User's Guide

Table of Contents

September 29, 2025

Qualified Persons

⚠ WARNING

Only qualified persons knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

NOTICE

Read this instruction sheet thoroughly and carefully before operating the Coordinaide program. Become familiar with the Safety Information on page 3. The latest version of this publication is available online in PDF format at **https://www.sandc.com/en/product-literature/**.

Retain this Instruction Sheet

This instruction sheet is a permanent part of the Coordinaide program literature. Designate a location where users can easily retrieve and refer to it.

End User License Agreement

The end user is granted a nontransferable, non-sublicensable, nonexclusive license to use Coordinaide—The S&C Protection and Coordination Assistant program only upon acceptance of all the terms and conditions of the seller's end user license agreement set forth in Price Sheet 155.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the IntelliRupter PulseCloser Fault Interrupter. Become familiar with these types of messages and the importance of these signal words:

⚠ DANGER

"DANGER" identifies the most serious and immediate hazards that will result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ WARNING

"WARNING" identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

"CAUTION" identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

"NOTICE" identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is not understood and assistance is required, contact the nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C's website, **sandc.com**, or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE

Read this instruction sheet thoroughly and carefully before using the Coordinaide program.

Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Coordinaide—The S&C Protection and Coordination Assistant permits quick and easy selection of the optimal S&C protective device to:

- Protect transformers against damaging overcurrents and coordinate with primary- and secondary-side protective devices (S&C's novel Transformer Protection Index (TPI) can be used to determine whether the primary fuse will protect against certain types of secondary-side faults, including arcing phase-to-ground secondary-side faults.)
- Protect capacitor units against case rupture
- Protect underground cables from insulation damage because of excessive temperatures
- Protect overhead conductors from damage because of annealing
- Confirm the proper operation of protective devices against incident-arc energy curves for various personal protective equipment (PPE) levels
- Selectively coordinate multiple protective devices in series to minimize service interruptions

Conditions of Use

S&C Electric Company does not accept responsibility for, nor warrant the proper application of, non-S&C protective devices or the accuracy of their respective time-current characteristic curves. Moreover, S&C is not responsible for any errors, mistakes, miscalculations, or miscoordination that may occur through use of the Coordinaide assistant program. Results should be reviewed and approved by a consultant or end user who is familiar with the principles of selective coordination and system and equipment protection.

This program is the property of S&C Electric Company, Chicago, IL, and may not be sold, nor may any part of the program source code be used to produce a commercial, marketable product.

Cookies are used for the best online experience. By using our website, you agree to our use of cookies in accordance with our privacy policy. The privacy policy is stated at this link: sandc.com/en/privacy-statement-terms-of-use/.

Opening the Program

Coordinaide—The S&C Protection and Coordination Assistant—is an online program accessible through an Internet browser at either of these links: **https://www.sandc.com/en/support/coordinaide/** or **https://coordinaide.sandc.com/**.

When the program starts, the Terms and Conditions dialog box opens. Click on the **Accept** button to continue. See Figure 1.

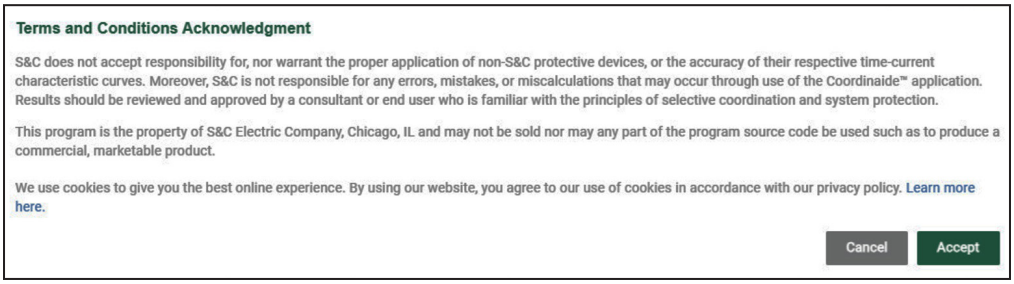

Figure 1. The Terms and Conditions Acknowledgment dialog box.

If this is your first time accessing the Coordinaide application or you have recently cleared your web browser's browsing data, the Privacy Settings dialog box will open after accepting the Terms and Conditions. Select Save Settings, Deny, or Accept All to continue depending on your desired privacy settings. See Figure 2.

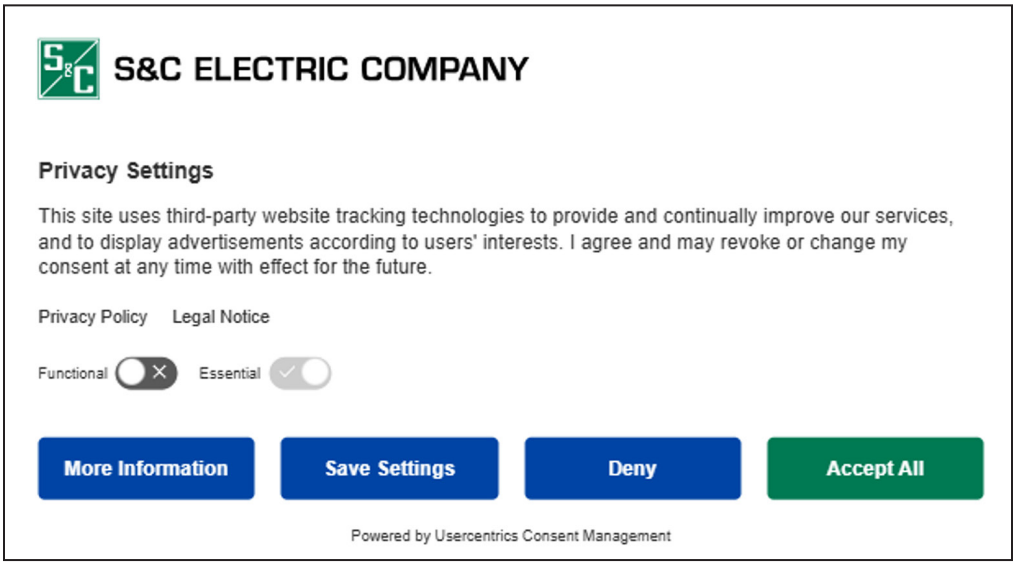

Figure 2. The Terms and Conditions Acknowledgment dialog box.

Program Screen

When the terms and conditions are accepted, the *Program* screen opens. See Figure 3:

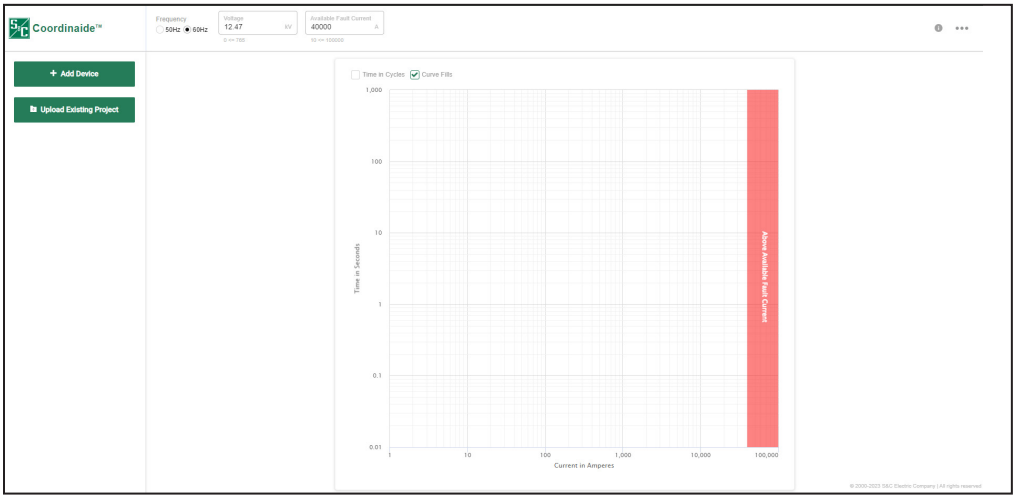

Figure 3. The Program screen.

The screen has the following sections:

- **General/System Information—**Used to enter general system information
- **Device Selection Area—**Used to add a device or upload a project
- **TCC Plot Area—**Used to display the generated curves
- **Options—**Used to access the User's Guide and download PDF files

General/System Information

The **Frequency**, **Voltage**, and **Available Fault Current** system values are displayed at the top section of the *Program* screen and can be changed by the user. See Figure 4.

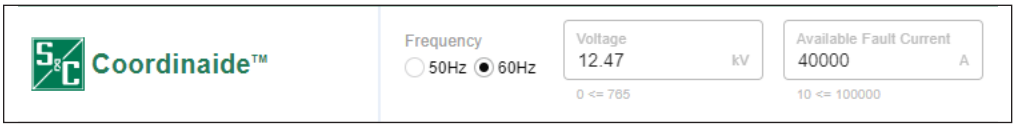

Figure 4. The "System Values" section.

Configuring a Protective Device

Follow these steps to select a protective device and the device parameters:

STEP 1. Select a protective device and add it to the "TCC Plot Area" section by clicking on the **+ Add Device** button at the top left of the *Program* screen. See Figure 5.

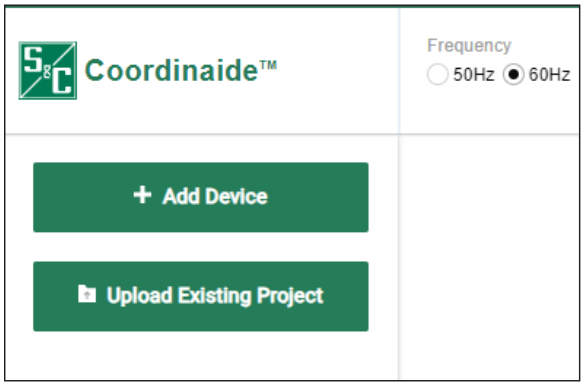

Figure 5. The device-selection area on the *Program* screen.

STEP 2. Select the protective device to be added and enter the parameters for that device in the Device Parameters dialog box. See Figure 6.

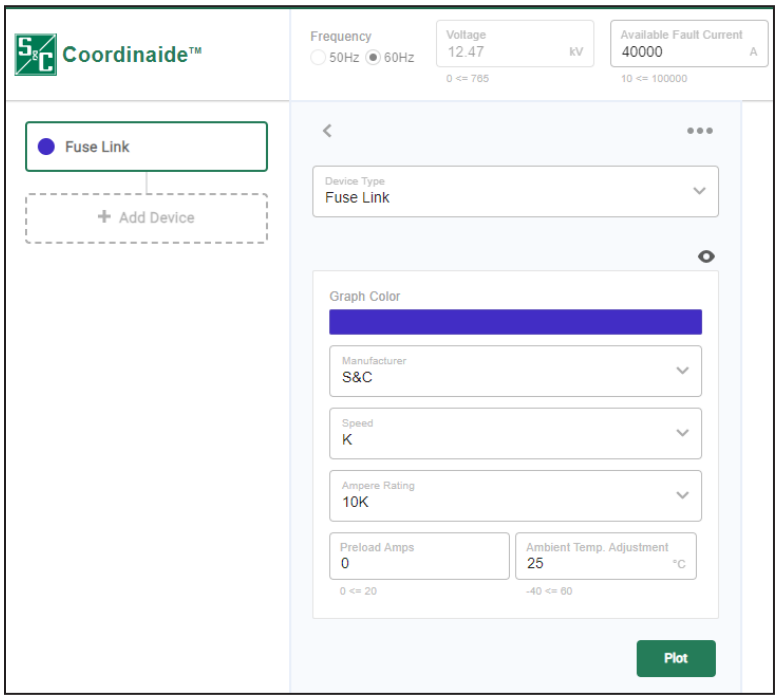

Figure 6. The Device Parameters dialog box on the Program screen.

STEP 3. When the parameters for the protective device have been entered, click on the **Plot** button to create the TCC curve for the device. See Figure 7.

