Groza Outage Calculation Software

USER MANUAL

Streamer Electric AG
Technopark Graubünden, Bahnhofstrasse 11,
7302 Landquart Switzerland
Tel.: 0041 81 250 05 25
E-Mail: office@streamer-electric.com
Website: https://streamer-electric.com/

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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 https://groza.wpasia.dev/public/
2. Enter E-mail and password (that was used for registration) – fig.1

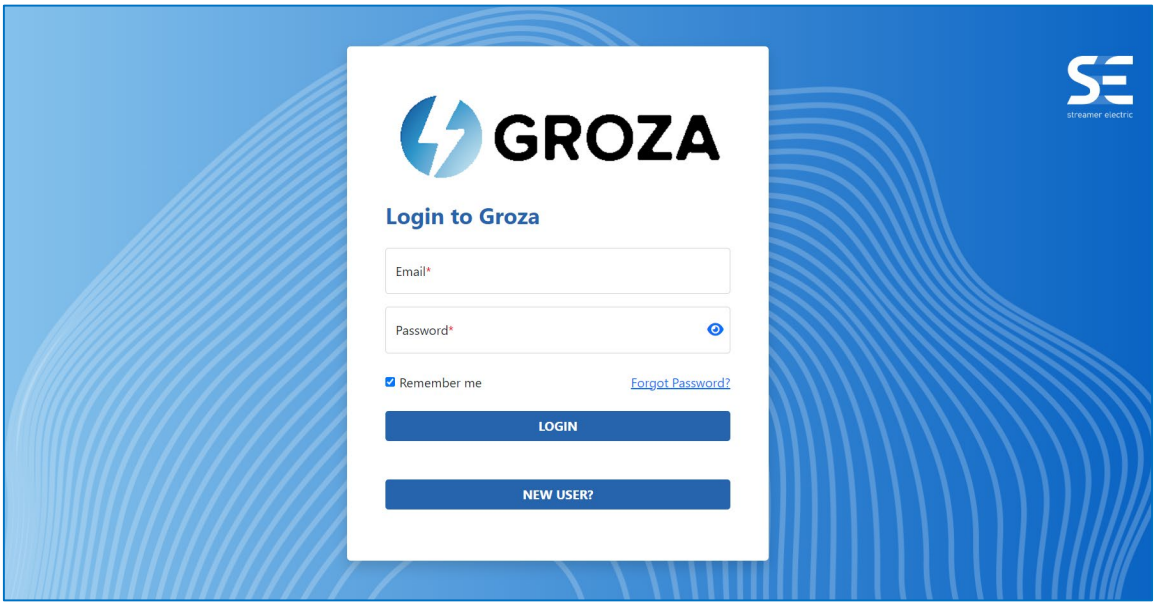

Fig.1

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

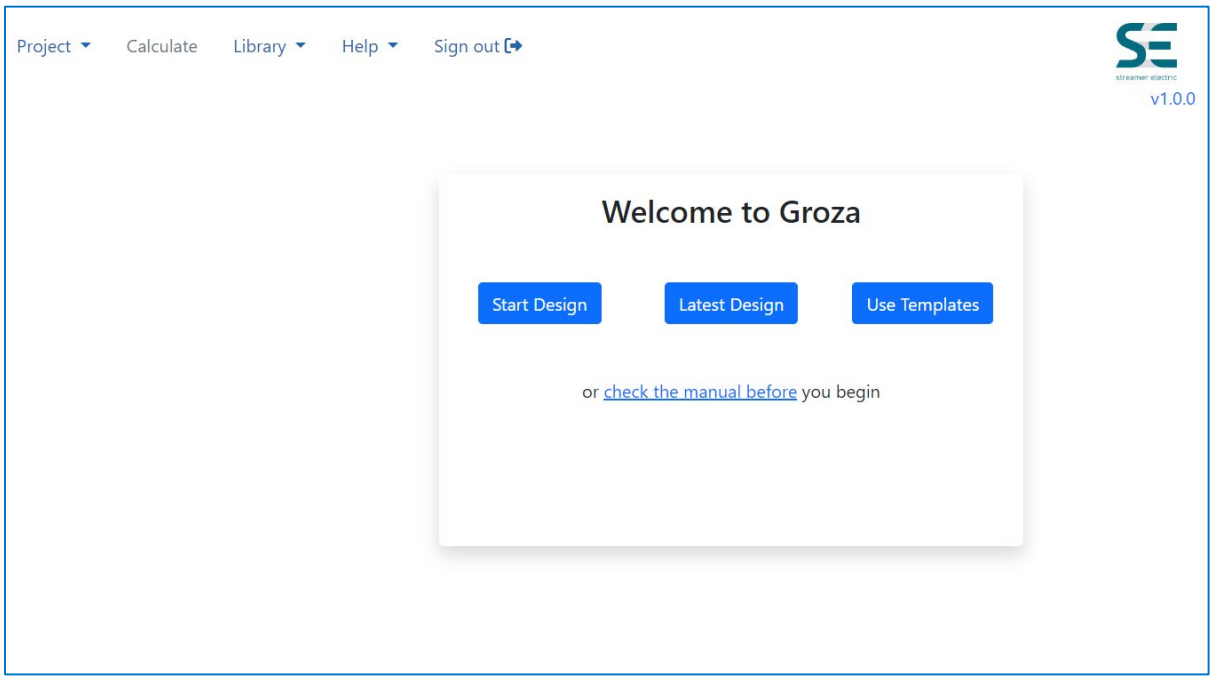

Fig.2

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)

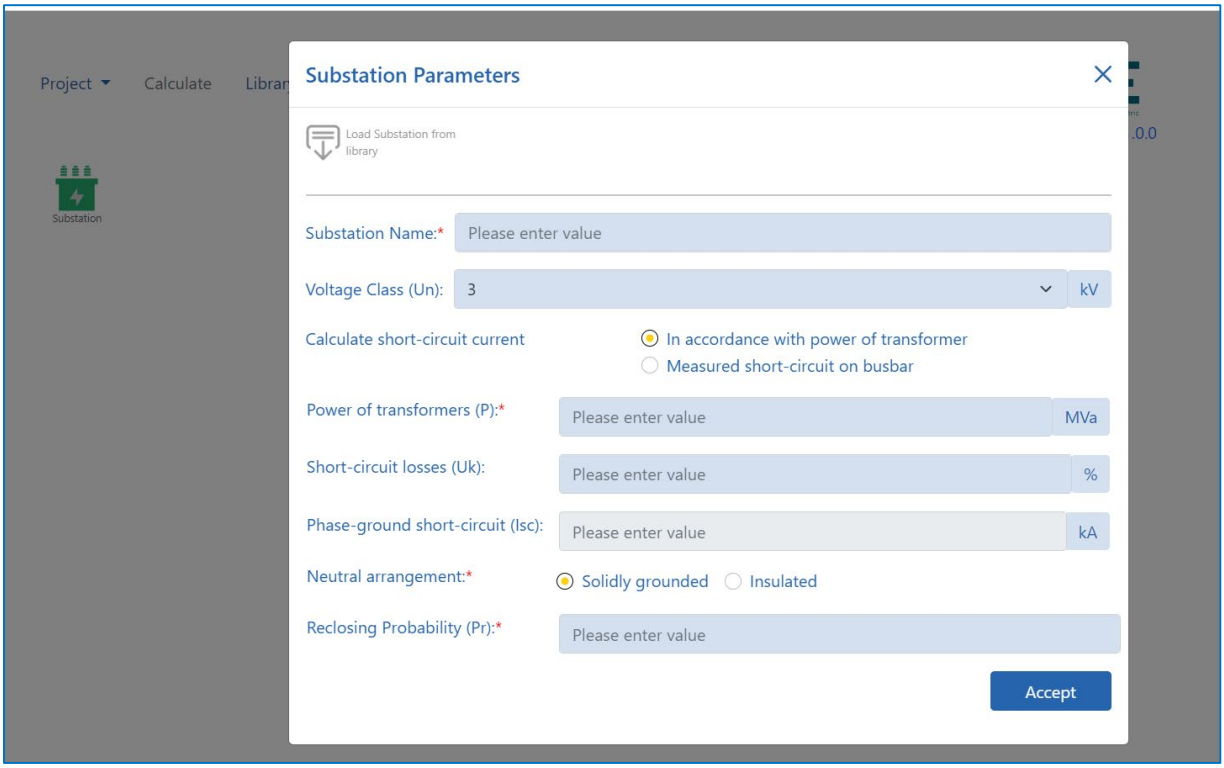

Fig.3

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 ✕ .

