SmartPlant Electrical

Basic User's Training Guide

Process, Power & Marine

INTERGRAPH

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Preface

This training guide introduces concepts, procedures, and features of SmartPlant Electrical.

Send documentation comments or suggestions to PPMdoc@intergraph.com.

Introduction

Training Prerequisites

- An intermediate knowledge of electrical design
- Familiarity with windows-based applications
- A plant with default reference data

Scope

The purpose of this document is to educate the user on Smart Plant Electrical operational procedures and methods, features and functionalities.
The document contains the following sections:

- **Chapter 1** : Electrical Equipment
- **Chapter 2** : Tabular Editor
- **Chapter 3** : Power Distribution Equipment
- **Chapter 4** : Wiring Equipment
- **Chapter 5** : Propagating Default Data and Association
- **Chapter 6** : Cable sizing
- **Chapter 7** : Reports
- **Chapter 8** : Electrical Engineer
- **Chapter 9** : Single Line Diagram
- **Chapter 10** : Schematics
- **Chapter 11** : Associate External Document
- **Chapter 12** : Archive Document
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- **Appendix A** : ‘S-001 Demo SLD’ drawing

Electricity and Electrical Engineering

Following is a brief synopsis of Electrical Engineering and Design and also some guiding principles that were employed in the creation of SmartPlant Electrical.

The Electrical Distribution Network

The electrical distribution network includes all the equipments and devices used to control and deliver electrical power safely and efficiently from the 'incoming' service to the ultimate end 'users' or 'consumers'.

Equipment

The distribution network consists of:

1.Sophisticated equipment that in some cases is designed and manufactured for particular network-
specific (or plant design-specific) use.

2.Standard or 'typical' equipment that has the same characteristics from device to device or even from project to project. SmartPlant Electrical has the ability to handle both cases. One advantage the user will discover about SmartPlant Electrical is that the 'typical data' need only be entered once and then copied as needed to other similar devices. Both typical and copied items of equipment will have specific parameters defined in the course of the design and recorded on the project documents and drawings. The equipment includes (but is not limited to):

1. Incoming utility feeders
2. Generators
3. Substations
4. Switchgears
5. Motor Control Centers
6. Local Control Equipments
7. Motors
8. Heaters
9. Converting Equipments
10. Cables
11. Low Voltage Distribution Panels
12. Lighting

Electrical Engineering and Design

Involves the design of those electrical parameters and equipment that make up the distribution and utilization network. Part of the design is also involved with correctly assembling all the 'pieces' to form a cohesive and robust system (with calculated results) to fill the current needs of

the client as well as providing for future expansion. This design is all handled in a framework of recognized Codes (National and Local), Standards, and Accepted Practices. Another important function of electrical design is to develop and record accurate calculations related to specific electrical and physical phenomena that the engineer/designer uses daily. These design activities and the resulting design documents are ultimately used to:

- Provide safety and adherence to codes, client requirements, and so forth.
- Provide the contractor with direction and materials related needs during construction.
- Provide documentation to the particular facility's 'technical libraries' for future reference, and so forth.

Documentation

These engineering and design activities are presented to the facility and to the contractor in a variety of documents. Some of these documents will only be used during construction, however, some will form a part of the facility's technical library. Some of these documents will include (but not be limited to):

- Single Line diagrams
- Motor schematic diagrams
- Power Distribution Board layout diagrams
- Cable block diagrams
- Wiring diagrams
- Cable Schedules reports
- Cable Take off reports
- Cableway segment schedule reports
- Cableway component material take off reports
- Segment fill reports
- Drum composition reports
- Terminal strip schedule reports
- Material Take-offs and Reports
- Equipment List reports
- Electrical Load List reports

Workflow

SmartPlant Electrical does not force a particular workflow, and there are several ways to perform the required design. SmartPlant Electrical has been designed to create and enter data or entities in a series of stand-alone operations. These operations can be performed in sequences that suit the user's needs. Some of the major issues with which SmartPlant Electrical development was concerned were:

1. The very real assumption that current contracts are short in the **Electrical Index** duration and that accurate and efficient tools are required to maintain the data involved.
2. The design process is never a 'one time through' operation and that changes do occur at any point during the life cycle of the design process.
3. SmartPlant Electrical users need a mechanism whereby they can set up 'default' information once and re-use it during the course of the project and in future projects as well.

Smart Plant Electrical Modules

EI – Electrical Index

The **Electrical Index** is the module where you create and store project-specific equipment and data. Logging into a SmartPlant Electrical project or plant will grant you accessing your tags and relations as per your granted access rights set by your Administrator. The **Electrical Index** will present the tags that belong to the entire plant or specifically the ones of the lowest plant group (for example, Unit), based on your settings.

To view all plant items, on the **View** menu, select the option **Show Items of All Plant Groups** (when selected, a check mark appears beside the option as shown), otherwise, to see only those items that belong to the current unit, deselect this option.

EE – Electrical Engineer

The **Electrical Engineer** is the module where graphical representations of Equipment and Associations are stored.

RDE – Reference Data Explorer

The **RDE** is the module where you create and store reference (or generic) equipment and data. This equipment and data can later be used as seed data to populate project-specific electrical equipment in the **Electrical Index**. The more that is invested in properly preparing the 'generic data' or 'defaults' the greater the savings will be during the course of the current project and on future projects.

Chapter 1

Electrical Equipment

Power Sources

Power sources include offsite power supplies, generators, and battery banks.

Create a project Generator in Electrical Index (EI)

You create project items in **Electrical Index** (**EI**) window.

Use the following procedure to create a new project generator 'G-2'.

1.In Electrical Index, click Electrical Equipment, and select the Generators folder.

2.Right-click, and on the shortcut menu, click **New Generator**.

Note: To rename the item tag name, you select the item tag, right-click, and from the shortcut menu, click Rename, to open Item Tag dialog box.

Tip

To display the Item Tag dialog box each time you create a new item, click File, Preferences, and on the Preferences dialog box, general tab, under Open after creating or duplicating an item, check the Item Tag dialog box radio button.

Duplicate an Item

Use the following procedure to duplicate Generator G-2.

1.In the Electrical Index, select the Generator G-2

2.Right Click, and from the shortcut menu, select Duplicate.

3.On the Item Tag dialog box, type G-3.

Delete an Item

Use the following procedure to delete Generator G-3.

1.In the Electrical Index, select the Generator G-3.

2.Right-Click, and from the shortcut menu, select Delete.

3.On the Delete Confirmation prompt, select Yes.

Create typical Generator in Reference Data Explorer (RDE)

You create typical items in **Reference Data Explorer** (**RDE**) window.
You use those typical to create the project items in the **Electrical Index** (which contains the project specific items).
1.In the Reference Data Explorer, click Electrical Equipment, Generators.

2.Right-click and from the shortcut menu, click **New Generator**.
3.Except the default name, 'Generator-2'.

Create a project Generator in Electrical Index from Typical Generator

1. In the **RDE**, select generator, **'Generator-2'**.
2. Drag **Generator-2** onto the **Generators** folders in the **Electrical Index**.
3. A "⊞" sign appears when dragged cursor over the **Generators** folder in **Electrical Index**.

4.Release the mouse to create the generator.
5.Rename the generator to **G-3**.

Create an Offsite Power Supply

Create typical offsite power supply in RDE:

Use the following procedure to create a new typical Offsite Power Supply:
1.In RDE, select Electrical Equipment, Offsite Power Supplies
2.Right click on the Offsite Power Supply folder and select New Offsite Power Supply.
3.Rename the new offsite power supply if required and name it 'S-2'

Create project Offsite Power Supply in EI:

Use the following procedure to create a new project Offsite Power Supply:
1.Select the typical Offsite Power Supply, 'S-2' from RDE, and copy it to EI.
2.Rename the new offsite power supply if required and name it 'S-2'

Loads

Loads include motors, heaters, heat traces, capacitors, harmonic filters, resistors, lighting fixtures, socket outlet, welding outlet, and other electrical equipment.

Create Motor

Create typical Motor in RDE:

Use the following procedure to create a new typical Motor:
1.In the RDE, select Electrical Equipment, Load, and Motors.
2.Right click on the Motors folder and select New Motor.
3.Rename the new motor and call it 'M-1'

Create project Motor in EI:

Use the following procedure to create a new project Motor:
1. Select the typical motor 'M-1' from RDE and copy it to EI.
2. Rename the new motor and call it 'M-1'.

Create typical Motor with space heater in RDE:

Use the following procedure to create a new typical Motor with space heater:
1. In the RDE, select Electrical Equipment, Load, and Motors.
2. Right click on the Motors folder and select New Motor with Heater.
3. Rename the new motor and call it 'M-2'
4. Rename the new motor space heater to 'H-2'

Create project Motor with space heater in EI:

Use the following procedure to create a new project Motor with space heater:
1. Select the typical motor with space heater M-2' from RDE and copy it to EI.
2. Rename the new motor and call it 'M-2'.
3. Rename the new motor space heater and call it 'H-2'

Create Heaters

Create typical Heater in RDE:

Use the following procedure to create a new typical Heater:
1. In RDE, select Electrical Equipment, Load, Static Electrical Equipment, and Heater.
2. Right click on the Heaters folder and select New Heater.
3. Rename the new heater and call it 'H-1'

Create project Heater in EI:

Use the following procedure to create a new project Heater:
1. Select the typical heater 'H-1' from RDE and copy it to EI.
2. Rename the new heater and call it 'H-1'.

