User Manual

Revision Date
January 25, 2013

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1 BeSecure Description

BeSecure is a set of tools to help analyze, document, and report hazards on your electrical system. The tools can help you in all phases of managing your electrical system, whether you are starting from little to no documentation, are looking to manage your existing studies and keep them up to date, or you need to work on equipment that was not included in your original study.

1.1 BeSecure Manage

BeSecure Manage is a cloud based tool to help store and access information about your system and to help keep it up to date. Information about your system is on-line, giving you instant access to the most recent study results, instead of searching your bookshelves for the latest study.

1.2 BeSecure Extend

BeSecure Extend is a tool to quickly identify the Arc Flash Hazard Category and Boundary for equipment that was not included in your existing study. This calculation is performed on a hand-held device by electricians in the field, without having to wait for an engineer to update your study.

2 User Interface Help

2.1 BeSecure Manage

To access BeSecure Manage go to https://manage.besecuresolutions.net

BeSecure Manage is the secure web based management console. Users can manage their BeSecure account and information from any computer with internet access.

The main functions of BeSecure manage are:

- Create/edit site, building, system, and scenarios for organizing data (**Base Data**)
- Upload existing arc-flash study results into BeSecure (**Upload Data**)
- Specify which buses are auto HC 0 based on voltage and transformer size (**Auto HC 0**)
- View/edit uploaded and extended data for one scenario at a time (**Study Data**)
- View arc flash results for all scenarios at a time (**Bus Detail**)
- Purge/restore deleted bus data (**Del Buses**)
- Print arc flash labels (**Print Labels**)
- Setup preferences, including units, defaults, thresholds, tracking (**Site Config**)
- Setup user accounts and permissions for both BeSecure Manage and Extend (**User Accts**)
- View extended bus input details (**Ext Inputs**)

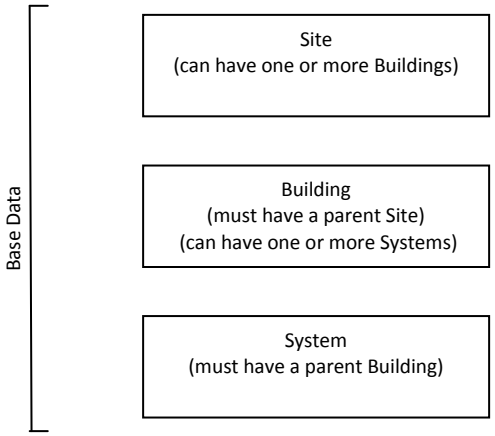
Users with the Client Admin role will see all of the above pages in BeSecure Manage. Pages and task buttons will be hidden from users with lower access levels.

Note: The printing function is fully supported in Microsoft Internet Explorer. Google Chrome web browser has limited printing support and cannot print directly. When reports are displayed, select PDF format then click Export. A .pdf file will be created and downloaded. Open the file and print.

2.1.1 Base Data

BeSecure uses a hierarchy to organize uploaded data and user access. The Base Data is managed by administrators; administrators can add/remove data at or below their access level. For example, a Site Administrator can add Buildings, Systems, Scenarios, and upload bus data. A Client Administrator can add Sites in addition to those items.

Figure 2.1-1 BeSecure Hierarchy



Systems, buildings, and sites are specific to their parent level.

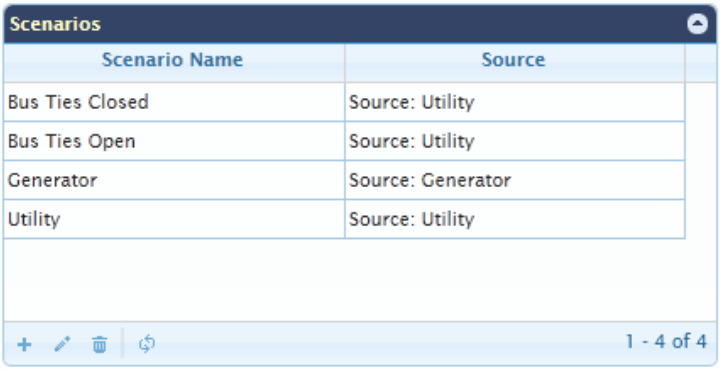
For example, if a client has two sites “World HQ” and “Satellite Office”, and each site has a “Building 1”, then “Building 1” must separately be added to “World HQ” and “Satellite Office”

Figure 2.1-2 Base Data Tools: Add, Rename, Delete Refresh

Scenarios

Scenarios are used to define different study options. The Scenario name is used on the hand-held and in BeSecure Manage. The Source is a text field that is available to be printed on labels.

Figure 2.1-3 Scenarios



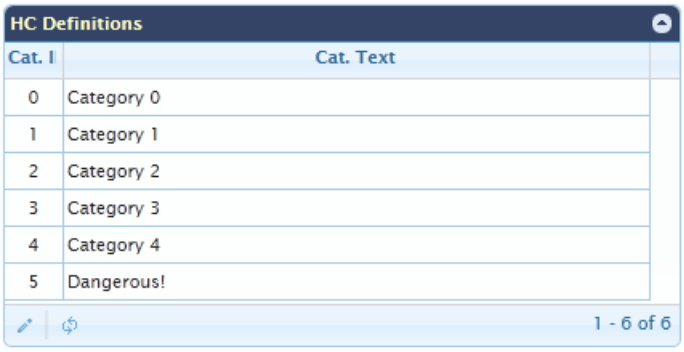
Scenarios are named at the client level and can be used across different systems.

For example, if “World HQ, Building 1, Main Service” and “World HQ, Building 2, Main Service” both have a “Normal Operation”, “Shutdown”, and “Standby Generator” scenarios. Those three scenarios are added once at the client level and can be used by each system.

Hazard Category (HC) Definitions

Administrators can assign the wording that will appear on the arc flash labels for each category. For example, the text for a category 1 label could read “Category 1”, “Cat. 1”, “HC 1”, or any similar wording.

Figure 2.1-4 Hazard Category Definitions



The wording is set at the *client* level; the same across all *sites, buildings, systems* and *scenarios* within the *client*.

The category incident energy range is defined by NFPA 70E. See *Table 3.1-1* for the category description.

2.1.2 Upload Data

Existing arc flash reports can be uploaded to BeSecure in one of these formats; Microsoft Excel spreadsheet (.xls or .xlsx), or as comma separated value (CSV) input file.

The following inputs are required to upload a study:

Site Select a *Site*, for example "World Headquarters Campus"

Bldg Select a *Building* (requires a *Site* to be selected) only *Buildings* located at the selected *Site* will be available in the dropdown menu. For example, "Office Building 1"

System Select a *System* (requires a *Building* to be selected) only *Systems* located at the selected *Building* will be available in the dropdown menu. For example, "Main Utility Service"

Scenario Select a Scenario, for example "Normal Operation" or "Standby Generator Source**"**

The *Site, Building, System,* or *Scenario* must be defined on the *Base Data* screen before data can be uploaded.

Labels There are four label statuses that can be applied to the imported buses. The label status selected is only applied to new buses. For existing buses, the existing label status is maintained unless the hazard category has changed or the incident energy or flash hazard boundary has exceeded the defined threshold in which case the label status is changed to Not Printed.

Not Printed
Printed, Not Applied
Printed and Applied
Not Used

Select File Browse for the file containing the arc flash study results. This file must be in SKM format, ETAP format or CSV format. See below for format details.

Study Name Enter a short description of the study being uploaded. This name is used for reference purposed only.

If a study is uploaded into an existing system with buses that have the same names as existing buses, the new buses will overwrite the existing data. If the bolted fault changed for a bus that was used as the source bus for an extended bus, the arc flash hazard at the extended bus will be recalculated and if it changes the bus will be flagged as Not Printed.

Microsoft Excel Spreadsheet

SKM Format

To export from SKM:
Open the Arc Flash Evaluation, make sure "Summary View" is selected, right click in the report and select Export To…, save an .xls spreadsheet.

Other SKM arc flash reports are not supported for upload.

ETAP Format

To export from ETAP:
ETAP creates a .xls spreadsheet in the project folder when running an arc flash study.

Other ETAP arc flash reports are not supported for upload.

Generic Format

The data can be uploaded from a Microsoft Excel spreadsheet (.xls or .xlsx) format. The data is required to be in the format shown below. This may require manual formatting of the data to meet the upload requirements.

The first row can either be data or headers.

Column	Data	Valid Entry Requirements
A	Bus Name	Name must be unique within the study being uploaded
B	Protective Device Name	None
C	Nominal Voltage	Units: Volts or kV (kV will be converted to V)
D	Bolted Fault	Units: kA
E	Grounded	Grounded or Ungrounded or Yes or No
F	Arc Flash Hazard Boundary	Units: inches
G	Working Distance	Units: inches
H	Incident Energy	Units: cal / cm2
I	Hazard Category	0-5 or Category 0 – Category 5 or Dangerous!

Example Generic Spreadsheet Format:

	A	B	C	D	E	F	G	H	I
1	Bus	Prot. Device	Volts	BF	Gnd	AF Boundry	Working Dist	IE	Cat
2	Bus 1	CB1	480	15.5	Yes	20	18	1.5	1
3	Bus2	CB2	480	12.5	Yes	18	18	1.1	0

Comma Separated Value (CSV)

The data can be uploaded from a comma separated value (CSV) format. The data is required to be in the format shown below. This may require manual formatting of the data to meet the upload requirements.