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)

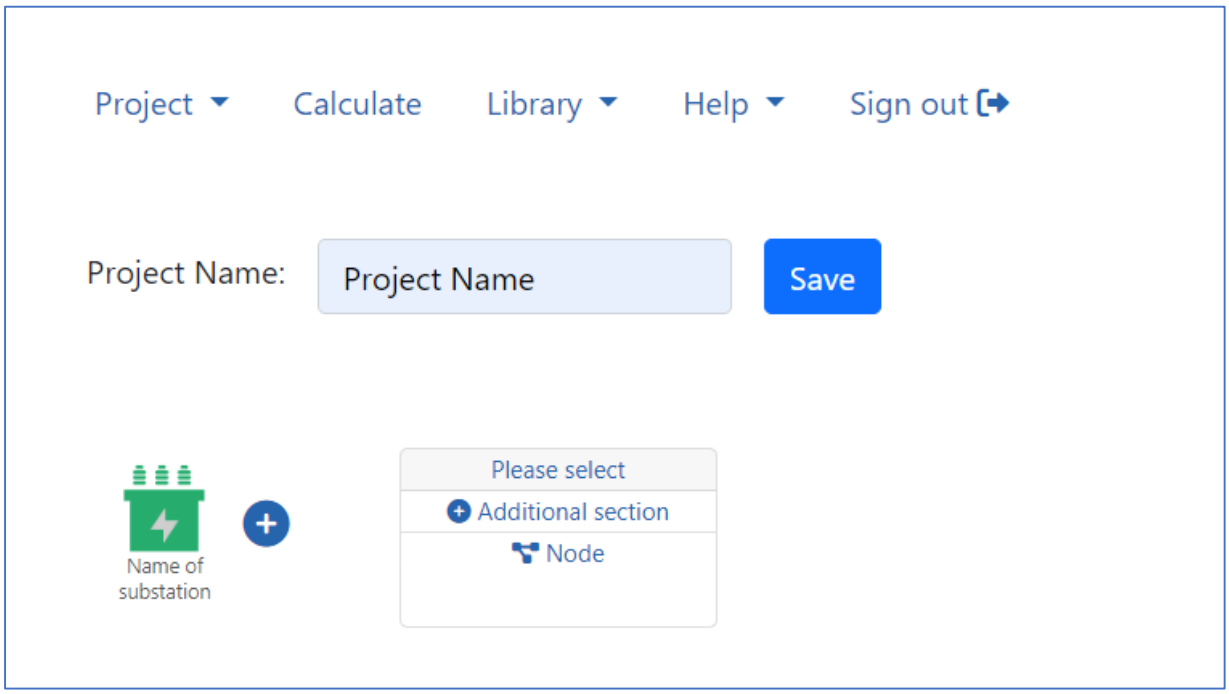

Fig.4

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).