Create Other Electrical Equipment

Create typical Other Electrical Equipment in RDE:

Use the following procedure to create a new typical Other Electrical Equipment:
1. In RDE, select Electrical Equipment, Load, Miscellaneous Electrical Equipment, and Other Electrical Equipment
2. Right click on the Other Electrical Equipment folder and select New Other Electrical Equipment
3. Rename the new Other Electrical Equipment and call it 'OEE-1'

Create project Other Electrical Equipment in EI:

Use the following procedure to create a new project Other Electrical Equipment:
1. Select the typical Other Electrical Equipment, 'OEE-1' from RDE and copy it to EI.
2. Rename the new Other Electrical Equipment, and call it 'OEE-1'.

Delete Load with associated items

When deleting a load, the software lets you delete various items associated with the load. Use the following procedure to delete project motor M-2 with associated items from EI:

1. From EI select the motor M-2.
2. Right click and select delete.
3. You will get the following delete confirmation window:

Selecting the 'Show options' button opens the delete associated items box, where You can select the associated items you would like to delete with the load.

If you select 'Yes', it deletes M-2 with any checked associated item.
Please select 'No' to cancel the deletion.
Note: You can set a preference that instructs the software the associated items to be deleted.

Converting Equipment

Create a Transformer

Create typical transformers in RDE:

Use the following procedure to create a new typical 2-Winding Transformer:
1. In RDE, select Electrical Equipment, Converting Equipment, and Transformers
2. Right click on the Transformers folder and select New 2-Winding Transformer
3. Rename the new 2-Winding Transformer and call it 'T-1'
4. Rename the transformer secondary and call it 'S-1'

Use the following procedure to create a new typical 3-Winding Transformer:
1. In RDE, select Electrical Equipment, Converting Equipment, and Transformers
2. Right click on the Transformers folder and select New 3-Winding Transformer
3. Rename the new 3-Winding Transformer and call it 'T-2'
4. Rename the transformer secondary and call them 'S-2-1' and 'S-2-2'

Create project Transformer in EI:

Use the following procedure to create a new project 2-Winding Transformer:
1. Select the typical 2-Winding Transformer, 'T-1' from RDE and copy it to EI.
2. Rename the new 2-Winding Transformer, and call it 'T-1'.
3. Rename the transformer secondary and call it 'S-1'

Use the following procedure to create a new project 3-Winding Transformer:
1. Select the typical 3-Winding Transformer, 'T-2' from RDE and copy it to EI.
2. Rename the new 3-Winding Transformer, and call it 'T-2'.
3. Rename the transformer secondary and call them 'S-2-1' and 'S-2-2'

Create a Current Limiting Reactor

Current limiting Reactors help to restrain the magnitude of fault current within an electrical or electronic system.

Create typical Current Limiting Reactor in RDE:

Use the following procedure to create a Current Limiting Reactor:
1. In RDE, select Electrical Equipment, Converting Equipment, and Current Limiting Reactor
2. Right click on the Current Limiting Reactor folder and select New Current Limiting Reactor
3. Rename the new Current Limiting Reactor and call it ‘CLR-1’

Create project Current Limiting Reactor in EI:

Use the following procedure to create a new project Current Limiting Reactor:
1. Select the typical Current Limiting Reactor, ’CLR-1’ from RDE and copy it to EI.
2. Rename the new Current Limiting Reactor, and call it ‘CLR-1’.

Common Features

Find - Allows you to search for a specific item based on user-defined search Criteria. The items that are available depend on the object from which you Invoke the Find command.

Refresh - Update the Electrical Index, Electrical Engineer, Reference Data Explorer, or Reference Electrical Engineer display. This feature is useful where multiple Users are working on the same set of data.

Views - Allows you to toggle through different views of the items in the list view pane. The arrow beside the icon allows you to select a specific view.

Buttons - Allows you to toggle between showing and hiding existing buttons. The arrow beside the icon includes options that allow you to add or remove buttons for the currently selected item or folder. Note that when removing a button, if you do not select a specific button, the software removes the uppermost button in the list.

Properties Window (Property Grid)

The Properties window display is a two-column table that provides the common properties of the Current item tag in the active window (Electrical Index, Electrical Engineer, Reference Data Explorer, Reference Electrical Engineer) or Tabular Editor.
You can display properties alphabetically or by categories by clicking the corresponding display mode button.

Select change the display to category.

Select change back to alphabetically.

Data Types

Character data type

Allow you to enter characters.

Select Lists data type

Allow you to select value from list.
Customize the select list values can be done from spel update select list option, or from data dictionary manager and controlled by user access rights. You can add new value, rename or hide existing values.

Adding values to select list

To add **480 V** and **4.16 kV** values to Rated Voltage Select list, select 'Update Select Lists' from Tools menu.

Type the new value, **480 V** in the last row (blue row) and select Apply.

Do the same steps for 4.16 kV

Select OK to close the Update Select Lists window.

Units of Measurement data type

The 'Units of Measurement' select list is a special select list. The user cannot modify the values in the list because they have associated conversions and calculations.
When the user selects one of these fields, such as 0.0 hp, 0.0 hp will appear in the window and the user can then type instead of 0.0 the required value.
The default unit of measure for a particular property is set in the Data Dictionary.

Calculated value data type

Displays a read-only value that the software calculates.

Select Set

Apply change to set of Items
Notice that select set is a temporary set and will not be saved after user moves to another action.

Select the Motors folder in the **Electrical Index**. From the lower pane select the motors M-1, and M-2.

The properties grid window pick the Select Set.

Whatever change is made (with Select Set selected) it will apply to all items that are included in the Select Set.
When a select set is chosen, a value will appear only if all the items share the same value.

Item counter in the Electrical Index or the Reference Data Explorer

The counter of the selected items exists in the bottom left part of the SmartPlant Electrical window. The counter displays when highlighting a folder.

Create sub-folders

SmartPlant Electrical enables you to add sub-folders to the folders in the **Electrical Index** and **Reference Data Explorer**. This makes it easier to find items in a folder that holds a long list of items.

Create sub-folder for 1 hp 460 V project Motors in EI
1. From Electrical Index select Motor folder
2. Right click and select 'New Custom Folder'. Type in '**1 hp 460 V Motors**'

Select the Browse button. In the select filter windows

Select the Multi-purpose Filters folder, and create new simple filter, name it '**1 hp 460 V Motors**'.
Set in the Filter Properties windows, Motor Rated Power = 1 hp, and Rated Voltage = 460 V
Set the match all/match any radio button to match all, to get only motors match both 1 hp and 460 V.

Select OK to close the Filter Properties window.

Select OK again to close the select Filter window, and return to create custom folder window.

Select OK to close the create custom folder windows.
The result in Electrical Index will be a new sub folder for the 1 hp 460 V motors.

Notes: 1. Filter created under Plant folders available to all users, filter created under my folders available only to creator.
2. A compound filter consists of more than one simple filter. The simple filters are added to the compound Filter by dragging the simple filter or by creating new simple filters under the compound filter in the filter Hierarchy. Compound filters apply only to homogeneous item types.

Electrical Loads form

Entering engineering values using the Common Properties entry form.
Note: Rated power property, varies and depends on the type of electrical equipment. For all types of Equipment it has units of measure type of property, while for Motors it is a select list.

Motor Form (Common Properties)

From Electrical Index, select motor M-1, Right-Click, and from the shortcut menu select Common **Properties.**

General tab
Identify and characterize the motor. An asterisk beside a property name indicates required data.

Load Data tab

Provides information about the mechanical power and usage requirements of the motor. You can find many of these quantities on the motor nameplate. An asterisk beside a property name indicates required data. To obtain the **Demand factor**, on the **Load Data** tab, you should fill in values for **Rated power** and **Brake power.** The software also validates that the brake power does not exceed the rated power value. Select a value for **Rated voltage** and let the system calculate the value for **Full load current** (this property appears on the **Electrical Data** tab). To obtain the synchronous speed, you should enter values for the **Frequency**, **Poles**, and **Supply** properties. The software validates that the asynchronous speed never exceeds the synchronous speed. Select an operating mode to enter the coincidence factor of that motor. To get the **Power factor** and **Efficiency** values at demand you need to enter the **Electrical Index** values at 50%, 75%, and 100% of operation. We will see later that there is a better way to populate these values using lookup tables.

Electrical Data tab

Calculations behind these calculated fields.
Once you have entered all the previous values on the **Load Data** tab the software calculates all three vectors of the electrical consumption from the bus that feeds this motor.
The full load current can be the **Electrical Index** the calculated or entered manually, depending on the **Override FLA Calculation** flag. If it is set to **Calculate**, the values are calculated using the rated power, power factor at 100%, rated voltage, number of phases and according to whether the supply is AC or DC.
Observe the relation between the FLA, LRC, and the **Electrical Index** ratio.

Controls & Signals tab

Provides optional information for control stations that control the motor operation, and controls and signals for the motor.