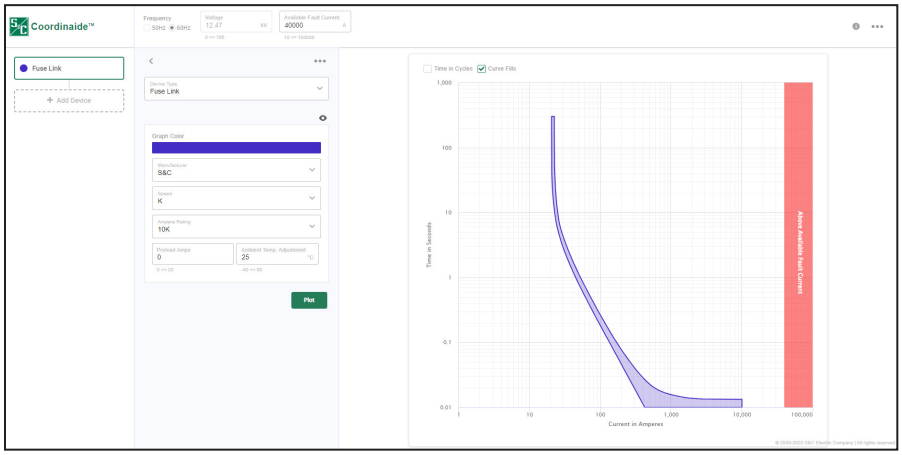

Figure 7. The TCC curve generated by the Plot button.

STEP 4. The plotted device TCC data points can be downloaded in .CSV format from the Device Parameters dialog box by clicking on the "**...**" button and then clicking on the **Download Curve Points** selection. See Figure 8.

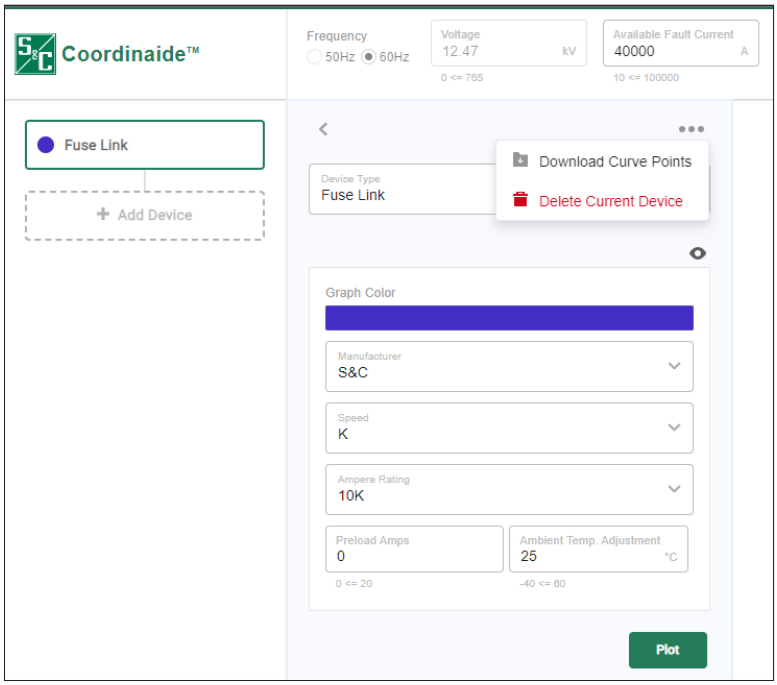

Figure 8. The Download Curve Points selection.

STEP 5. More device TCC curves can be added to the plot by clicking on the **+ Add Device** button again. See Figure 5 on page 7.

After the new **Device Type** setting is entered, the device parameters can be selected.

TCC Plot Area

On the right side of the *Program* screen is the TCC curve graph where multiple protection devices can be plotted. This is a log-log graph with current in amperes on the x-axis and time in seconds on the y-axis. (X-axis range: 1-100,000 amperes; Y-axis range: 0.01-1,000 seconds)

Project Options

Click on the "**...**" button at the top right corner of the screen. The **Project Options** drop-down menu opens. See Figure 9.

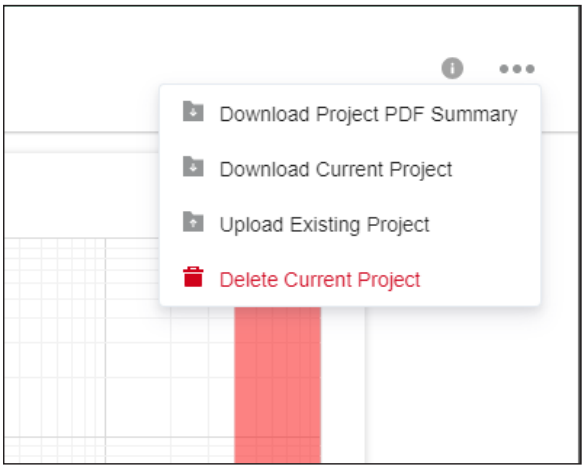

Figure 9. The Project Options drop-down menu.

Reloading Exported Data

Settings files can be saved and reloaded. A completed project can be downloaded to a local computer by clicking on the **Download Current Project** option and selecting the folder. A PDF summary of the project can be saved by clicking on the **Download Project PDF Summary** option and selecting the folder. To upload an existing project file, click on the **Upload Existing Project** option, browse to the desired file entry, click on the file name, and click on the **Open** button.

Device Selection

The Coordinaide program can display TCC curves for multiple protection devices. Devices have selection parameters accessible from a drop-down menu after the device is selected.

The devices available in the Coordinaide program are:

- S&C Fault Fiter® Electronic Power Fuse
- S&C Fault Tamer® Fuse Limiter
- S&C Fusistor Fuse
- S&C IntelliRupter® PulseCloser® Fault Interrupter
- S&C TripSaver® Dropout Recloser
- S&C TripSaver® II Cutout-Mounted Recloser
- S&C VacuFuse® Self-Resetting Interrupter
- S&C Vista overcurrent control 2.0 (E, K, T, Main, and Tap Curves)
- S&C Vista overcurrent control 2.0 (IEEE and IEC Relay Curves)
- S&C Vista overcurrent control (E, K, Main, and Tap Curves)
- S&C Vista overcurrent control (IEEE and IEC Relay Curves)
- Bay-O-Net (weak link) fuse
- Capacitor unit (case-rupture curve)
- Current-limiting fuse
- Fuse link
- Incident-arc energy curve
- Motor (generic starting curve)
- Overhead conductor (damage curve)
- Power fuse
- R-rated motor starter fuse
- Recloser equation-based (microprocessor control)
- Recloser point-based (hydraulic, electronic controls)
- Relayed circuit breaker
- Transformer (damage curve)
- Underground cable (damage curve)
- User provided (import data points)

Fault Fiter® Electronic Power Fuse

The Fault Fiter Electronic Power Fuse represents a major advancement in circuit-interruption technology by integration of state-of-the-art electronics with an advanced-design high-current fuse. It is ideal for protecting medium-voltage service entrances, feeders, transformers, and underground distribution subloops. The number of parameters varies depending on the type of control module selected.

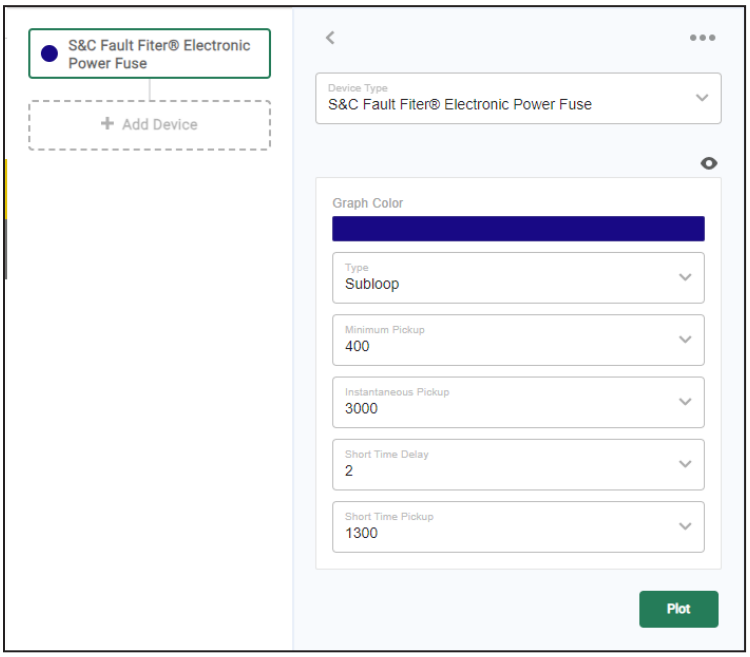

Figure 10. The device parameters for a Fault Fiter Electronic Power Fuse.

The example shown in Figure 10 is a Subloop-Type Fault Fiter control module. This example shows the most selectable parameter fields:

- **Type:** Select the type of TCC curve.
- **Minimum Pickup:** Select the desired minimum pickup current in amperes.
- **Instantaneous Pickup:** Select the desired instantaneous pickup current in amperes. The Coordinaide program may automatically select a value based on the selected minimum pickup.
- **Short-Time Delay:** Select the desired short-time delay in seconds. The Coordinaide program may automatically select a value based on the selected minimum pickup.
- **Short-Time Pickup:** Select the desired short-time pickup current in amperes. The Coordinaide program may automatically select a value based on the selected minimum pickup.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Fault Tamer® Fuse Limiter

The Fault Tamer Fuse Limiter is used to protect single- and three-phase transformers on overhead distribution circuits. It combines the functions of a conventional fuse cutout and a backup current-limiting fuse in one unit, providing benefits over traditional fuse cutouts or cutouts used in combination with backup current-limiting fuses. See Figure 11.

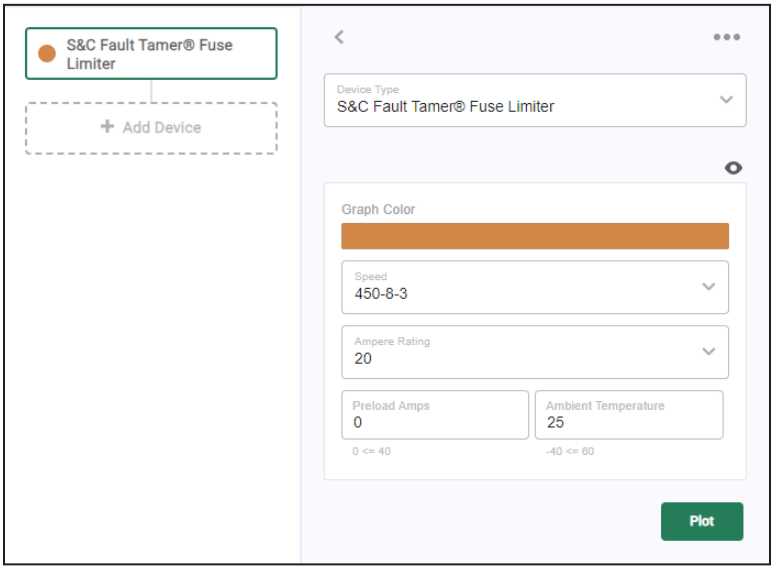

Figure 11. The device parameters for a Fault Tamer Fuse Limiter.

These are the selectable parameters for Fault Tamer Fuse Limiters:

- **Speed:** Select the desired speed (TCC) characteristic.
- **Ampere Rating:** Select the desired ampere rating.
- **Preload Amps:** This field allows adjustment for the reduction in the Fault Tamer Fuse Limiter's minimum melting time because of the pre-fault load current. Enter the load on the fuse expressed as a percent of the Fault Tamer Fuse Limiter's ampere rating.
- **Ambient Temperature Adjustment:** This field allows adjustment for the increase or decrease in Fault Tamer Fuse Limiter's minimum melting time because of high or low ambient temperatures. Enter the desired ambient temperature in degrees Celsius.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Fusistor® Fuse

The Fusistor Fuse, now a discontinued product, is an indoor power fuse providing full-fault-spectrum protection for voltage, control-power, and auxiliary-power transformers. See Figure 12.