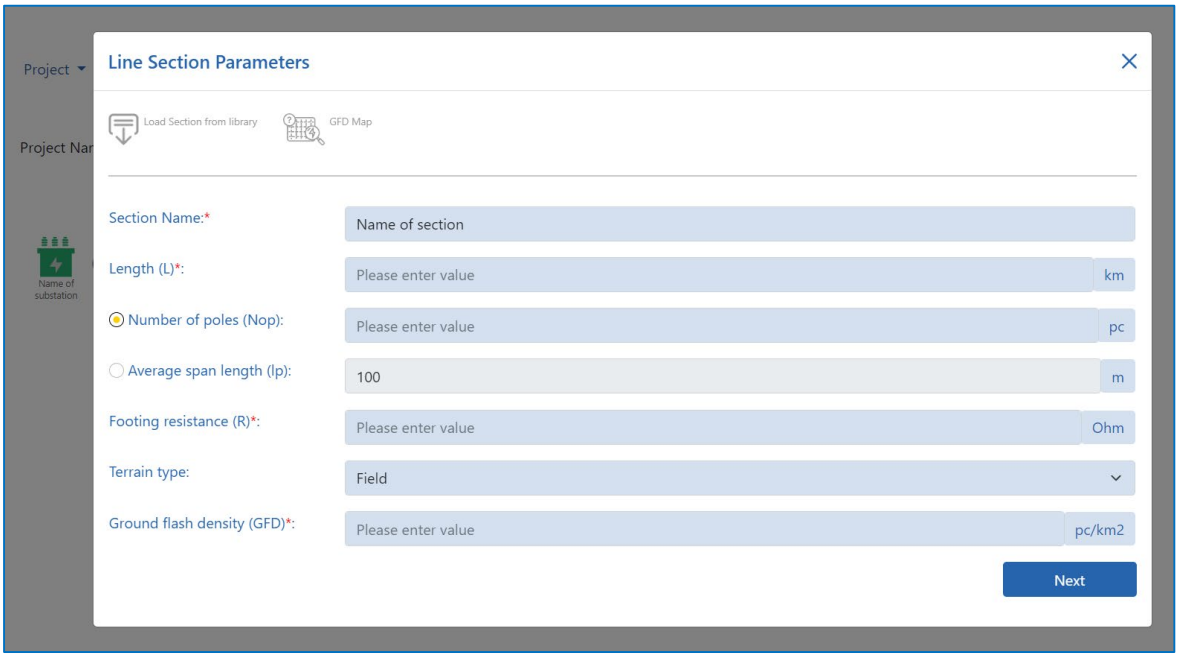

Fig.5

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)