Electrical Motor Common Properties [M-1]
General
Load Data
Electrical Data
Controls & Signals
Instruments
Feeder Data
Alternative Feeder
Associated control stations
Item Tag
Type
Associated I/O signals
Item Tag
Equipment Type
Description
I/O Type
Last applied typical I/O set:
Controller
Type of controller:
Variable frequency drive
Auto restart:
Restart group:
OK
Cancel
Apply
Help

Instruments tab

Displays instruments that monitor and control the motor operation.

Feeder Data tab

Provides information about the feeder and details of associated protection devices such as fuses, circuit breakers, overload relays, and so forth in motors that belong to your project. The values on this tab reflect the definitions that you make in the **Electrical Engineer**.

Once you associate the motor with a circuit, the feeder data becomes read-only. Further changes are possible only through the **Electrical Engineer**.

Feeder equipment displays the name of the equipment other than feeders that the load is fed from. Such equipment can be a transformer's secondary, variable speed drive and so forth.

Alternate Feeder tab

Showing the second power source that may be feeding this motor, in case there is such:

Static Loads, Heater Equipment form

In this session you learn about all the various properties that may be edited or viewed for Static loads, using the forms and the **Electrical Index** behavior under various circumstances. Also, the corresponding editing functionality using property grid will be mentioned.
The function of the various tabs is very much the same as for the motor except for few minor differences due to the fact that static loads are not rotating, therefore properties such as brake power, LRC power factor, synchronous and asynchronous speeds, and so forth, do not apply.

Heater form

In the **Electrical Index**, select heater H-1, Right-Click, and from shortcut menu select Common **Properties**

General tab

Load Data tab

Note that Rated power for static loads is not a select list but rather a property with engineering units. Each type of static load has its own category of units of measure. For example, heaters have Power, whereas capacitors and harmonic filters have Reactive power, etc. The demand factor, power factor, and efficiency at demand are manual entries rather than calculated values.

Electrical Data tab

Calculations behind these calculated fields.
The calculated electrical properties are very similar to those for motors.

Control & Signal tab

Instruments tab

Feeder Data tab

Alternative Feeder tab

Converting Equipment form

Transformer form

In the **Electrical Index**, select transformer T-2, Right-Click, and from shortcut menu select Common **Properties**

General tab

Electrical Data tab

Control & Signal tab

Instrument tab

Feeder Data tab

Current Limiting Reactor Form

In the **Electrical Index**, select Current Limiting Reactor CLR-1, Right-Click, and from shortcut menu select Common **Properties**

General tab.

Electrical Data tab

Controls & Signals tab

Instruments tab

Feeder Data tab

Lab 1

Typical Electrical Equipments (create in Reference Data Explorer)

	Item type	Item Tag	Rated Power	Break Power	Rated Voltage	Demand Factor	Supply AC/DC	Frequency	Phase	Poles
1.1	Ref Generator	**1 MVA 4.16 kV**	1 MVA Rated Apparent Power	n/a	4.16 kV	n/a	AC	60 Hz	3	4
1.2	Ref Offsite Power Supply	**1 MVA 4.16 kV**	1 MVA Offsite Power Rated Power	n/a	4.16 kV	n/a	AC	60 Hz	3	n/a
1.3	Ref Motor +S.H (Motor + S.Heater)	**1 hp 460 V w/sh 100 W 120 V**	1 hp	.75 hp	460 V	calc.	AC	60 Hz	3	4
	Ref S.Heater	**100 W 120 V**	100 W	n/a	120 V	1	AC	60 Hz	1	n/a
1.4	Ref Motor	**10 hp 460 V**	10 hp	6.8 hp	460 V	calc.	AC	60 Hz	3	4
1.5	Ref Motor	**100 hp 460 V**	100 hp	80 hp	460 V	calc.	AC	60 Hz	3	4
1.6	Ref Heater	**100 kW 480 V**	100 kW	n/a	480 V	1	AC	60 Hz	3	n/a
1.7	Ref Transformer	**1 MVA 4.16 kV 480V/480V** (3-Winding)	1 MVA	n/a	4.16 kV	n/a	AC	60 Hz	3	n/a
	Sec 1	**S1-480V**	500 kVA	n/a	480 V	n/a	AC	60 Hz	3	n/a
	Sec 2	**S2-480V**	500 kVA	n/a	480 V	n/a	AC	60 Hz	3	n/a
1.8	Ref CLR	**1 MVA 4.16 kV**	1 MVA	n/a	4.16 kV	n/a	AC	60 Hz	3	n/a

Project Electrical Equipments (create in Electrical Index)

	Item type	Item Tag	FLA Flag	PF 100 %	PF 75 %	PF 50 %	LRC PF LRC/ FLA	PF Operating	DF	Operating Factor	Eff. 100 %	Eff. 75 %	Eff. 50 %	Eff. Operating	Oper. Mode
1.9	**Generator** (copy 1 MVA 4.16 kV)	**G-001**	calc.	.90	n/a	n/a	n/a	n/a	n/a	n/a	.90	n/a	n/a	n/a	**Cont.** x=1
1.10	**Offsite Power Supply** (copy 1 MVA 4.16 kV)	**S-001**	calc.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**Cont.** x=1
1.11	**Motor**/SH (copy 1 hp 460 V w/sh 100 W 120 V)	**M-100**	calc.	.76	.66	.52	.60 7.3	calc.	calc.	.95	.83	.82	.79	calc.	**Cont.** x=1
	(SH)	**SH-100**	calc.	1	n/a	n/a	n/a	1	1	n/a	1	n/a	n/a	1	**Cont.** x=1
1.12	**Motor** (copy 10 hp 460 V)	**M-101**	calc.	.84	.79	.68	.50 6.2	calc.	calc.	.95	.90	.90	.90	calc.	**Cont.** x=1
1.13	**Motor** (copy 100 hp 460 V)	**M-102**	calc.	.87	.85	.80	.30 6.4	calc.	calc.	.95	.95	.95	.95	calc.	**Cont.** x=1
1.14	**Motor** (copy 10 hp 460 V)	**M-103**	calc.	.84	.79	.68	.50 6.2	calc.	calc.	.95	.90	.90	.90	calc.	**Cont.** x=1
1.15	**Heater** (copy 100 kW 480 V)	**H-104**	calc.	1	1	n/a	n/a	1	1	n/a	1	n/a	n/a	1	**Cont.** x=1
1.16	**Transformer** (copy 1 MVA 4.16 kV 480V/480V)	**T-001**	calc.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.90	**Cont.** x=1
	Sec 1	**S-001**	calc.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Sec 2	**S-002**	calc.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1.17	**CLR** (copy 1 MVA 4.16 kV)	**CLR-001**	calc.	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1	**Cont.** x=1

Chapter 2

Tabular Editor

You use the **Tabular Editor** for viewing and performing editing or other operations on one or more items of a specified item type.

Create a Table

To create a table select new table from window menu.

Select 'Motor' for item type, 'Motor List' for layout, and select OK.

Total count: 6 Item type: Motor Layout: Motor List

	Item Tag	Motor Rated Power	Brake Power	Rated Voltage
1	M-1	1 hp	0.8 hp	460 V
2	M-100	1 hp	0.75 hp	460 V
3	M-101	10 hp	6.8 hp	460 V
4	M-102	100 hp	80 hp	460 V
5	M-103	10 hp	6.8 hp	460 V
6	M-2			

Notes: 1.When you create a Tabular Editor view for abstract item types such as loads or converting electrical equipment, as opposed to specific item types such as motors or transformers, the software displays all the common properties for these item types in the Tabular Editor. With loads, for example motors and heaters both appear, but the software cannot display the Electrical Index specific properties in one common Tabular Editor view. However, when you select items of the same specific type, all of the properties appear in the Properties window.
2. The flag shows items of all plant groups apply to tabular editor.

Close the tabular editor by select close from file menu,

or select the internal windows [x] close button.

	Item Tag	Motor Rated Power	Brake Power	Rated Voltage
1	M-1	1 hp	0.8 hp	460 V
2	M-100	1 hp	0.75 hp	460 V
3	M-101	10 hp	6.8 hp	460 V
4	M-102	100 hp	80 hp	460 V
5	M-103	10 hp	6.8 hp	460 V
6	M-2			

Create and use layout in tabular editor

Select new table from window menu.

From Table Properties dialog box select item type motor, and select Advanced.

In Advanced Table Properties window, select layout tab. Name the layout, 'My First Motor Layout'. Add to the definition contents section the properties, **Item Tag**, **Motor Rated power**, and **Rated Voltage.** Add to the definition sorting section the property, **Item tag.** Save the new layout.

Select OK to close the Advanced Table Properties and return to table properties.
Select OK to open the tabular editor.

	Item Tag	Motor Rated Power	Rated Voltage
1	M-1	1 hp	460 V
2	M-100	1 hp	460 V
3	M-101	10 hp	460 V
4	M-102	100 hp	460 V
5	M-103	10 hp	460 V
6	M-2		

Close the tabular editor.

Layout usage

Layout Usage - Lists the property display types associated with the Properties window. Options include a blank value, Brief, Bulk, and Brief/Bulk. The selected item type and display attributes define what appears in the Properties window when you select the Show Brief Properties, Copy Bulk Properties, or Paste Bulk Properties commands from the Properties window toolbar (property grid).