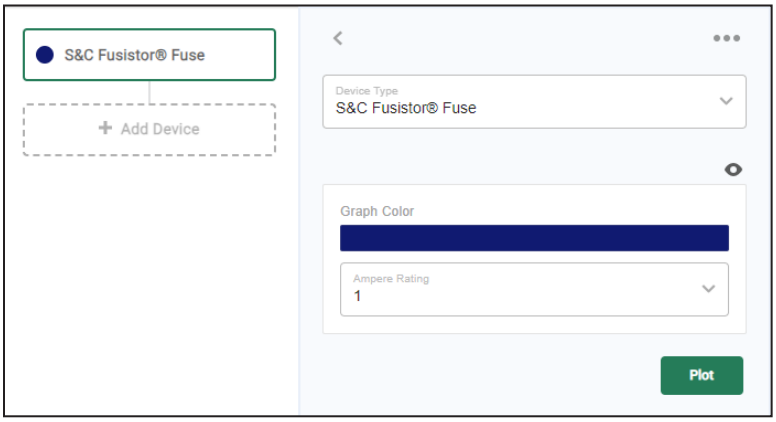

Figure 12. The device parameters for a Fusistor Fuse.

Select the desired ampere rating from the list. This is the only selectable parameter.

After the ampere rating has been configured, click on the **Plot** button to create the TCC curve.

IntelliRupter® PulseCloser® Fault Interrupter

The IntelliRupter® fault interrupter is an overhead distribution protective device similar to a recloser. Unlike a fuse, which has a single TCC curve pair (minimum melt and total clear) or a relayed circuit breaker, which has two curve pairs (minimum trip and total clear for both the phase and ground elements), an IntelliRupter fault interrupter can have up to 20 individual curve pairs (minimum trip and total clear) for a given protection profile and direction of current flow. These are specified by selecting the appropriate parameters. See Figure 13.

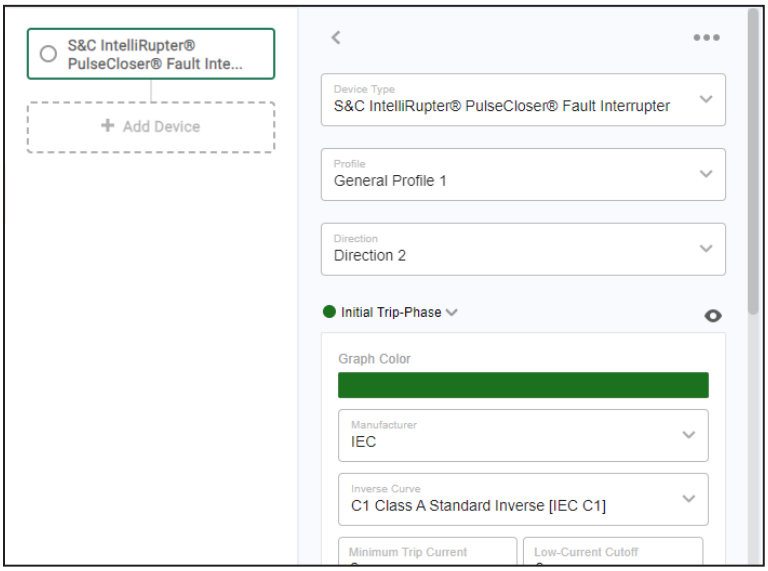

Figure 13. The device parameters for an IntelliRupter fault interrupter.

The Coordinaide program supports the IntelliRupter fault interrupter setpoints file format, XSPT. When all parameters have been selected, the XSPT setpoint file can be uploaded for use in the future. The setpoint file can be read by uploading it to the IntelliRupter fault interrupter control at the protection profile and direction level. All parameters configuring a specific IntelliRupter fault interrupter TCC curve must be selected. See Figure 14.

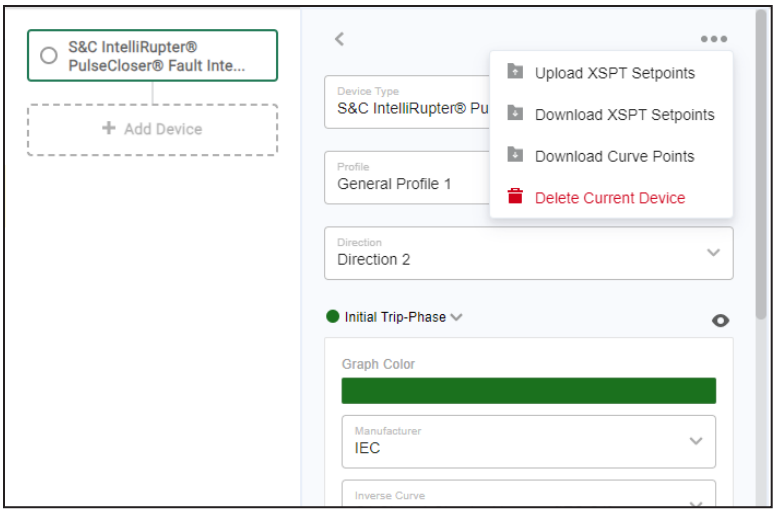

Figure 14. The Upload and Download setpoint commands for an IntelliRupter fault interrupter.

Follow these steps to configure an IntelliRupter fault interrupter TCC curve:

STEP 1. Select the device to be emulated for the Initial Trip-Phase curve. See Figure 15.

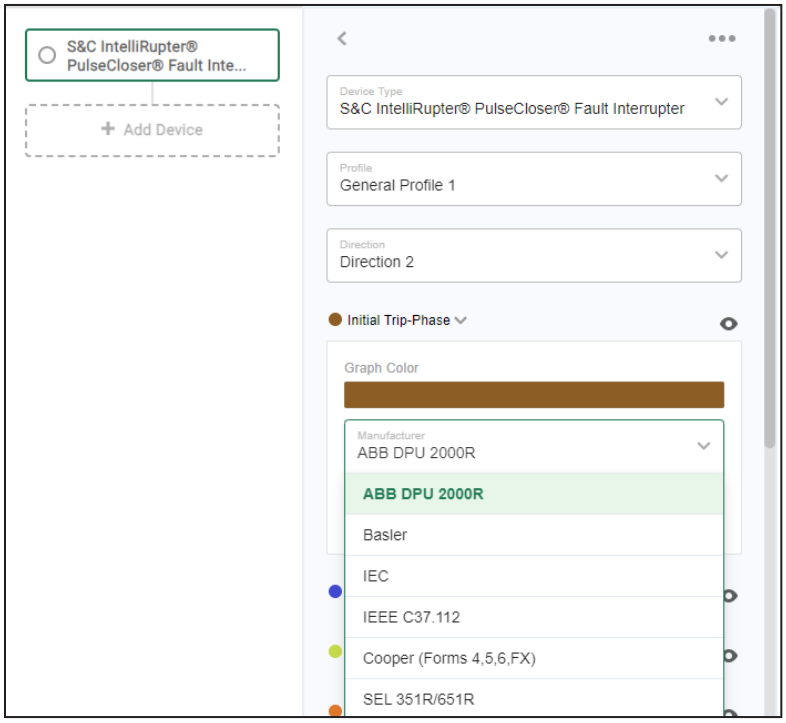

Figure 15. The device selection for an Initial Trip-Phase TCC curve.

STEP 2. After the emulated device has been selected, select the TCC curve. See Figure 16.

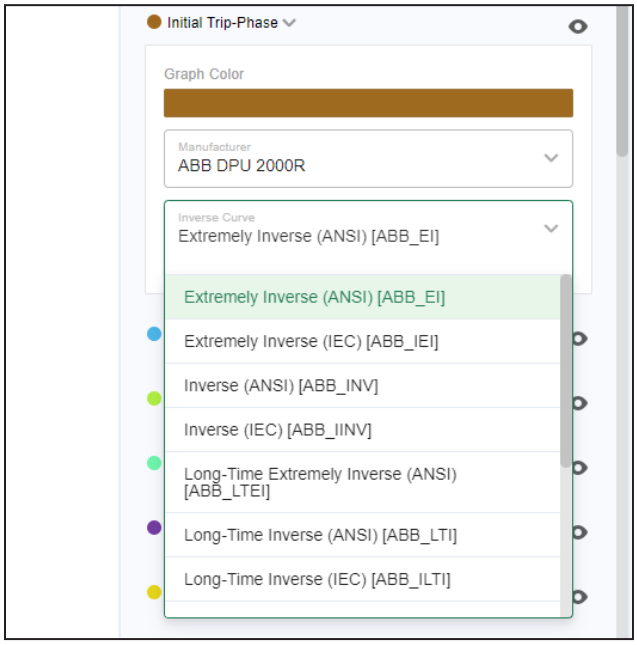

Figure 16. The emulated device curve selection drop-down menu.

STEP 3. Select parameters for the curve.

STEP 4. After curve parameters have been configured, click on the **Plot** button to create the TCC curve.

TripSaver® Dropout Recloser

The TripSaver Dropout Recloser is a discontinued product. See Figure 17.

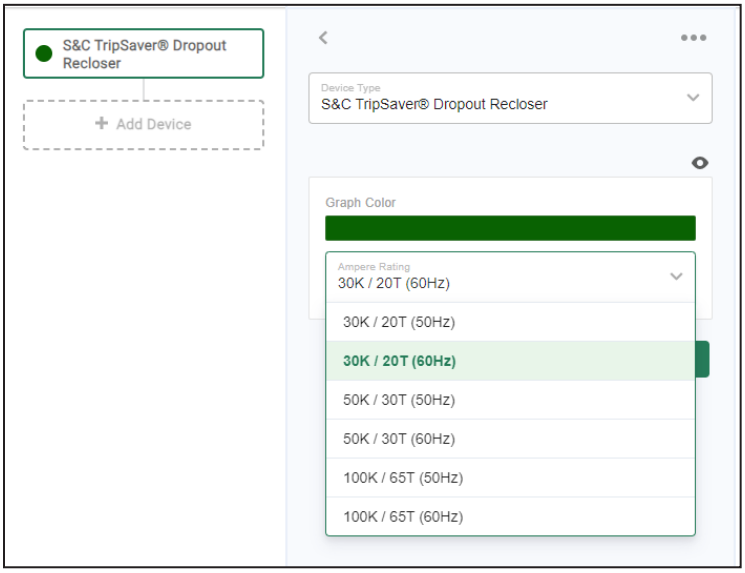

Figure 17. The Ampere Rating selection for a TripSaver Dropout Recloser.

Only the ampere rating is configurable, with six available options:

- 30K/20T (50 Hz)
- 30K/20T (60 Hz)
- 50K/30T (50 Hz)
- 50K/30T (60 Hz)
- 100K/65T (50 Hz)
- 100K/65T (60 Hz)

When the desired ampere rating has been selected, click on the **Plot** button to create the TCC curve.

TripSaver® II Cutout-Mounted Recloser

A TripSaver II Cutout-Mounted Recloser protects overhead lateral circuits. Used instead of a fuse cutout, it improves system reliability by eliminating the permanent outage resulting when a lateral fuse responds to a temporary fault. It is designed to protect laterals experiencing frequent momentary faults. See Figure 18.

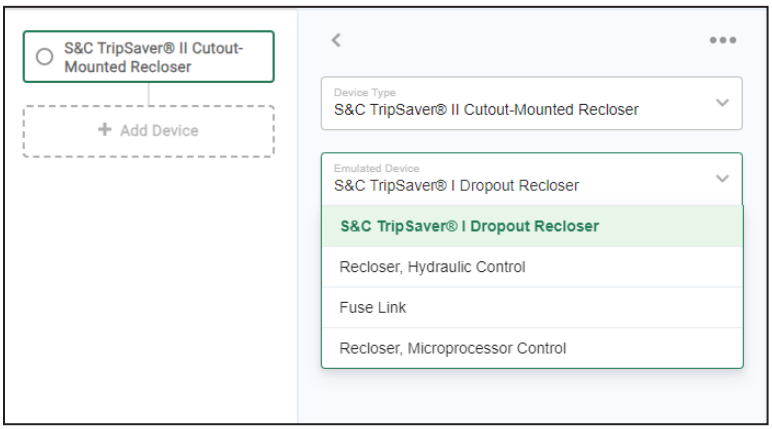

Figure 18. The Emulated Device selection for a TripSaver II Cutout-Mounted Recloser.

