



# **Groza Outage Calculation Software**

USER MANUAL

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## 1. Intended use

This software has been designed to calculate annual lightning resulted outages of 6-115 kV overhead power lines with possible implementation of Streamer Electric AG LLPDs with different options of installation on poles as well as identification of reasonable LLPDs installation options in accordance with maximal allowed amount of lightning resulted trips or number LLPDs on hand.

## The manufacturer shall not be held responsible for failure to comply with the instructions in this manual.

## 2. Login to the software

During installation, commissioning, operation, maintenance and repair of the unit, it is not allowed:

- 1. Use the link <u>https://groza.wpasia.dev/public/</u>
- 2. Enter E-mail and password (that was used for registration) fig.1

🛟 GI	ROZA		streamer electric
Login to Groza			///
Email*			
Password*	0		
🗹 Remember me	Forgot Password?		
LO	GIN		
NEW	USER?		
	<u> </u>		
	Login to Groza Email* Password* Commenter me	Correction of the second secon	Correction of the second secon

Fig.1

## 3. Software interface

3.1 The start page contains 3 available options (fig.2)

- 1. «**Start design**» to make a new project.
- 2. «Latest design» to open a previous project.
- 3. «Use templates» to use templates for making a project.

#### 3.2 The top menu contains following items: «Project», «Calculate», «Library», «Help», «Sign out».

The **«Project**» menu item contains commands:

- «New» to make a new project.
- «Open» to open a previous project.

These commands duplicate the functions of options - «Start design» and «Latest design»

The **«Calculate»** menu item contains calculation setting commands and the command to execute calculation according to specified calculation type (available after entering the parameters of substation and line sections).

The «Library» menu item contains the list of libraries available to display ready data options: Substations, Sections, Poles, Conductors, Shielding wires, Insulators, LLPDs

The «Help» menu item contains lightning activity map and user manual

The «Sign out» menu item - log out



roject 🔻 Ca	alculate	Library 🔻	Help 🔻	Sign out 🗭	streamer electric v1.0.0
				Welcome to Groza         Start Design         Latest Design	Jse Templates
				or <u>check the manual before</u> you begi	n

Fig.2

# 4. Working with program

## 4.1 Substation parameters

For starting new project need to click - «**Start design**». In appeared window enter name and technical parameters of substation or load substation from the Library (fig.3)

Project 🔻	Calculate	Librar	Substation Para	imeters		×	
			Load Substation from	n			.0.0
47 Substation			Substation Name:*	Please ente	er value		
			Voltage Class (Un):	3		<ul><li>✓ kV</li></ul>	
			Calculate short-circu	uit current	<ul> <li>In accordance with power of transformer</li> <li>Measured short-circuit on busbar</li> </ul>		
			Power of transforme	ers (P):*	Please enter value	MVa	
			Short-circuit losses (	(Uk):	Please enter value	%	
			Phase-ground short	t-circuit (lsc):	Please enter value	kA	
			Neutral arrangemen	nt:*	Solidly grounded		
			Reclosing Probabilit	ty (Pr):*	Please enter value		
						Accept	

Fig.3

Substation name may be entered in Name field.

The software menus propose to choose nominal (phase to phase) voltage class from the list.





A reference value automatic reclosing probability needs to be entered in "Reclosing probability". Value "0" excludes probability of successful reclosing from calculations; Values in the range of 0,01 - 0,99 fix the probability of successful automatic reclosing. Probability values of modern switchgears successful reclosing operations can be found in range of 0,6 - 0,9. If there is no data on the successful reclosing probability of the substation, it is recommended to use the values from Table 1.

#### Table 1. Conformity between Nominal voltage and Reclosing probability

Rated voltage, kV	Reclosing probability
6 - 13,8	0,6
15 – 25	0,65
30 - 45	0,7
66, 69	0,75
110, 115	0,8

The software includes an option to calculate distribution of phase to ground fault current values along the power line. To do a "Calculate short-circuit current" option must be tagged.

There are two options to calculate fault current:

In accordance with power of transformer

Total capacity of transformers supplying the analyzed line and short-circuit current losses in percentage are required.

• Measured short-circuit on busbars.

Set the current value of the calculated or measured current at the substation.

Next, select neutral grounding mode (Solidly grounded or Insulated).

To enter substation parameters, click «Accept».

To close the window unchanged, click imes .

After accepting, all parameters will be set. For changing parameters need to click substation pictogram.

Project name may be entered in Project Name field.

#### 4.2 Substation parameters

To add line section, click 🔮 "Additional section" (fig.4)







When the first section is added, all its parameters will have the initial or null values. If next section is added, all section parameters will duplicate the values of the previous section.

In appeared window enter name and technical parameters of line section or load section from the Library (fig.5).