Let's select 'Brief/Bulk' usage for 'My First Motor Layout'.
Select new table from window menu.

Select motor for item type, 'My First Motor Layout' for layout, and select advanced.

In the layout tab, select Brief/Bulk from the usage drop down list. Select save and click OK.

In the table properties select cancel to close the window.

The brief feature allows you to create brief view.
Select motor M-1 from Electrical Index.

And in the property windows, select the 'Brief Properties' button to switch to brief view.

The bulk feature allows you to copy and paste bulk properties.
Create in Electrical Index new motor and name it M-3.
Select motor M-1 from Electrical Index, and from properties window select the copy bulk properties button. To paste the bulk properties into M-3, select M-3 from Electrical Index, and from the properties windows select the 'paste bulk properties' button.

Only properties defined in the layout will be copied from M-1 to M-3.

In this example, only the 1 hp for motor rated power, and 460 V rated voltage will be copied.

You can also paste the data into more than one item in one operation, by select for example both M-2 and M-3 in electrical index window lower pane (use the Ctrl key), and from the properties grid choose 'Select Set', than select the 'Paste Bulk Properties' button.

This will copy the values of the properties defined in the layout from M-1 to both M-2 and M-3.

Filters in Tabular Editor

From advanced table properties windows, filter tab, you can define 2 types of filters.

1. "One time filter", where you can set a filter criteria in the definition Section. This type of filter cannot be saved for later use.

2. 'Base filter", where you can create a plant filter that saved for later use.

The plant filter is been saved in the database for later use, and created with filter manager, or from in Smart Plant Electrical, by select browse button in advanced table properties windows, where "select filter" windows open and allow to create plant filter.

The plant filter can be selected in the table properties windows when you create new table.

To remove the filter from the table, clear the filter name in the table properties windows.

Auto Filter - Allow to filter the items according to various values that the selected property contains.

To activate the auto filter. Open tabular editor, select right click and select auto filter.

When you click the Auto Filter command, arrows appear at the top of each column. Click on the arrow at the top of the column that contains the data you want to filter on and choose the value from the list that appears. You can include more than one property in the auto filter of your table, creating a chained filter.

To remove the auto filter, click Auto Filter command again.

Using tabular editor and data manipulation

You can perform the following operations in the Tabular Editor:

- Create new items
- Duplicate items
- Rename items
- Modify items
- Delete items
- Move a cell from one location to another like in Excel.
- Change the width of a cell by dragging the edge of the cell header and making the cell wider or narrower. When you save the settings, the software retains cell widths until the next time you open the layout.
- Copy and paste data from one item to another.
- Copy and paste data from one group of cells to another similar set of cells.
- Sort data.
- Filter data.
- Open the item common properties form
- Find items in Electrical Index and Electrical Engineer.

Copy and Paste

To copy data of complete item to another item. You select the required item by clicking on the left side sequence number of that item, right-click to display the shortcut menu, click Copy, and then select another tag and click Paste on the shortcut menu.

To copy a complete record to a group of records, copy the required item as before, then select the required target items using the mouse + Ctrl key, and then right-click and paste.

To copy only certain fields of an item 1 to item 2. Highlight certain fields of item 1 by marking them with left click. Then select right click and select copy.
Highlight the same fields in item 2 by marking them with left click. Then select right click and select paste. The copy certain fields option let you paste the data **only** to single item.

Freeze Panes - Allow to scroll in tabular editor while keeping the display of specified rows and columns constant. For instance, the first column can contain the item tag, but you want always to see the item tag as you scroll to the right end of the rows to view the supplier.

To freeze the first column (item tag). Highlight the header of the 2nd column. Right click and select freeze panes.

To unfreeze the pane. Reselect freeze panes option.

Using tabular editor data to Microsoft Excel

Allow you to copy tabular editor data including the headers to Microsoft excel.

To copy from tabular editor to excel. Open tabular editor (select motor for item type, and 'My First Motor Layout' for layout). Left click on the most upper left cell to mark the complete table area. Right click and select copy.

Then, open excel, select cell A1, right click and select paste.

Lab 2

Create Table and view the data

2.1. Create new table with the following parameters and view the data.
Item type: **Motor**.
Layout name: **Motor Layout Lab 2**
Contents: **Item tag, Description, Motor Rated Power, Rated Voltage**
Sort: **Item Tag**

2.2. Set filter for 1 hp **or** 10 hp motors using auto filter and view the result.
Remove to auto filter for the next step.
2.3. From the table, add 3 new motors M-4, M-5 and M-6.
2.4. From the table, edit M-4, and set its 'Motor Rated Power' to 2 hp, and its 'Rated Voltage' to 460V.
Note: Double click on cell enables the cell for editing.
2.5. From the table, copy the complete record of motor M-4, to the group of motors, M-5, and M-6.
Note: Copy complete record executed only for properties that appear in the layout.

Modify layout and adding base filter

2.6. Modify the table layout by adding the properties, **Frequency,** and **Frame Size**.
Save the change and view the result.
2.7. Add to the layout a 'Base Filter', and name it, '**2 hp 460 V Motors**'.
The filter should bring motors with 2 hp of motor rated power, **and** 460 V of rated voltage.
Save the change and view the result.

Using freeze panes option

2.8. Use the freeze panes option in the table to freeze the **Item Tag**.
To view the result, scroll to the right and verify the Item Tag column freezes.

Chapter 3

Power Distribution Equipment

Power Distribution Boards (PDB)

PDB's and the related internal associated items play a major role in the design of an electrical distribution network. A PDB usually is a confined enclosure that contains the necessary electrical internal equipment that will accept and distribute power from power sources to loads or other secondary distribution PDB's. While all types of PDB's behave the same (Smart Plant Electrical wise) there are different names for these PDB's, based on what load they supply and what function they serve in the electrical network. The following terms are used in a mixed way in various regions and countries:

Switchgear, PDB that supplies power to other lower voltage PDB's such as MCC'S

Load Center is a PDB that distributes power to MCC's

MCC (Motor Control Center) is a PDB that supplies power mainly to motors.

Switchboard is usually a PDB that delivers power to small loads such as lighting fixtures and low voltage circuit breaker distribution boards

PDB's accept power (current under specific voltage levels) from power sources such as generators, UPS, battery banks, other PDB's, transformers, etc.

PDB's deliver power (current under specific voltage levels) to loads and to other PDB's.

PDB's accept power through **incomer** circuit that is connected to internal physical metal buses (copper or other conducting material).

PDB's deliver power through internal **feeder** circuits that connect to the internal buses.
Internal buses of a PDB can supply power to each other by interconnecting circuits of 2 types. Either by coupler-riser to form a bus tie (for redundant buses where the 2 buses have the same voltage) or by simply feeder-incomer circuits (the feeder circuit of bus A supplies power to lower level voltage bus B, an auxiliary bus).

Create Typical PDB in RDE

Use the following steps to create a new typical PDB:

1. In RDE, select Electrical Equipment, Power Distribution Equipment, and Power Distribution Board.
2. Right Click on Power Distribution Board folder and select New Power Distribution Board.
3. Rename the new Power Distribution Board and call it 'PDB-1'.

The type of the PDB can be defined from the Electrical Equipment Type select list.

To create new Bus in the new PDB-1 does the following:
1. Select the Buses folder, right click and select New Bus
2. Rename the new bus and call it Bus-1

Create Project PDB in EI:

Use the following steps to create new typical PDB in EI

1. From RDE select PDB-1 and copy it to EI, under Electrical Equipment, Power Distribution

Equipment, Power Distribution Board.
2. Rename the new PDB to 'PDB-1'.

To add 2nd bus to the PDB do the following:
1. Select PDB-1, right click on the Buses folder and select New Bus.
2. Rename the new Bus and call it Bus-2.

Cell (bucket) – A removable compartment in a power distribution board that contains circuitry.

Use the following steps to create cell in EI:
1. Select the bus 'Bus-1', right click, select new Cell.
2. Rename the new cell and call it 'F1A'.

Circuits, and Circuit Internals

Circuits - A circuit is a logic electrical object that contains electrical equipments.
We define 4 different circuit types in Smart Plant Electrical that you can create and use in PDB.

Incomer circuit A circuit that supplies power to a power distribution board.

Feeder circuit A circuit that distributes power from a distribution board to other equipment.

Coupler circuit A circuit that connects two buses in a power distribution board for the purpose of Creating a bus tie. This circuit belongs to the bus that serves as the power source of The coupled bus in the PDB.

Bus Riser circuit A circuit that connects two buses in a power distribution board for the purpose of Creating a bus tie. This circuit belongs to the bus that serves as the receiver of Backup power from the feeder bus in the PDB.

Circuit Internals

Circuit internals are electrical equipments that you can add to circuit.
The circuits internal you can add are:

Battery Charger
Other Converting Equipment
2-winding transformer
Uninterruptible Power Supply (UPS)
Variable Frequency Drive (VFD)
Contactor
Overload Relay
Disconnect Switch

Circuit Breaker
Fuse
Starter
Other Disconnect Equipment
Current Transformer
Potential Transformer
Voltmeter
Ammeter
Multimeter
Protection Relay

Create typical circuit in RDE

Use the following steps to create new typical circuit:

1. In RDE, select Typical Circuit.
2. Right Click on typical circuit folder and select New Feeder Circuit
3. Rename the new typical circuit and call it 'Feeder-1'

Use the following steps to create typical circuit internal:

1. From RDE, select typical circuit 'Feeder-1'.
2. Right click, select New Circuit Breaker.
3. Rename the new circuit breaker and call it 'CB-1'

Typical Circuit Common Properties window

To open typical circuit common properties, select the typical circuit, right click and Select common properties.