Follow these steps to configure the TCC curve:

STEP 1. Select an emulated device from the drop-down menu:

- TripSaver Dropout Recloser (This is the original TripSaver recloser.)
- Recloser, Hydraulic Control
- Fuse Link
- Recloser, Microprocessor Control

The selectable parameters vary depending on the device being emulated. See Figure 19 for the parameters available when "Recloser, Microprocessor Control" is selected.

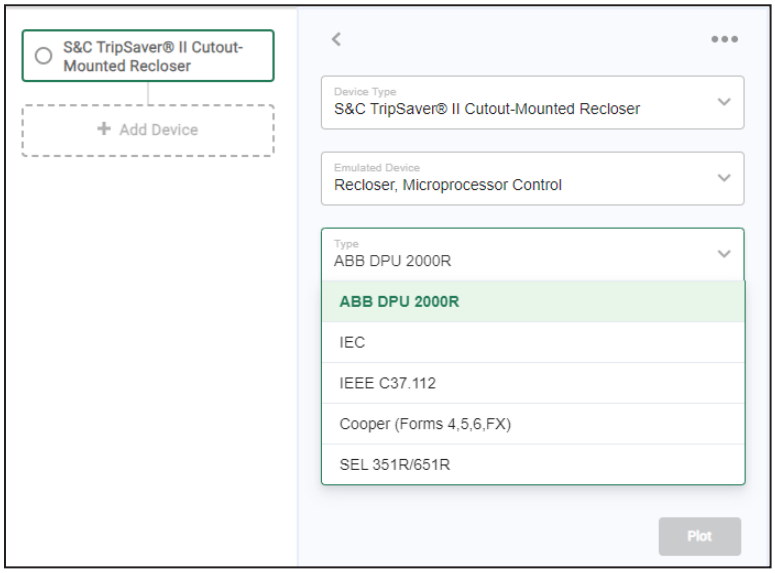

Figure 19. The parameter selections for an emulated recloser, microprocessor control.

STEP 2. Select the appropriate Fast and Slow TCC Curve parameters. See Figure 20.

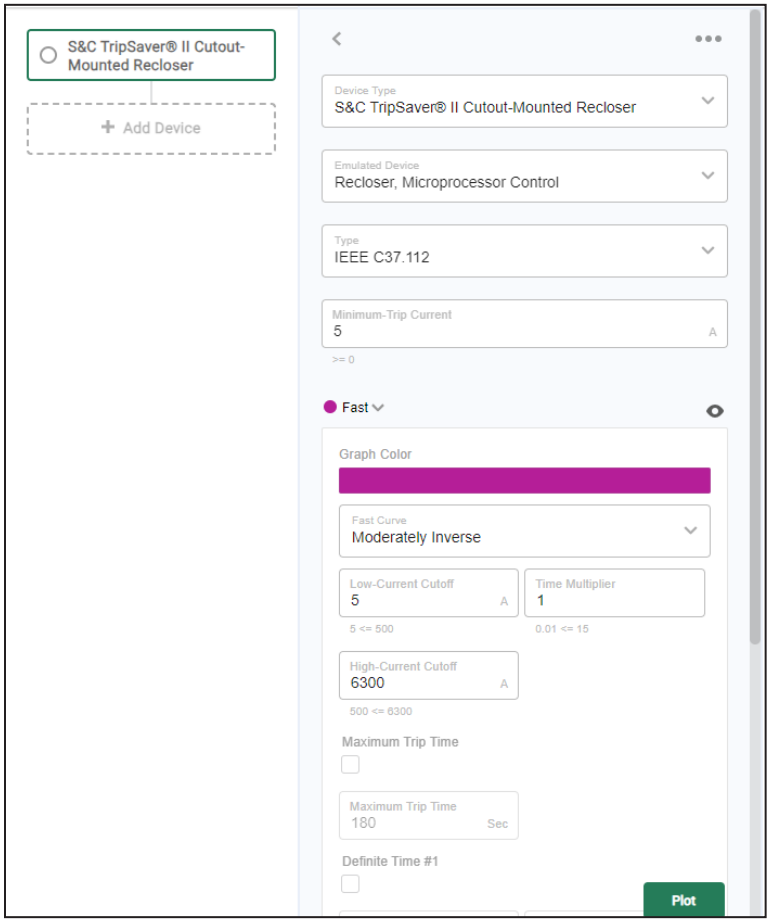

Figure 20. The Fast curve configuration settings.

STEP 3. After the curve has been selected and configured, click on the **Plot** button to create the TCC curve.

VacuFuse® Self-Resetting Interrupter

The VacuFuse interrupter is a discontinued product. See Figure 21.

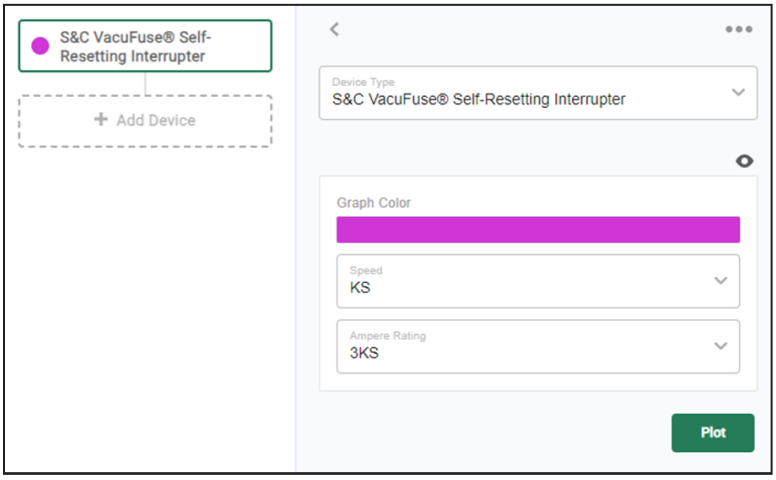

Figure 21. The device parameters for a VacuFuse interrupter.

These are the selectable parameters for a VacuFuse interrupter:

- **Speed:** Select the desired speed (TCC) characteristic.
- **Ampere Rating:** Select the desired ampere rating.

Vista Overcurrent Control 2.0

Vista® Underground Distribution Switchgear models have resettable vacuum fault interrupters or arc spinners in series with the load-interrupter switches. In the Coordinaide program, Vista Overcurrent Control 2.0 TCC curves are available in two categories: E, K, T, Main and Tap Curves or IEC and IEEE relay curves. Appropriate curves can be selected by clicking on the **+ Add Device** button to add the appropriate device and curve selection. See Figure 22.

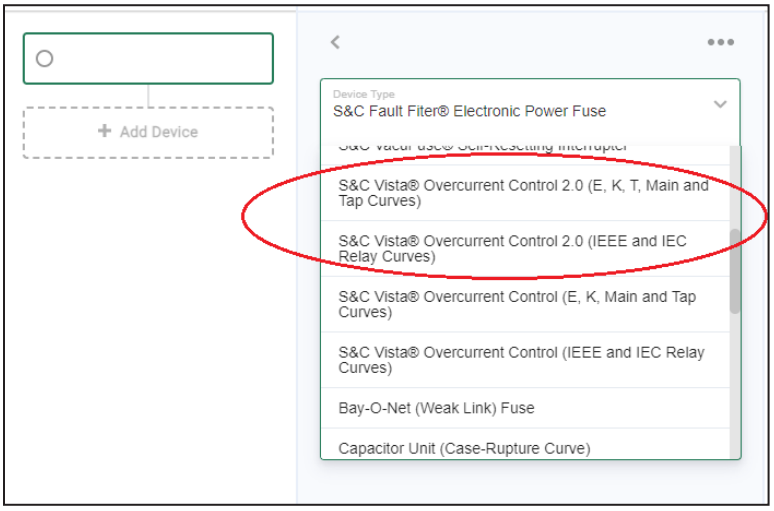

Figure 22. The TCC curve categories are selected on the Device Type menu.

After selecting the curve category, select the **CT Ratio** and **Interrupting Rating** settings from the drop-down menus. See Figure 23.

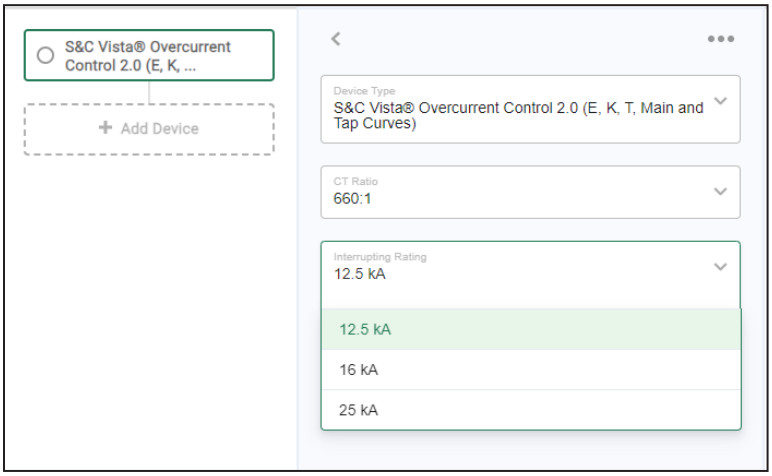

Figure 23. The CT Ratio and Interrupting Rating menus.

After the **CT Ratio** and **Interrupting Rating** settings are configured, select the appropriate TCC curves and configure their parameters. An example for the phase curve is shown in Figure 24.

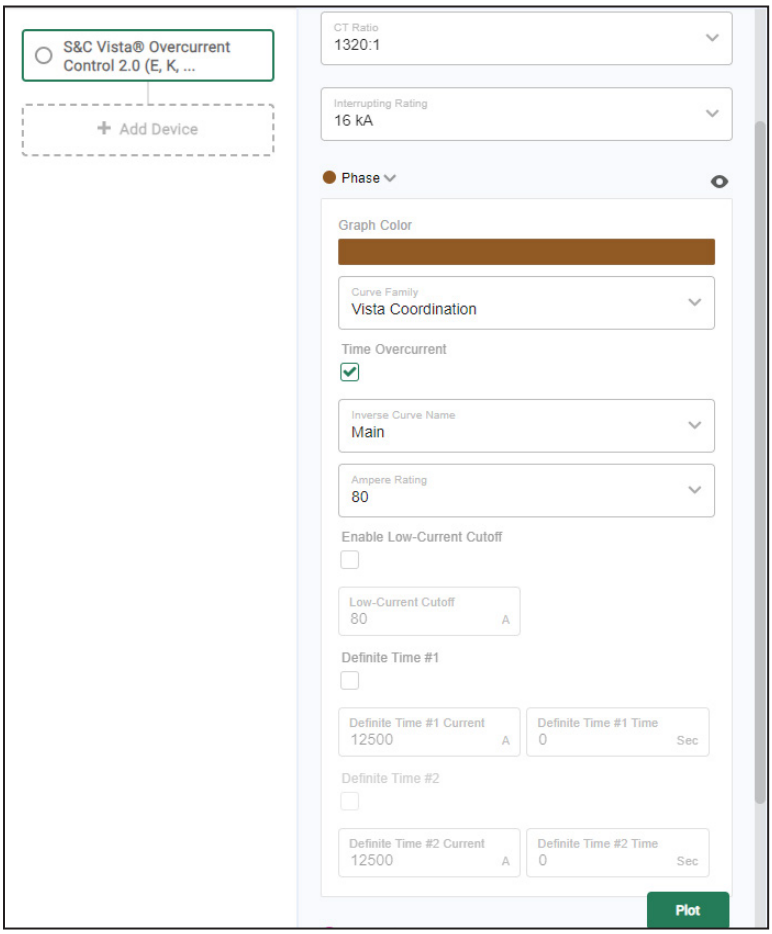

Figure 24. The TCC curve configuration for the phase curve.