The first record can either be data or headers.

Each record must be in CSV format, the following data:

Order	Data	Valid Entry Requirements
1	Bus Name	Name must be unique within the study being uploaded
2	Protective Device Name	None
3	Nominal Voltage	***Units: Volts*** or ***kV*** (kV will be converted to V)
4	Bolted Fault	***Units: kA***
5	Grounded	***Grounded*** or ***Ungrounded*** or ***Yes*** or ***No***
6	Arc Flash Hazard Boundary	***Units: inches***
7	Working Distance	***Units: inches***
8	Incident Energy	***Units: cal / cm^2***
9	Hazard Category	***0-5*** or ***Category 0 – Category 5*** or ***Dangerous!***

Example CSV Format:

```
PANEL 100, CKTBKR 100, 480, 22.54, Grounded, 20, 18, 1.41, 1
PANEL 101, CKTBKR 101, 480, 18.32, Grounded, 17, 18, 1.10, 0
```

Note: Commas (,) and double quotes (“) in the data may cause the CSV file to be uploaded incorrectly. Avoid using these characters in bus and device names.

2.1.3 Auto Hazard Category (HC) 0

Based on IEEE 1584, equipment below 240V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply. BeSecure refers to these buses as Auto Hazard Category (HC) 0. The Auto HC0 screen shows all of the buses that are less than 240V. Buses that meet the above criteria can be selected. When Auto HC 0 buses are selected as source buses in BeSecure Extend, the extended buses will also be Auto HC 0.

SKM can be configured to include a note "(*N15) – Report as category 0 if fed by one transformer size < 125 kVA" for these buses. When files are uploaded from SKM the system looks for the N15 note and marks the buses as Auto HC 0.

2.1.4 Study Data

The Study Data page displays Study Data for all uploaded studies. The Study Data screen is organized into two windows "Master Study Data" and "Study Data Detail."

In the "Master Study Data" window, an administrator can edit the Study Name, change the system print the displayed data or delete a previously uploaded study. Data columns other than Study Name cannot be edited.

The "Study Data Detail" window displays the uploaded data for all the buses that are part of the study selected in the "Master Study Data" window. The "Study Data Detail" window is initially minimized. Double click a row in the Master Study Data window or click the <> symbol in the Study Data Detail header to expand the "Study Data Detail" window.

The "Study Data Detail" window allows the administrator user to rename or delete buses from the study. Data columns other than Bus Name cannot be edited. The displayed data can also be printed. Deleted buses are not permanently deleted until purged on the Deleted Buses page. Deleted bus names cannot be reused until they are purged. If a bus is deleted that also feeds downstream buses, the downstream buses must be manually deleted.

2.1.5 Bus Detail

The Bus Detail page shows the arc flash hazard data from all scenarios for all of the buses or a selected bus.

The user must select a Site, Building, System, and Bus.

Click **Show** to display the selected bus information.

2.1.6 Deleted Buses

The deleted buses page allows the administrator user to undelete or purge (permanently delete) buses from the database. Deleted buses are maintained in the BeSecure database until they are purged from the deleted buses page. Bus names cannot be reused within the same system until they have been purged.

Select a *Site*, *Building*, and *System* then **show** to view a list of deleted buses in that system.

In the *Select Buses* window, select the checkbox(es) of the buses to be restored or permanently deleted then click on the appropriate *Deleted Bus Tool*.

Figure 2.1-5 Deleted Bus Tools: Refresh, Print, Select/Deselect All, undelete, Delete

Note: Deleted buses that were imported from a previous arc flash study should not be purged until the original model has been updated.

2.1.7 Print Labels

The *Print Labels* page allows the user to view and select labels to be printed.

The user will select a Site, Building, and System, and then select one or more scenarios to **show**.

The *Print Labels* window will show each scenario selected. The print labels screen is designed to show side by side the print status of multiple scenarios, so the user can see if the label has been printed for any scenario. Any of the columns are sortable by clicking the column header.

Figure 2.1-6 Print Labels Tools:
Refresh, Print, Select All, Select None, Select Unprinted for All Scenarios, Select Worst Case Scenario

Select the columns to be displayed for each scenario. HC will display the hazard category and IE will display the incident energy in cal/cm^2. Either one or both of the columns can be displayed.

The results can be filtered by their Category. Select All, 0-4, or any individual category.

Select the format of labels to be printed from the Label list. The available label formats are configured on the Site Configuration screen.

Generic barcode labels can be printed on Avery 5160 or similar (30 labels per page) labels. Enter the quantity of sheets and click the Print button. These labels are used to assign bar codes to extended buses.

2.1.8 Site Config

The Site Config page allows an administrator to set preferences to be used for reporting, tracking, and printing arc flash labels.

IE Threshold — Sets the *Incident Energy* change in cal/cm^2 allowed before a new arc flash label is required to be printed. This feature prevents unnecessary printing of labels with only a small change in incident energy. Any label with a change in *Hazard Category* overrides this setting and is required to be printed.

This value should be set to -1.00 if the incident energy in cal/cm^2 is not reported on the label.

FHB Threshold — Sets the *Flash Hazard Boundary* change allowed before a new arc flash label is required to be printed. This feature prevents unnecessary printing of labels with only a small change in the flash hazard boundary. Any label with a change in *Hazard Category* overrides this setting and is required to be printed.

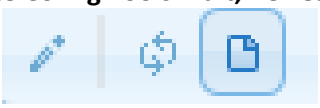
Min FHB — Sets the *Minimum Flash Hazard Boundary* that is reported if the calculated flash hazard boundary is less than the specified minimum.

FHB Units — Units for reporting Flash Hazard Boundary. Options: feet, inches, meters, centimeters, or millimeters.

Show PS — Default values to show on the print screen. Options: HC – hazard category, IE – Incident Energy, or HC + IC – to display both.

Label Format — Select the approved arc flash label formats to be used when printing labels for the selected site. See appendix A for samples of each of the available label formats.

Figure 2.1-7 Site Config Tools: Edit, Refresh, Select Label



If the desired label format is not available, contact BeSecure support to request a custom label template.

2.1.9 User Accounts

The User Accounts page allows administrators to manage the user accounts for users of BeSecure Manage and BeSecure Extend.

The Accounts window shows any user accounts that the logged in user has permissions to manage. The administrator can **add**, **edit**, **delete**, **set passwords, assign sites and print user reports** for users using the buttons on the bottom left of the Accounts window.

Figure 2.1-8 Accounts Tools: Add, Edit, Delete, Refresh, Set Password, Assign Sites, Print

To setup a user account, the administrator will need setup the following:

Login Must be a unique name.

Email The email address will be used for communication of system messages, forgotten passwords, etc.

Role The options are:

Site Mobile	User has access to use the BeSecure Extend mobile device only.
Site Operator	*Site Mobile permissions plus* view/edit data at assigned site(s). Does not have access to Base Data, Upload Data, Site Config, or User Accts screens. Does not have access to sites that are not assigned.
Site Administrator	*Full a*ccess to all features for assigned sites. Does not have access to sites that are not assigned.
Client Administrator	*Full access to all features for all client sites.*

RPW Remember Password. Check this box to allow the user to remember the password used to login to the BeSecure Extend hand-held device. If this box is not checked, the user will be required to enter their password each time they log into the BeSecure Extend hand-held device.

Password The set password window will automatically appear after creating a new user account. Enter and re-enter a password for the user following the on screen password requirements. The password must be at least 7 characters long with at least 1 non-alphanumeric (special) character.

Assigned Sites Assign the sites that the user has access to.

2.1.10 Extended Bus Inputs

The Extended Bus Inputs page shows all of the information for an extended bus that was entered on the hand-held with BeSecure Extend. It also shows the user name of the person who added the bus and the date it was added. This data can be used for reviewing the work done or updating the original arc flash study.

Select a *Site*, *Building*, and *System* then **show** to view a list of the extended bus inputs.

2.2 BeSecure Extend

2.2.1 Uses and Limitations

The BeSecure Extend is an application on a hand-held unit that is intended to be used in situations where the arc flash hazard for a piece of equipment needs to be calculated but was not included in the existing Arc Flash study.

Terminology:
Extended Equipment- Equipment enclosure where work will be performed (also referred to as Extended Bus)

Source Equipment - Panelboard, switchboard, disconnect, etc, that supplies the *extended equipment* and for which the bolted fault is known (Also referred to as Source Bus).

BeSecure Extend can only be used if:

- The bolted fault for the source equipment is known. The bolted fault information is typically from a previous arc flash or short circuit study that was uploaded into the system, but it can also be a manually entered bus or a previously extended bus.
- the *extended equipment* is supplied by the *source equipment* (and no other source)
- the supply circuit is protected by a low voltage molded case circuit breaker or fuse
- the supply circuit conductors size is unchanged over the complete length of the run
- the *extended equipment* and *source equipment* are the same nominal voltage (no intermediate transformers)

In general, the components of the source circuit are:

Source Equipment – Protective Device – Cable – Extended Equipment

Assumptions that yield conservative results:

- the *source equipment* protective device is assumed to be selectively coordinated
- current limiting characteristics of fuses are not included
- adjustable circuit breakers are assumed to be set at the maximum trip setting

Library Limitations

The BeSecure Extend protective device library is located on the BeSecure server. Updates and additions are automatically synchronized with the BeSecure Extend hand-held unit with no actions taken by the end user.

