all 3 Zone           htmm-2020.00           Ångulo/Angle           Ø.0006           0.2%6           0.1%6           elded buried lin           n): Årea AL (n           12.0000           ation or data lin	s) Idioma/L: Portugu R4 RC e (bonded)	anguag Relatór Zone 2 R for flash for flash and volt	ge ● Engli rios/Report 2.1 ● Z2 M ? 2.414 99.7% 46.6% 46.6% • ? • Not ] age (UW in cc (RS): [:	sh s Z3 RW Connecte Area near	2 ed shield r line: A 4.000.000 J: [1,5(S)	
clightning - Risk Analys         o/Record Zonas - Dados/Zones - Data [1]         ctive measures due to touch and step         Z1 - External Area         wml Z1: [8,333]         onal measure (PTU/P): No protection measure         yonal measure (PTU/P): No protection measure         yspd/P)       No coordinated SPD syst         yspd/P)       No coordinated SPD syst         yspd/P)       No coordinated SPD syst         duction factor (rp):       No provisions         ute of Connected Power Line       .         .ground. and isolation (CLD/CLI):       Shielded         length?       Length LL (m);         responder [2]       500         tot Installation Factor (Ci):       Buried         mmental Factor (Cc):       Suburban         ype Factor (Ct):       LV power         YEB):       No SPD	Figure s and Scalin Dados Téc./Technice voltage and other ym2 Z1: 8,333 v es v p em v	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea T2 - Computer Co wm1 Z2: 8,333 No protection meas No protection meas No protection meas No protection meas No coordinated SPD No provisions Atuali y Comm a for flashes near? Area Yes V Not 1 const resistance (RS): RS < 10 refer to avoid loops	e setting modul n against Atn tA Factors Resultado tak Factors Resultado tak Factors Resultado sult of the risk analysis \$ \$ al R (10 <sup>5</sup> ) al in the Zon % de R 2,421 46,8% % RY % RX/RTotal ected shield near line: Al (m <sup>2</sup> ) 0,000 PLI: 2,50 ? 2/km	e of the Zones nospheric Di s/Results Metódo : Atualizar/Up 5,176 RA 2 RU 0,000 4 Atualizar/Up 5,176 RA 2 RU 0,000 4 Conductor Installatic Environmental Factor Line Type Factor (C SPD (PEB): Type of internal wiri Specific Sector (C) Specific	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0% 0,0% 1 0,0 0,0% 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ere with a breker of the second lines of the s	All 3 Zone htrung-2020.00 0 Ångulo/Angle 0,006 0,22% 0,19% elded buried lin n): Årea AL (n 12.000 1 ation or data lin ble – routing pr	s) Idioma/L: O Portugn R4 RC (bonded) r <sup>2</sup> ): Area f V Y Withsta e Shield n caution in o	anguag Relatór Zone 2 R 2 R 2 R 2 R 2 R 4 C 2 R 4 C 4 C 4 C 4 C 4 C 4 C 4 C 4 C 4 C 4 C	ge (e) Engli rios/Report (1) (e) Z2 (2,414 99,7% 46,6% (c)	sh s s z3 RW Connectu Area neau 4 kV) - PL Ω/km <f< td=""><td>2 ed shield 1.000.00 I: [1,50]</td><td>RZ</td></f<>	2 ed shield 1.000.00 I: [1,50]	RZ
cLightning - Risk Analys         >/Record Zonas - Dados/Zones - Data []         :tive measures due to touch and step         Z1 - External Area wml Z1: [\$,333]         mal measure (PTA):         No protection measures         tion measure (PTU/P):         No coordinated SPD syst         spd/P)       No coordinated SPD syst         uction factor (rp):       No provisions         ute of Connected Power Line ground, and isolation (CLD/CL1):       [Shielded length?         tor Installation Factor (Cc):       [Buried mental Factor (Ce):         Suburban pe Factor (Ct):       [LV power         EB):       No SPD         internal wring (Ks3);       [Unshielded cable - rc	Figure is and Scalin Dados Téc./Technice voltage and other m2 Z1: 8,333 es es em em em prime p em prime p prime p pri	e 6: Screen of the ag for Protection al data Fatores da AR/R mitigating mea Tel: No protection meast No protection meast No protection meast No protection meast No coordinated SPI No provisions Atuali Yes Not 1 2000 tand voltage (UW in kV)-1 d resistance (RS): RS<10 rder to avoid loops Gravar / Record	e setting modul n against Atn tA Factors Resultado suit of the risk analysis to al R (10 <sup>5</sup> ; al in the Zon % de R 2,421 46,8% % RX/RTotal ected shield mear line: A1 (m <sup>2</sup> ) 0.000 PLI: 2,50 2 ? 2/Km	e of the Zones nospheric Di s/Results Metódo Atualizar/Up 5,176 RA 2 RU 0,000 C Attribute of Con Shield, ground and Known length? ✓ Yes No Conductor Installatis Environmental Factor Line Type Factor (C SPD (PEB): Type of internal wiri	s (structu scharge ER/RS Meth late R 0,000 0,0% 0,0% 1 r r r r r r r r r r r r r	e Brelig Brelig Met de B ? 0,001 0,0% 0,0% com lines D/CL): [Shi Lengh LL (r 300 10,0% 0,0% 10	All 3 Zone htrung-2020.00 O Ångulo/Anglo O,006 0,2% 0,1% elded buried lin m): Årea AL (n 12.0001 1 ation or data lin ole – routing pro-	s) Idioma/L: Portugn R4 RC () () () () () () () () () ()	Anguag auês Relatón 2 Zone 2 R 1 2 7 R 1 7 R 1 8 R 1 7 R 1 8 R 1 8 R 1 8 R 1 7 R 1 8 R 8 R 1 8 R 1 8 R 1 8 R 1 8 R 1 8 R 1 8 R 1 8 R 8 R 1 8 R 1 8 8 R 1 8 R 1 8 R 1 8 8 R 1 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	ge ● Engli rios/Report 2.1 ● Z2 M ? 2.414 99,7% 46,6% 46,6% W ? age (UW in ce (RS): [: age (UW in ce (RS): [: age (UW in ce (RS): [:	sh s σZ3 RW Connectt Area near 4 kV) - PL 1Ω/km <f tops tecord</f 	2 ed shield r line: A 4.000.00 J: 1,5(2)	

Rua Ministro Mirabeau da Cunha Melo, 1925 | Ap 401 | Candelária | Natal-RN | Brasil | Cep.: 59064-490 www.biagione.com.br | contato.brc@biagione.com.br | cel.: +55-84-98723-8753

Figure 7: Setting screen of the connected lines and other zone data

## 4.3. The setting data of the connected lines and Zone

This Section provides the space to enter information about power lines and telecommunications lines: how they connect to the site (building; installations; etc.). The designer can also enter protective measures due to touch and step voltage and other riskmitigating measures, individually for each defined Zone. In this section, it was introduced improvements to the Help pop-up form with the result of the risk analysis, as shown in Figure 7. Thus, the designer can monitor the effectiveness of each mitigating measures in real-time. This pop-up, once visible, can be viewed in all sections of the risk analysis module.

Also, there is a pop-up to help define line parameters and other alert parameters as shown in Figure 8.

#### 4.4. Risk Analysis Factors Module

This section presents the typical loss values for each zone (as shown in Figure 9), based on the definitions established in section one (as shown in Figure 4) and two (as shown in Figure 5).

adastro/Record Zonas - D	Dados/Zones - Data Dados To	éc./Technica	l data Fatores da AR/RA Facto	rs Resultado	s/Results   Metódo E	ER/RS Method   Mét. do Âi	ngulo/Angle Method   Relate	órios/Reports	
Protective measures due	to touch and step voltage	and other	mitigating measures in Zones						
	Z1 - External Area		22 - Computer Center	Z3 - C	ffices				
	wm1 Z1: 8,333 wm2 Z1:	8,333	Frm_Tipo_Linha					_	
Additional measure (PTA):	No protection measures	~ Þ	External line type:	Aerial line u	nshielded				
trotaction massura (DTU/D)	No protection measures	~	External me type.		nsmelded				
rotection measure (PTU/T)	No protection measures	~	Connection at entrance:	Undefined					
PD (Pspd/P)	No coordinated SPD system	~	Additional description:						
PD (Pspd/T):	No coordinated SPD system	~							_
ire reduction factor (rp):	No provisions	~		Atua	lizar/Update		CLD: 1,0	CLI:	1,0
		R	aistro: I 🔸 1 de 10 🕨 🕨 🗮	📞 Sem Filtro	Pesquisar				
Attribute of Connected	Power Line			<u></u>	Attribute of Con	nected Telecom lines			
hield., ground. and isolation	(CLD/CLI): Shielded buried lin	ie (bonded)	<ul> <li>Connected sh</li> </ul>	ield	BrcLightning		×	· ? Conn	ected shield
nown length?	Length LL (m): Area AL	(m <sup>2</sup> ): Area	a for flashes near? Area near line	: Al (m²)				es near? Area 1	near line: Al (m <sup>2</sup> )
✓ Yes 🗌 Not	? 500 20.0	00	Yes 🗹 Not 2.000.000		If there is e	equipment with different impulse	withstand levels in an	□ Not	4.000.000
onductor Installation Factor	r (Ci): Buried			~	internal sys	stem, the lowest impulse withsta	nd level should be selected.		
nvironmental Factor (Ce):	Suburban	<ul> <li>Withs</li> </ul>	and voltage (UW in kV)-PLI: 2	50 🗹 🥐				ige (UW in kV) -	PLI: 1,50 ~
ine Type Factor (Ct):	LV power	<ul> <li>✓ Shield</li> </ul>	resistance (RS): RS≤1Ω/km	~			ОК	$ce(RS): 1\Omega/kr$	n <rs≤5ω km<="" td=""></rs≤5ω>
PD (PEB):	No SPD			~			OK		
ype of internal wiring (Ks3)	Unshielded cable - routing pre	ecaution in or	der to avoid loops	~ ?	Type of internal wirin	ng (Ks3): Unshielded cable -	- routing precaution in order t	o avoid large loop	s 🖌
Atralias	r/Update		Gravar / Record		A	Atualizar/Update		Gravar / Record	1