After the curve has been selected and configured, click on the **Plot** button to create the TCC curve.

Vista Overcurrent Control

Vista Overcurrent Control TCC curves are available in two categories: E, K, T, Main and Tap Curves or IEC and IEEE relay curves. Appropriate curves can be selected by clicking on the **+ Add Device** button to add the appropriate device and curve selection. See Figure 25.

The Vista Overcurrent Control was discontinued on November 30, 2018 and replaced by the Vista Overcurrent Control 2.0.

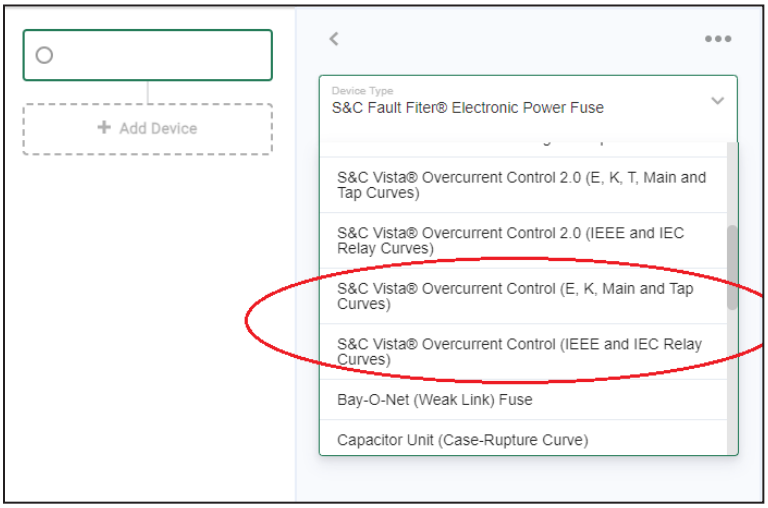

Figure 25. The TCC curve categories are selected on the Device Type menu.

After selecting the curve category with the Device Type selection, additional parameters are available for selection to define the TCC curve. See Figure 26.

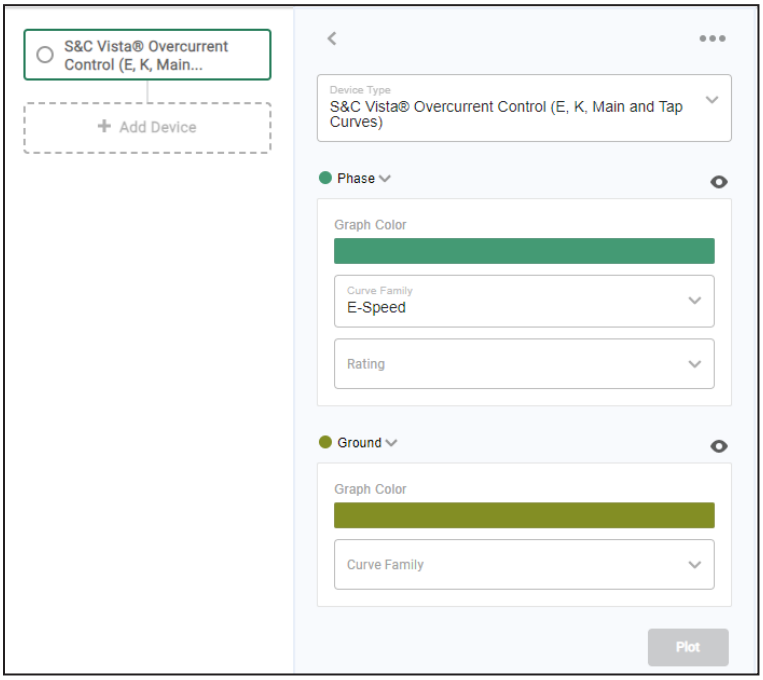

Figure 26. The additional curve parameters for the TCC curve.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Bay-O-Net (Weak Link) Fuse

The Bay-O-Net fuse, known as the "weak-link" fuse, is an under-oil fuse used in pad-mounted transformers.

See Figure 27 for the selectable parameters:

- **Manufacturer:** Select the desired manufacturer.
- **Speed:** Select the desired speed (TCC) characteristics.
- **Ampere Rating:** Select the desired ampere rating for the fuse.
- **Include 25% Setback Allowance?:** This field applies a 25% setback allowance, in terms of time, to the minimum-melting curve.

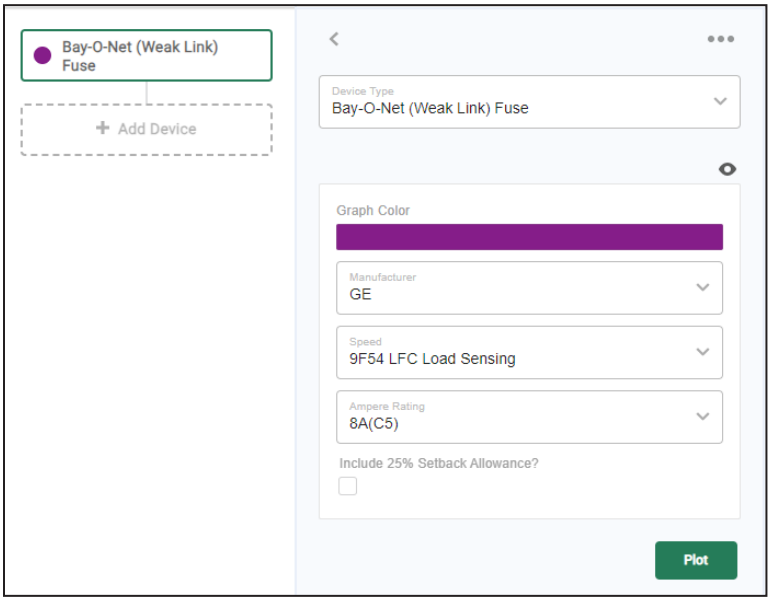

Figure 27. The fuse configuration parameters for a Bay-O-Net (Weak Link) Fuse.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Capacitor Unit (Case-Rupture Curve)

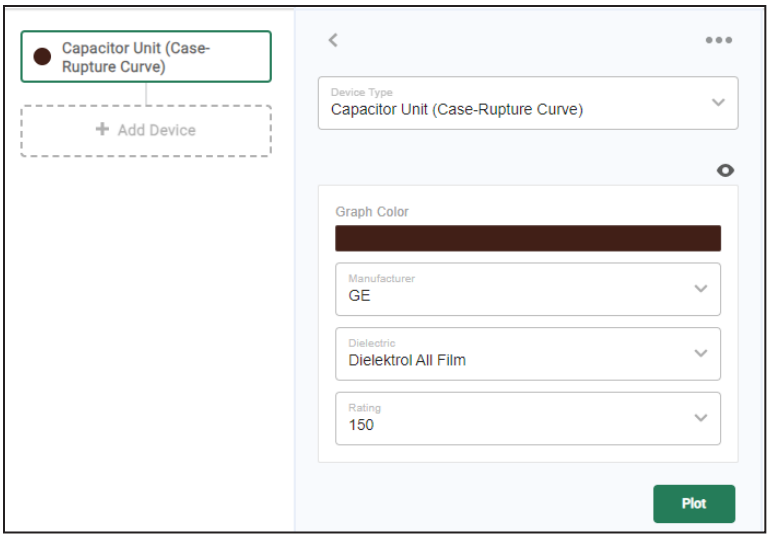

Figure 28. The device configuration parameters for a Capacitor Unit (Case-Rupture Curve).

See Figure 28 for the selectable parameters:

- **Manufacturer:** Select the desired manufacturer.
- **Dielectric:** Select the desired dielectric characteristics.
- **Ampere Rating:** Select the desired ampere rating for the fuse.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Current-Limiting Fuse

The appropriate TCC curve can be plotted by selecting the devise parameters and clicking on the **Plot** button to generate the TCC curve.

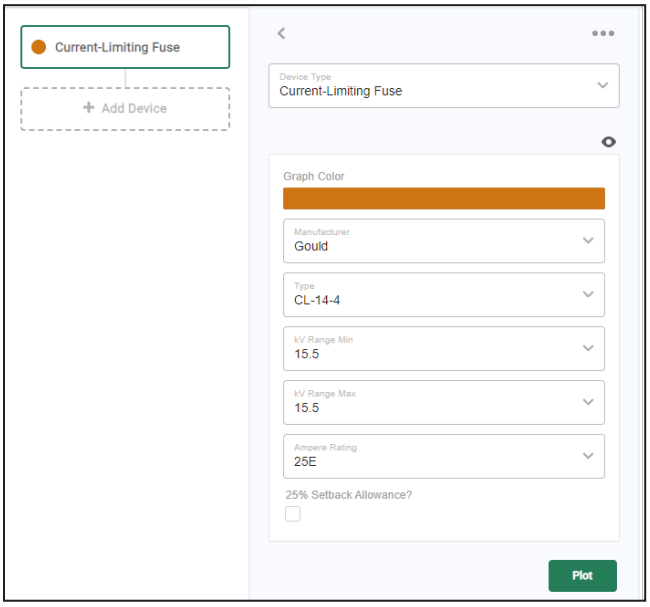

Figure 29. The device configuration parameters for a Current-Limiting Fuse.

See Figure 29 for the selectable parameters:

- **Manufacturer:** Select the desired manufacturer.
- **Type:** Select the desired fuse type.
- **kV Range Minimum:** Select the desired kV minimum.
- **kV Range Maximum:** Select the desired kV maximum.
- **Ampere Rating:** Select the desired ampere rating for the fuse.
- **Include 25% Setback Allowance?:** This field applies a 25% setback allowance, in terms of time, to the minimum-melting curve.

The appropriate TCC curve can be plotted by selecting the devise parameters and clicking on the **Plot** button to generate the TCC curve.

Fuse Link

Distribution fuse links are used in overhead distribution fuse cutouts and are available in a wide variety of speed characteristics to optimize device protection and coordination. See Figure 30.

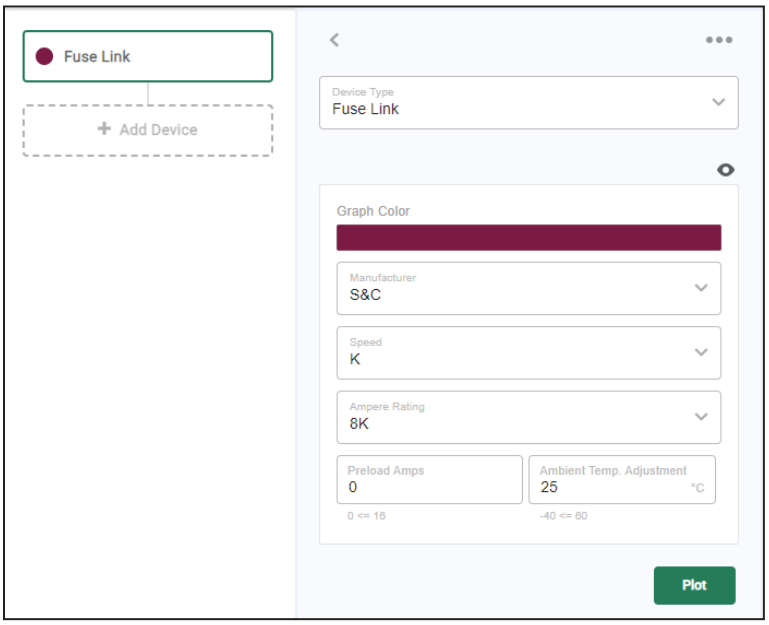

Figure 30. The device configuration parameters for a Fuse Link.