The BeSecure Extend protective device library contains fuses and molded case circuit breakers that are commonly used, relatively small (<600 Amp rating), and have the instantaneous only adjustable trip setting or fixed instantaneous trip. Larger fuses or circuit breakers and breakers with multiple adjustable trip settings are suggested to be studied by an engineer. No adjustability of trip settings is provided by BeSecure Extend.

If circuit breakers in your facility are not in the BeSecure Extend library, the IEEE 1584 standard provides alternate equations that do not use the time-current characteristics. The user can select these alternate equations if needed. The standard equations that use the manufacturer's published time-current characteristic of the protective device are the preferred equations. BeSecure Extend provides the ability to send protective device manufacturer/type information for devices that are not included in the library to Excel BeSecure Solutions, LLC. User submitted protective device information will be used for future library updates.

2.2.2 Login

The login screen requests information to access the BeSecure Extend application and the database on the BeSecure server.

Client ID: Each client is issued a client ID (typically based on your organization's name)

User ID: Unique username for each user

Password: if you forget your password, the *site administrator*, *client administrator*, or *BeSecure technical support* can reset your password.

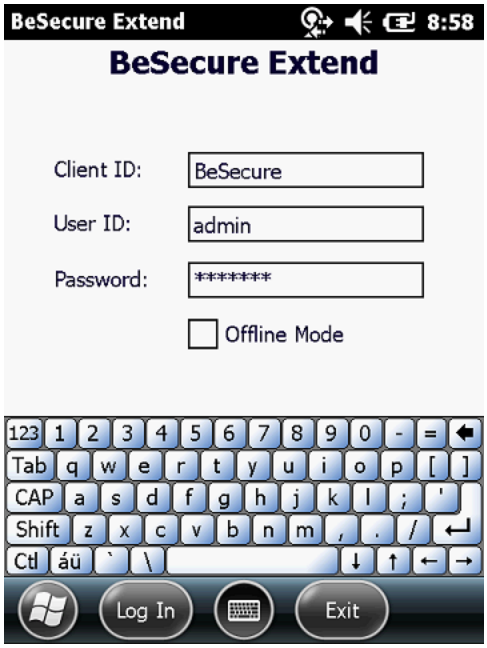
Click **Log In** (at the bottom of the screen) to submit the information and proceed to the next screen.

Client and User IDs are saved on the hand-held device and fields are pre-populated the next time the application is launched. If *Remember Password (RPW)* is enabled for a user by the *site administrator* or *client administrator* using BeSecure Manage then the password will also be pre-populated the next time the application is launched.

Offline Mode

Offline mode allows a user to precede to the data entry screens without logging in. Offline mode should only be used if no cellular or wireless signal is available. Source Equipment, protective device, cable information and extended equipment name can be entered while offline, but the hand-held unit must be online before the calculations can be run.

Data from the last system accessed is loaded. To switch *site*, *building*, or *system* the hand-held device must have a wireless signal and valid login credentials.



2.2.3 Select System (Site-Building-System) Screen

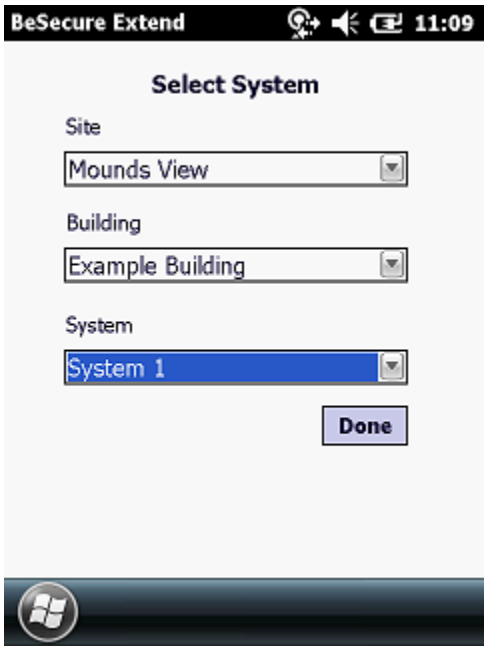
Select the *site*, *building*, and *system* supplying the *source equipment* for your study. The last accessed system will be pre-populated in the fields. The selection boxes for the *site*, *building*, and *system* are limited to the sites that the user has been given access to. User access is managed by the *client administrator* or *site administrator* using BeSecure Manage.

Site: Each client is allowed multiple sites. Only sites in the user's access scope are shown in the selection list

Building: Each site is allowed multiple buildings.

System: Each building is allowed multiple systems.

Click **Done** to proceed to the next screen.



2.2.4 Main (One-line) Screen

The Main screen shows a one-line diagram of the equipment related to the study. Each component is outlined red or green.

Red Outline - The component requires information to be entered before a study can be run.

Green Outline- The required information for the component has been entered

The components requiring data entry are:

Source Equipment: (also named **Source Bus** or **Src Bus**)

Located at the top of the screen. Click **Select** at the top left of the screen or the **Src Bus** tab on the bottom of the screen to proceed to the *source equipment* data entry screen.

Protective Device: (also named **Breaker** or **Brkr** or **Fuse**)

Located at the top right of the screen. Click **Select Protective Device** at the top right of the screen or the **Brkr** tab on the bottom of the screen to proceed to the *protective device* data entry screen.

Cable: (also named **Cbl**)

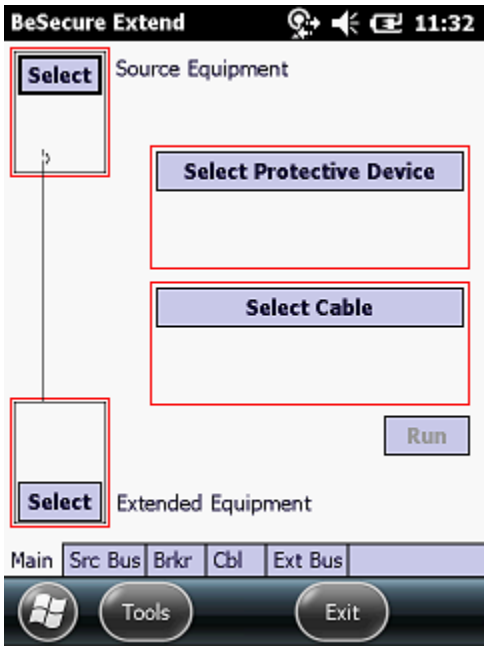
Located at the middle right of the screen. Click **Select Cable** at the middle right of the screen or the **Cbl** tab on the bottom of the screen to proceed to the *cable* data entry screen.

Extended Equipment: (also named **Extended Bus** or **Ext Bus**)

Located at the bottom of the screen. Click **Select** at the bottom left of the screen or the **Ext Bus** tab on the bottom of the screen to proceed to the *extended equipment* data entry screen.

The **Run** button will be enabled when all of the required information is entered. See Section 3 Calculation Documentation later in this manual for calculation documentation. The **Run** button sends the input data to the BeSecure server to perform the calculations, and the results are returned back to the hand-held device. See Section 2.2.9 Main Arc Flash Results Screen for the details on the results.

A wireless or cellular signal is required to **Run**.



Tools Menu

Apply Label — Opens a new screen allowing the user to indicate when a label has been applied. See Section 2.2.12 Apply / Verify Label Screen for more details.

Change System — Returns to the *Select System Screen* for user to switch to a new *site*, *building*, and *system.*

Create Bus — Allows the user to perform create a bus that is not included in an existing study so that it can be used as the source equipment when extending to new equipment. The user must input the equipment ID, bolted fault, voltage, and grounded/ungrounded.

Create Auto HC0 — Allows the user to create an auto HC 0. The user must verify that the bus is less than 240 volts and fed from a transformer that is less than 125kVA.

Legend — Show the abbreviations used in the application and give a brief description of each.

Locate Bus

Allows the user to find which *building and system* includes the equipment in question. The user will type the equipment name, select the equipment name from the list or scan the bar code and the screen will display all *building and system* records with the entered bus name.

This tool is helpful when a system supplies multiple buildings, or buildings have multiple systems.

If the equipment name is typed or selected, the screen will display all *building/ system* records with the same equipment name. Since bus names are only required to be unique at the system level, there may be more than one possible result. If the label is scanned, only one *building/system* will be displayed since bar codes must be unique at the *client* level.

Refresh Data

Connects to the BeSecure database to synchronize data stored on the hand-held device. Data is automatically refreshed when selecting a new *site, building, system*. The data will need to be refreshed if changes are made on BeSecure Manage and the BeSecure Extend hand-held unit has not been logged out.

2.2.5 Source Equipment Information Screen

The source equipment screen allows the user to enter information to identify the *Source Equipment*

The source equipment can be entered into **Enter / Scan Source Equipment ID** in one of two ways:

Scan Bar Code Make sure the cursor is in the **Enter / Scan Source Equipment ID**. Use the hand-held device laser scanner to scan the bar code on the *source equipment* arc flash label.

Select Bus Name Type the *source equipment* name, or select it from the pull down menu.

Click **Find.** The selected equipment arc flash hazard information will appear in **Label Printed / Applied Status** box.