Figure 8: The pop-up helps with line parameters and other information

BrcLightning - Risk Analy	sis and S	Scaling	for Pro	otection	against	Atmos	pheric I	Dischar	ge Bro	Lightning-2020.00	_ <b>Idioma/Langu</b> a ○Português	e English	
Cadastro/Record Zonas - Dados/Zones - Data	Dados Téc./	Technical d	ata Fatores	s da AR/RA I	Factors Re	sultados/Re	sults Metódo	o ER/RS M	ethod Mét.	do Ângulo/An	gle Method Relat	órios/Reports	
BrcLightning     O     Designer	Z1 - Extern	al Area		Z2 - Compu	iter Center		Z3 - Office	s					
L1 Loss of human life (including permanent injury)	LT (L1/Z1):	LF (L1/Z1):	LO (L1/Z1):	LT (L1/Z2):	LF (L1/Z2):	LO (L1/Z2)	LT (L1/Z3):	LF (L1/Z3)	LO (L1/Z3)				
		LF (L2/Z1):	LO (L2/Z1):		LF (L2/Z2):	LO (L2/Z2)		LF (L2/Z3)	LO (L2/Z3)				
	17.0.170	LF (L3/Z1):		T TT (T 4/72)	LF (L3/Z2):	10 (14/72)		LF (L3/Z3)					
L4 Loss of economic value (structure, content, and loss of activity)	0,0000	LF (L4/21):	0,0000	L1 (L4/Z2):	0,2000	0,0100	LT (L4/Z3):	LF (L4/Z3): 0,2000	0,0100				
Considerations:													
B													
					Ð			Ģ					
			Rua Ministro	o Mirabeau da Cu www.biagione.co	nha Melo, 1925 om.br   contato.	5   Ap 401   C .brc@biagione.	andelária   Natal- com.br   cel.: +!	RN   Brasil   0 55-84-98723-8	Cep.: 59064-490 8753				

In the version presented in SIPDA XV [1], it was already possible for designers to change the typical loss value, if they had another interpretation regarding the one previously defined in the system (these factors defined in the system were based on the definitions established in NBR 5419 -2 [2] and IEC 62305-2 [3] for typical loss values). In this case, in the previous version, the designers had to standardize their basic values for each type of installation in advance. The improvement introduced allows that, in case they don't have a database parameterized with the values according to their interpretation criteria, they can do so by simply selecting the designer parameters (in the input field) and applying a double click on each factor that they want to parameterize. This way, a pop-up (as shown in Figure 10) form will appear for each factor and they will define it at their discretion. The new defined typical loss value, after being updated, will be highlighted in green (as shown in Figure 10), but there are security restrictions and other requirements (see item 9.4).

## 4.5. Results Module

In this section, the final result is as shown in Figure 11. Mitigating measures can also be inserted (the description of these measures), if the results indicate that this is necessary. Mitigation measures, as needed, can be included (these should be inserted descriptively). A technical note with the analysis design also can and should be inserted. Another improvement is the possibility of issuing, in a summarized format, the risk analysis report, as shown in Figures: 12 (a) and (b). This report contains the basic information of the risk analysis study and the result.

BrcLightning - Risk Analy	sis and s	Scaling	for Pro	tection	against	t Atmos	spheric I	Dischar	ge	I	dioma/Lang	guage	
Cadastro/Record Zonas - Dados/Zones - Data	Dados Téc. Z1 - Extern	'Technical d nal Area	ata    Fatores	z da AR/RA	Factors Re uter Center	sultados/Ro	D2 - P L1 - L LF - L	De Physical dat oss of hum oss in a str	finition o mage an life (incl ructure due t	f typical loss luding permanen to physical dama	t injury) age		
L1       Loss of human life (including permanent injury)         Image: Image of the system of the syste	LT (L1/Z1): 0,0000 LT (L4/Z1): 0,0000	LF (L1/Z1): 0 LF (L2/Z1): 0,0000 LF (L3/Z1): 0,0000 LF (L4/Z1): 0,0000	LO (L1/Z1): 0,0000 LO (L2/Z1): 0,0000 LO (L4/Z1): 0,0000	LT (L1/Z2): 0,0100	LF (L1/Z2): 0,01 LF (L2/Z2): LF (L3/Z2): LF (L4/Z2): 0,2000	LO (L1/Z2) LO (L2/Z2) LO (L4/Z2) 0,0100	LT (L4/Z3):	of structur	LO (L4/Z3,	OK!	7 1 	Typical oss value	
Considerations:							]	De					
			Ruo Ministro	Mirahaau da Ci	inha Malo, 102	E L Ao 401 L (	andelária   Natal-	DN   Brooil   C	Pan - 50064-400				

www.bagione.com.br (contab.trg/Sbagione.com.br (contab.trg

BrcLightning - Risk .	Analysis	and So	caling	for P	Protecti	on aș	gainst	t Atmo	ospher	ic Di	schar	ge	BrcLightning	g-2020.00	Idiom: OPor	/ <b>Langu</b> : tuguês	english	
Cadastro/Record Zonas - Dados/Zona	s - Data Dad	os Téc./Te	echnical d	ata Fat	ores da AR	/RA Fac	ctors Re	sultados/	Results N	fetódo E	ER/RS M	ethod M	ét. do Ân	gulo/Ang	le Metho	d Relat	órios/Reports	
DTAL RISK CALCULA (values x 10 <sup>-5</sup> )	<b>FE</b> Z1 - E	xternal Ar	ea		Z2 - Roo	ms Blo	ck		Z3 - Sur block	gical Blo	ocks/opera	ating	Z4 - Inte	ensive Ca	are Unit		-	
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4		
<b>BA</b> 2 0.010 0.0%		5			0.001				0.000				0.000					
RU 2 0,000 0,0%		-			0,000				0,000				0,000					
<b>RB</b> ? 42,600 60,9%	— í			<u> </u>	42,422				0,156				0,022			<u> </u>		
RV ? 9,245 13,2%					9,206				0,034				0,005	BrcLight	tning - Inf	ormation		×
RC ? 12,057 17,2%			-		8,484				3,126				0,447					
RM ? 3,442 4,9%			-		2,414				0,900				0,128		RB - Ris	k compone ted line).	ent (physical damage	to structure – flashes to
RW? 2,616 3,7%					1,841		¥ P‡		0,678				0,097					
RZ ? 0,000 0,0%					0,000				0,000				0,000					
Tota] 69,970 100,09	6 0,009	0,000	0,000	0,000	64,368	0,000	0,000	0,000	4,894	0,000	0,000	0,000	0,699					ОК
D1: ? 0,010 0,0%	0,009			0,000	0,001			0,000	0,000			0,000	0,000			0,000		
D2: ? 51,845 74,1%	0,000	0,000	0,000	0,000	51,628	0,000	0,000	0,000	0,190	0,000	0,000	0,000	0,027	0,000	0,000	0,000		
D3: ? 18,115 25,9%	0,000	0,000	-	0,000	12,739	0,000		0,000	4,704	0,000		0,000	0,672	0,000		0,000		
Atualizar/Update	s	alvar MI	P/ Save P	М	Protecti measure	on 1 s: o	) providin n internal	ig the who power an	le building d telecom s	with an I systems;	LPS Class 3) providi	I, include ng zone Z	d lightning 2 with auto	equipote omatic fir	ential bon re detecti	ding; 2) ir on systen	nstall coordinated n; 4) install coordin	SPD protection nated SPD
Salvar Resultados/Save Resu	ts Sa	lvar Con	clusão/Sa	ave	Technica opinion	l E	Due to the imulation	risk R1 = s must be	69.96 x1.0 carried out	00E - 5 b to defin	e much hij e the SPD	gher than t and LPS 1	the tolerab protection	le x1.00E class. wh	3 - 5, mit iich are n	gation me lost appro	easures are necess priate and most ef	ry. However, fective.
				Rua Mi	inistro Mirabear www.biag	i da Cunha ione.com.	a Melo, 192 br   contato	5   Ap 401 .brc@biagic	Candelária	Natal-RN cel.: +55-	Brasil   C 84-98723-8	ep.: 59064-4 753	490					

Figure 11: Result Module Screen and the button for printing the summarized report