Associate cables section; allow you define typical Instrumentation, Control, or Grounding cable(s). And when you create project circuit, cable(s) will be created, and their 'To' side connected to the circuit. The 'From' side can be connected to a DCS/PLC.

Create PDB's circuit in EI

Use the following steps to create circuit in a PDB:

1. From RDE, select typical circuit 'Feeder-1', copy it to EI, under

The cell ‘F1A’ in PDB-1, Bus-1.

2. Name the new circuit ‘Feeder-1’

PDB’s circuit Common Properties window

To open PDB’s circuit common properties, select the circuit, right click and Select common properties

Disconnect Electrical Equipment

Disconnect Electrical Equipment (DEE) are the components that are used internally in Power Distribution Boards in buckets and circuits, or as stand-alone items. Individual DEE that we create in RDE can be used in the project by dragging them to the appropriate **Electrical Index** folder or dragging them onto typical circuits.

DEE in a circuit (circuit internal) can be moved out of the circuit and become standalone item and vice versa.
Note: Power Distribution Board internal circuit components are not shown in the individual folders.

Disconnect Electrical Equipment include:

Contactors
Overload Relay
Disconnect
Circuit Breaker
Fuses
Starters
Other Disconnect Equipment

Create typical Disconnect Electrical Equipment in RDE

Use the following steps to create new typical disconnect electrical equipment in RDE:
1. From RDE select, Electrical Equipment, Power Distribution Equipment, Disconnect Electrical Equipment, and Contactors.
2. Right Click on the Contactors folder, select New Contactor.
3. Name the new contactor, 'CTR-1'.

Create Stand-alone Disconnect Electrical Equipment in EI

Use the following steps to create stand alone disconnect electrical equipment in EI:
1. From RDE select the contactor 'CTR-1' and copy it to EI, under Electrical Equipment, Power Distribution Equipment, Disconnect Electrical Equipment, Contactors.
2. Name the new contactor 'CTR-1'

Metering Equipment

Metering Equipment uses for measuring electrical parameters such as voltages and currents. The software allows you to create voltmeters, ammeters, and multimeters. For measuring large voltages and currents, you can also create measuring transformers for these parameters. You create standard meters and measuring transformers in the Reference Data Explorer as standalone items or as part of reference circuits. In addition, you can create protection relays with various functions for protecting the circuit.

The metering equipment includes:

Current Transformer (CT) – An instrument transformer, with its primary winding connected in series with the conductor carrying the current to be measured, which gives an accurate low-current (five-ampere) indication in its secondary winding of the high-amperage current in its primary winding. The low-current output is used for relaying, metering, and indication.

Potential Transformer (PT) – An instrument transformer, with its primary winding connected in shunt with the voltage that is to be measured, which gives an accurate low-voltage (115 volts) indication of the high-voltage system it is measuring. The low-voltage output is used for relaying, metering, and indication.

Voltmeters - An instrument for measuring voltage or electrical potential difference, with a scale in volts or kilovolts.

Ammeters - An electrical instrument, with a scale usually graduated in amperes, placed in a circuit to measure the magnitude of electric current.
Multimeters - An electronic measuring instrument that combines several functions in one unit. A standard multimeter may include features such as the ability to measure voltage, current and resistance.

Protection Relays - An electrical device that is designed to respond to specific input conditions by closing contacts or making a similar abrupt change in a control circuit. Inputs are usually electric but may be mechanical or thermal.

Create typical metering equipment in RDE

Use the following steps to create typical stand alone CT:
1. From RDE, select Electrical Equipment, Power Distribution Equipment, Disconnect Electrical Equipment, Metering Equipment, and Current Transformer
2. Right Click on the Current Transformer folder, select New Current Transformer.
3. Name the new current transformer 'CT-1'

To open typical current transformer common properties, select the current transformer 'CT-1', right click and select Common properties.

Same steps to create typical Potential transformer, voltmeter, ammeter and multimeter.

Create Relay function in RDE

Use the following steps to create new typical relay function:

1. From RDE, select electrical equipment, relay function.
2. Right click on the relay function folder, select New Relay Function.
3. Name the new relay function 'RF-1'

Use the following steps to create typical stand-alone Protection Relay:

1. From RDE, select Electrical Equipment, Power Distribution Equipment, Disconnect Electrical Equipment, Metering Equipment, and Protection Relay.
2. Right Click on the Protection Relay folder, select New Protection Relay.
3. Name the new Protection Relay 'PR-2'

To open typical protection relay common properties, select the protection relay 'PR-2', right click and select Common properties

To add relay function, select functions tab. Select add and in the find windows choose the function you would like to add.

Create stand-alone Metering Equipment in EI

Use the following steps to create stand-alone current transformer in EI:

1.From RDE select the current transformer 'CT-1' and copy it to EI, under Electrical Equipment, Power Distribution Equipment, Disconnect Electrical Equipment, Metering Equipment, current transformer.
2. Name the new current transformer 'CT-1'

You can create metering equipment in EI under the following items:

- Loads
- Offsite Power Supplies
- Generators
- Battery Banks
- Converting Equipment
- Power Distribution Boards
- Transfer Switches
- Buses
- Cells
- Circuits

Use the following steps to create a CT in EI under motor:

1.From RDE select the typical stand alone current transformer 'CT-1' and copy it to EI, under Electrical Equipment, Loads, Motors, M-1, Metering Equipment folder.
2. Name the new current transformer 'CT-2'

Transfer Switch

Transfer switches are two-way manual or automatic switches that are used to switch or transfer an essential load from the main power source to a backup power source.

Automatic Transfer Switches are an integral part of the power generation process, allowing Smooth and immediate transfer of electrical current between multiple sources and the load. When the generator is operating, the transfer switch prevents dangerous feedback of current to the utility's system. It also ensures that different power sources are fully synchronized before the power is combined or loads are transferred, which is imperative for safe operation. The transfer switches senses when utility power is interrupted, and starts up the generator if the utility power remains absent. In about five to ten seconds, when the generator is producing full power, the transfer switch disconnects the load from the utility and connects it to the generator, restoring electricity to the load. The transfer switch continues to monitor utility power, and when it is restored, switches the load from the generator back to the utility. Once the generator is disconnected, it goes through a cool-down routine and is automatically shut down.
These devices are standalone, usually housed in cabinets or mounted on walls, have 2 inputs to accept the mains and backup power source and one output, which connect to one of the switch inputs.
The transfer of the power from input 1 to input 2 can be done in the Electrical Index manually, switching the load from one to a second power source, or automatically, via a monitoring and protection circuitry that senses a loss in power in one of the sources and then switches to the alternate power source.

Create Transfer Switch

Use the following steps to create Transfer Switch in EI

1. In EI, select Electrical Equipment, Power Distribution Equipment, and Power Distribution Boards, Transfer Switches.
2. Right Click on Transfer Switches folder and select Transfer Switch
3. Rename the new Transfer Switch and call it 'TS-1'

Free-Standing-Buses

SmartPlant Electrical allows you to create stand-alone buses that are not associated with power distribution boards. You create these buses in the free-standing-buses folder of the electrical index, power distribution equipment. Stand-alone buses can be parent items of circuits and circuit internals, but not cells.

Use the following steps to create new free-standing-buses in EI

1. In EI, select Electrical Equipment, Power Distribution Equipment, and Free-Standing-Buses.
2. Right Click on Free-Standing-Buses folder and select New Bus
3. Rename the new Free-Standing-Buses and call it 'FSB-1'

Instruments

Instruments can be created in Smart Plant Electrical and associated with main equipment, such as motors or generators.

Use the following steps to create a new typical instrument in RDE:
1. In RDE, select Electrical Equipment, Instrument.
2. Right Click on instruments folder and select New Instrument
3. Rename the new instrument and call it 'Inst-1'

To open the instrument common properties, select instrument 'Inst-1', right click
And select common properties.

Use the following steps to create a new project instrument in EI:
1. From RDE select the instrument 'Inst-1' and copy it to EI, under Electrical Equipment, Instrument
2. Name the new instrument 'Inst-1'

Use the following steps to associate instrument with equipment in EI:

1. Open the instrument common properties.
2. Select the associated items tab.
3. Select find button to open the find windows.
4. Select motor from the equipment type and select the find now button.
5. From the result list select the motor 'M-1' and select OK.

The association between the instrument 'Inst-1- and motor 'M-1' also can be seen
From the motor 'M-1' common properties, instrument tab.

Design PDB structure

Smart Plant Electrical provides you with tools for the design of power distribution boards. You can define a PDB structure when creating a PDB. Then, after creating a new PDB layout drawing, you drag a PDB to the drawing thus creating the structure (a grid) that was defined for that PDB. You can than place the cells in the drawing by dragging the cells from the Electrical Index to the appropriate location in the layout grid.