Confirm that the arc flash information on the label matches the information on the device. The physical label may only contain information for one scenario (examples: normal, standby), while BeSecure Extend will show all scenarios.

Abbreviations and symbols used on screen:

HC Hazard Category - PPE category 0 through 5 (category 5 = Dangerous)

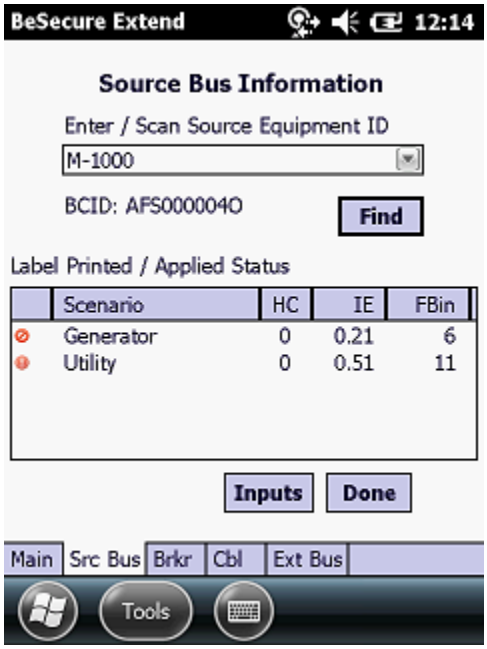
IE Arc Flash Incident Energy (cal/cm^2)

FBi Flash Hazard Boundary (in selected units)

 Arc Flash Label has been applied

 Arc Flash Label has not been applied

If the bus selected is an extended bus, there will be two buttons available at the bottom of the screen. **Done** will keep the selected bus as the source bus for a new extension. **Inputs** will recall all of the input data that was used for that bus. This feature allows the user to review previously entered information, correct an error and re-run the bus, or enter a new extended bus based on similar information to an existing bus. Note that if an extended bus has been used as the source for another extended bus it cannot be overwritten from the hand-held. The downstream equipment must first be deleted from BeSecure Manage.



2.2.6 Protective Device Information Screen

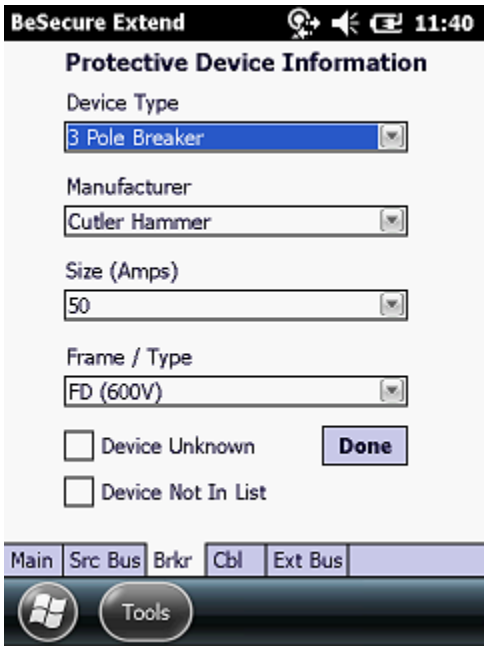
The protective device information screen requests four inputs from the user:

Device Type Select either a Fuse or 3 Pole Breaker

Manufacturer Select the device manufacturer. The selection list is limited to manufacturers with curves in the BeSecure library. If the device manufacturer is not in the list, see the Device Not in List section below.

Size (Amps) Select the protective device rating. Typically circuit breakers show this value in amps on the breaker handle. If a breaker has interchangeable trip units be sure to select the trip unit rating and not the breaker frame rating.

Frame / Type Select the device frame or type, typically a two or three letter code. The selection list is limited to frames/types with curves in the BeSecure library that have voltage ratings greater than or equal the source equipment voltage.



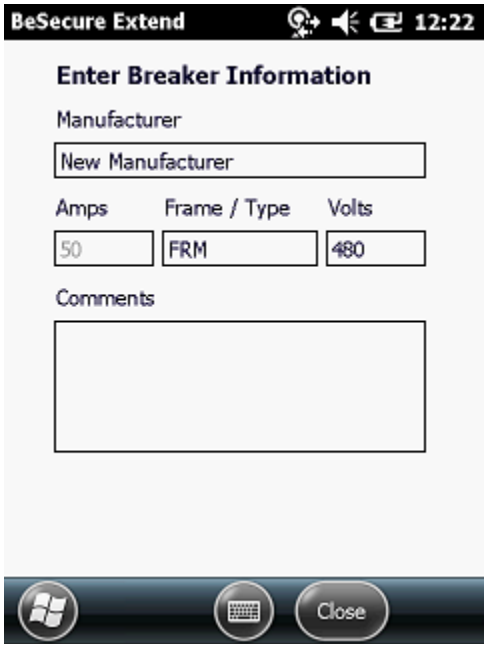
Device Not in List

When the *Device Not In List* checkbox is checked, the BeSecure Extend calculations can still continue using alternate formulas which do not require the actual clearing time to be known. For circuit breakers, IEEE 1584 alternate equations in Table E.1 are used. For fuses, the two second cutoff is used (if option is selected on *Extended Equipment* screen.

The **Size (Amps)** is required to continue with the calculation.

The preferred calculation method is to use the actual device clearing time, the Device Not in List option should only be used if the device characteristics are not found in the library.

When *Device Not In List* is selected, an **Info** button will appear allowing the user to enter manufacturer, frame, voltage rating, and additional comments. This information is send back to the BeSecure administrator to be reviewed. User submitted protective device information will be used for future library updates.



Device Unknown

When the *Device Unknown* checkbox is checked, the BeSecure Extend calculations can still continue using alternate formulas which do not require the actual clearing time to be known. For circuit breakers, IEEE 1584 alternate equations in Table E.1 are used. For fuses, the two second cutoff is used (if option is selected on *Extended Equipment* screen.

The **Size (Amps)** is required to continue with the calculation.

The preferred calculation method is to use the actual device clearing time, the device unknown option should only be used if the device characteristics are unobtainable.

2.2.7 Enter Cable Information Screen

The *Enter Cable Information* screen requests cable information from the user to define the electrical characteristics of the conductors from the *source equipment* to the *extended equipment*:

Length Enter the length in feet of the conductors from the *source equipment* to the *extended equipment.* An exact measurement is not required. BeSecure Extend will calculate the arc flash hazard over a range of conductor lengths and report at what lengths the hazard category changes. See Section 0 Cable Length Sensitivity Screen for more details.

Size Enter the size of the conductor. Typically the conductor size is marked on the cable. To find this information, equipment covers may need to be removed. If the size is not readable or accessible, the conductor size can be estimated by checking the *Use NEC 310-16 Estimate* checkbox. See below for details.

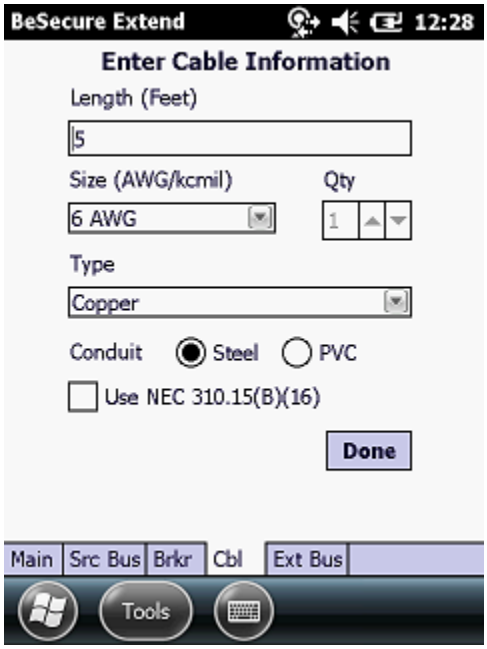
Qty Enter the number of conductors per phase (paralleled conductors). Typically this is one conductor per phase. NEC 310.4 allows only conductors 1/0 AWG or larger to be paralleled.

Type Enter the conductor material, copper or aluminum.

Conduit Select the conduit type, steel or PVC.

Use NEC 310-16 Estimate

In situations where the conductor size is unreadable or inaccessible, the conductor size can be estimated based on the protective device size. The conductor size is estimated to be the smallest size protected by the protective device according to NEC 310.15(B)(16) with no additional derating.



2.2.8 Extended Equipment Information Screen

The *Extended Equipment* requests the name of the equipment to be printed on the arc flash label and recorded in the database.

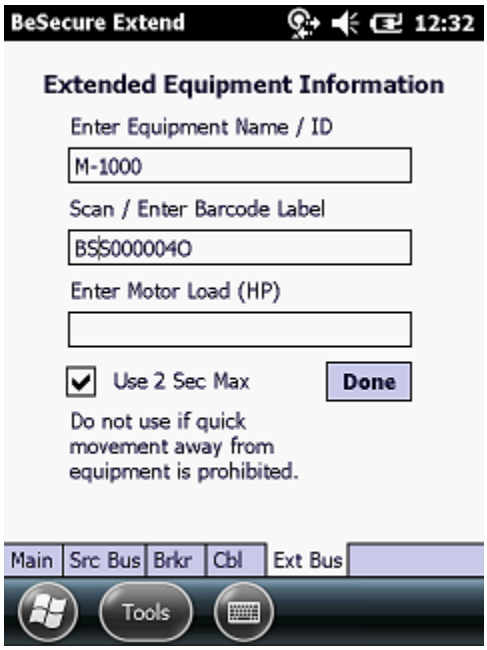
Enter the name of the equipment in the **Enter Equipment Name / ID** box. The name entered must be unique to the *system*. See the overwrite capability below for the exception to the requirement for a unique name.