ign N*: BRAAC 202 IFDA 0000 <u>Registration data - Hospital</u> sign name: <u>STANDARD E.4 EXAMPI</u> idres 1000 Central Ava. NATAL. <u>Invsical and Environmental Characteristics</u> mod Bach density (1987) (1987)		leport				Kisk Analysis Su (IEC6)	ummary Report 2305-2)			
sign name: STANDARD E.4 EXAMPI dress 1000 Central Ave. NATAL. Physical and Environmental Characteristics mad flavia for an interformation (Interformation)	01 - 0		Design D	ate:	Design N°: Location factor of	BRAAC2021FDA00 Isolated structure: no o	001 - 0 other objects in the vicinity	Design I CDJ	Date:	16/02/20 Table A
Physical and Environmental Characteristics	E HOSPITA	AL - E	conomic val	ses: \$	Withs tand voltage of internal system (PV)			Uw	2,5	
much floods domites (1/low 2/const). !	. KIN 390000	00. Dfazii						KS4	0.40	Ea. (B.7
ustra dimensiona (m):	150. U-10	Callert	(-7)	NG 4,			Resulting parameters	PLD	0,2	Table B. Table B
ljacent structure dimensions (m): L=20; W=	=150; H=10 =30; H=5	- Collectio	m area (m <sup>r</sup> ): m area (m <sup>r</sup> ):	AD . ADj	5.2 - Telecomline			114	0.5	1401010
cation factor of structure Isolated structure	no other ot	jects in the	vicinity	CD 1	Input parameter	C	omment	Symbol	Value	Referen
cation factor of Adj. struc isolated structure Additional features	: no other of	ojects in the	vidnity	CDJ I	Installation factor	Buried		CI	0.5	Table A
ditional protection m Structure not prote	cted by LPS			PB 1	Line type factor	Telecommunication or	r data line	СТ	1.00	Table A
tal people in structur 1000 - Time	in hours pe	r year:	8760 -	Number of Z	Environmental factor	Suburban		CE	0.5	Table A
-External Area Z3 - Surgic	al Blocks/or	perating bloc			Sheet of the (wikit	·		100	≤5Ω/km	Tableb
Rooms Block Z4 - Intens	ive Care Uni	it			Shielding, grounding isolation	;, Shielded buried line (b	oonded)	CLD	0	Table E Table B
- Specific characteristics of the Zones the Zone considered in the Riels Ambrid?	Z1 Væ	Z2 Var	Z3 Vm	Z4 Ver	Adjacent structure (r	n) Length. width. height (	(Li, Wi, Hi)		20 x 30 x 5	
is part of the main structure?	Yes	Yes	Yes	Yes	Location factor of adjacente structure	Isolated structure: no o	other objects in the vicinity	CDJ	1	Table A
umber of persons (nz):	10	950	35	5	Withstand voltage of			Uw	1,5	
me of presence in the Zone, in hours (tz):	8760	8760	8760	8760	internal system (kV)			V.C.A	0.67	E. O
suction factor (type of surface) Type of surface:	Concrete	Linoleum	Linoleum	Linoleum			Resulting parameters	PLD	0.8	Table B
t (Factor Value):	0.01	0.00001	0.00001	0.00001				PLI	0,5	Table B
duction factor (risk of fire or explosion)	"rf" Evolusion	(Table C.5) Fire	Fire	Fire	6 - Risk R1 for the u Zone %	norotected structure R1(10 <sup>5</sup> ) RA RB	RC RM	RU	RV RV	7 R2
	or fire		The	1110	Z1 0,0%	0.009 0.009				
Imount of risk f (Factor Value)	None	Ordinary 0.01	Low 0.001	Low 0.001	Z2 92,0%	64,368 0,001 42,42	22 8,484 2,414	0,000	9,206 1,84	1 0.00
there a REI partitioning in the Zone?	Not	Not	Not	Not	Z3 /.0% Z4 1.0%	4.894 0.000 0.15	2 0.447 0.128	0.000	0.034 0.67	8 0.00
rease factor in the amount of loss	"hz	(Table C.6)			Total R1 100.0%	69.970 0.010 42.6	00 12.057 3.442	0.000	9.245 2.61	6 0.00
resence of a special hazard) Sind of special hazard	Difficulty	Difficulty	Difficulty	Difficulty	% by risk compo	ment 0,0% 60,9	% 17,2% 4,9%	0,0% 1	3,2% 3,79	6 0,09
	of	of	of	of	due to shock	010 0,0% D2 - Phy dama	ge 51,845 74,1%	inter	nal	25,9
Rua Ministro Mirabeau da Cunha Melo, 192 www.biagione.com.br   contato	15   Ap 401   Ca brc@biagione	andelária   Nata .com.br   cel.:+	1-RN   Brasil   -55-84-98723-	Cep.: 59064-49 8753	Z3, Z4. Rua Ménis	ro Mirabeau da Cunha Melo, II www.biazione.com.br.i.conta	925   Ap 401   Candelária   Nata to brc/@biazione.com.br   cel.;+	-RN   Brasil 55-84-98723	Cep.: 59064-4	90
Figure 12 BrcLightning - Risk An	(a) (a): Sun alysis an	nmary of nd Scalin	f risk ana	lysis repo	ge) (b): Summary of r	isk analysis report	(b) t (last but one page dioma/Language	;)		8
	•		0			BrcLightning-2020.00	⊖Português	h Biad		l i
Cadastro/Record Zonas - Dados/Zones - D	Data Dados 1	Téc./Technica	al data Fator	es da AR/RA	dos/Results Metódo ER/RS Meth	od Mét. do Ângulo/Angle	Method Relatórios/Reports			_
Cálculo d x h/Calculate d x h Cálculo Sp	oda Isolado/C	alculate Isolat	ted LPS Cál	culo Planos C	ion of Plans Coverage Verificação	de limites/Limit check				
	• IEC	62305-3	C	) NFPA 780	Height protected	h (m) of LPS for Horiz	ontal protected distance of	l (m) - Cla	ass IV	
○ NBR 5419-3	'd'? • h (	d Data	Base:	Separate:	12					
<ul> <li>NBR 5419-3</li> <li>Is the calculation 'h' or</li> </ul>		eira			10					
NBR 5419-3         Is the calculation 'h' or         Technical Expert:         Fulano de	os Anzois Pere									
NBR 5419-3         Is the calculation 'h' or         Technical Expert:         Fulano de         Design name/Rev:	os Anzois Pere			~						
NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano do         Design name/Rev:       Image: Calculation of the calculat	os Anzois Pere	ng protection			8					
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       I         No. LPS:       1         LPS Design Class:	os Anzois Pere	ng protection	[	Class IV						
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       I         No. LPS:       1         LPS Design Class:       Rolling sphere radius (m):	os Anzois Pere	ng protection	Г Г	Class IV 60						
NBR 5419-3         Is the calculation 'h' or         Technical Expert:         Fulano de         Design name/Rev:         No. LPS:         1         LPS Design Class:         Rolling sphere radius (m):         Horizontal protected distance -	DS Anzois Pere LPS for parki d (m):	ng protection	[ [ [	Class IV 60 30,0						
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       Image: Calculation 'h' or         No. LPS:       1         LPS Design Class:       Rolling sphere radius (m):         Horizontal protected distance -       Height of LPS (calculated) - h (calculated) - h (calculated)	DS Anzois Pere LPS for parki d (m): (m):	ng protection	[ [ [	Class IV 60 30,0 8,04						
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       Image: Calculation 'h' or         No. LPS:       1         LPS Design Class:       Rolling sphere radius (m):         Horizontal protected distance -       Height of LPS (calculated) - h (         Height of LPS (Colsign) - h p (m)	LPS for parki d (m): (m):	ng protection		Class IV 60 30,0 8,04 10,0		8.68 8.5 11.112 11.113 11.15 1	22.14 22.15 25.55 29.06 20.020			
NBR 5419-3         Is the calculation 'h' or         Technical Expert:         Fulano de         Design name/Rev:         No. LPS:         1         LPS Design Class:         Rolling sphere radius (m):         Horizontal protected distance -         Height of LPS (calculated) - h (         Height of LPS (Design) - hp (m)         Horizontal protected distance (	LPS for parki d (m): (m): 1): Design) - d (n	ng protection	ן ך ך ך	Class IV 60 30,0 8,04 10,0 33,2		0 0 10 10 10 10 10 10 10 10 10 10 10 10	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
NBR 5419-3         Is the calculation 'h' or         Technical Expert:         Fulano de         Design name/Rev:         No. LPS:         1         LPS Design Class:         Rolling sphere radius (m):         Horizontal protected distance -         Height of LPS (Design) - hp (m)         Horizontal protected distance (	LPS for parki d (m): (m): (m): (m):	ng protection		Class IV 60 30,0 8,04 10,0 33,2		0 8 8 16 1 16 1 18 1 19 1 19 1 19 1 19 1 19 1 19 1 19	9 9 9 5 5 5 9 9 9 9 7 7 7 7 7 7 7 7 7 7			
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       Image: Calculation 'h' or         No. LPS:       1         LPS Design Class:       Rolling sphere radius (m):         Horizontal protected distance -       Height of LPS (calculated) - h (m)         Horizontal protected distance (Image: Classing Protected distanc	ss Anzois Pere LPS for parki d (m): (m): (n): Design) - d (n	ng protection	[ [ [ [ ]	Class IV 60 30,0 8,04 10,0 33,2		98 101 133 133 137 137 137 137 137 137 137 13	99 99 99 99 99 99 99 99 99 99 99 99 99			
○ NBR 5419-3         Is the calculation 'h' or         Technical Expert:       Fulano de         Design name/Rev:       Image: Calculated         No. LPS:       1 migest         LPS Design Class:       Rolling sphere radius (m):         Horizontal protected distance -       Height of LPS (calculated) - h (         Height of LPS (Design) - hp (m)       Horizontal protected distance (         Image: Class in the image in the	DPS Anzois Pere LPS for parki d (m): (m): (m): (h): Design) - d (n	ng protection n):	[ [ [ [ ]	Class IV 60 30,0 8,04 10,0 33,2 1		q 135 0 137 0 100 0 1000	23 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			

Figure 13: Example of calculation of h x d for Class IV

BrcLightning - Risk Analysis and Scaling for D	Protection	against Atmospheric Disc	BrcLightning-2020.00 O Português  BrcLightning-2020.00
Cadastro/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fa	tores da AR/RA F	actors Resultados/Results Metódo ER/	/RS Method Mét. do Ângulo/Angle Method Relatórios/Reports
Cálculo d x h/Calculate d x h	Cálculo Planos Co	bertura/Calculation of Plans Coverage V	/erificação de limites/Limit check
● NBR 5419-3 ○ IEC 62305-3	O NFPA 780	Design limits	
Are there any hazardous areas? <ul> <li>N O Y</li> <li>Data Base:</li> </ul>	O Separate:	Limit for height 'h1', keeping the distance	e 'd1' from the LPS (m): 3,26 Maintaining the coverage margin values (mc) and
Technical Expert:	-	Limit for the distance 'd1', keeping the he	eight 'h1' of the LPS (m): 17,19 the project height (hp) of the LPS.
Design name/Rev:			
No. LPS: 1 LPS for parking protection	,		Height protected h (m) of LPS for Horizontal protected distance d (m) - Class IV
LPS Design Class:	Class IV 🗸		12
Rolling sphere radius (m)	60		10
Height 'h1' of the structure to be protected (m):	2,5		8
Horizontal distance 'd1' of the structure to be protected (m):	15,0		6
Coverage margin 'mc' for the design of the LPS (m): (m):	0,5		
Height 'hc' calculated for the structure protection LPS (m):	10,44		0.0 1.19 1
Horizontal protection distance 'dn' of design provided by the LPS (m):	36.00	If all or some of the chart legend	—— R • h1 • Lim h11 • Lim d11
Margin of coverage 'mcp'. of project, provided by the LPS (m).	1.21	markers aren't visible, it is because there	
E New @	LM.	values: h1≈h11 and / or d1≈d11.	
		11	
Rua N	Ainistro Mirabeau da Cu	nha Melo, 1925   Ap 401   Candelária   Natal-RN   B	Brasil   Cep.: 59064-490
	www.biagione.co	m.br   contato.brc@biagione.com.br   cel.: +55-84-9	98723-8753



o/Record Zonas - Da	dos/Zones - Da	ta Dados Téc	./Technical data	Fatores da AR/RA F	actors Rest			
ulo d x h/Calculate d x	h Cálculo Spd	a Isolado/Calci	ilate Isolated LPS	Cálculo Planos Co	bertura/Calci		Complementary Design Data	
						Design name:	LPS for parking protection	
NBR 541	9-3	O IEC 623	305-3	O NFPA 780	Design lii	City:	Natal	
Are there any h	azardous areas	? • N • Y	Data Base:	○ Separate: ●	Limit for h			
Technical Expert					Limit for tl	Technical Report:	The option for an isolated LPS with a mast of 12m (1.	56m in addition to the
Design name/Rev							calculated) was to allow adjustment in the installation.	
No. LPS:	1 × LP	S for parking pr	otection					
LPS Design Class	:			Class IV 🗸				
Rolling sphere ra	lius (m)			60		Technical Expert:	Dantas Sicrano B No Identifica	ation: Crea 99999-0
Height 'h1' of the	structure to be pr	rotected (m):		2,5		reennen Espera		
Horizontal distan	e 'd1' of the stru	cture to be prot	ected (m):	15,0			OK!	
Coverage margin	mc' for the desig	n of the LPS (n	n): (m):	0,5				
							2	
Height 'hc' calcul	ted for the struc	ture protection	LPS (m):	10,44			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 0 0 4
Design height 'hp'	for the LPS of p	rotection struct	ure (m):	12,00		64 1 (1 1		
Horizontal protec	tion distance 'dp'	, of design, prov	rided by the LPS (n	n): 36,00	markers aren't	visible, it is because there		
Margin of covera	e 'mcp', of proje	ct, provided by	the LPS (m)	1,21	is an overlap d	lue to the similarity of		
	ų.	New	÷	bd.	values. III~III	and / of dradit.		

Figure 15: Pop-up for supplementary data

## 5. Rolling sphere module

This Module maintains the 4 Sections of the original version presented in SIPDA XV [1] and is in accordance with NBR 5419-3 [4]; IEC 62035-3 [5] and NFPA 780 [6]. However, the possibility of performing the sizing separately and the printing of the report of this dimensioning was introduced in all four sections. This can be seen in the sequence. Other improvements have been introduced and are detailed in each of the sections.

## 5.1. Section for sizing 'h' or 'd'

In the version presented in SIPDA XV [1], the system included one graph related to the calculation of the protected horizontal distance at ground level or on a reference surface when the height of the LPS is known and another for the calculation of the height, required to provide protection of a horizontal distance at ground level or a reference surface. Now, these graphs have been integrated into one (as shown in Figure 13). When calculating the height, it is a non-standard commercial value, this version provided an input field to adjust the calculated height. In addition, it was added the option for issuing the report of this dimensioning.