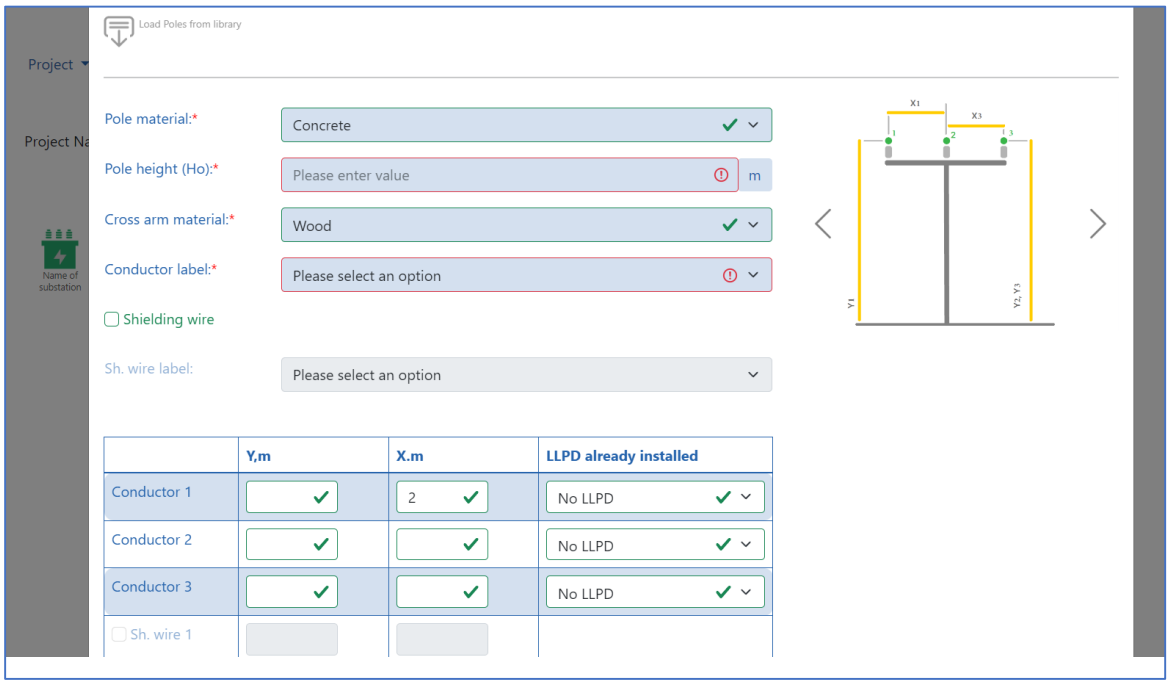

Fig.6

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

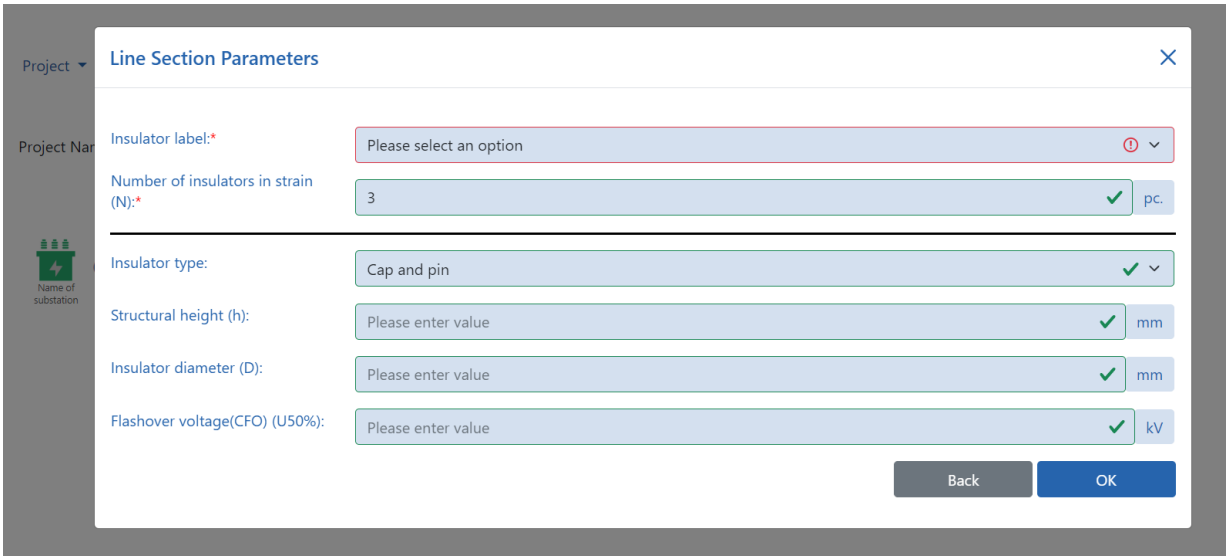

Fig.7

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 (fig. 8).