Optional **Scan / Enter Barcode Label**: If applying pre-printed bar codes to the equipment, scan the bar code on the preprinted label to link the bar code to the equipment name. If no bar code is scanned, the BeSecure system will automatically assign a unique ID to the equipment.

Connected motor load that is capable of contributing fault current can be entered in the **Enter Motor Load (HP)** field. Motors controlled by AC or DC drives that do not contribute fault current upstream should not be included.

Two Second Cutoff

IEEE 1584 Annex B.1.2 allows for a two second maximum to be used in situations where it is physically possible to quickly move away from the equipment. Do not use if lift, fall protection, or other obstacle prevents quick movement away from an arc flash.



Overwrite Capability

If the bus name is already used for extended equipment, BeSecure will ask the user if the existing bus record should be overwritten. Buses that were uploaded or buses that have been used as the source bus for other extended buses cannot be overwritten.

2.2.9 Main Arc Flash Results Screen

If all of the required information has been entered, the Run button will be enabled. When **Run** is clicked, the results of the arc flash calculation performed on the BeSecure server are returned to the hand-held device via the wireless connection.

For each scenario, the Hazard Category, Incident Energy, and Flash Hazard Boundary are displayed.

Select the appropriate PPE for the system conditions represented by the scenario. For example, there may be scenarios for normal utility source and generator backup source.

Abbreviations and symbols used on screen:

HC Hazard Category - PPE category 0 through 5 (category 5 = Dangerous)

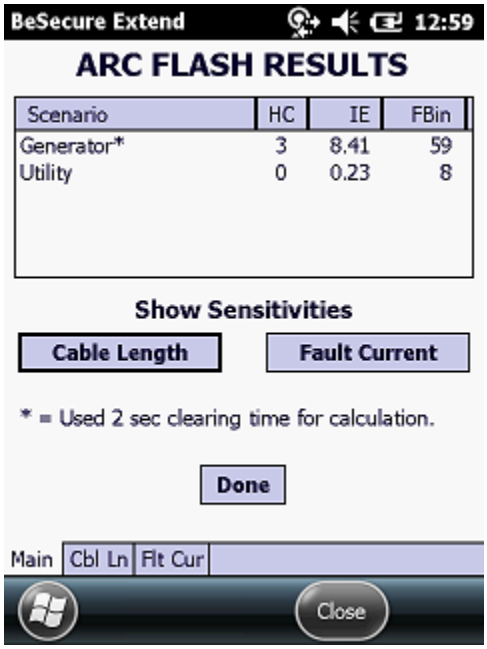
IE Arc Flash Incident Energy (cal/cm^2)

FBx Flash Hazard Boundary (see Legend under Tools for unit abbreviations)

Show Sensitivities

Small changes in available fault current can result in large changes in incident energy due to the time-current characteristics of the protective device.

Cable length and fault current sensitivities are shown to help the user understand if the arcing fault conditions are near a change in Hazard Category.



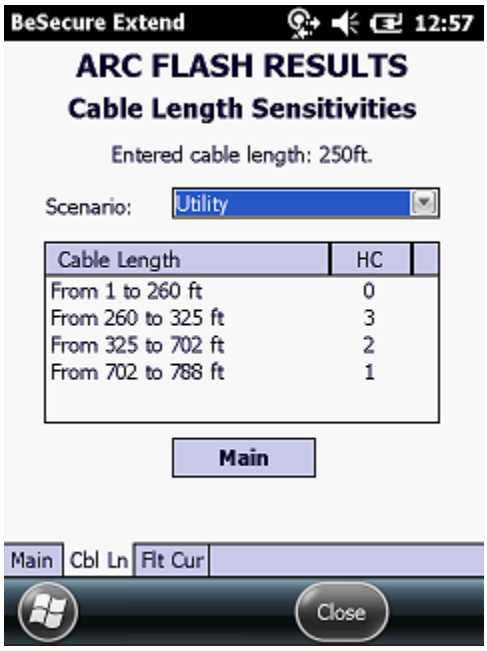
2.2.10 Cable Length Sensitivity Screen

Cable lengths are often estimated in arc flash studies due to the time and effort to precisely measure conductors in the system. Since small changes can have a large impact on hazards, BeSecure Extend calculates the hazard over a range of cable lengths to determine if the estimated length is near a change in calculated hazard category.

BeSecure Extend calculates the arc flash hazard at the user entered cable length and also for a range of cable lengths starting at 1 foot with 1 foot increments up to 1000 feet (or maximum length that results in the fault current equation limits.)

An example: The entered cable length was 250 feet and the resulting hazard category (HC) was 0. The cable length sensitivity table shows a change in hazard category (HC) to 3 if the cable length is 260 feet to 325 feet. The users would be aware that a small change in the length (10') would cause a significant change in the hazard. The user in this example may want to wear category 3 PPE to be conservative.

Cable sensitivity results are displayed for one scenario at a time.

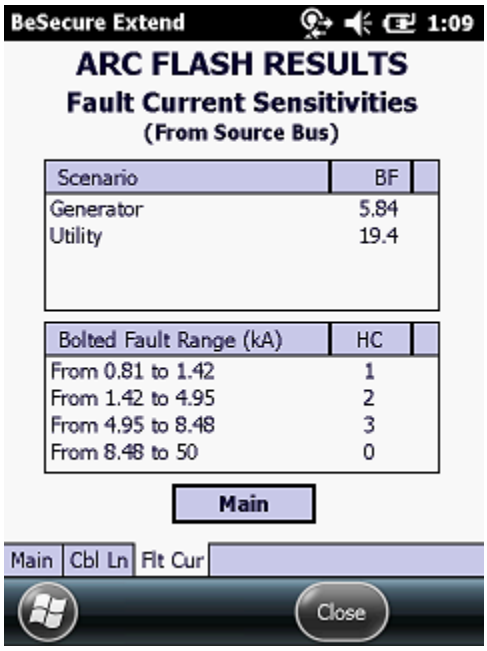


2.2.11 Fault Current Sensitivity Screen

Utility fault current is often estimated base on transformer size in arc flash studies when the actual utility system impedance is not available, or to account for potential changes to the utility. Since small changes can have a large impact on hazards, BeSecure Extend calculates the hazard over a range of source bus fault currents to determine if the fault current is near a threshold that would cause a change in the calculated hazard category.

The top table on the screen shows the calculated bolted fault (BF) value in kA at the source equipment for each scenario.

The bottom table shows the hazard category calculated for a range of bolted fault values at the source equipment from 0.7 kA to 50 kA calculated at 0.01 kA increments. This bolted fault range is independent of the scenario.



2.2.12 Apply / Verify Label Screen

This tool allows the user to record when printed labels have been applied.

Select Scenario for Label — Select the appropriate scenario for the label to be applied. Only scenarios with printed labels will be available in the list.

Enter / Scan New Label — Select the bus name from list or scan the bar code on the label to be applied.

Scan Label on Equipment for Verification — Optionally: If a temporary bar code label was used when the equipment was added, the temporary bar code can be scanned to verify that the new label is being applied to the correct equipment. A warning will display if the New Label and the Verification ID's do not match.

Click **Apply** to record that the label has been applied.

2.2.13 Create Bus

The *Create Bus* screen allows the user to create a new bus with a known bolted fault that can be used as the *source equipment* to extend to other buses. The new bus is added to the BeSecure database as *manually entered* source equipment, and does not have any arc flash hazard data recorded.

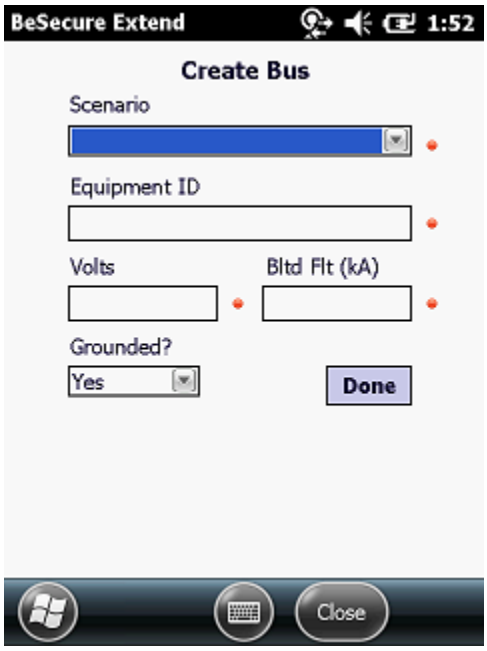
Scenario Select the scenario that the bolted fault is based on.

Equipment ID Equipment ID must be unique to the selected system.

Volts Equipment nominal line to line voltage, in volts.

Bltd Flt (kA) Enter the known bolted fault value in kA.

Grounded Select **Yes** if the source equipment is grounded and **No** if the source equipment is ungrounded. Select **No** (ungrounded) for impedance grounded systems.