In this section, the height of the insulated LPS is scaled (mast or air termination system of the insulated (only one) overhead wire to protect a specific structure) based on the required LPS Class and the determined coverage margin, including the characterization of a structure with or without hazardous area, as shown in Figure 14. Improvements were also incorporated to print the report of the sizing (the button with the printer icon) and the option to scale the LPS of a database design or a separate design for the issuance of

=

the report, it is necessary to provide additional data, as shown in Figure 15 (in the case of a separate project). The pop-up appears when the print button is pressed. The issued report is shown in Figure 16. Separated projects are not saved in the database.

When the design definitions of the structure to be protected ('h1' and 'd1', besides 'mc') do not allow the sizing of the LPS to the defined protection Class, the System issues an alert of the impossibility of sizing and indicates the limit of the maximum distance and height the structure can be protected by LPS, as shown in Figure 17.

ghtning - Risk Analysis and Scaling for Protection against Atmosphe Height Sizing Report for a LPS - Rolling Sphere Method (Structure without Hazardous Areas)	ric Discharge
Data Standard: IEC 62305-3 Davian come:	e contration I De
I DS Number	12 Diotection LP3
LPS resentation:	Central LPS
Class of LPS:	Classe IV (60m)
Structure height to protect - hl (m):	2.50
Horizontal distance to be protected - dl(m):	15.00
Design coverage margin - mc (m):	0.50
Calculated height for LPS - hc (m):	10.44
Design height for LPS - h (m):	12.00
Horizontal protected distance, design - d (m):	36.00
Coverage margin. design - mcp (m)	1.21
Limit for height 'h1'. keeping the 'd1' from the LPS (m):	3.26
Limit for the distance 'dl'. maintaining the 'hl' of the LPS (m):	17.19
$ \begin{array}{c} 14 \\ 12 \\ 10 \\ 8 \\ 6 \\ 4 \\ 2 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0$	
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	6, 2, 6, (m)
— R ● h1 ● Lim h1 ● Lim d1	

there is an overlap due to the similarity of values: hl≈hl1 and / or

Technical Report:

The option of an isolated LPS with a mast of 12 m (1.56 min addition to the calculated one) will be to allow adjustment in installation.

Araujo, Sivrano P.

Crea 9999-0

Rua Ministro Mirabeau da Cunha Melo, 1925 | Ap 401 | Candelária | Natal-RN | Brasil | Cep.: 59064-490 www.biagione.com.br | contato.brc@biagione.com.br | ce1.: +55-84-98723-8753