Create MCC and define its structure:
From EI create new PDB, and name it MCC-1.
Add to MCC-1 new bus and name it ‘460 V Bus’.
Add to the bus 2 cells for incomer and feeder circuits, and name the cells, ‘Main Incomer’, and ‘Transformer Feeder’. For the Main Incomer cell create new incomer circuit and name it ‘Main Incomer’. For the Transformer Feeder cell create feeder circuit and name it ‘Transformer Feeder’.

From the property windows define the size of the cells by defining the number of height units and width units (normally this is based on the connected equipment or vendor information of the circuit internals)
For the ‘Main Incomer’ cell, set for the ‘**Cell Height In Units**’ property the value 20, and for the ‘**Cell Width In Units**’ property the value 3.
For the ‘Transformer Feeder’ cell, set for the ‘**Cell Height In Units**’ property the value 20, and for the ‘**Cell Width In Units**’ property the value 2.

Select MCC-1, right click and select Design PDB Structure.
Enter the following data.

Click OK to confirm and close the form.

Create PDB Layout Drawing Document

Right click on Document, PDB Layout Drawings folder and create a new PDB layout drawing. Name it MCC-1 Layout.

Right click on the drawing to open the Document properties dialog where you can define the template and the scale factor.

Click OK to confirm and close the form.
Right click on the MCC-1 Layout drawing, and select open to open the drawing.
Drag MCC-1 to the open drawing. Place the cursor on the left upper side of the drawing.

Save and close the drawing.

Design the Layout

Open the drawing to place and position the cells. First, zoom in to the leftmost upper part of the section B and allocate the Incomer cell as shown in the screen bellow. When dragging the cell allow some time until you see the cell attached to the dynamic cursor and only then drop the cell. The upper-left most part of the cell is the positioning target. Place it to the starting point at the PDB structure.

In the same way place the Transformer Feeder cell at the lower part of section A.

Viewing PDB layout drawings using the option 'Associated Drawings'

Once the PDB layout has been created as a document it will appear as an associated document. From Electrical Index, right click on MCC-1, and select associated drawings. In the filter by drawing type select list select PDB Layouts. And select open drawing button.

Lab 3

3.1 – 3.11 Create the following typical items in Reference Data Explorer Window

Typical Circuits

3.1. Create typical circuit '**SWGR Incomer 4.16 kV'**

Circuit Name	**SWGR Incomer 4.16 kV**
Circuit Type	Incomer
Circuit Rated Voltage	4.16 kV
Fuse Name	**F-1**
Fuse Rated Voltage	4.16 kV
Fuse Current Rating	120 A
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	4.16 kV
DS Current Rating	120 A

3.2. Create typical circuit '**SWGR Feeder 4.16 kV'**

Circuit Name	**SWGR Feeder 4.16 kV**
Circuit Type	Feeder
Circuit Rated Voltage	4.16 kV
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	4.16 kV
DS Current Rating	120 A
Protection Relay (PR) Name	**PR-1**
PR Rated Voltage	4.16 kV
PR Current Rating	120 A

3.3. Create typical circuit '**MCC Incomer 120 V'**

Circuit Name	**MCC Incomer 120 V**
Circuit Type	Incomer
Circuit Rated Voltage	120 V
Fuse Name	**F-1**
Fuse Rated Voltage	120 V
Fuse Current Rating	120 A
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	120 V
DS Current Rating	120 A

3.4. Create typical circuit '**MCC Incomer 480 V'**

Circuit Name	**MCC Incomer 480 V**
Circuit Type	Incomer
Circuit Rated Voltage	480 V
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	480 V
DS Current Rating	120 A
Protection Relay (PR) Name	**PR-1**

PR Rated Voltage	480 V
PR Current Rating	120 A

3.5. Create typical circuit '**Motor Feeder 1 hp 480 V'**

Circuit Name	**Motor Feeder 1 hp 480 V**
Circuit Type	Feeder
Circuit Rated Voltage	480 V
Fuse Name	**F-1**
Fuse Rated Voltage	480 V
Fuse Current Rating	1 A
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	480 V
DS Current Rating	120 A

3.6. Create typical circuit '**Motor Feeder 10 hp 480 V**'

Circuit Name	**Motor Feeder 10 hp 480 V**
Circuit Type	Feeder
Circuit Rated Voltage	480 V
Fuse Name	**F-1**
Fuse Rated Voltage	480 V
Fuse Current Rating	12 A
Circuit Breaker (CB) Name	**CB-1**
CB Rated Voltage	480 V
CB Current Rating	16 A
Overload Relay (OL) Name	**OL-1**
OL Rated Voltage	480 V
OL Current Rating	16 A
OL Control Voltage	24 V

3.7. Create typical circuit '**Motor Feeder 100 hp 480 V'**

Circuit Name	**Motor Feeder 100 hp 480 V**
Circuit Type	Feeder
Circuit Rated Voltage	480 V
Circuit Breaker (CB) Name	**CB-1**
CB Rated Voltage	480 V
CB Current Rating	100 A
Disconnect Switch (DS) Name	**DS-1**
DS Rated Voltage	480 V
DS Current Rating	120 A

3.8. Create typical circuit '**Heater Feeder 100 W 120 V'**

Circuit Name	**Heater Feeder 100 W 120 V**
Circuit Type	Feeder
Circuit Rated Voltage	120 V
Circuit Breaker (CB) Name	**CB-1**
CB Rated Voltage	120 V
CB Current Rating	1 A

3.9. Create typical circuit '**Heater Feeder 100 kW 480 V'**

Circuit Name	**Heater Feeder 100 kW 480 V**
Circuit Type	Feeder
Circuit Rated Voltage	480 V
Circuit Breaker (CB) Name	**CB-1**
CB Rated Voltage	480 V
CB Current Rating	180 A

3.10. Create typical circuit '**Bus Tie 480 V Coupler**'

Circuit Name	**Bus Tie 480 V Coupler**
Circuit Type	Coupler
Circuit Rated Voltage	480 V
Disconnect Switch (DS) Name	**DS-1**
CB Rated Voltage	480 V
CB Current Rating	120 A

3.11. Create typical circuit '**Bus Tie 480 V Bus Riser'**

Circuit Name	**Bus Tie 480 V Bus Riser**
Circuit Type	Bus Riser
Circuit Rated Voltage	480 V
Disconnect Switch (DS) Name	**DS-1**
CB Rated Voltage	480 V
CB Current Rating	120 A

Typical Power Distribution Board

3.12. Create typical power distribution board '**SWGR 4.16 kV Bus'**

Power Distribution Board (PDB) Name	**SWGR 4.16 kV Bus**
Electrical Equipment Type	Switchgear
Bus Name	**4.16 kV Bus**
Bus Rated Voltage	4.16 kV

3.13. Create typical power distribution board '**MCC 120 V Bus A, 480 V Bus B/C'**

Power Distribution Board (PDB) Name	**MCC 120 V Bus A, 480 V Bus B/C**
Electrical Equipment Type	Motor Control Center
1st Bus Name	**120 V Bus A**
1st Bus Rated Voltage	120 V
2nd Bus Name	**480 V Bus B**
2nd Bus Rated Voltage	480 V
3rd Bus Name	**480 V Bus C**
3rd Bus Rated Voltage	480 V

3.14 – 3.17 Create the following items in Electrical Index Window

Power Distribution Board

3.14. a. Create new power distribution board and name it '**SW-300'**, by copy the typical power distribution board 'SWGR 4.16 kV Bus'.
b. Create new cell and name it '**F1A'** in the power distribution board, 'SW-300', Bus, '4.16 kV Bus'.
c. Create new incomer circuit and name it '**SW-300 Incomer**', in the cell, 'F1A', by copy the typical Circuit, 'SWGR Incomer 4.16 kV'.
d. Create new cell and name it '**F2A**' in the power distribution board, 'SW-300', Bus '4.16 kV Bus',
e. Create new feeder circuit, '**SW-300 Feeder**', in the cell, 'F2A', by copy the typical circuit, 'SWGR Feeder 4.16 kV'.
f. Create new cell and name it '**F2B**' in the power distribution board, 'SW-300', Bus '4.16 kV Bus',
g. Create new feeder circuit and name it '**SW-300 Feeder Spare**', in the cell, 'F2B', by copy the typical Circuit, 'SWGR Feeder 4.16 kV'.