Project 💌	Line Section Parameters		×
Project Nar	Load Section from library		
	Section Name:*	Name of section	
Name of	Length (L)*:	Please enter value	km
Substation	Number of poles (Nop):	Please enter value	рс
	O Average span length (lp):	100	m
	Footing resistance (R)*:	Please enter value	Ohm
	Terrain type:	Field	~
	Ground flash density (GFD)*:	Please enter value	pc/km2
			Next

Fig.5

Section name can be applied in the Section Name field.

Section length needs to be specified in km.

Total number of poles in the section or the average span length need to be entered.

Set the average footing resistance for poles of this section.

To account the shielding factors, select the terrain type around line section: "Field", "City", "Forest".

Next, the lightning activity must be set - lightning strikes density per area can be chosen for calculation. Values of lightning activity for different regions of the globe can be seen in lightning activity maps by clicking "GFD Map" icon.

#### Next step to enter Poles parameters or to load poles from the Library (fig.6).

The section poles parameters need the main material of poles to be selected: "Concrete", "Steel" or "Wood".

Pole height needs to be entered in "Pole Height" field.

Cross arm material to be entered in "Cross arm material" field.

Phase wire thickness can be entered by either specifying the conductor radius or selecting the conductor label from the library.

If the shielding wire is present, check the "Shielding wire" option and set the radius of shielding wire or select the label from the

### library.

The table with pole geometry specifies coordinates of phase conductors:

- The Y coordinate specifies the height position of the wire, m;
- The X coordinate specifies the horizontal position of the wire from the middle of pole, negative values are allowed if the wire is on the other side from the pole middle.
- To choose type of pole, click (fig.6 red circle)



													_
Project 🔻	Load Poles from library												
Project Na	Pole material:*		Concrete			<ul> <li></li> </ul>	~	-	X1	×3	3		
,	Pole height (Ho):*		Please enter va	alue		0	m		-	İ			
	Cross arm material:* Conductor label:*		Wood			<b>~</b>	~ <	,				>	
Name of substation			Please select a	n option		0	~				2, Y3		
	C Shielding wire							×			2		
	Sh. wire label:		Please select a	n option		`	~						
					1								
		Y,m		X.m	LLPD already installed								
	Conductor 1		~	2 🗸	No LLPD	<ul> <li>✓ ~</li> </ul>	~ ]						
	Conductor 2		✓	<ul> <li>✓</li> </ul>	No LLPD	<ul> <li>✓ ~</li> </ul>	·						
	Conductor 3		✓	<ul> <li>✓</li> </ul>	No LLPD	<ul><li>✓ ~</li></ul>	· ]						
	Sh. wire 1												

Fig.6

Next step to enter insulator label and parameters (fig.7).

Project 🔻	Line Section Parameters		×
Project Nar	Insulator label:* Number of insulators in strain	Please select an option	• •
### <b>4</b>	(N):* Insulator type:	Cap and pin	✓ pc.
Name of substation	Structural height (h):	Please enter value	✓ mm
	Insulator diameter (D):	Please enter value	✓ mm
	Flashover voltage(CFO) (U50%):	Please enter value	✓ kV
		Back	ОК

Fig.7

Select the insulator label, set the number of insulators in the string.

Select the needed insulator type: "Cap and pin", "Composite" or "Pin", structural height and insulator diameter.

Set the 50% critical flashover voltage of insulation.

To submit line section parameters, click «OK».

To return previous window, click «Back».

To add new line section or substation, click 🕈 (fig. 8).

To remove previous line section, click  $\bigotimes$  (fig. 8).



Project 🔻 C	alculate Library 🔻	Help 🔻 Sign out 🕩
Project Name:	Project Name	Save
Name of Substation Sec	tion	
	Fig.8	

## 5. Calculation

After all substations and sections of power line have been entered option «Calculate» is available (fig.9).





There is possibility to choose 4 types of calculation:

- Short-circuit current and availability of LLPD installation.
- Evaluation of lightning performance.
- LLPD amount based on target lightning performance.
- Lightning performance based on LLPD amount.

To start calculation, click «Run».





#### 5.1 Substation parameters

After clicking «Run» for this type of calculation a window with calculated parameters appears (fig. 10).

Ŧ	Short-circuit current Availability of LLPD installation						
Nar	Total area: 30 km						
f	i-LLPD SC < 1.5k Allowed for i-LLPD installation: 18.02 km	d-LLPD SC < 3.5kA Allowed for d-LLPD installation: 26.73 km	prohibited SC > 3.5kA Prohibited area: 2.97 km				
1	Report Back						
l	Marx 40464 Mm 1598A         Marx 1588A Mm 0398A         Marx 0797A Mm 0398A           Name of substation         Name of section         Name of section         Name of section						
l	Data			$\sim$			
	Result			~			

Fig.10

According to technical parameters of substation there is shown value of single phase fault current for the line and allowed area of LLPD installation.