Figure 16: Example report of sizing the isolated LPS

Perend Zenes Ded	as/Zanas Data	Dadas Tás /T	ashnisal data 1	Fotonon do AD/DA I	Fastars Damitadas/Dam	ulta Matéria TD/DC Mathad	Mét de Ânoule/A	nele Method   Beletéries/Benert	
o/Record Zonas - Dad	Ds/Zones - Data	Dados Tec./T	echnical data	ratores da AR/RA I	Factors Resultados/Res	uits Metodo ER/RS Method	Met. do Angulo/A	ngie Method Relatorios/Report	8
ulo d x h/Calculate d x h	Cálculo Spda Is	solado/Calculat	e Isolated LPS	Calculo Planos Co	bertura/Calculation of P	lans Coverage Verificação d	le limites/Limit check	۲ ۲	
A NED 5410	2	O IEC 62206		O NEDA 790	Desire l'este				
NDK 3419		0 IEC 02505		O NFPA 780	Design limits				
Are there any has	ardous areas?	ON OY I	Data Base:	○ Separate: ●	Limit for height 'h1', ke	eeping the distance 'd1' from the	e LPS (m): 0,0	the project height (hp) of	e margin values (mc) f the LPS.
Technical Expert:				~	Emilt for the distance	di, keeping die height hit of d	iie 11 5 (iii).   0;		
Design name/Rev:		11.05		×   ×		Brolightning		×	
LPS Design Class:	ji jeenua	1115		Class II 🗸	Ī	breaghtning			
Rolling sphere radi	15 (m)				d1 Máx/Max:	It isn't possible to p	protect the structure with	n 1 (ONE) LPS for the	
Height 'h1' of the st	ructure to be prote	ected (m):		2,5	16,81	Selected Class and t	the reported data.		
Horizontal distance	'd1' of the structur	re to be protect	ed (m):	20,0					
Coverage margin 'n	c' for the design o	f the LPS (m): (	(m):	0,5				ОК	
	10 11 1 1		<b>a</b> ( )		-				
Design height 'hn' f	or the LPS of prote	e protection LP:	s (m).		-				
Horizontal protecti	on distance 'dp', of	design, provide	ed by the LPS (m	):	-				
Margin of coverage	'mcp', of project,	provided by the	LPS (m)		-				
в	<b>N</b> •	New	4	M	1				
	· ·								
			Rua Fi	a Ministro Mirabeau da Cu www.biagione.co gure 17: Alert	nha Melo, 1925   Ap 401   Ca m.br   contato.bro@biagione.c t for impossibility	ndeläria   Natal-RN   Brasil   Cep.: 59 om.br   cel.: +55-84-98723-8753 ° of isolated LPS sizir	9064-490 ng		
rcLightning - F	Risk Analys	sis and Se	Rua Fi caling for	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b>	nha Melo, 1925   Ap 401   Car m br   contato.brc@biagione.o t for impossibility against Atmosp	ndeläria   Natal-RN   Brasil   Cep.: 59 m br   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge	9064-490 ng	Idioma/Language	37
rcLightning - F	tisk Analys	sis and So	Rua Fi caling for	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b>	nha Melo, 1925   Ap 401   Ca om br   contato.bro@biagione.o t for impossibility <b>against Atmos</b> [	ndeläria   Natal-RN   Brasil   Cep.: 59 om.br   cel.: +55-84-98723-8753 of isolated LPS sizin oheric Discharge	0064-490 ng BrcLightning-2020.0	Idioma/Language	
rcLightning - F	isk Analys	sis and So	Rua Fi caling for	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b>	nha Melo, 1925   Ap 401   Ca om br   contato.bro@biagione.o t for impossibility against Atmosp Factors   Resultados/Ress	ndeläria   Natal-RN   Brasil   Cep.: 55 om br   cel.: +55-84-98723-8753 • of isolated LPS sizin <b>Dheric Discharge</b>	2064-490 ng BrcLightning-2020.0	Idioma/Language O O Português	
rcLightning - F	Risk Analys	sis and So Dados Téc./T	Rua Fi caling for 'echnical data 1	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b> Fatores da AR/RA I	nha Melo, 1925   Ap 401   Ca m br   contato bro@biagione or t for impossibility against Atmosp Factors   Resultados/Resu	ndelária   Natal-RN   Brasil   Cep.: 56 om.br   cel: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge	0064-490 ng BrcLightning-2020.0 Mét. do Ângulo/A: limites/Limit check	Idioma/Language O Português	
rcLightning - F ro/Record Zonas - Dad o d x h/Calculate d x h	<mark>Eisk Analys</mark> Ds/Zones - Data Cálculo Spda Iso	sis and So Dados Téc./T lado/Calculate	Rua Fi caling for echnical data 1 Isolated LPS	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b> Fatores da AR/RA I Cálculo Planos Cob	nha Melo, 1925   Ap 401   Ca mbr   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndelāna   Natal-RN   Brasil   Cep.: 59 om br   cel: +55-84-98723-8753 of isolated LPS sizin <b>Dheric Discharge</b> ults   Metódo ER/RS Method ns Coverage   Verificação de	1064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check	Idioma/Language O Português	sh BIRGIONE
rcLightning - F To/Record Zonas - Dad o d x h/Calculate d x h	tisk Analys os/Zones - Data Cálculo Spda Iso 3	sis and S Dados Téc./T lado/Calculate ) IEC 62305-	Rua Fi caling for echnical data 1 Isolated LPS	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b> Fatores da AR/RA I Cálculo Planos Cob	nha Melo, 1925   Ap 401   Ca om br   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu	ndelária   Natal-RN   Brasil   Cep.: 55 om br   cel.: +55-84-98723-8753 • of isolated LPS sizin <b>Dheric Discharge</b> ults   Metódo ER/RS Method ns Coverage   Verificação de	0064-490 ng BrcLightning-2020.0 Mét. do Ângulo/A limites/Limit check	Idioma/Language O Português	sh BIRGIONE &
rcLightning - F To/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419-	Risk Analys Ds/Zones - Data Cálculo Spda Iso 3 @	Sis and So Dados Téc./T lado/Calculate	Rua Fi caling for echnical data 1 Isolated LPS    4 -3	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob O NFPA 780	nha Melo, 1925   Ap 401   Ca om br   contato bro@biagione o t for impossibility against Atmosp Factors Resultados/Resu Factors Resultados/Resu	ndelária   Natal-RN   Brasil   Cep.: 56 om.br   cel.: +55-84-98723-8753 of isolated LPS sizin oheric Discharge alts   Metódo ER/RS Method ns Coverage Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check	Idioma/Language	sh BIRGIONE C
rcLightning - F ro/Record Zonas - Dad o d x h/Calculate d x h NBR 5419 Is there an haza	tisk Analys os/Zones - Data Cálculo Spda Iso 3 @ rdous areas? (	Dados Téc./T lado/Calculate DIEC 62305- N © Y   D	Rua Fi caling for 'echnical data 1 Isolated LPS    -3 Pata Base:	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert <b>Protection</b> Fatores da AR/RA I Cálculo Planos Cob O NFPA 780 O Separate: ()	nha Melo, 1925   Ap 401   Ca m br   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Rest hertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 56 om.br   cel: +55-84-98723-8753 of isolated LPS sizin <b>Dheric Discharge</b> ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check	Idioma/Language O Português	sh BIRGIONE S
rcLightning - F ro/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419- Is there an haza Technical Expert:	Risk Analys os/Zones - Data Cálculo Spda Iso 3 (e rdous areas? ( Fulano dos Anzo	sis and S Dados Téc./T lado/Calculate DIEC 62305- DN @ Y D is Pereira	Rua Fi caling for cechnical data 1 Isolated LPS	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob ONFPA 780 OSeparate: O	nha Melo, 1925   Ap 401   Ga m br   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Ress Pertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 59 om.br   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check	Idioma/Language O Português	sh BIRGIONE
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419 Is there an haza Technical Expert: Design name/Rev : No. LPS:	Cálculo Spda Iso Cálculo Spda Iso 3 rdous areas?	sis and So Dados Téc./T lado/Calculate DIEC 62305- DN @Y D is Pereira	Rua Fi caling for echnical data 1 Isolated LPS    -3 Data Base:	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob NFPA 780 Separate: •	nha Melo, 1925   Ap 401   Ca mbr   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndelāna   Natal-RN   Brasil   Cep.: 56 om br   cel: +55-84-98723-8753 of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check ermination system rod air-termination sy	Idioma/Language O Português	sh BIRGIONE G
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS:	tisk Analys os/Zones - Data Cálculo Spda Iso 3 @ rdous areas? C Fulano dos Anzo	sis and So Dados Téc./T lado/Calculate DIEC 62305- N @ Y   D is Pereira	Rua Fi caling for echnical data 1 Isolated LPS    -3 Data Base:	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob O NFPA 780 O Separate: O	nha Melo, 1925   Ap 401   Ca om br   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 55 om br   cel.: +55-84-98723-8753 of isolated LPS sizin oheric Discharge alts   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar limites/Limit check ermination system rod air-termination system	Idioma/Language O O Português	sh BIRGIONE C
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class:	Sisk Analys os/Zones - Data Cálculo Spda Iso 3 @ rdous areas? C Fulano dos Anzo 1 V	sis and So Dados Téc./T lado/Calculate DIEC 62305- N @ Y D is Pereira	Rua Fi caling for 'echnical data 1 Isolated LPS    -3 Data Base:	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob NFPA 780 Separate: •	nha Melo, 1925   Ap 401   Ca om br   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Resu Factors   Resultados/Resu	ndelaria   Natal-RN   Brasil   Cep.: 56 om.br   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	2064-490 ng BrcLiphtning-2022.0.0 Mét. do Ángulo/Ar limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português	sh BRGIONE 20 8
rcLightning - F to/Record Zonas - Dad o d x h/Calculate d x h NBR 5419. Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m):	tisk Analys os/Zones - Data Cálculo Spda Iso 3 @ rdous areas? ( [Fulano dos Anzo ]	sis and S Dados Téc./T lado/Calculate DIEC 62305- N @ Y D is Pereira	Rua Fi caling for 'echnical data 1 Isolated LPS    -3 Pata Base:	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob O NFPA 780 O Separate: O V	nha Melo, 1925   Ap 401   Ca mbr   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Resu rertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 56 om.br   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 Mét. do Ângulo/Ar Imites/Limit check emination system rod air-termination system termination system	Idioma/Language O Português  Englis ngle Method Relatórios/Reports	sh BRGIONE &
rcLightning - F ro/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419 Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio	Risk Analys         Os/Zones - Data         Cálculo Spda Iso         3         rdous areas?         Fulano dos Anzo         1         1         vala         coverage plane	sis and S Dados Téc./T lado/Calculate IEC 62305- N • Y D is Pereira	Rua Fi caling for cechnical data 1 Isolated LPS	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob ONFPA 780 OSeparate: O	nha Melo, 1925   Ap 401   Ga mbr   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Ress errtura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 59 ombr   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 Mét. do Ángulo/Ar Imites/Limit check ermination system termination system termination system	Idioma/Language O Português	sh BRGIONE G
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio	tisk Analys os/Zones - Data Cálculo Spda Iso 3 (e rdous areas? ( Fulano dos Anzo 1 ) 1 ) nal coverage plane nal coverage plane	sis and S Dados Téc./T lado/Calculate ) IEC 62305- ) N () Y D is Pereira h(pFc) (m): plane (m):	Rua Fi caling for echnical data 1 Isolated LPS    -3 Data Base:	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob NFPA 780 Separate: •	nha Melo, 1925   Ap 401   Ca mbr   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndelāna   Natal-RN   Brasil   Cep.: 59 om br   cel: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 I Mét. do Ángulo/Ar limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português	sh BIRGIONE G
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio Coverage margin 'm	Cálculo Spda Iso Cálculo Spda Iso 3 @ rdous areas? () Fulano dos Anzo 1 1 nal coverage plane nal (rFp) coverage c' for calculating t	sis and So Dados Téc./T lado/Calculate DIEC 62305- N • Y D is Pereira h(pFc) (m): plane (m): he limit distance	Rua Fi caling for echnical data 1 Isolated LPS    -3 Data Base:	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob O NFPA 780 O Separate: •	nha Melo, 1925   Ap 401   Ca mbr   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndefana   Natal-RN   Brasil   Cep.: 56 om br   cel: +55-84-98723-8753 of isolated LPS sizin pheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 Ing BrcLightning-2020.0 I Mét. do Ângulo/Ar limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português	sh BIRGIONE C
rcLightning - F	Sisk Analys Sizones - Data Cálculo Spda Iso 3 rdous areas? Fulano dos Anzo Fulano dos Anzo I 1 I I I I I I I I I I I I I	sis and So Dados Téc./T lado/Calculate DIEC 62305- N @ Y D is Pereira h(pFc) (m): plane (m): he limit distance	Rua Fi caling for echnical data 1 Isolated LPS    -3 Pata Base:	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob O NFPA 780 O Separate: • O	nha Melo, 1925   Ap 401   Ca om br   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Rest vertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 56 om.br   cel: + 55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage Verificação de LPS Type	1064-490 ng BrcLightning-2020.0 Mét. do Ângulo/A limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português  Englis ngle Method Relatórios/Reports ystem	sh BIRGIONE &
rcLightning - F To/Record Zonas - Dad o d x h/Calculate d x h NBR 5419 Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio Coverage margin 'm Radius 'r' of the haz Struture height limi	Sisk Analys         Os/Zones - Data         Cálculo Spda Iso         3         rdous areas?         I	sis and S Dados Téc./T lado/Calculate IEC 62305- N O Y D is Pereira	Rua Fi caling for cechnical data 1 Isolated LPS	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob ONFPA 780 OSeparate: O Construction Constr	nha Melo, 1925   Ap 401   Ca m br   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Resu ertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 50 ombr   cel: + 55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLiphtning-2020.0 I Mét. do Ángulo/Ai Iimites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português  © Englis ngle Method Relatórios/Reports ystem	sh BRGIONE
rcLightning - F To/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419 Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio Coverage margin 'm Radius 'r' of the haz Struture height limi Horizontal distance	Sisk Analys         Os/Zones - Data         Cálculo Spda Iso         3         rdous areas?         I	sis and S Dados Téc./T lado/Calculate IEC 62305- N • Y D is Pereira	Rua Fi caling for cechnical data 1 Isolated LPS    -3 Data Base:	a Ministro Mirabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob ONFPA 780 OSeparate: O Construction Constr	nha Melo, 1925   Ap 401   Ga mbr   contato bro@biagione o t for impossibility against Atmosp Factors   Resultados/Ress ertura/Calculation of Pla	ndelária   Natal-RN   Brasil   Cep.: 59 ombr   cel.: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	0064-490 ng BrcLightning-2020.0 I Mét. do Ángulo/Ar Imites/Limit check emination system termination system termination system termination system	Idioma/Language O Português  © Englis ngle Method Relatórios/Reports ystem	sh BRAINE
rcLightning - F ro/Record Zonas - Dad o d x h/Calculate d x h O NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio Coverage margin 'm Radius 'r' of the haz Struture height limit Horizontal distance Height Limit of stru-	Risk Analys	sis and S Dados Téc./T lado/Calculate ) IEC 62305- ) N () Y D is Pereira h(pFc) (m): plane (m): he limit distanc :- d1(Lim) (m): uus areas - h1(ha dous areas - d1)	Rua Fi caling for caling for cechnical data 1 Isolated LPS	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob Separate: •	nha Melo, 1925   Ap 401   Ga mbr   contato bro@biagione o t for impossibility against Atmosp Factors Resultados/Resu errtura/Calculation of Pla	ndelānā   Natal-RN   Brasil   Cep.: 59 om br   cel: +55-84-98723-8753 • of isolated LPS sizin oheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 ng BrcLightning-2020.0 Mét. do Ángulo/Ar limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language	sh BIRGIONE
rcLightning - F o/Record Zonas - Dad o d x h/Calculate d x h NBR 5419- Is there an haza Technical Expert: Design name/Rev : No. LPS: LPS Design Class: LPS height - h (m): Height of the fictio Radius of the fictio Coverage margin 'm Radius 'r' of the haz Struture height limit Horizontal distance Height Limit of stru Distance Limit of stru	Cálculo Spda Iso Cálculo Spda Iso Cálculo Spda Iso 3 (Calculo Spda Iso 1 (Fulano dos Anzo 1 (Fulano dos Anzo 1 (Fp) coverage c' for calculating t ardous area (m): t - h1 (Lim) (m): limit for structure ucture with hazardo ructure with hazardo	sis and So Dados Téc./T lado/Calculate DIEC 62305- N • Y D is Pereira h(pFc) (m): plane (m): he limit distanc : - d1(Lim) (m): pus areas - h1(hi dous areas - d1	Rua Fi caling for echnical data 1 Isolated LPS	a Ministro Minabeau da Cu www.biagione.cc gure 17: Alert Protection Fatores da AR/RA I Cálculo Planos Cob ONFPA 780 OSeparate: •	nha Melo, 1925   Ap 401   Ca mbr   contato.bro@biagione.o t for impossibility against Atmosp Factors Resultados/Resu rertura/Calculation of Pla	ndefana   Natal-RN   Brasil   Cep.: 56 om br   cel: +55-84-98723-8753 of isolated LPS sizin pheric Discharge ults   Metódo ER/RS Method ns Coverage   Verificação de LPS Type	1064-490 Ing BrcLightning-2020.0 I Mét. do Ângulo/Ar limites/Limit check ermination system rod air-termination system termination system termination system	Idioma/Language O Português  Englis ngle Method Relatórios/Reports ystem	sh BIRGIONE C

Figure 18: Screen with pop-up to define the LPS type

	nes - Data Dados Téc	c./Technical data	Fatores da AR/RA Fac	tors Resultados/Results Metódo ER/RS Method Mét. do Ângulo/Angle Method Relatórios/Reports
h/Calculate d x h Cálcu	ilo Spda Isolado/Calcu	ate Isolated LPS	Cálculo Planos Cobert	ura/Calculation of Plans Coverage Verificação de limites/Limit check
O NBR 5419-3	@ IEC 623	05-3	○ NFPA 780	LPS Coverage Plan for Class I of the Structure and Incorporated Hazardous Areas Lin
Is there an hazardou	s areas? ON OY	Data Base:	○ Separate: ●	
Technical Expert:  Ful:	no dos Anzois Pereira		~	12
Design name/Rev :			~	10
No. LPS: 1	LPS for a gas stati	on		
Vertical rod air-terminati	on system			h(m) 8
LPS Design Class:			Class I 🗸	6
LPS height - h (m):			10,0	
Height of the fictional co	verage plane h(pFc) (m)	:	6,0	4
Radius of the fictional (rl	p) coverage plane (m):		3,04	
Coverage margin 'mc' for	calculating the limit dis	tance of the structu	ure (m): 0,5	
Radius 'r' of the hazardou	s area (m):		1,5	
Struture height limit - h1	(Lim) (m):		4,60	
Horizontal distance limit	for structure - d1(Lim)	(m):	1,61	d(m)
Height Limit of structure	with hazardous areas - h	1(ha) (m):	5,65	
Distance Limit of structu	re with hazardous areas	d1 (Ae) (m	2,68	
	n			The LPS conductor does not cross or won't cross the hazardous area, but does not meet the coverage

Figure 19: Calculation of the Fictional Coverage Plan with alert

5.2. Evaluation section of the limits of an installed LPS

This last section of the Rolling Sphere Module is intended to assess the protection that a specific LPS can provide, considering all the Classes of Protection established by NBR-5419-3 [4]; IEC 62305-3 [5] and NFPA 780 [6]. Improvements have been made to the definition of the LPS type and alert with a technical note, as shown in Figure 20.