2.2.14 Create Automatic Hazard Category (HC) 0 Bus

The IEEE 1584 specifies that, equipment below 240V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply. BeSecure refers to these buses as Auto Hazard Category (HC) 0. The *Create Automatic HC 0 Bus* screen allows the user to create buses that meet these criteria. Protective device and cable information do not need to be entered.

Enter / Scan Source Equipment ID

Optional: If the source equipment is Auto HC 0, the ground, voltage and transformer size verification will automatically be filled in. If the source equipment voltage is less than 240V, the voltage will be filled in, but the user will need to verify the transformer size requirement. If the source equipment voltage is greater than or equal to 240V, the user can enter a voltage of less than 240V (this would be case if there is a transformer between the source and the new bus).

Enter Equipment Name / ID

Equipment name / ID must be unique to the selected system.

Scan / Enter Barcode Label

Optional: If applying pre-printed bar codes to the equipment, scan the bar code on the preprinted label to link the bar code to the equipment name. If no bar code is scanned, the BeSecure system will automatically assign a unique ID to the equipment.

Gnd?

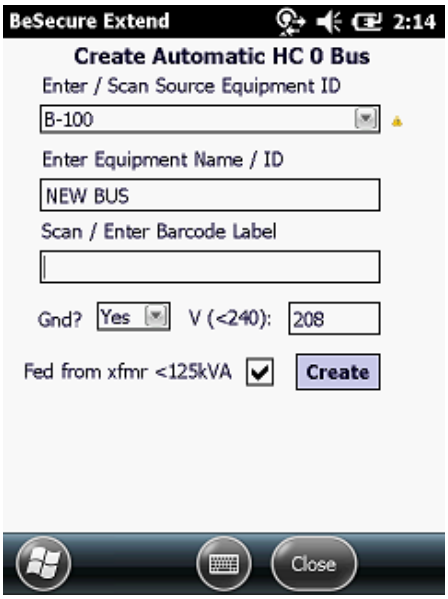
Select **Yes** or **No** to indicate if the equipment is grounded.

V (<240)

Enter the bus voltage. The voltage entered must be less than 240V.

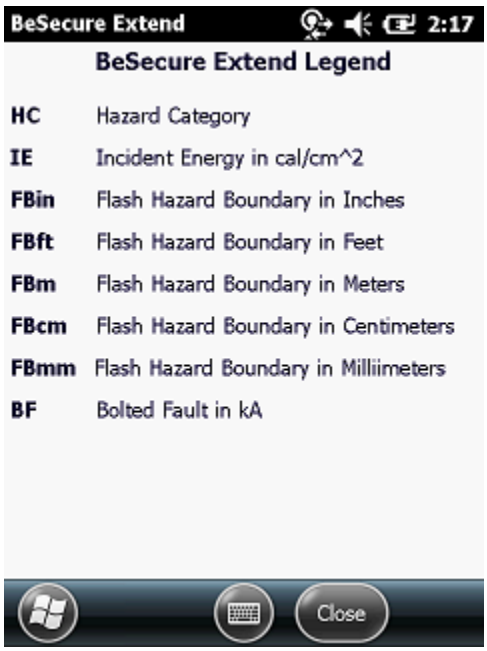
Fed from xfmr <125kVA

Check the box to verify that the equipment is fed from a transformer that is less than 125kVA. The Create button will not be enabled unless this box is checked.



2.2.15 Legend

The legend screen shows the various abbreviations used in BeSecure Extend.



2.2.16 Locate Bus Screen

The user can type the equipment name, select the equipment name from the list or scan the bar code and the screen will display all *building / system* records with the entered bus name.

This tool is helpful when there are different systems at a site and you are not sure which system a particular bus is in.

If the equipment name is typed or selected, the screen will display all *building / systems* with the same equipment name. Since bus names are only required to be unique at the system level, there may be more than one possible result.

If the label is scanned, only one *building / system* will be displayed since bar codes are always unique

2.2.17 Label Scanning

The BeSecure database stores a unique identifier which can be printed on the temporary or arc flash labels as either a “1D” bar code or a “2D” code. See the hand-held device’s user manual for scanning instructions.

3 Calculation Documentation

3.1 BeSecure Extend

3.1.1 Calculation Assumptions

The following conditions are assumed when using BeSecure Extend

- Three phase circuit
- Box configuration, Panel or MCC
- Conductor/Bus Spacing = 1 inch (25 mm)
- Working distance = 18 inches
- Selected protective device will clear the fault
- Bolted fault current from *Source Equipment* does not have motor decay
- Motor contribution connected to or downstream of the *extended equipment* is included in the calculation
- System X/R ratio of 8

3.1.2 Calculation Process

- The *bolted fault* value of the *source equipment* is retrieved from the BeSecure server
- The *bolted fault* value of the *extended equipment* is calculated by adding the conductor impedance from the source panel to the *extended equipment.*
- The system doesn't know how much, if any, motor contribution was included in the original uploaded study. It is possible that motor load downstream of an extended bus was already included at an upstream bus as part of a group of motors. The bolted fault current for an extended bus is calculated with and without the motor load that was specified at the bus and the bolted fault that results in the highest incident energy is used.
- The *arcing fault* value is calculated from the *bolted fault* value and assumed parameters (see Section 0)
- The *fault clearing time* is calculated using the protective device library from the *arcing fault* value (see Section 0)
- The incident energy and hazard boundary are calculated from the *arcing fault* and *fault clearing time* values. (see Section 0) If the clearing time is more than 5 cycles, the incident energy is recalculated based on removing a range of possible motor contributions after 5 cycles.

Cable Length Sensitivity

- The *bolted fault* value of the *source equipment* is retrieved from the BeSecure server
- For each cable length from 1 to 1000 ft, in 1 ft increments:
    - The *bolted fault* value of the *extended equipment* is calculated by adding the impedance due to the conductor from the source panel to the *extended equipment*
    - The *arcing fault* value is calculated from the *bolted fault* value and assumed parameters (see Section 0)
    - The *fault clearing time* is calculated using the protective device library from the *arcing fault* value (see Section 0)
    - The incident energy and hazard boundary are calculated from the *arcing fault* and *fault clearing time* values. (see Section 0)
- Each cable length where a transition in Hazard Category occurs is recorded, with the Hazard Category.

Fault Current Sensitivity

- For each *bolted fault* level at the source equipment, from 0.7 to 35 kA, in 0.01 kA increments:
    - The *arcing fault* value is calculated from the *bolted fault* value and assumed parameters (see Section 0)
    - The *fault clearing time* is calculated using the protective device library from the *arcing fault* value (see Section 0)
    - The incident energy and hazard boundary are calculated from the *arcing fault* and *fault clearing time* values. (see Section 0)
- Each bolted fault where a transition in Hazard Category occurs is recorded, with the Hazard Category.

Exceptions

- *Device Not in List* and *Device Unknown*
    - For fuses with unknown characteristic, the 2 second maximum fault clearing time is used
    - For circuit breakers with unknown characteristics, the alternate equations for circuit breakers in IEEE 1584 Annex E.1 are used for bolted fault within the applicable range. If the bolted fault current is outside of the Annex E.1 range, the 2 second maximum fault clearing time is used.

3.1.3 Arc Flash

Arc Flash calculations are based on IEEE Standards 1584 IEEE Guide for Performing Arc-Flash Hazard Calculations.

When the protective device time-current characteristic is known:

Arcing Current is calculated by equations in IEEE 1584 Section 5.2
Incident Energy is calculated by equations in IEEE 1584 Annex E.3 for 100% and 85% Arcing current

If the maximum clearing time 2 seconds option is selected and the calculated clearing time is greater than 2 seconds, the formula uses 2 seconds for the Annex E.3 calculations.

When the protective device time-current characteristic is unknown:

Incident Energy is calculated by equations in IEEE 1584 Annex E.3.2 for circuit breakers. The incident energy for fuses is calculated by assuming a 2 second maximum clearing time.

Hazard Category boundaries are determined from NFPA 70E 2012, and shown in Table 3.1-1 below:

Table 3.1-1

Category #	Lower Bound cal/cm2	Upper Bound cal/cm2	Category Description
0	0	1.2	Category 0
1	1.2	4	Category 1
2	4	8	Category 2
3	8	25	Category 3
4	25	40	Category 4
5	40	and above	Dangerous

Current Limiting Fuses

IEEE 1584 current limiting fuse equations are not used in BeSecure Extend.

3.1.4 Cable

Cable resistance and reactance values are from NEC 2008, Table 9.
System X/R ratio is assumed to be 8.