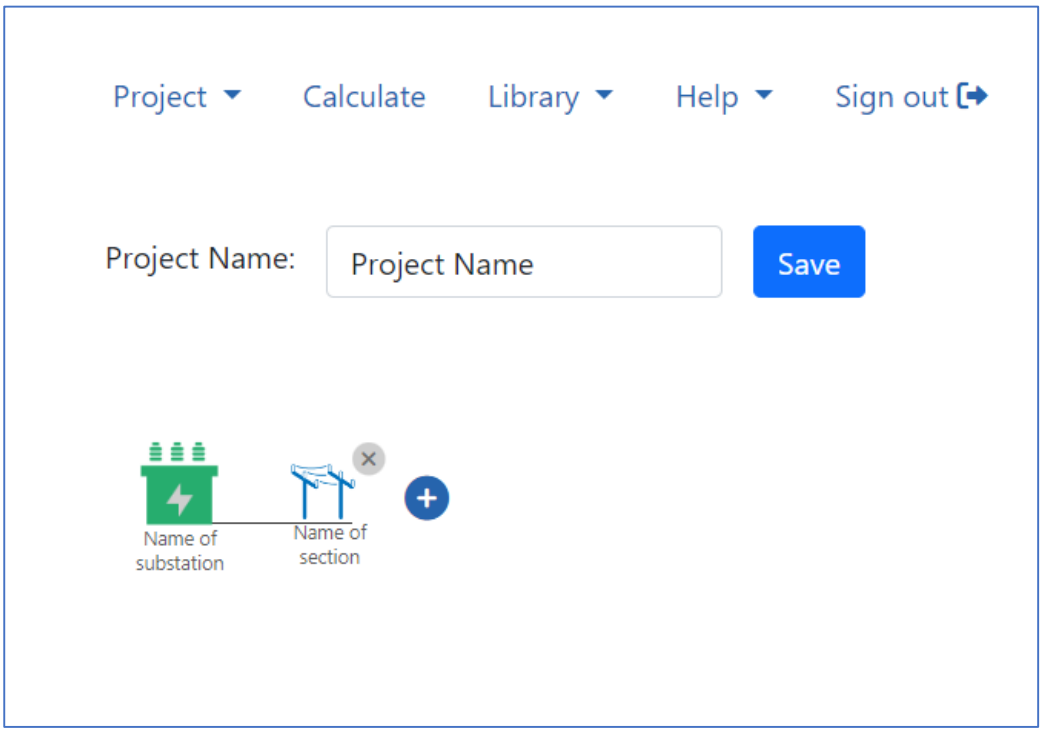

Fig.8

5. Calculation

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

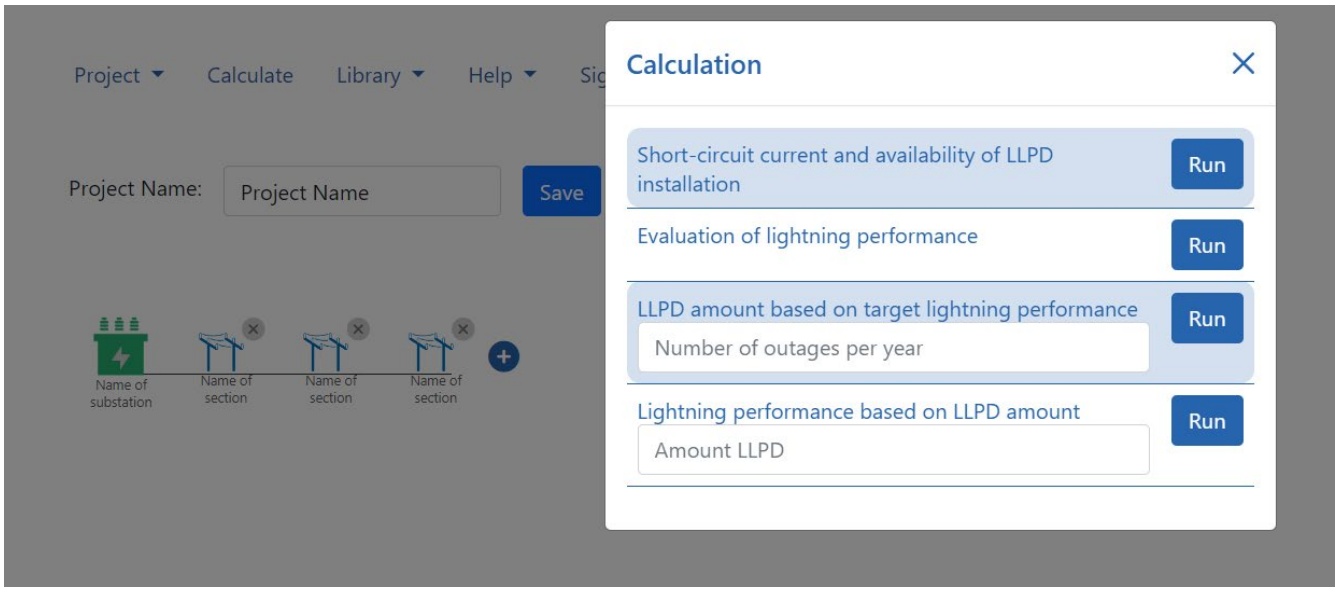

Fig.9

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).

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.