- Blue area shows the "Allowed area of LLPD installation" for LLPS against induced overvoltage, where the fault current values do not exceed the fault current limitations for considered LLPDs (<1.5kA)
- Green area shows the "Allowed area of LLPD installation" for LLPS against direct lightning stroke, where the fault current values do not exceed the fault current limitations for considered LLPDs (≤3.5kA)
- Red area shows prohibited area for installation of LLPSs. The fault current values exceed the fault current limitations for considered LLPDs

If to click on colored rectangle of every section the diagram of single phase fault current values distribution along the line against the distance to substation, is built. (Fig. 11)

The yellow curve indicates distribution of fault current values without LLPD consideration.

The red and green curves consider non-linear impedance of LLPDs.



Fig.11





**5.2** «Evaluation of lightning performance» calculation

After clicking «Run» for this type of calculation a window with calculated parameters appears.

The window shows the computed values of total lightning outages in line at initial state without LLPDs and considering LLPDs (1,2 or 3 LLPDs per pole) installed along the set length (fig. 12).

▼ Sig	Evaluation of Lightning performance						
Save		Outages No LLPD 1 LLPD per pole 2 LLPDs per pole	DLS* 2.78 2.05 -26.32% 1.42 -48.94% 1.00				
	Report	per pole Section Detail	-64.11% Back				
	Data			$\checkmark$			
	Result			$\sim$			
	Error			$\sim$			

Fig.12

To see technical details of every section, need to click on tab «Section Detail» (fig. 13) and after to click on colored rectangle of every section (fig.14).

-	Evaluation of Lightning performance Section Detail						
	Name of substation				Total number of outages		
Nar	Report	Back			Initial amount 2.78		
	Report	Duck			with 1 LLPD/Pole 2.05		
					with 2 LLPD/Pole 1.42		
4					with 3 LLPD/Pole 1.00		
'n							
		x: 0.93 1: 0.68 2: 0.47	x: 0.93 1: 0.68 2: 0.47	x: 0.93 1: 0.68 2: 0.47			
	A Name of	3: 0.33 Name of	3: 0.33 Name of	3: 0.33 Name of			
	substation	section	section	section			







Performance	0.00	0.00	0.00
	-•	-•	-•
	1 LLPD	2 LLPDs	3 LLPDs
Initial	0.93	0.93	0.93
After LLPD	0.68	0.47	0.33
LLPD on phase	А	B,C	A,B,C
Required LLPDs	100	200	300
Number of poles with LLPDs	100	100	100
Number of empty poles	0	0	0



«Initial» line shows quantity of outages for some period without LLPDs.

«After LLPD» line shows quantity of outages for some period with LLPDs (1,2 or 3 LLPDs per pole).

«LLPD on phase» line shows what phase of line will be equipped with LLPDs

«Required LLPD» line shows amount of LLPDs for equipping of all line.

#### 5.3 «LLPD amount based on target lightning performance» calculation.

When selecting "LLPD amount based on target lightning performance" calculation, should specify a target number of the whole line outage.

After clicking «Run» for this type of calculation a window with calculated parameters appears (fig. 15)

To return previous window, click «Back».

LLPD amount based o	n target lightning p	erformance	×
Target outage nun	nber 2.50 / year		
Outages No LLPD WITH LLPD 152 pcs	DLS* 2.78 2.50 -10.10%	Total Improvement	
* Direct Lightning Strike Report Section Detail	Back	10.10%	
Data			~
Result		×	/
Calculation		×	/





5.4 «Lightning performance based on LLPD amount» calculation.

When selecting "Lightning performance based on LLPD amount" calculation, should specify number of LLPDs available for installation.

After clicking «Run» for this type of calculation a window with calculated parameters appears (fig. 16).

Target LLPD number 250 pcs   Outages DLS*   No LLPD 2.78   WTH LLPD 2.29   250 pcs -17.81%   * Direct Lightning Strike   Report Section Detail   Back	Li	ightning performan	ce based on LLPD a	imount	×
Outages DLS*   No LLPD 2.78   WITH LLPD 2.29   250 pcs -17.81%   * Direct Lightning Strike   Report Section Detail   Back		Target LLPD nu	mber 250 pcs	prose pros	
Data ~ Result ~	*	Outages No LLPD WITH LLPD 250 pcs Direct Lightning Strike Report Section Detail	DLS* 2.78 2.29 -17.81% Back	Total Improvement 17.81%	
Calculation V		Data Result Calculation			1

Fig.16

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