3.15. a. Create new power distribution board and name it '**MCC-201**', by copy the typical power distribution Board, 'MCC 120 V Bus A, 480 V Bus B/C'
b. Create new cell and name it, '**F1A**', in the power distribution board, 'MCC-201', Bus, '120 V Bus A'.
c. Create new incomer circuit, '**MCC-201 Incomer A**', in the cell, 'F1A', by copy the typical circuit, 'MCC Incomer 120 V'.
d. Create new cell and name it, '**F2A**', in the power distribution board, 'MCC-201', Bus, '120 V Bus A'.
e. Create new feeder circuit and name it, '**SH-100 Feeder**', in the cell, 'F2A', by copy the typical Circuit, 'Heater Feeder 100 W 120 V'.
f. Create new cell and name it, '**F1B**', in the power distribution board, 'MCC-201', Bus, '480 V Bus B'.
g. Create new incomer circuit and name it, '**MCC-201 Incomer B**', in the cell, 'F1B', by copy the Typical circuit, 'MCC Incomer 480 V'.
h. Create new cell and name it, '**F2B**', in the power distribution board, 'MCC-201', Bus, '480 V Bus B'.
i. Create new feeder circuit and name it, '**M-100 Feeder**', in the cell, 'F2B', by copy the typical circuit, ' Motor Feeder 1 hp 480 V'.
j. Create new cell and name it, '**F2C**', in the power distribution board, 'MCC-201', Bus, '480 V Bus B'.
k. Create new feeder circuit and name it, '**M-101 Feeder**', in the cell, 'F2C', by copy the typical circuit, 'Motor Feeder 10 hp 480 V'.
l. Create new cell and name it, '**F2D**', in the power distribution board, 'MCC-201', Bus, '480 V Bus B'.
m. Create new feeder circuit and name it, '**Motor Spare Feeder**', in the cell, 'F2D'.
n. Create new cell and name it, '**F2E**', in the power distribution board, 'MCC-201', Bus, '480 V Bus B'.
o. Create new coupler circuit and name it, '**MCC-201 Coupler**', in the cell, 'F2E', by copy the typical circuit,' Bus Tie 480 V Coupler'.
p. Create new cell and name it, '**F1G**', in the power distribution board, 'MCC-201', Bus, '480 V Bus C'.
q. Create new incomer circuit and name it, '**MCC-201 Incomer C**' , in the cell, 'F1G', by copy the typical circuit, 'MCC Incomer 480 V'.
r. Create new cell and name it, '**F2G**', in the power distribution board, 'MCC-201', Bus, '480 V Bus C'.
s. Create new bus riser circuit and name it, '**MCC-201 Bus Riser**', in the cell, 'F2G', by copy the typical circuit, ' Bus Tie 480 V Bus Riser.
t. Create new cell and name it, '**F2H**', in the power distribution board, 'MCC-201', Bus, '480 V Bus C'.
u. Create new feeder circuit and name it, '**M-102 Feeder**', in the cell, 'F2H', by copy the typical circuit, 'Motor Feeder 100 hp 480 V'.
v. Create new cell and name it , '**F2J**', in the power distribution board, 'MCC-201', Bus, '480 V Bus C'.
w. Create new feeder circuit and name it, '**M-103 Feeder**', in the new cell, 'F2J', by copy the typical circuit, 'Motor Feeder 10 hp 480 V'.
x. Create new cell and name it , '**F2K**', in the power distribution board, 'MCC-201', Bus, '480 V Bus C'.
y. Create new feeder circuit and name it, '**H-104 Feeder**', in the new cell, 'F2K', by copying the typical circuit, 'Heater Feeder 100 kW 480 V'.

3.16. a. Create new power distribution board and name it '**MCC-202**' by duplicating the power distribution board 'MCC-201'.
b. In the new power distribution board '**MCC-202**' rename the following items:

Circuit 'MCC-201 Incomer A' to '**MCC-202 Incomer A**'.
Circuit 'MCC-201 Incomer B' to '**MCC-202 Incomer B**'.
Circuit 'MCC-201 Coupler' to '**MCC-202 Coupler**'.
Circuit 'MCC-201 Incomer C' to '**MCC-202 Incomer C**'.
Circuit 'MCC-201 Bus Riser' to '**MCC-202 Bus Riser**'.

Transfer Switch

3.17. **Create Transfer Switch 'TS-001'**

Transfer Switch (TS) Name	**TS-001**
Bus Name	**4.16 kV Bus**
Feeder Circuit Name	**TS-001 Feeder**
1st Incomer Circuit Name	**TS-001 Incomer 1**
2nd Incomer Circuit Name	**TS-001 Incomer 2**

Chapter 4

Wiring Equipment

Smart Plant Electrical has wiring capability that allows you create wiring equipments, manage wiring entities, and create wiring documents. The software also provides wiring termination connection capability, and producing wiring connection diagrams, and cable block diagrams.

The software allows doing the following tasks:

Create cables, bus ways, cable drums, panels (cabinets, local panels, junction boxes), control stations.
Create I/O signals.
Create terminal strips for all types of applicable equipment.
Create terminals on terminal strips.
Manage both cable sides.
Manage both conductor sides.
Create wiring drawings and make connections.
Generate termination reports.
Create cable block diagrams.

Smart Plant Electrical deals with equipment interconnections that are external to PDBs or main equipment item types. The software handles the internal circuit wiring in typical schematics. Cable terminations can reach and include equipment terminal strips.
After creating your wiring items and making the required terminations, you can generate cable wiring schedule and terminal strip connection reports.

Panels

Cabinets

Serves as place holder for panels that will be retrieved as loads.
It has common properties form with 4 tabs, General, Electrical data, Feeder Data, and Alternative Feeder.
In the electrical tab you define the power consumption in Watts or Kilowatts and the system calculates the current as for any other load.
Cabinets can be connected to a bus under the feeder circuits as any other load.

Use the following steps to create typical cabinet in RDE:
1. In RDE, select Wiring Equipment, Panels, and Cabinets.
2. Right Click on Cabinets folder and select New Cabinet
3. Rename the new cabinet to ‘Cab-1’.

Use the following steps to create cabinet in EI:
1. From RDE select cabinet, 'Cab-1', and copy it to EI, under Wiring Equipment, Panels, Cabinets folder.
2. Rename the new cabinet to 'Cab-1'.

Control Stations

Local or remote panel that contains the control elements (start-stop push buttons) activated manually by the person operating the plant. You can create such control station with or without associated cables.
A control station can be associated to one or more cables (control, ground or instrumentation cable categories). Once a cable is associated to a control station, the control station becomes the "to" side reference of that cable. A control station can be associated to one load.
When the creation of the control station is a result of an automated process, the association is created as part of the automation process, both to the cable and to the load.
In case the control station is created manually, the user is responsible for these associations.

Use the following steps to create typical control station in RDE:
1. In RDE, select Wiring Equipment, Panels, and Control Stations.
2. Right Click on Control Stations folder and select New Control Station.
3. Rename the new control station to 'CS-1'

Use the Following steps to create control station in EI:

1. From RDE select control station, 'CS-1', and copy it to EI, under Wiring Equipment, Panels, Control Stations folder.
2. Rename the new control station to 'CS-1'.

Use the following steps to associate equipment to control station in EI.

1. Open the control station common properties.
2. Select find and associate the motor 'M-1'

Local Panels and Junction Boxes

Local Panel

Cabinets containing circuit, equipment, and wiring items, used for example, to provide switching or isolation close to a motor.

Use the following steps to create typical local panel in RDE:
1. In RDE, select Wiring Equipment, Panels, and Local Panels.
2. Right Click on Local Panels folder and select New Local Panel.
3. Rename the new Local Panel to 'LP-1'

You can add circuit and circuit internals to the local panel.

User the following steps to create local panel in EI:

1. From RDE select local panel, 'LP-1', and copy it to EI, under Wiring Equipment, Panels, Local Panels Folder.
2. Rename the new local panel to 'LP-1'

Junction Boxes

Cabinets used to connect wires that run between various items of electrical equipment.

Use the following steps to create typical junction box in RDE:

1. In RDE, select Wiring Equipment, Panels, and Junction Boxes.
2. Right Click on Junction Boxed folder and select New Junction Box.
3. Rename the new Junction Box to 'JB-1'.

You can add circuit and circuit internals to junction box.

User the following steps to create junction box in EI:

1.From RDE select junction box, 'JB-1', and copy it to EI, under Wiring Equipment, Panels, and Junction Boxes folder.

2. Rename the new junction box to 'JB-1'.

Note: In contrast to Power Distribution Boards (PDBs), local panels and junction boxes are much Smaller in size and do not contain bus bars.

Cables

Smart Plant Electrical specifies the following cable categories according to the purpose of the cable: Power, control, grounding, and instrumentation. The software supports compliance with the strict regulations governing cable definitions by using standard reference cables as a basis for all the cables that you create in your project. Reference cables contain technical cable data such as voltage rating, ampacity, resistivity, cable material, and data relating to the construction of the cable. For this reason, you must initially create all your reference cables in the **Reference Data Explorer**. The software allows you to organize your reference cables in families known as cable specifications. When you select a reference cable to use as a basis for your project cable, you must select the appropriate cable category and cable specification for the reference cable. Also, when you size project cables, the software looks for the appropriate reference cable based on a particular cable specification and conductor arrangement.

Power Cable Category

Cables of various sizes, construction and insulation, single or multi-conductor, designed to distribute primary power to various types of equipment.

Reference Power Cable (created in RDE)

Use the following steps to create reference power cable in RDE:

1. In RDE, select Wiring Equipment, Cables, and Power Cables.
2. Right Click on Power Cables folder and select New.
3. Rename the new cable to '600 V 3/C - 14 AWG'.

Edit the cable properties on the Reference Cable Common Properties dialog box according to the available catalog information, including conductor arrangement, size, material and electrical cable data.

Power Cable in Electrical Index (EI)

Use the following steps to create power cable in EI:

1. In EI, select Wiring Equipment, Cables, and Power Cables.
2. Right Click on Power Cables folder and select New.
3. Rename the new cable to 'PC-0001'.