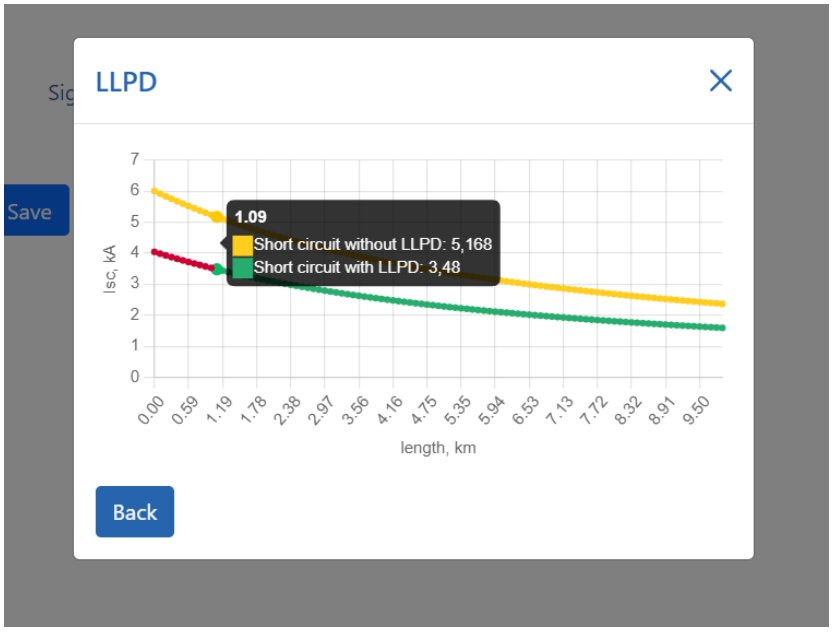

Fig.11

To return previous window, click «**Back».**

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).

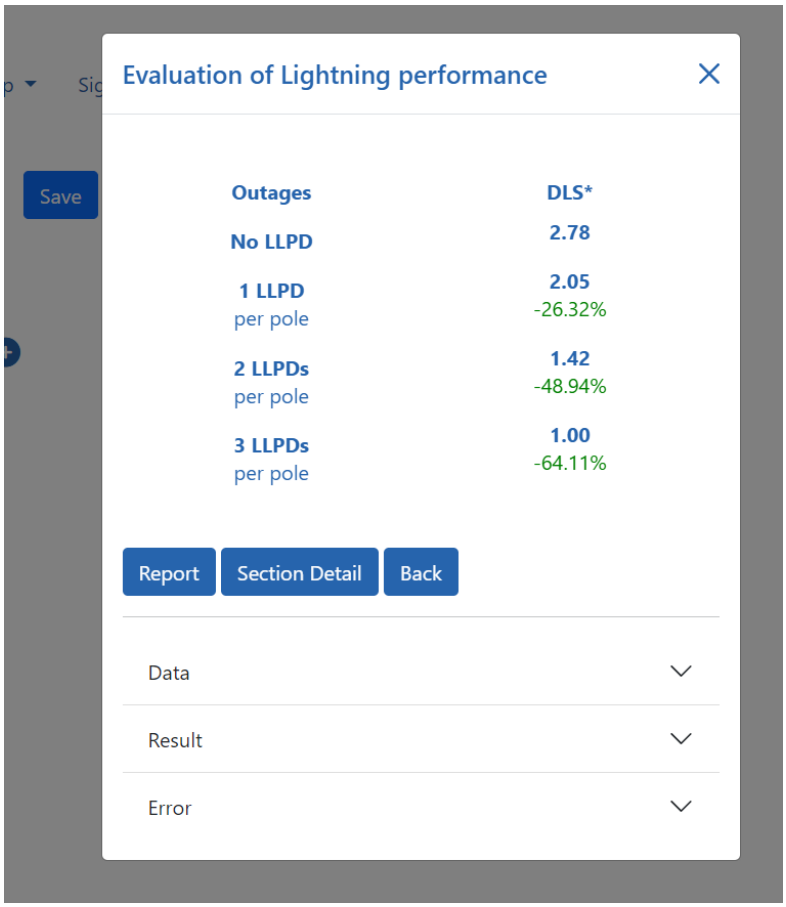

Fig.12

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).