These are the selectable parameters for a fuse link:

- **Manufacturer:** Select the desired manufacturer.
- **Speed:** Select the desired speed (TCC) characteristic.
- **Ampere Rating:** Select the desired ampere rating.
- **Preload Amps:** This field adjusts for the reduction in the minimum-melting time because of the pre-fault load current. Enter the load on the fuse expressed as a percent of the fuse ampere rating. (Default: 0 amperes)
- **Ambient Temperature Adjustment:** This field adjusts for the increase or decrease in the fuse minimum-melting time because of high or low ambient temperatures. Enter the desired ambient temperature in degrees Celsius. [Default: 25°C (77°F)]

Note: Specific preload and ambient-temperature adjustments apply only to Positrol® Fuse Links. For other manufacturer fuse links, a 25% setback allowance, in terms of time, can be applied to the minimum-melting curve.

Note: Positrol Fuse Links should not be loaded to currents more than their published continuous peak-load capabilities. Refer to S&C Information Bulletin 352-190.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Incident-Arc Energy Curve

When this device is selected, the Coordinaide program develops incident-arc-energy curves for various PPE levels (from 1 – 4) using either the empirical (1 < kV < 15) or theoretical (kV > 15) methods found in Annex D to NFPA–70E (Electrical Safety in the Workplace). Both methodologies are described in Table 1 and the "Theoretical Method Equation" section.

Table 1. Empirical Method Equations

	0 < kV ≤ 1	1 < kV ≤ 15
Arcing Current	$\log_{10} I_a = K + 0.662 \log_{10} I_{bf} + 0.0996 V + 0.000526 G + 0.5588 V \log_{10} I_{bf}$	$\log_{10} I_a = 0.00402 + 0.983 \log_{10}$
Normalized Incident Energy	$\log_{10} E_n = k_1 + k_2 + 1.0811 \log_{10} I_a + 0.0011 G$	
Time	$t = \frac{0.2 E D^x}{4.184 \times 610^x \times C_f E_n}$	

Table 1. Theoretical Method Equation

Time: $t = \frac{E D^2}{2.142 \times 10^6 V I_{bf}}$

where:

C_f = 1.0 for voltages above 1 kV; 1.5 for voltages at or below 1 kV

D = Working distance (mm) from the arc to the person

E = Incident energy (based on PPE level)

E_n = Incident energy normalized for time and distance

G = Conductor gap in mm (see Table 2 on page 30)

I_a = Arcing current in kA

I_{bf} = Bolted three-phase available fault current in kA

K = –0.153 for open air arcs; –0.097 for arcs-in-a-box (i.e., for switchgear)

k_1 = –0.792 for open air arcs; –0.555 for arcs-in-a-box (i.e., for switchgear)

k_2 = 0 for ungrounded and high resistance systems; –0.113 for grounded systems

t = arcing time in seconds

V = System voltage in kV

X = Distance exponent (see Table 2 on page 30)

Table 2. Distance Exponent

System Voltage (kV)	Type of Equipment	Typical Conductor Gap Inch (mm)	Distance X-Factor
0.208-1	Open-air	0.4-1.6 (10-40)	2.000
	Switchgear	1.3 (32)	1.473
	MCCs and panels	1.0 (25)	1.641
	Cables	0.5 (13)	2.000
> 1-5	Open-air	4.0 (102)	2.000
	Switchgear	0.5-4.0 (13-102)	0.973
	Cables	0.5 (13)	2.000
> 5-15	Open-air	0.5-4.0 (13-153)	2.000
	Switchgear	4.0 (153)	0.973
	Cables	0.5 (13)	2.000

After configuring the selection parameters, click on the **Plot** button to create the TCC curve. See Figure 31.

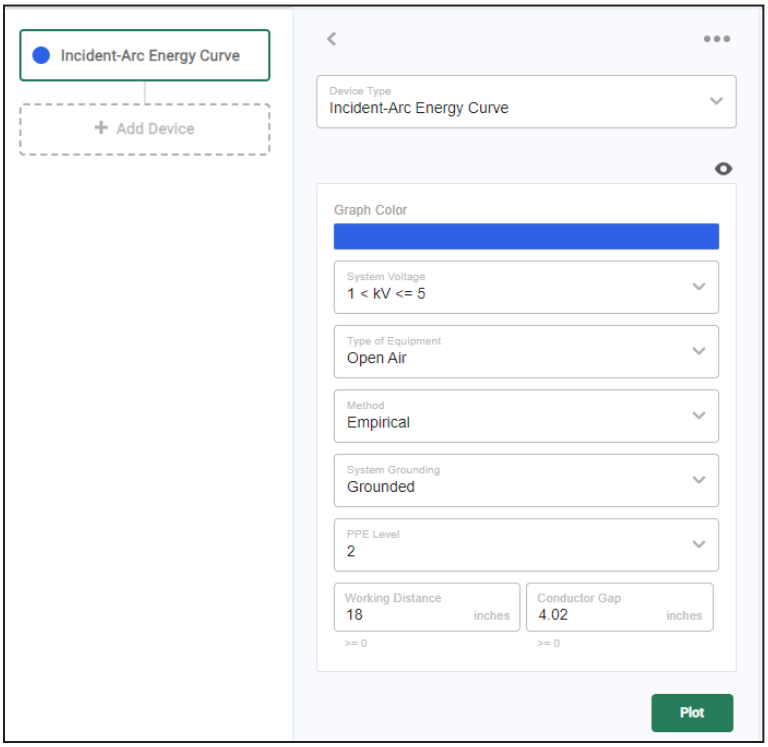

Figure 31. The selectable parameters for the Incident-Arc Energy Curve.

Motor (Generic Starting Curve)

When this device is selected, the Coordinaide program develops a generic motor-starting curve based on the specifications of the motor. Click on the **+ Add Device** button and configure the selectable parameters. See Figure 32.

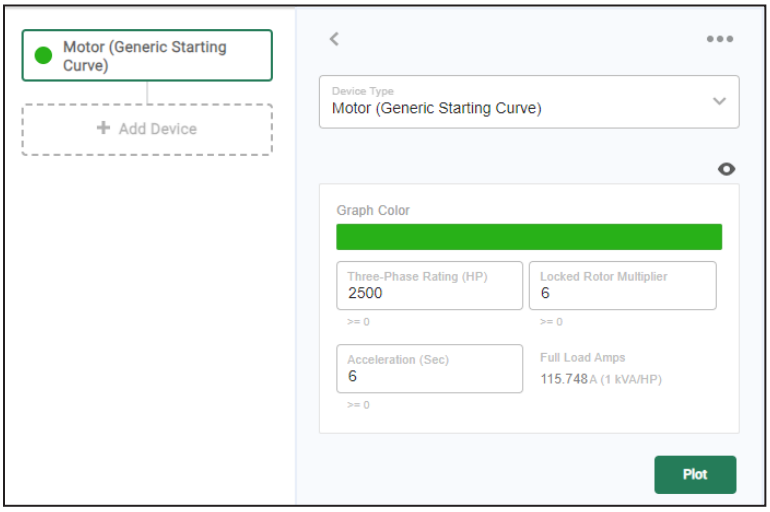

Figure 32. The selectable parameters for the Motor (Generic Starting Curve).

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Overhead Conductor (Damage Curve)

When this device is selected, the Coordinaide program develops an industry-recognized conductor damage curve based on the material and the size of the conductor selected. The Coordinaide program uses three different methods of determining damage curves, which are shown in Table 3.

Table 3. Overhead Conductor Damage Curve Equations

Curve Type	Soares Annealing Curve Using 1 Ampere per 30 Circular Mils for 5 Seconds (for Copper Conductors Only)	Onderdonk Melting Curve (for Copper Conductors Only)	Aluminum Association Method (for Aluminum and ACSR Conductors)
Equation	$I = \sqrt{\frac{\left(\frac{CM}{30}\right)^2 \times 5}{t}}$	$I = CM\sqrt{\frac{\log_{10}\left(\frac{T_f - T_0}{234 + T_0} + 1\right)}{33t}}$	$\left(\frac{1}{CM}\right)^2 (t) = 0.0125 \log_{10} \frac{T_f + 228}{T_0 + 228}$
Source	Grounding Electrical Systems for Safety (Eustice Soares)	Standard Handbook for Electrical Engineers	Aluminum Electrical Conductor Handbook

where:

CM = Conductor area in Circular Mils

I = Fault current

t = Time of fault current

T_o = Rated insulation operating temperature limit

T_f = Rated maximum insulation short circuit temperature limit

When the device is added using the **+ Add Device** button, the selectable parameters are available. See Figure 33.

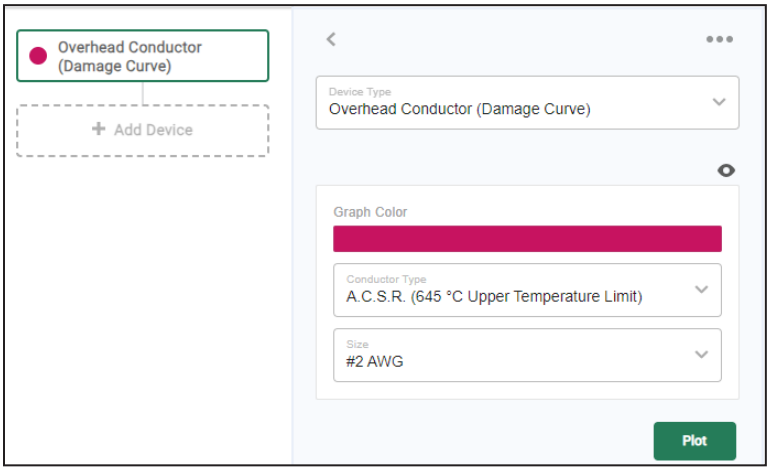

Figure 33. The selectable parameters for the Overhead Conductor (Damage Curve).

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Power Fuse

Power fuses provide reliable and economical full-fault-spectrum protection for transformers and capacitor banks in utility and industrial substations. They are one of the most widely deployed devices in the electric power industry. See Figure 34.

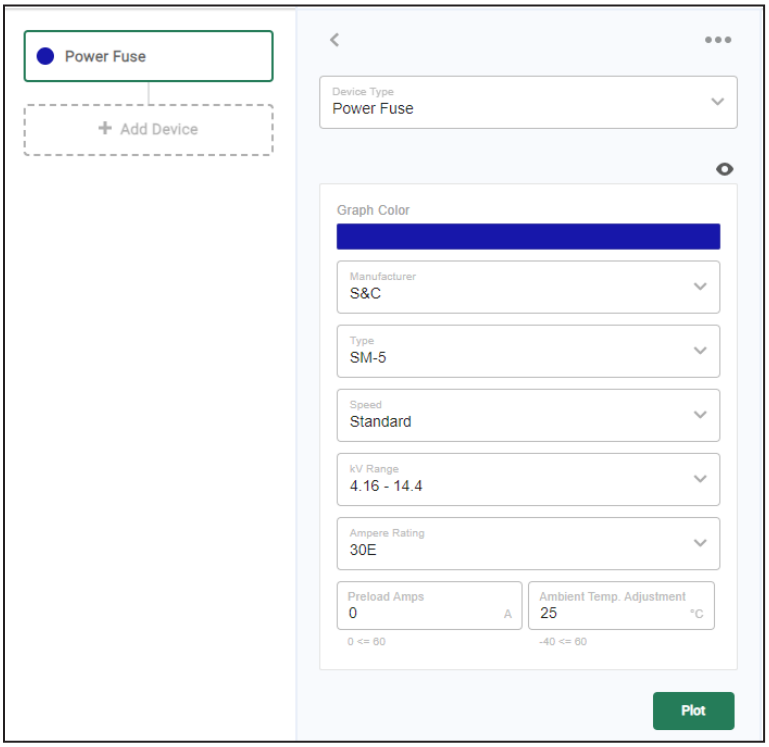

Figure 34. The selectable parameters for a Power Fuse.