3.1.5 Protective Device Clearing Time

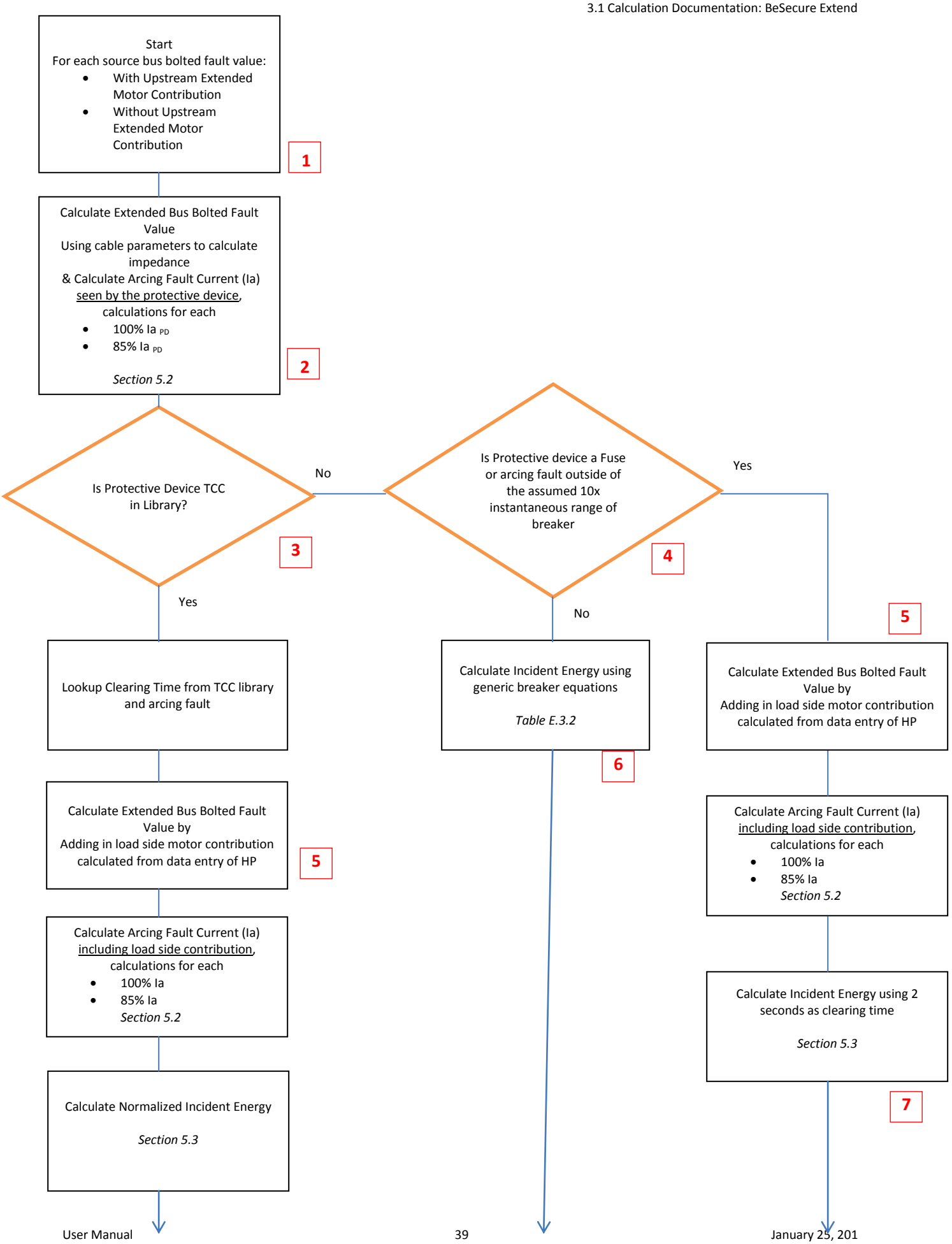
BeSecure Time-Current Characteristics (TCC) available from manufacturers for many commonly used circuit breakers and fuses are stored in the database which is wirelessly accessed by the hand-held device.

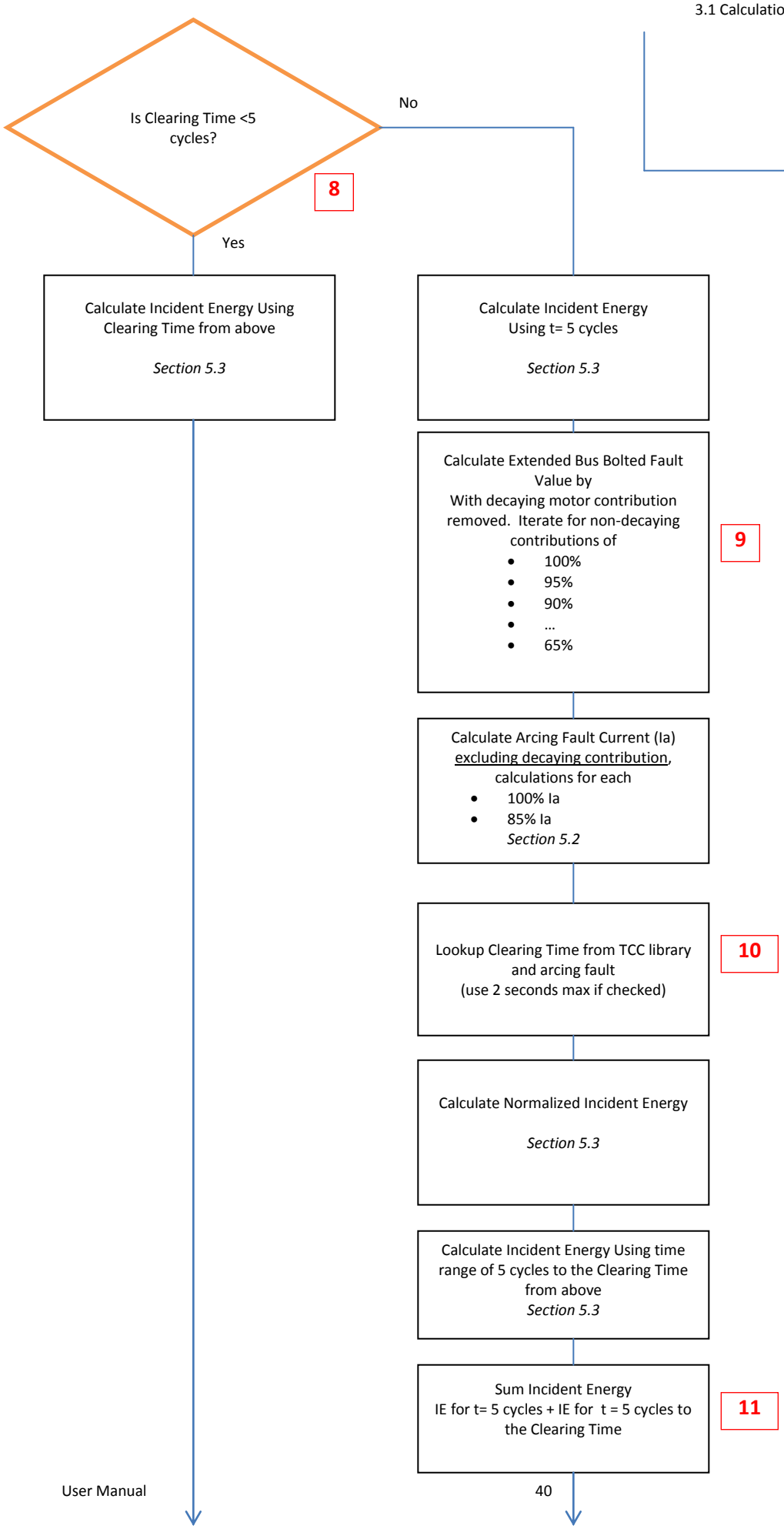
As a conservative approach, the maximum clearing time and maximum adjustable magnetic trip setting were used to define the protective device clearing curve. The calculated arcing fault current is used to identify the protective device clearing time.