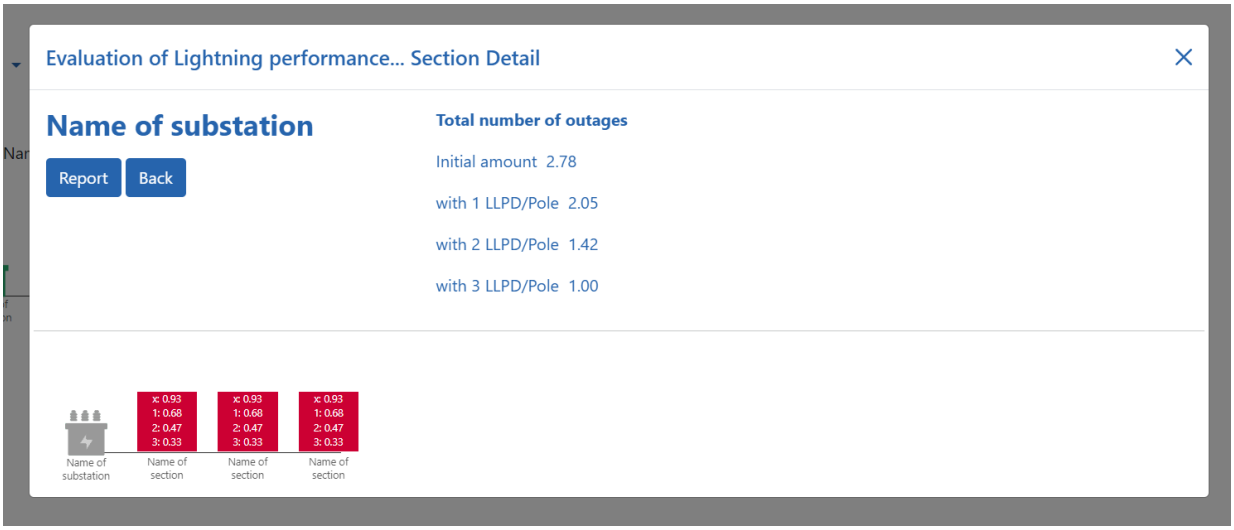

Fig.13

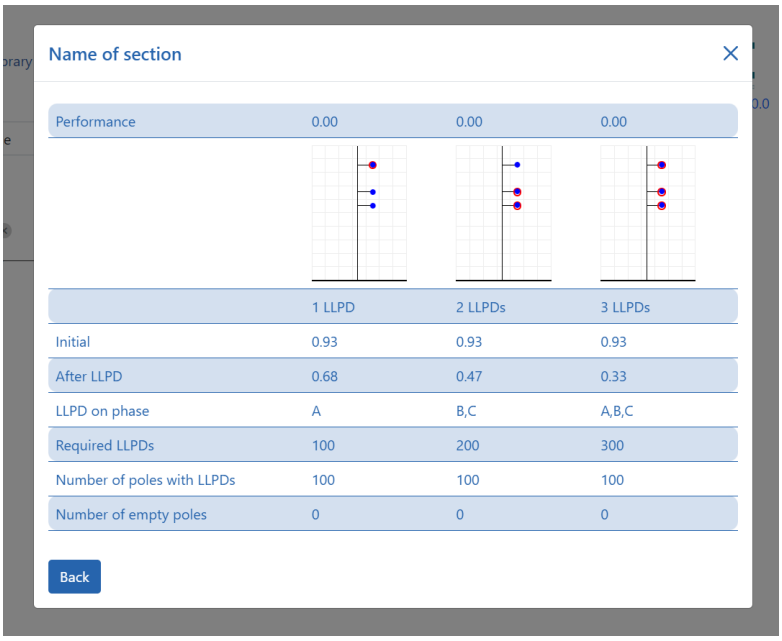

Fig.14

«**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**».

Fig.15

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).

Fig.16

Contact us

Streamer Electric AG, HQ
Bahnhofstrasse 11
7302 Landquart, SWITZERLAND
Phone: +41 81 2500525
office@streamer-electric.com
www.streamer-electric.com

www.streamer-electric.com