These are the selectable parameters for power fuses:

- **Manufacturer:** Select the desired manufacturer.
- **Type:** Select the desired type of fuse.
- **Speed:** Select the desired speed (TCC) characteristic.
- **kV Range:** Select the appropriate kV range.
- **Ampere Rating:** Select the desired ampere rating.
- **Preload Amps:** This field adjusts the reduction in the power fuse's minimum-melting time due to the pre-fault load current. Enter the load on the fuse expressed as a percent of the fuse's ampere rating. (Default: 0 amperes)
- **Ambient Temperature Adjustment:** This field adjusts the increase or decrease in the power fuse's minimum melting time because of high or low ambient temperature. Enter the desired ambient temperature in degrees Celsius. [Default: 25°C (77°F)]

Note: Specific preload and ambient temperature adjustments apply only to S&C Power Fuses. For other power fuses, a 25% setback allowance, in terms of time, can be applied to the minimum-melting curve.

Note: S&C Power Fuses should not be loaded to currents more than their published continuous peak-load capabilities. Refer to S&C Information Bulletins 210-190 (SMD® Power Fuses) and 242-190 (SM, SML, SMD-20 and SMD-40 Power Fuses).

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

R-Rated Motor-Starter Fuse

An R-rated motor starter fuse is a partial range current-limiting fuse used in Class E-2 industrial control equipment (i.e., fused motor starters). See Figure 35.

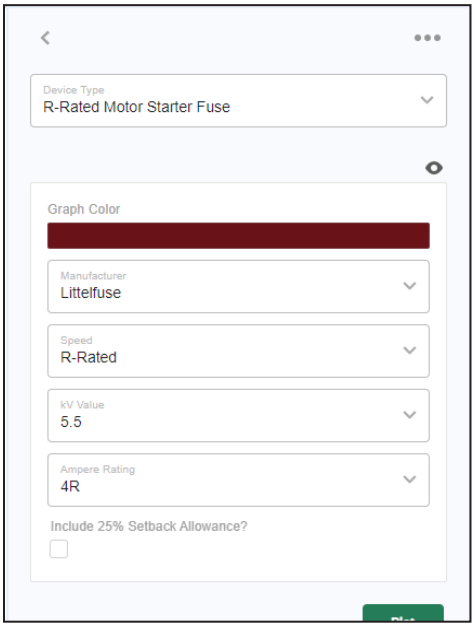

Figure 35. The selectable parameters for the R-Rated Motor Starter Fuse.

The selectable parameters are:

- **Manufacturer:** Select the desired manufacturer.
- **Speed:** The default speed is R.
- **kV Value:** Select the desired voltage range.
- **Ampere Rating:** Select the desired ampere rating.
- **Include 25% Setback Allowance?:** This field applies a 25% setback allowance in terms of time to the minimum-melting curve.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Recloser Equation-Based (Micro-Processor Control)

A recloser is designed to clear a temporary fault through various trip operations without causing a permanent outage, but it can electrically open in case of a permanent fault. These reclosers use a microprocessor control, so curves are based on a formula rather than point-to-point data. See Figure 36.

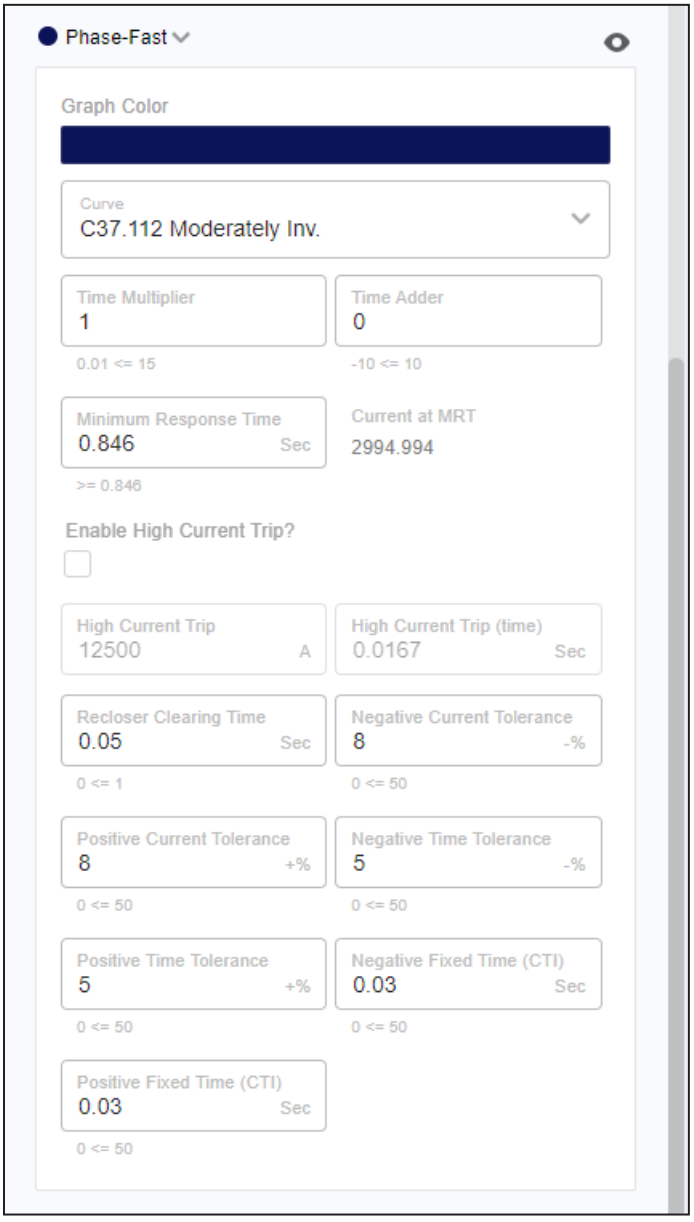

Figure 36. The selectable parameters for the Recloser Equation-Based (Microprocessor Control).

These are the selectable parameters for equation-based controllers:

- **Manufacturer:** Select the manufacturer of the recloser.
- **Min. Trip Current:** Enter the desired minimum trip current in amperes.
- The Phase and Ground Curves parameters can now be selected.
- **Time Multiplier:** Enter the desired time-dial multiplier for the selected curve. The Coordinaide program automatically interpolates between defined curves to plot intermediate time-dials.
- **Time Adder:** Enter the desired time in seconds.
- **Min. Response Time:** Enter the desired minimum response time in seconds. If left blank, the Coordinaide program populates this field with an appropriate default value.
- **High Current Trip:** Enable the **High Current Trip** feature and enter the desired **High Current Cutoff** setpoint in amperes, where a trip will occur regardless of other setpoints.
- **Recloser Clearing Time:** This field adjusts recloser clearing time. Curves are plotted with +/- tolerances and this fixed time is added. (Default: 0.04167 seconds)
- **Current Tolerances:** This field specifies current tolerances in percent of current. Tolerances vary among manufacturers.
- **Time Tolerances:** This field specifies time tolerances in either percent of time or a fixed time value. For Fixed Time (CTI) tolerance, enter a positive value to create negative tolerance.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Recloser Point-Based (Hydraulic, Electronic Controls)

A recloser is designed to clear a temporary fault through various trip operations without causing a permanent outage, but it can electrically open when a permanent fault occurs. The term point-based means these recloser curves come from point-to-point data rather than a formula.

The selectable parameters for point-based controls vary, depending on the manufacturer selected. See Figure 37. These are the parameters for an SEL control:

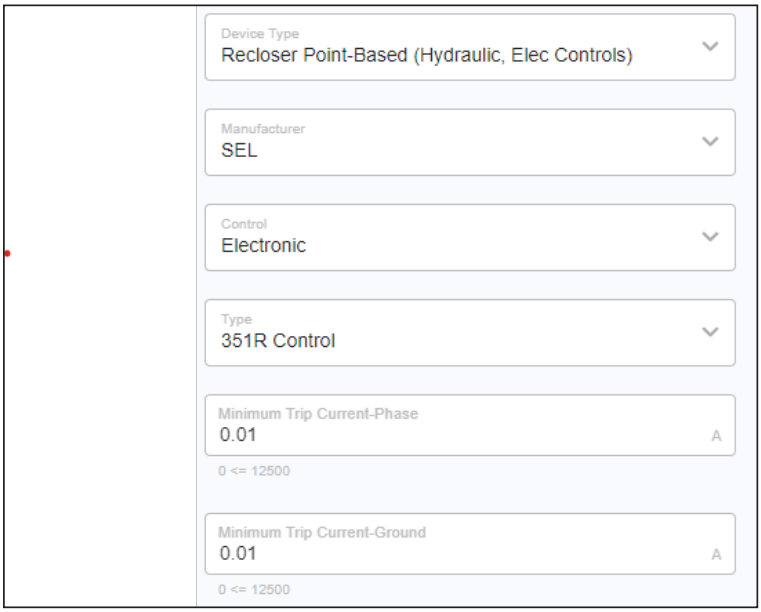

Figure 37. The selectable parameters for an SEL control.

Shown in Figure 38 are the curves parameters:

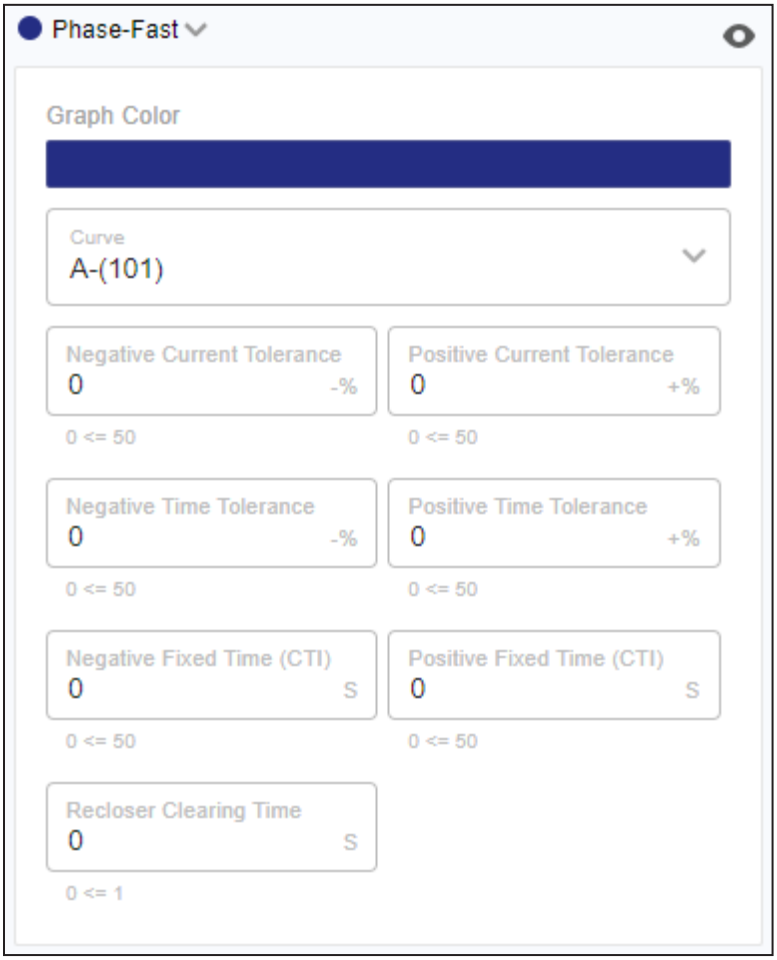

Figure 38. The selectable curve parameters for the recloser point-based (hydraulic, electronic controls).

- **Current Tolerances:** This field specifies current tolerances in terms of percent of current. Tolerances vary by manufacturer.
- **Time Tolerances:** This field specifies time tolerances in terms of either percent of time or a fixed time value. For Fixed Time (CTI) tolerance, enter a positive value to create negative tolerance.