## 6. Angle Method Module

This module maintains the three Sections of the original version presented in SIPDA XV [1] and in accordance with NBR 5419-3 [4]; IEC 62035-3 [5]. However, it was introduced in all of them the possibility to carry out the sizing separately and printing the report of this. Considering that this method is not widely used, only an improvement was introduced, in addition to those reported above, in Section 1, as detailed below.

## 6.1. Height or Distance Sizing (Angle Method)

This Section calculates the horizontal distance protected at ground level or from a reference surface when the height of the LPS is known. It also allows you to calculate the height required for an LPS when you know the horizontal distance that needs to be protected, as shown in Figure 21.

o/Record   Zonas - Dados/Zones - Data   Dados Téc./Technical data   Fatores da AR/RA Fac	tors Resultados/Results Metódo ER/RS Method Mét, do Ângulo/Angle Method Relatórios/Reports
ulo d x h/Calculate d x h. Cálculo Suda Isolado/Calculate Isolated LPS   Verificação Proteção	Protection Check
○ NBR 5419-3	Height protected h (m) of LPS for Horizontal protected distance d (m) - Class III
Calculate 'h' or 'd':      h     d     Data Base:     O     Separate:	35
Technical Expert:       Fulano dos Anzois Pereira         Project name :       Image: Class of LPS         No. LPS:       Image: Class of LPS         Class of LPS:       Class III means         Radius R (m):       45         Horizontal protected distance - d (m):       20,0         Height of LPS (calculated) - h (m):       13,80         Horizontal protected distance (calculated)- d (m):       20,02         Calculated protection angle for LPS (° - degree):       55,4         Height of LPS (Design) - h (m):       14,0         Horizontal protected distance (Design) - d (m):       20,11         Design protection angle for LPS (° - degree):       55,2         Image: Design protection angle for LPS (° - degree):       55,2         Image: Design protection angle for LPS (° - degree):       55,2         Image: Design protection angle for LPS (° - degree):       55,2         Image: Design protection angle for LPS (° - degree):       55,2         Image: Design protection angle for LPS (° - degree):       140	25 20 15 10 10 10 10 10 10 10 10 10 10
www.biagione.com.b	- Longhing and by Longhing and by Longhing 65, 04, 00722, 0752
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag	Calculation of the height x distance cainst Atmospheric Discharge Idioma/Language
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag	Calculation of the height x distance calculation of the
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag	Calculation of the height x distance Calculation of the
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac alo d x h/Calculate d x h Cálculo Spda Isolado/Calculate Isolated LPS Verificação Proteção	Calculation of the height x distance  Calculation of the height x dist
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac do d x h/Calculate d x h <u>Cálculo Spda Isolado/Calculate Isolated LPS</u> Verificação Proteção NBR 5419-3 © IEC 62305-3 O NFPA 780	Calculation of the height x distance Calculation of the
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag vRecord Zonas - Dados Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac lo d x h/Calculate d x h <u>Cálculo Spda Isolado/Calculate Isolated LPS</u> Verificação Proteção <u>NBR 5419-3</u> <b>BIEC 62305-3 NFPA 780</b> Calculate 'h' or 'd': <b>@ h </b> d Data Base: <u>Separate</u> : <b>@</b>	Calculation of the height x distance  Calculation of the height x dist
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag vRecord Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac to d x h/Calculate d x h Cálculo Spda Isolado/Calculate Isolated LPS Verificação Proteção NBR 5419-3 @ IEC 62305-3	Calculation of the height x distance  Calculation of the height x dist
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag vRecord Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac do d x h/Calculate d x h Cálculo Spda Isolado/Calculate Isolated LPS Verificação Proteção NBR 5419-3 ® IEC 62305-3 NFPA 780 Calculate 'h' or 'd': ® h d Data Base: Separate: ® Technical Expert: Fulano dos Anzois Pereira Project name : Y	Calculation of the height x distance
Figure 21: C cLightning - Risk Analysis and Scaling for Protection ag vRecord Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac to d x h/Calculate d x h Calculo Spda Isolado/Calculate Isolated LPS Verificação Proteção NBR 5419-3 • IEC 62305-3 • NFPA 780 Calculate 'h' or 'd': • h • d Data Base: • Separate: • Technical Expert: Fulano dos Anzois Pereira Project name : • • • • • • • No. LPS: • 1 • Centría LPS • Clare # •	Calculation of the height x distance
cLightning - Risk Analysis and Scaling for Protection age         v/Record       Zonas - Dados/Zones - Data       Dados Téc./Technical data       Fatores da AR/RA Fac         do d x h/Calculate d x h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         to d x h/Calculate d x h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         to d x h/Calculate 'h' or 'd': <ul> <li>h</li> <li>d</li> <li>Data Base:</li> <li>Separate:</li> <li>Technical Expert:</li> <li>Fulano dos Anzois Pereira</li> <li>Project name :</li> <li>I</li> <li>Centria LPS</li> <li>Class II</li> <li>Radius R (m):</li> <li>Suggested</li> <li>30</li> </ul>	Calculation of the height x distance
cLightning - Risk Analysis and Scaling for Protection age         v/Record       Zonas - Dados/Zones - Data       Dados Téc./Technical data       Fatores da AR/RA Fac         do d x h/Calculate d x h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         to d x h/Calculate d x h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         NBR 5419-3       IEC 62305-3       NFPA 780         Calculate 'h' or 'd':       h d       Data Base:       Separate:         Technical Expert:       Fulano dos Anzois Pereira       Yei         Project name :       Yei       Yei       Yei         No. LPS:       1       Centria LPS       Class II         Radius R (m):       Suggested       30         Horizontal protected distance - d (m):       15,20       15,2	Calculation of the height x distance  Tainst Atmospheric Discharge  Tecliptoing-200.00  Português  English  Frotection Check  Protection Check
cLightning - Risk Analysis and Scaling for Protection age         v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac         do d x h/Calculate d x h         Cálculate d x h         Cálculate d x h         Cálculate 'h' or 'd':          h       d         Data Base:       Separate:          Project name :       Image: Calculate Isolated LPS         No. LPS:       1         1       Centria LPS         Class of LPS:       Class III M         Radius R (m):       15,20         Height of LPS (calculated) - h (m):       16,50	Calculation of the height x distance
Figure 21: C         cLightning - Risk Analysis and Scaling for Protection age         v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac         do dx h/Calculate dx h         Cálculate dx h         Cálculate 'h' or 'd':          h       d         Data Base:       Separate:          Project name :          No. LPS:       1         Class ILPS       Class ILPS         Class ILPS       30         Horizontal protected distance - d (m):       15,20         Height of LPS (calculated) - h (m):       15,15	Calculation of the height x distance
r/Record       Zonas - Dados/Zones - Data       Dados Téc./Technical data       Fatores da AR/RA Fac         ulo dx h/Calculate dx h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         ulo dx h/Calculate dx h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         ulo dx h/Calculate d'n or 'd':       h       d       Data Base:       Separate:       Image: S	Calculation of the height x distance  Tainst Atmospheric Discharge  Tecliphnang-2020.0  Portuguès  English  Protection Check
r/Record       Zonas - Dados/Zones - Data       Dados Téc./Technical data       Fatores da AR/RA Fac         do dx h/Calculate dx h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         to dx h/Calculate dx h       Cálculo Spda Isolado/Calculate Isolated LPS       Verificação Proteção         NBR 5419-3       IEC 62305-3       NFPA 780         Calculate 'h' or 'd':       h       d       Data Base:       Separate:       Image: Separate: <td>Calculation of the height x distance  Tainst Atmospheric Discharge  Tecliphnang-2020.0  Portuguès  English  Tecliphnang-2020.0  Protection Check</td>	Calculation of the height x distance  Tainst Atmospheric Discharge  Tecliphnang-2020.0  Portuguès  English  Tecliphnang-2020.0  Protection Check
Figure 21: C         cLightning - Risk Analysis and Scaling for Protection age         v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac         do dx h/Calculate dx h         Cálculate dx h         Cálculate 'h' or 'd':          h d         Data Base:         Verificação Proteção         NBR 5419-3         IEC 62305-3         NFPA 780         Calculate 'h' or 'd':          h d         Data Base:         Separate:         Project name :         No. LPS:         1       Centria LPS         Class of LPS:         Radius R (m):       Suggested         Advisor (Lass II )         Height of LPS (calculated) - h (m):         Height of LPS (calculated) - h (m):         Height of LPS (Calculated) - h (m):         Height of LPS (Design) - h (m):         Horizontal protected distance (Design) - d	Calculation of the height x distance
Figure 21: C         cLightning - Risk Analysis and Scaling for Protection age         v/Record Zonas - Dados/Zones - Data Dados Téc./Technical data Fatores da AR/RA Fac         do dx h/Calculate dx h         Cálculate dx h         Cálculate 'h' or 'd':          h d         Data Base:         Verificação Proteção         Calculate 'h' or 'd':          h d         Data Base:         Verificação Proteção         Calculate 'h' or 'd':          h d         Data Base:         Separate:         Project name :         No. LPS:         1       Centria LPS         Class II >         Radius R (m):       15,20         Height of LPS (calculated) - h (m):         Height of LPS (calculated) - h (m):         Height of LPS (Design) - h (m):         Height of LPS (Design) - h (m):         Horizontal protected distance (esculated) - d (m):         Ibitorial protected distance (Design) - d (m):         Design protection angle for LPS (°- degree):         Height of LPS (Design) - h (m):         Horizontal protected distance (Design) - d (m):         Design protection angle for LPS (°- degree):         Height of LPS (Design) - h (m):	Calculation of the height x distance  Tainst Atmospheric Discharge  Teclopteng-2000  Português  English  English  Protection Check

ua Ministro Mirabeau da Cunha Melo, 1925 | Ap 401 | Candelária | Natal-RN | Brasil | Cep.: 59064-490 www.biagione.com.br | contato.brc@biagione.com.br | cel.: +55-84-98723-8753

Figure 22: Calculation of the height x distance - Alert

d x h/Calculate d	x h Cálculo Spda Isolado/Calculate Isolato	ed LPS Verificação Prote	cão/Protection Cl	eck
O NBR 5419	-3 O IEC 62305-3	NFPA 780	,	
Calculate 'h'	or 'd': <ul> <li>h O d</li> <li>Data Base:</li> </ul>	O Separate:		Help conversion Feet to Meters
Technical Expert:	Fulano dos Anzois Pereira	~		d (ft): 34 d (m): 10,36
Project name:		×   ×		Suggested limit for 'd' (ft) 33.1
No Air terminal	1 Central LPS			OKI
Rolling sphere radi	us:	Class I 🖂		
Radius R (m):		20		
Horizontal protecte	ed distance - d (m):	0,0	0,0 (ft)	Prelightning
Height of Air Term	inal (calculated)- h (m):		(ft)	bittiginaling
Horizontal protecte	ed distance (calculated) - d (m)		(ft)	
Calculated protecti	on angle for Air Terminal (° - deį			The limit is 33.1(ft)
Height of Air Term	inal (Design)- h (m):	0,0	0,0 (ft)	
Horizontal protecte	ed distance (Design):		(ft)	
Design protection a	ngle for Air Terminal (° - degree			OK
	New 🖨	Lid.		