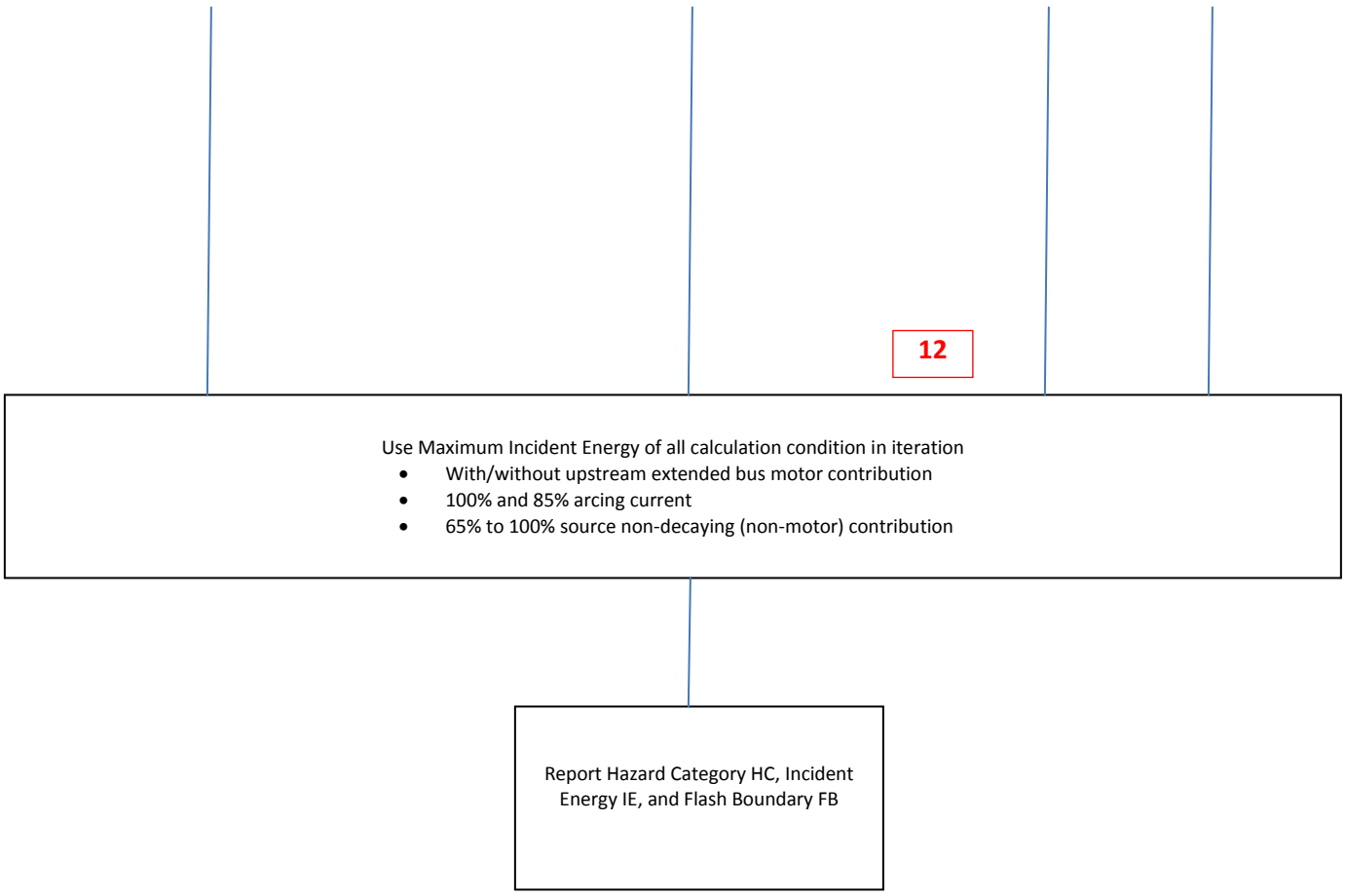
3.1.6 Calculation Limitations

The calculations are limited to the limitations of the IEEE Standard equations.

3.1.7 Calculation Flowchart


Start
For each source bus bolted fault value:
With Upstream Extended Motor Contribution
Without Upstream Extended Motor Contribution
1
Calculate Extended Bus Bolted Fault Value
Using cable parameters to calculate impedance
& Calculate Arcing Fault Current (Ia) seen by the protective device, calculations for each
100% Ia PD
85% Ia PD
Section 5.2
2
Is Protective Device TCC in Library?
3
No
Is Protective device a Fuse or arcing fault outside of the assumed 10x instantaneous range of breaker
4
Yes
Yes
No
Lookup Clearing Time from TCC library and arcing fault
Calculate Extended Bus Bolted Fault Value by
Adding in load side motor contribution calculated from data entry of HP
5
Calculate Arcing Fault Current (Ia) including load side contribution, calculations for each
100% Ia
85% Ia
Section 5.2
Calculate Normalized Incident Energy
Section 5.3
Calculate Incident Energy using generic breaker equations
Table E.3.2
6
Calculate Extended Bus Bolted Fault Value by
Adding in load side motor contribution calculated from data entry of HP
5
Calculate Arcing Fault Current (Ia) including load side contribution, calculations for each
100% Ia
85% Ia
Section 5.2
Calculate Incident Energy using 2 seconds as clearing time
Section 5.3
7


Is Clearing Time <5 cycles?
8
No
Yes
Calculate Incident Energy Using Clearing Time from above
Section 5.3
Calculate Incident Energy Using t= 5 cycles
Section 5.3
Calculate Extended Bus Bolted Fault Value by
With decaying motor contribution removed. Iterate for non-decaying contributions of
100%
95%
90%
…
65%
9
Calculate Arcing Fault Current (Ia) excluding decaying contribution, calculations for each
100% Ia
85% Ia
Section 5.2
Lookup Clearing Time from TCC library and arcing fault
(use 2 seconds max if checked)
10
Calculate Normalized Incident Energy
Section 5.3
Calculate Incident Energy Using time range of 5 cycles to the Clearing Time from above
Section 5.3
Sum Incident Energy
IE for t= 5 cycles + IE for t = 5 cycles to the Clearing Time
11


12
Use Maximum Incident Energy of all calculation condition in iteration
With/without upstream extended bus motor contribution
100% and 85% arcing current
65% to 100% source non-decaying (non-motor) contribution
Report Hazard Category HC, Incident Energy IE, and Flash Boundary FB

This Flowchart describes the BeSecure Extend calculation process. The process is first completed using the user entered information to calculate results. Sensitivities are then completed two more times, iterating two input variables, cable length and source equipment bolted fault value. The sensitivity tables for these two variables are reported on separate sensitivity screens.

There are several iterations of the calculations required to assess the possible conditions given the limited input data. The maximum hazard of all of the iterations is reported to provide a conservative hazard assessment.

Several variables in the IEEE Std 1584 are assumed to simplify the data entry process, these include:

- Working distance 18”
- Box configuration
- Arcing Bus Gap 25mm
- Non-current limiting fuses

Comments and explanations for flowchart items are listed below:

1. The calculations are performed for two source equipment bolted fault values, one including motor contribution from previous extended buses and one without.

Studies often aggregate motor load at the last modeled bus, such as a MCC. When “extending” a study there is no record of whether the downstream motor contribution of the “extended” equipment was included at the upstream/source equipment or not. Therefore, to obtain conservative results, the arc flash incident energy is calculated for both conditions and the greater hazard is reported.

The sensitivity calculations are performed for a range of source bus bolted fault values from 0.7 kA to 35 kA, with results reported in a sensitivity table showing what values the hazard category transitions to a new value.

Studies often have estimated or varying utility source strength, raceway material, and cable lengths in the system are often measured at low precisions. These factors can impact the source bus fault value, and small changes can greatly affect the hazard. The sensitivity table provides an indication whether the calculated value is near a HC transition point.

2. The sensitivity calculations are performed for a range of cable lengths from 1 to 1000 feet, with results reported in a sensitivity table showing what values the hazard category transitions to a new value.

Often the length of the cable to the extended equipment is measured at low precisions (ie nearest 5 foot increment.) This length impacts the extended bus fault value, and small changes can greatly affect the hazard. The sensitivity table provides an indication whether the calculated value is near a HC transition point.

The arcing fault current value is calculated. Calculations are performed for both values of 100% and 85% of the arcing fault value.

IEEE Std 1584, Section 5.2

3. The BeSecure library is limited to 3 phase breakers and fuses that would typically be encountered when extending a study. These are 200 A continuous rating or less, 600 V or less, with no adjustable trip or INST only adjustable trip. The BeSecure library models the time-current values of the maximum clearing time curve, with all adjustable settings at maximum values. There is the possibility that the protective device is not modeled in the BeSecure library or the device type is unknown.

4. If the protective device type is unknown, there are generic equations to calculate incident energy for circuit breakers. The generic equations can be used if the arcing fault value is in the instantaneous range, which is assumed to be greater than 10 times the pickup value, and no less than 1300 A plus a 30% margin. If the fault current is below the instantaneous range or if the protective device is a fuse, generic equations are not available. In these cases, an exposure time of 2 seconds is used as a reasonable reaction time to move away from the arc. This situation will override the “use 2 sec max” checkbox if it is unchecked since no other clearing time can be determined.

5. The load side motor fault current contribution is added after the fault clearing time has been determined.

The load side contribution is not sensed by the protective device, but it does contribute to the incident energy. It is assumed that the downstream fault contribution cannot sustain the arc so the opening of the upstream protective device will extinguish the arc.

6. The generic breaker equations assume fault clearing by the magnetic element, in less than 5 cycles. No reduced fault current calculation due to motor contribution decay is necessary.

7. When using the 2 second maximum for arc exposure, the iterations of lower non-decaying source bus fault contribution are not necessary since the arc duration time is unchanged at 2 seconds. Higher fault currents result in higher incident energy when holding time constant.

8. The motor contribution to the fault decays to negligible after 5 cycles. If the clearing time is less than 5 cycles, then the motor contribution decay does not need to be accounted for in the clearing time lookup. If the initial clearing time with motor contribution is greater than 5 cycles, then the clearing time based on non-decaying fault current needs to be calculated.

9. The system characteristics from the uploaded study do not contain any information relating to decaying and non-decaying fault contribution. As a conservative calculation approach, the calculations are iterated for increasing levels of source equipment non-decaying fault contribution, from 65% to 100%. The greatest hazard from this set is reported.

10. Two seconds is used as a reasonable maximum arc exposure duration when the working area provides easy egress. In situations where movement away from the arc flash is impeded by fall protection, confined space, etc. the full protective device clearing time should be used.

11. The incident energy is calculated in 2 steps, first for the energy in the first 5 cycles, then again for the energy from t= 5 cycles to the clearing time without the energy from decaying fault contribution. The sum of the two exposures is the total exposure which the hazard category is determined.

12. The maximum hazard of all of the combinations of variables is reported to provide a conservative hazard category. The combinations of variables include: 100% and 85% arcing current, upstream extended bus motor contribution included and excluded, non-decaying upstream fault contribution from 65% to 100%. The distinction between the upstream fault contributions is whether the contribution was from known extended buses or unknown from the uploaded study. There is a possibility of double counting motor contribution, or not accounting for fault contribution decay, but for each of these conditions the hazard reported is greater than the actual hazard.

3.1.8 Input/Result Record Keeping

All of the arc-flash calculation results are automatically appended to the existing study. All of the input data is recorded on the BeSecure server to be available for future studies of the full system.