  Other manufacturers have different selection parameters.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Relayed Circuit Breaker

The Coordinaide program database contains TCC curves for a large variety of relay manufacturers, from legacy Westinghouse "CO" and GE "IFC" curves to the new microprocessor based "IEC" and "US" curves. Some relayed circuit breaker TCC curves have been digitized, while others are generated using the following formula:

$$T_{nominal}(I) = \left(\frac{A}{\left({}^{I}/_{I_{\min\_trip}} \right)^{p} - C} + B \right) . TM + TA + K$$

where:

A, *B*, *C*, *p*, and *K* are essentially curve-fitting constants (not user-settable)

I = Fault current

I_{min_trip} = Minimum trip current

TM = Time multiplier (time dial setting)

TA = Time adder

These are the selectable parameters for relayed circuit breakers:

Manufacturer: Select the desired manufacturer.

Relay Type: Select the desired relay characteristic. (e.g., inverse, very inverse).

Minimum-Pickup Current, Amperes: Enter the desired minimum-pickup current in amperes.

Instantaneous-Pickup Current, Amperes: Enter the desired instantaneous-pickup current in amperes.

Phase Time-Dial Setting: Enter the desired time-dial multiplier for the relay curve. The Coordinaide program automatically interpolates between defined curves to plot intermediate time-dials. Although the time-dial historically ranged from 0.5 – 11, some of the newer electronic relays can have time-dial ranges from 0 – 99 (Basler) or from 0.05 – 1.1 (IEC).

Breaker Clearing Time: Enter the clearing time for the circuit breaker. The default range is 0 to 1000 seconds. Leave blank when using load-side coordination.

Current Tolerances: This field specifies current tolerances in terms of percent of current. Tolerances vary among manufacturers.

Time Tolerances: This field specifies time tolerances in terms of either percent of time or a fixed time value. For Fixed Time (CTI), enter a positive value to create negative tolerance.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Transformer (Damage Curve)

For the Transformer (Damage Curve) selection, the Coordinaide program develops a generic damage curve for a transformer based on the primary and secondary voltages, kVA rating, percent impedance, and the connection.

When this device is selected, the following notification opens: "The TCC curves of any Devices added after the Transformer are scaled down by the Primary-to-Secondary Voltage ratio of the Transformer. To compare Device TCC curves without any changes because of a Transformer, add the Device before the Transformer."

See Figure 39 on page 42. These are the selectable parameters for a Transformer (Damage Curve):

- **3-Phase Primary kV:** This is the primary-side voltage of the transformer. The default value is the system voltage entered on the "General System Information" section of the *Program* screen.
- **3-Phase Secondary kV:** This is the secondary-side voltage, expressed in kilovolts (kV). To enter a voltage smaller than 1 kV, use a decimal (i.e., 480 Volts = 0.48 kV).
- **3-Phase Rating kVA:** Enter the power rating (kVA) of the transformer.
- **Impedance:** Enter the transformer's impedance in percent.
- **Display magnetizing-inrush points?:** This field selects using the industry "rule-of-thumb" magnetizing inrush points.
- **Connection:** Select the desired transformer connection (e.g., Delta-Gnd.Y, Delta-Delta, Gnd.Y-Gnd.Y).

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

Note: To model a single-phase transformer, enter three times the kVA rating of the single-phase transformer in the **3-Phase Rating kVA** field and adjust the secondary voltage as needed.

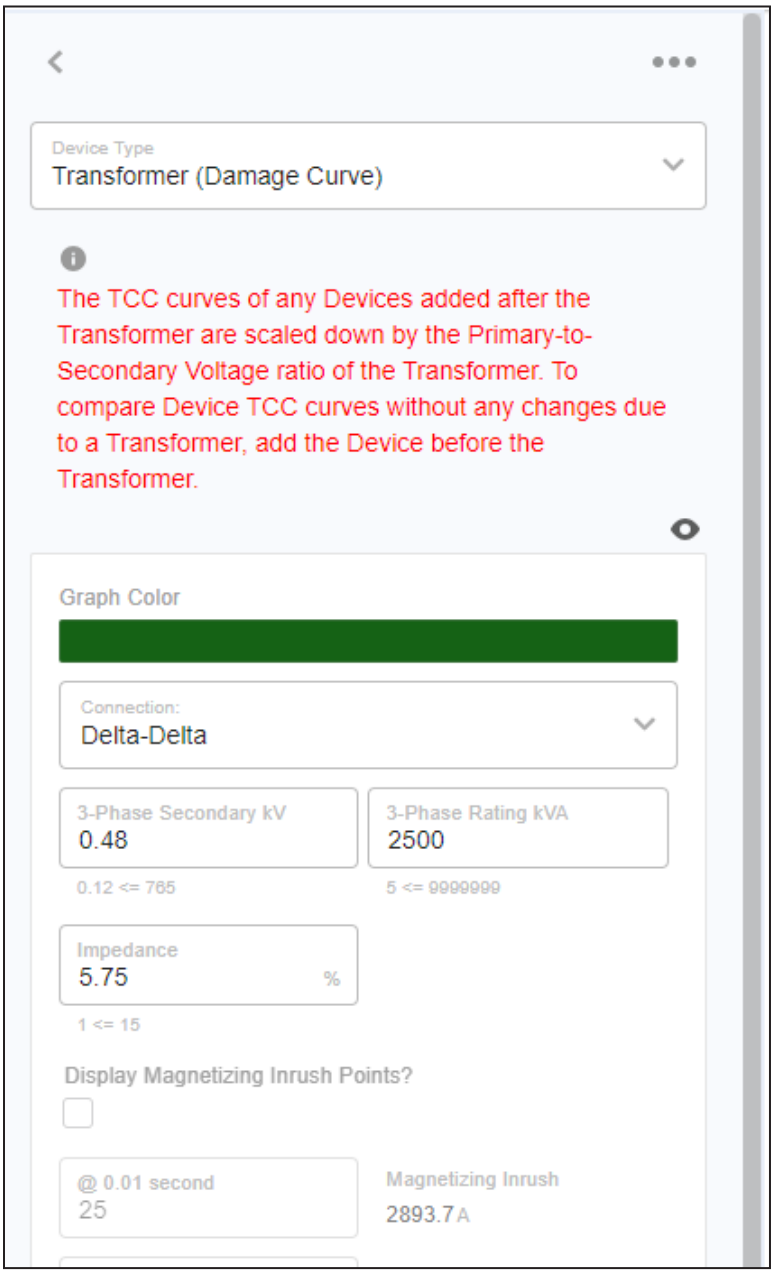

Figure 39. The selectable parameters for the Transformer (Damage Curve).

Underground Cable (Damage Curve)

When this device is selected, the Coordinaide program develops a cable damage curve based on the conductor type, the insulation material and the size. The formulas used are from IEEE Std. 242 and are shown in Table 4.

Table 4. Cable Damage Curve Formulas

Copper	Aluminum
$\left(\frac{I}{CM}\right)^2 (tF_{ac}) = 0.0297 \log_{10} \frac{T_f + 234}{T_0 + 234}$	$\left(\frac{I}{CM}\right)^2 (tF_{ac}) = 0.0125 \log_{10} \frac{T_f + 228}{T_0 + 228}$

Where

CM = Conductor area in Circular Mils

I = Fault Current

t^{Fac} = Time of short circuit

T_0 = Rated insulation operating temperature limit

T_f = Rated maximum insulation short circuit temperature limit

These are the selectable parameters for the Underground Cable (Damage Curve):

- **Conductor Type:** Select the conductor material. Available options are aluminum or copper.
- **Insulation:** Select the insulation material and the corresponding minimum and maximum temperature ranges.
- **Size:** Select the size of the conductor.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

User Provided (Import Data Points)

This option allows a TCC curve to be plotted from a set of time-current data points not available in the Coordinaide program database.

The time-current data points can be imported using the Import Curve Data selection. The only acceptable file format is a CSV file. Two sets of time-current data points can be loaded into the Coordinaide program using the CSV file. See Figure 40.

	A	B	C	D
1	Current	Time	Current	Time
2	6383.6	0.01	16089.5	0.025295
3	6288.562	0.010346	14255.9	0.026805
4	6054.072	0.01114	12245.6	0.029008
5	5678.751	0.012687	10699.2	0.031299
6	5342.703	0.014333	9218.13	0.034008
7	5066.91	0.015936	8126.84	0.036583
8	4691.403	0.018589	7114.77	0.039988
9	4404.96	0.021149	6316.55	0.043492
10	4107.156	0.02423	5686.94	0.046599
11	3780.028	0.02872	5145.76	0.050481
12	3461.603	0.034212	4726.44	0.054195
13	2982.406	0.046136	4415.73	0.057374
14	2653.105	0.058299	4108.97	0.061472
15	2386.273	0.071779	3793.06	0.067127
16	2167.841	0.087146	3540.16	0.072937
17	2003.175	0.102267	3193.68	0.0824
18	1864.012	0.117635	2826.88	0.096215

Figure 40. The Import Curve Data command can apply this type of CSV file.

Note: The Coordinaide program can also load CSV files with only one set of time-current data points.

Note: If the CSV files contain more than two sets of time-current data points, only the first two sets (data in the first four columns of the file) will be loaded and the other data points will be ignored.

After the device parameters have been configured, click on the **Plot** button to create the TCC curve.

A PDF file can be downloaded showing all parameter values selected for the devices in the present project, along with the TCC curve plot. On the *Program* screen, click on the "**...**" **Options** button, and click on the **Download PDF Project Summary** option. See Figure 41.

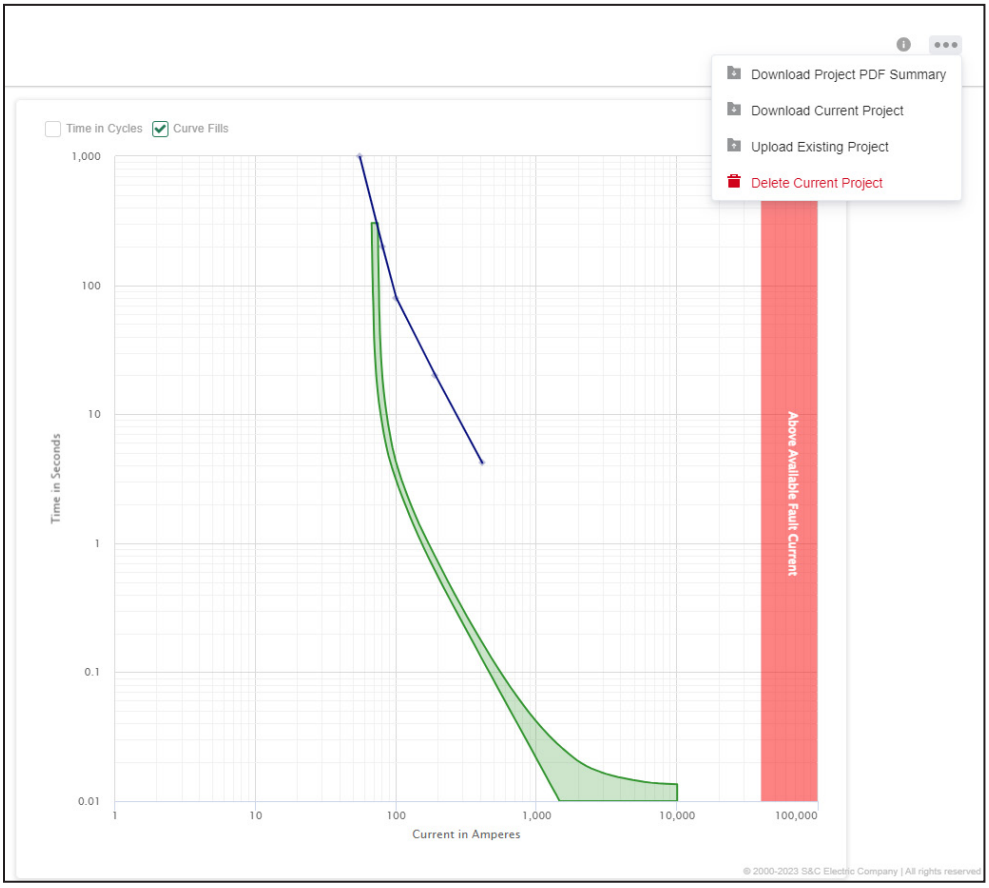

Figure 41. The *Program* screen showing the Options menu.