Figure 23: Calculation of the height x distance with alert

In order to comply with NFPA 780 [6], the improvement for converting units of measure in meters was introduced, as shown in Figure 23.

The system for this calculation only allows input in meters, thus, with this improvement, it becomes possible to insert the values in feet unit. To do so, two clicks are applied in the input field and one pop-up appears (as shown in Figure 23), providing an input field with the unit in feet. After this, when the pop-up is closed, the unit of measurement in meters. In case of exceeding the suggested limit, an alert will be issued.

## 7. Report Module

This Module includes options for the various preformat of reports that the system, currently, can provide: Risk Analysis Report; LPS project report by Rolling Sphere Method; Module Report using angle method, etc. The system screen where these options are available is shown in Figure 24 and several report templates are shown in Figure 25a Figure 25b. The improvements introduced in this module were composed by the increase in filter options to allow for more appropriate selectivity and the inclusion of the project revision number, as shown in Figure 24.

	Lan	guage / Country Filter:				
Database project     O	urrent Design Report	anguage: English	~	Country: Brazil		$\sim$
Filter for summary reports:	Risk Analysis / Si	ing report filters:		Filter for reports by F	roject / Review Code:	
<ul> <li>Technical Expert</li> </ul>	Technical Expert:	Fulano dos Anzois Pereira	~	Design code/Review:		 
O Country Filter:	Scope of the Report:	Risk Analysis/Calculation	~	Project Name/Rev.:		
O Hold Company Filtre:	Report Type:	Rolling Sphere Method	~	Scope of the Report:		$\sim$
O Installation / Building:	Subject of the Report:	Check limits	~	Report Type:		$\sim$
O Responsible for the installation:	Project Name/Rev.:	Fuel pump station LPS system	✓ 0 ✓	Subject of the Report:		~
O Risk Analysis filter:				Technical Expert:		
O Rolling Sphere Method filter:						
O Angle Method filter:		Atualizar/Update			4	

Figure 24: Screen of the reporting module

8



Figure 25 (a): System report templates formatted without hazardous areas (b): System report templates formatted with hazardous area

## 8. Improvements already identified for future insertion

#### 8.1. Module for sizing the surge protective device

Considering that one of the most important mitigating measures identified in the Risk Analysis is the installation of Surge Protective Devices - DPS, it was understood that the inclusion of a module to meet this need is extremely important and, as the methodology and formulas already exist and are supported by NBR-5419-4 [7] and IEC 62305-4 [8], the insertion of a module with this function was included in the planning of future improvements.



Figure 26: Efforts in wire air termination with supports of the same height



Figure 27: Efforts in wire air termination with supports of different heights

#### 8.2. Module for sizing wire air-termination support structures

Considering that many of the SPDA systems are composed of wire air-termination, it was identified that it is convenient to have a tool to scale the efforts requested from supports of this kind of captor, especially when there is variation in room temperature. Considering, also, that the guarantee of the volume of protection derives from a projection of the height of a captor element and that the control of this lowest point is critical. So, equations were developed to calculate these efforts from the catenary arrow that is required for the wire air-termination. Therefore, it was reversed the practice of calculating this type of sizing, where the effort is calculated and after that, the arrow of a catenary of the cable is calculated. The developed equations include both for supports for the same height and different heights, as shown in Figure 26 and Figure 27. However, these equations are not yet coded in a programming language.

The mathematical approach to dimension the efforts in the wire air-termination was developed in a spreadsheet and the results are in tables such as the Table 1. Other temperature ranges are possible. This is for information only.

## 8.3. Module to consolidate the list of materials of a project

The insertion of the LPS type in the sizing sections already allows to insert in the database the list of materials. Thus, it will be possible from commercially standardized systems to associate the spare parts list required for that dimensioning, when applicable. This module should have a restricted section to address the material list of grounding systems. There is no prediction to perform the calculation of grounding systems because several software are already dedicated to this purpose. Hence, the module includes only the integration of materials to the LPS design.

## 8.4. Module for sizing parallel wire air-termination system

We already have several mathematical models responsible for sizing this kind of LPS by parallel wire air-termination in several configurations for this type of systems, as shown in Figure 28 and Figure 29 (other details can be found in the XIII SIPDA [9]). However, we do not yet have the conversion of equations into programming codes, but this is not the biggest problem for insertion. The understanding is that the greatest difficulty is to develop the graphic formulation because it is more complex and I still do not have training in this area, and the addition of this qualification will require planning.



Figure 28: Representation for different levels of parallel wire air termination



Figure 29: Representation for equal levels of parallel wire air termination

The mathematical approach to determine the limits of a parallel wire air-termination design, considering a possible unevenness of the terrain – at the time of the project implementation or spacing between the wire air-termination or both – produces a table as the one presented in Table 2. This is only an example.

Span: 20,30	) (m)		Arrow (	of a catenary: 0,20 (m)	Length	: 20,30 (m)	Reference temperature: 26°C
Item	Temp.: (°C)	Length: A (m)	f (m)	To (kgf)	T (kgf)	p <sub>s</sub> (kgf)	Transverse force (kgf)
01	16	20,303	0,153	137,63	137,63	4,151	2,85
02	20	20,304	0,175	120,55	120,55	4,151	2,85
03	26	20,305	0,203	103,78	103,79	4,151	2,85
04	30	20,306	0,220	95,84	95,85	4,151	2,85
05	36	20,308	0,243	86,75	86,75	4,151	2,85
06	40	20,309	0,257	81,95	81,95	4,151	2,85
07	45	20,310	0,274	76,94	76,95	4,151	2,85
08	22	20,304	0,185	138,38	138,38	4,151	2,85
09	36/16	20,301	0,075	280,12	280,12	4,151	2,85
10	36/22	20,302	0,128	200,00	200,01	4,151	2,85

Table 1: Calculated forces for the wire air-termination

Note: Reference temperature: 26°C

Table 2: Calculations of the LPS Limits for Figure 28

Dagia	mation		Distance between LPS)								
Designation		30.0	(m)	30.5	5 (m)	31.0 (m)					
Reduce level	Height of the lower LPS	a	hpc	a	hpc	a	hpc				
- 16.00		13.23	10.50	13.55	10.21	13.87	9.92				

0.50	15.50	13.03	10.18	13.35	9.89	13.68	9.60
1.00	15.00	12.83	9.85	13.16	9.56	13.49	9.27
1.50	14.50	12.63	9.51				

### 8.5. Development of tools to integrate with software graph

Another important tool is the integration with design software, such as Autocad. Therefore, the future idea is to develop tools to migrate the sizing data of the various Modules and Sections to enable the plotting of drawings with the horizontal coverage planes for the various Covering projection for the various classes of protection of 15 meters high LPS over structures with a height of 3.5 m. These tools should incorporate the generation of 3D plants, which the resources necessary to rotate and promote cuts of the protected volume.

## 9. Software security requirements

This software is intended to be a tool used by professionals who design systems to protect against atmospheric discharges – either by direct or nearby impacts – and these might cause harmful effects with high probability of causing losses either by  $L_1$  - losses of human life (including permanent injury);  $L_2$  - losses of services to the public;  $L_3$  - losses of cultural heritage and  $L_4$  - losses of economic value. Thus, it is necessary for these professionals to carry out a very detailed and safe risk analysis. Therefore, safety requirements were established, with the goal of blocking errors or deviations from the requirements established by the standards on which this application was based. These requirements are as follows:

### 9.1. Controle na determinação das Zonas

The System alerts and blocks Zones from being repeated in the Risk Analysis, as shown in Figure 31.





## 9.2. Control of the total number of people in the Zones

When the number of people distributed in all Zones is inserted, the System verifies consistency. So, in case of divergence with the total number reported in the Registry (Figure 4), it issues an alert and blocks for further correction, either for more (Figure 32) or for less (Figure 33):



Figure 31: Zone alert already selected

BrcLightning - Risk Analysi	is and Scaling for Protection	1 against Atmospheric Di	<b>ischarge</b> BrcLightni	Idioma/Langua ng-2020.00 OPortuguês	<b>ge</b> English	
Cadastro/Record Zonas - Dados/Zones - Data I	Dados Téc./Technical data Fatores da AR/R	A Factors Resultados/Results Metódo	ER/RS Method   Mét. do Â	ngulo/Angle Method Relató	rios/Reports	
	72 60	<b>72</b>				
La it considered for analysis?	La it considered for analyzic?	La it considered for analysis?	)N			
Is it part of the main structure?	Is it considered for analysis?	Is it part of the main etypology (INCOMPARING)				
Total people in 71 (nz):	Total people in 72 (nz):	Total people in 73 (nz):				
Time persons in Z1 (tz): 8760	Time persons in Z2 (tz): 8760	Time persons in Z3 (tz): 8760	_			
Type of Surface (rt) Agricultural	Type of Surface (rt) Ceramic BrcL	ghtning - Alerta	×			
Risk - Amount of risk (rf):	Risk - Amount of risk (rf):					
Explosion or fire (None)	Fire (Low)	The Number of People in the Zones = 151	1 is inconsistent with the			
Partitioning REI? OY ON	Partitioning REI? O Y @	Total Number of People in the Struture =	150.			
Factor of increase of the relative of loss (hz)	Factor of increase of the relative of loss					
No special hazard	Average level of panic (e.g. Structure for cultural/sporting events for 100 to		ОК			
Total Z1: \$ 10 6 0,00	Total Z2: \$ 10 6 0,00	10(a125. \$10* 0,00				
Cultural heritage (Cz): \$ 10 6			_			
Animals (Ca): \$ 10 6			_			
Building (Cb): \$ 10 6		,				
Content (Cc): \$ 10 6						
Internal systems (Cs): \$10 6						
		Salvar / Save				
	Rua Ministro Mirabeau da	Cunha Melo, 1925   Ap 401   Candelária   Natal-RN	N   Brasil   Cep.: 59064-490			
	www.biagion	e.com.br   contato.brc@biagione.com.br   cel.: +55	-84-98723-8753			



BrcLightning - Risk Analys	is and Scaling for Protectio	n against Atmospheric Dischai	ge Idioma/Langua	nge <b>BRC</b>
			BrcLightning-2020.00 O Português	English
lastro/Record Zonas - Dados/Zones - Data	Dados Téc./Technical data Fatores da AR/R	A Factors Resultados/Results Metódo ER/RS M	Iethod   Mét. do Ângulo/Angle Method   Relat	órios/Reports
Z1: Entrance	Z2 Offices	Z3 Waiting Room		
Is it considered for analysis? $\bigcirc Y \bigcirc N$	Is it considered for analysis? $\bigcirc$ Y $\bigcirc$ N	Is it considered for analysis? $\bigcirc$ Y $\bigcirc$ N		
Is it part of the main structure? $\bigcirc Y \bigcirc N$	Is it part of the main structure? $\bigcirc$ Y $\bigcirc$ N	Is it part of the main structure? $\bigcirc$ Y $\bigcirc$ N		
Total people in Z1 (nz): 0	Total people in Z2 (nz): 145	Total people in Z3 (nz): 3		
Time persons in Z1 (tz): 8760	Time persons in Z2 (tz): 8760	Time persons in Z3 (tz): 8760		
Type of Surface (rt) Agricultural	Type of Surface (rt) Ceramic BrcL	ightning - Alerta	×	
Risk - Amount of risk (rf):	Risk - Amount of risk (rf):			
Explosion or fire (None)	Fire (Low)	The Number of People in the Zones = 148 is inconsi	tent with the	
Partitioning REI? OY ON	Partitioning REI? O Y	Total Number of People in the Struture = 150.		
Factor of increase of the relative of loss (hz)	Factor of increase of the relative of loss			
No special hazard	Average level of panic (e.g. Structure for cultural/sporting events for 100 to		ОК	
Total Z1: \$ 10 6 0,00	Total Z2: \$ 10 6 0,00	10tai 25. 310 ° 0,00		
Cultural heritage (Cz): \$ 10 6				
Animals (Ca): \$ 10 6	·			
Building (Cb): \$ 10 6	· · · · · · · · · · · · · · · · · · ·			
Content (Cc): \$ 10 6				
Internal systems (Cs): \$ 10 6	,			
	·	Salvar / Save		
		Suru / Save		
	Rua Ministro Mirabeau da	a Cunha Melo, 1925   Ap 401   Candelária   Natal-RN   Brasil	Cep.: 59064-490	
	www.blagion	e.com.br   contato.brc@blagione.com.br   cel.: +55-84-98723-	5/03	

Figure 33: Alert of fewer people in the Zones than the total registered

## 9.3. Consistencies of line parameters

The System filters the options of values of the probability PLD depending on the resistance RS of the cable screen and the impulse

withstand voltage UW of the equipment, based on the line type, routing, shielding, and bonding conditions, as can be seen in Figure 34. Power line is not bonded to the same bonding bar as equipment and telecom is bonded to the same bonding bar as equipment.

Lonas - D	ados/Zones - Data Dados Téc./Tec	hnical	data Fatores da AR/RA Factors Res	sulta	dos/Results Metódo ER/RS Metho	od Mét. do Ângulo/Ar	ngle Method Relat	órios/Reports
Protective measures due	to touch and step voltage and o	ther m	nitigating measures in Zones					
	Z1 - Entrance	Z	2 - Accommodation	Z3 -	Endangers Human Life Unit			
	wm1 Z1: 8,333 wm2 Z1: 8,333	wr	m1 Z2: 8,333 wm2 Z2: 8,333	wml	Z3: 8,333 wm2 Z3: 8,333			
ditional measure (PTA):	No protection measures	~ N	lo protection measures 🗸 🗸	Noj	protection measures ~			
otection measure (PTU/P)	No protection measures	~ No	o protection measures	No p	rotection measures 🗸			
otection measure (PTU/T):	No protection measures	~ No	io protection measures	No p	rotection measures			
PD (Pspd/P)	No coordinated SPD system	~ No	to coordinated SPD system	No c	oordinated SPD system 🗸			
PD (Pspd/T):	No coordinated SPD system	~ No	io coordinated SPD system	No c	oordinated SPD system 🗸			
re reduction factor (rp):	No provisions	~ No	lo provisions 🔍	No p	rovisions			
			Atualizar/Update		Ajuda/Help	Gravar / R	ecord	
ttribute of Connected I	Power Line			_	Attribute of Connected Tele	com lines		
ield., ground. and isolation	(CLD/CLI): Shielded buried line (bon	ded)	Connected shield	-	Shield., ground. and isolation (CLI	D/CLI): Shielded aerial	line (not bonded)	? Shield not connected
nown length?	Length LL (m): Area AL (m <sup>2</sup> ):	Area	for flashes near? Area near line: Al (m2	2)	Known length?	Length LL (m): Área AL	(m <sup>2</sup> ): Area for flas	hes near? Area near line: Al (m <sup>2</sup> )
Yes 🗸 Not	? 1.000 40.000		Yes 🔽 Not 4.000.000		Yes V Not ?	1.000 40.0	00 Ves	V Not 4.000.000
onductor Installation Factor	(Ci): Buried	_		~	Conductor Installation Factor (Ci)	: Aerial	-	
wironmental Factor (Ce):	Suburban	Vithsta	and voltage (UW in kV)-PLI: 2,50 🖂	?	Environmental Factor (Ce): Sub	burban	V Withstand vo	ltage (UW in kV) - PLI: 1,50 🗹 🤶
ne Type Factor (Ct):	LV power	shield r	resistance (RS):	~	Line Type Factor (Ct): Tel	lecommunication or data	line Shield resista	nce (RS): Unshielded or not bonde
D (PEB):	No SPD		RS≤1Ω/km 1Ω/km ≤PS ≤EΩ/km		0,20 ): No	SPD		
pe of internal wiring (Ks3)	Unshielded cable - routing precautio	n in ord	der to avoid large $5\Omega/km < RS \le 20\Omega/km$		0.95 ternal wiring (Ks3): Un	ishielded cable - routing	precaution in order	o avoid large loops
Atualiza	r/Update		Gravar / Record		Atualizar/Upd	date		Gravar / Record

Figure 34: Filters for line parameters

### 9.4. Restrictions for changing typical loss values

When it comes to loss of human life (L1), the typical LT loss values (loss due to injuries from electric shock) cannot be changed (the system freezes). The same applies to the typical LF loss value (loss in a structure due to physical damage) when it is indicated that there is a risk of explosion in the Zone or when it is indicated that the place is a hospital, hotel, school or civic building.

In addition, changes in typical LO loss values (loss in a structure due to failure of internal systems) are blocked when it comes to areas that are part of the hospital or life support structure. When dealing with L2 and L3 losses, the values of LF and LO are also blocked for changes. For losses of type L4, permissions similar to L1 losses are applied. Blocking alerts are via a pop-up message, as shown in Figure 35.

BrcLightning - Risk Analys	sis and S	Scaling	for Pro	tection	against	t Atmos	pheric D	)ischar	ge	Idioma/Language	
Cadastro/Record Zonas - Dados/Zones - Data	Dados Téc./	Technical d	ata Fatores	da AR/RA I	Factors Re	esultados/Re	sults Metódo	ER/RS M	ethod Mét.	do Ângulo/Angle Method Relatórios/Reports	
BrcLightning     O Designer	Z1 - Entrar	ıce		Z2 - Accom	modation		Z3 - Endan	gers Huma	n Life Unit		
L1 Loss of human life (including permanent injury)	LT (L1/Z1):	LF (L1/Z1): 0,1 LF (L2/Z1):	LO (L1/Z1): LO (L2/Z1):	LT (L1/Z2): 0,0100	LF (L1/Z2): 0,01 LF (L2/Z2):	LO (L1/Z2) LO (L2/Z2)	LT (L1/Z3):	LF (L1/Z3): 0,1 LF (L2/Z3):	LO (L1/Z3) 0,0100 LO (L2/Z3)	BrcLightning - Alert It was defined that this is an area with an Intee therefore, life-threatening. The loss amount ca	nsive Care Unit,
L4 Loss of economic value (structure,	LT (L4/Z1):	LF (L3/Z1):	LO (L4/Z1):	LT (L4/Z2):	LF (L3/Z2): LF (L4/Z2):	LO (L4/Z2)	LT (L4/Z3):	LF (L3/Z3): LF (L4/Z3):	LO (L4/Z3]		ОК
content, and loss of activity)		0,2000	0,0100		0,2000	0,0100		0,5000	0,0100		
B								D			
			Rua Ministro	Mirabeau da Cu www.biagione.co	nha Melo, 192 im.br   contato	5   Ap 401   C brc@biagione.	andelária   Natal-I com.br   cel.: +{	RN   Brasil   C i5-84-98723-8	ep.: 59064-490 753		

Figure 35: Blocking alert screen for changing typical loss value

### 9.5. Permission to modify data and customize

It is important to emphasize that to perform any customization and or modify parameters predefined in the System, there is a need for the professional to make, in advance, his or her registration in the system and, after that, he or she will have to define on the initial screen (Figure 4) the designer responsible for the project. This way, the system will save the modifications in an associated way with the person responsible for performing them.

## 10. Acknowledgment

This is a work that I have been developing alone, from the need I had to carry out the evaluation of projects of Protection Against Atmospheric Discrimination. Therefore, to be certain about my work, I developed the methodology and then the migration to the programming codes of this system, having paid every expense with my own resources, including all the development so far and the costs regarding my participation in all the previous symposia and the development of the papers.

#### 11. Conclusion

This paper is in line with the conclusion of the work originally presented at the SIPDA XV symposium [1], as it incorporates new resources to provide LPS designers with more efficient and safe tools and means for project development, in accordance with Brazilian, International and American standards.

In this context, the BrcLightning application continues, also, with the objective of consolidating itself as an integrated software, having as a support, for some of its modules, the dimensioning of LPS based on the mathematical approach, which was developed and presented at the SIPDA XIII [9] and SIPDA XIV [10] symposia. Thereby, we hope to be contributing to a better understanding of the standards and to the development of safer and more effective projects for protection against lightning strikes.

Also, its modulated design and the format of a database allows the development of applications to be used on the internet, online, and by app systems used on cell phones or other mobile devices.

#### References

- Araujo, R. Biagione, "BrcLightning Risk Analysis and Scaling for Protection against Atmospheric Discharge," International Symposium on Lightning Protection (XV SIPDA), 1(0), 8-17, 2019.
- [2] ABNT, "NBR-5419-2. Lightning protection Part 2: Risk management," ABNTCatálogo, p. 116, 2015.
- [3] IEC, "IEC 62305-2. Protection against lightning Part 2: Risk management," IEC, 2012.
- [4] ABNT, "NBR-5419-3. Lightning protection Part 3: Physical damage to structures and life hazard," ABNTCatálogo, 2015.
- [5] IEC, "IEC 62305-3 Protection against lightning Part 3: Physical damage to structures and life hazard," IEC, 2012.
- [6] NFPA, "NFPA 780. Standard for the Installation of Lightning Protection Systems. s.l. : IHS," NFPA, 2014.
- [7] ABNT, "NBR-5419-4. Lightning protection Part 4: Electrical and electronic systems within structures. n.l.," ABNTCatálogo, 2015.
- [8] IEC, "IEC 62305-4 Protection against lightning Part 4: Electrical and electronic systems within structures. n.l.: IEC,," IEC, 2010.

- [9] Araujo, Biagione R, Oliveira Jose T., "Mathematical Approach Methodology to Analysis and Design of LPS," International Symposium on Lightning Protection, 13(SIPDA), 2015.
- [10] Araujo, Biagione R, "Mathematical Modeling for Analysis and Design of LPS Angle Method," International Symposium on Lightning Protection (SIPDA XIV), 2017.