4. Open the cable common properties window, general tab, and select cable specification, Power- NEC, And conductor arrangement, 3 Core Cable.
   From the Reference cable select list pick a reference cable '600 V 3/C – 14 AWG'.
5. Selecting the reference cable '600 V 3/C – 14 AWG' populate the values from the reference cable.

Cable Common Properties [PC-0001]
General
Design Data
Connections
Sizing Data
Earth Loop Impedance
Procurement
Sizing required
Cable tag:*
PC-0001
Cable usage:
Insulation voltage rating:
600 V
Description:
Armor type:
Non Armored
Insulation temperature rating:
75 Degc
Cable category:*
Power
Outer jacket insulation:
Polyethylene
Basic ampacity in air:
20 A
Cable specification:*
Power - NEC
Notes:
Basic ampacity in ground:
Reference cable:*
600 V 3/C - 14 AWG
Construction
Conductor arrangement:*
3 Core Cable
Current-carrying conductors:
3
Additional conductors:
Compare to Reference...
Drum definition
Locked to drum
Drum:
Find...
Unassign
Pulling area:
Cable routing
Select predefined route
Copy route from cable
Segregation level: *
Power
Find...
Save as New Route...
Seque
Cableway
Segment
Length
Segment fill
1
Add
Remove
Insert
Up
Down
Design data
Use external routing length
Estimated length:*
OR
Design length:*
20 m
OR
Routing length:
0.0 m
External routing length:
External routing path:
Note that the software uses ONE of the above values (where the order of preference is 1.Routing length; 2.Design length; 3.Estimated length) as the length in the actual length of cable:
Tail 1:
Length:
20 m
Tail 2:
Spare length:
Actual design/installed length:
20.0 m
Installed data
Marked length - side 1:
Marked length - side 2:
Installed length:
Cable installed
Compare to Reference...
OK
Cancel
Apply
Help

Note: 1. You can leave the default 'Non Sized Cable' for reference cable, fill in the values for cable construction manually, and select a reference cable later.

2. Asterisk indicates field required for cable sizing calculation.

Control Cable Category

A multi-conductor cable made for operation in control or signal circuits.

Reference Control Cable (created in RDE)

Use the following steps to create reference control cable in RDE:

1. In RDE, select Wiring Equipment, Cables, and Control Cables.
2. Right Click on Control Cables folder and select New.
3. Rename the new cable to '600 V 5/C - 12 AWG'.

Edit the cable properties on the Reference Cable Common Properties dialog box according to the available catalog information, including conductor arrangement, size, material and electrical cable data.

Control Cable in Electrical Index(EI)

Use the following steps to create control cable in EI:

1. In EI, select Wiring Equipment, Cables, and Control Cables.
2. Right Click on Control Cables folder and select New.
3. Rename the new cable to 'CC-0001'.

4. Open the cable common properties window, general tab, and select cable specification, Control, And conductor arrangement, Multi Core Cable.
   From the Reference cable select list pick a reference cable '600 V 5/C – 12 AWG'.
5. Selecting the reference cable '600 V 5/C – 12 AWG' populate the values from the reference.

Grounding Cable Category

Grounding cables have only one conductor arrangement, which is the single conductor cable. The other parameters and behavior is similar to control cables.

Reference Grounding Cable

Use the following steps to create reference grounding cable in RDE:

1. In RDE, select Wiring Equipment, Cables, and Grounding Cables.
2. Right Click on Grounding Cables folder and select New.
3. Rename the new cable to '600 V 1/C - 12 AWG'.

Edit the cable properties on the Reference Cable Common Properties dialog box according to the available catalog information, including size, material, insulation and electrical cable data.

Grounding Cable in Electrical Index (EI)

Use the following steps to create grounding cable in EI:

1. In EI, select Wiring Equipment, Cables, and Grounding Cables.
2. Right Click on Grounding Cables folder and select New.
3. Rename the new cable to 'GC-0001'.

4. Open the cable common properties window, general tab, and select cable specification, Grounding. From the Reference cable select list pick a reference cable you would like to copy from.
5. Selecting the reference cable 600 V 1/C – 12 AWG populate the values from the reference cable.

Instrumentation Cable Category

Cables composed of two or more pairs of twisted conductors.

Reference Instrumentation Cable

Use the following steps to create typical instrumentation cable in RDE:

1. In RDE, select Wiring Equipment, Cables, and Instrumentation Cables.
2. Right Click on Instrumentation Cables folder and select New.
3. Rename the new cable to '600 V 3/Pair - 12 AWG'

Edit the cable properties on the Reference Cable Common Properties dialog box according to the available catalog information, including set type, number of sets, size, material, insulation, and electrical cable data.

Instrumentation Cable in Electrical Index (EI)

Use the following steps to create instrumentation cable in EI:

1. In EI, select Wiring Equipment, Cables, and Instrumentation Cables.
2. Right Click on Instrumentation Cables folder and select New.
3. Rename the new cable to 'IC-0001'.

4. Open the cable common properties window, general tab, and select cable specification, Instrumentation. From the Reference cable select list pick a reference cable you would like to copy from.
5. Selecting the reference cable 600 V 3/Pair – 12 AWG populate the values from the reference cable.

Parallel Cables

Two or more cables used to share the current in heavily loaded power cable which permits the use of smaller conductors.
In Smart plant Electrical parallel cables are groups of power cables that are created as a result of the cable sizing, added, or converted into parallels cables, and as such they behave as a group for all senses and operations.
The number of parallel cables (or cores per phase) is indicated in the UI.

Change the cable back to none parallel cable by select none in the parallel cable total number, and hit apply.

Busways

A busway is a bus bar or other metallic bar, like in the PDB, used to connect between two item tags, on cases that regular cables cannot do the job due to the high required current or for other reason.

Busway functionality is similar to the one of the power cable without the sizing capability and with no common properties form.

Single-Core Cable Assemblies

This functionality enables the user to specify assemblies and groups of single core cables to deal with the cases in which multi core cables are not adequate and there is a need to connect the equipment via single core cables per phase.

SPEL allows specifying Reference Single core Cable Assembly (SCA):

Create Reference Single-Core Cable Assembly

From RDE, right click on the Single-Core Cable Assembly folder, select 'New Single-core Cable Assembly', and name it '3 x 1/C 250 Kcmils SCA'.

Fill in the assembly tag, arrangement (not mandatory, for information only), phase arrangement (will determine the assembly configuration- number of phase conductors and neutral/grounding cables) and click on the "Ellipsis" to select the single core reference cable for the phase.

We have selected the phase labels as L1, L2, and L3. Select apply to accept the setting.

Note: We could have selected another phase arrangement such as 3PH + N, 3PH + G,3P + N + G each of which would have opened the additional conductors definition window in the form

Create Project Single-Core Cable Assembly

1.From electrical index, select the single-core cable assemblies folder. Right click and select new single-core cable assembly. Name the new SCA, 'SCA-1'.

2.Open SCA-1 Common Properties screen. Select the 'Select Predefined Cable Assembly' button, and find the reference SCA, '3 x 1/C 250 Kcmils SCA'.

The system creates an assembly based on the predefined Ref Cable Assembly.

Select Apply.
The system creates the assembly by created a group of 3 cables, grouped together, with the same ref cables and data.

Note: The item tag of the individual cables follows the naming convention definition, if such is defined. In this case, there is no special naming convention and the default naming for SCA was applied.

Editing the properties of one current carrying cable changes the properties of the others of the same type in the SCA (replacing the single core with another size or type, length data, routing one cable routes all current carrying ones)

There are few properties that are not forced to be exactly as the others such as description.

Note: Neutral and grounding cables are defined individually and do not inherit from the phase cables. Associating one cable to an equipment results in associating all the others

Signals

An item type that is used for mediating between Smart Plant Electrical and Smart Plant Instrumentation. You can associate a signal with a load, a control station, or a circuit for the purpose of publishing data to Smart Plant Instrumentation. You can perform wiring connections in Smart Plant Instrumentation and retrieve the host information back to Smart Plant Electrical, where it appears as read-only properties of the signal. Smart Plant Electrical can then use the values of those properties to display I/O assignment information in a schematic.

I/O Sets

Set of I/O signals created in RDE.

You can use it for plant item by drag and drop it from the RDE to EI.

You may also use it as part of typical item like typical control station or typical circuit.

Typical Circuit Common Properties [Feeder-1]
Circuit:
Feeder-1
Circuit type:
Feeder
Details of circuit internals
Component Type
Componer
Lookup Table
Order
Show in S
Ref Circuit Breaker
CB-1
1
True
Associated cables
Reference Cable
Specification
Cable Formation
Add...
Remove
Typical I/O set
Motor St/Sp/Rn IO
Find...
Clear
OK
Cancel
Apply
Help

Reference Control Station Common Properties [CS-1]
Item tag:*
CS-1
Associated cables
Reference Cable
Cable Specification
Cable Formation
Add...
Remove
Typical I/O set
Motor St/Sp/Rn IO
Find...
Clear
OK
Cancel
Help

Lab 4

4.1 - 4.14 - Create typical wiring items in Reference Data Explorer window

Reference Cables

Reference Power Cable

4.1. **Create reference power cable '6/10 kV - 3+1/C - 750 kcmil'**

4.2. **Create reference power cable '0.6 kV - 3+1/C - 350 kcmil'**

4.3. **Create reference power cable '0.6 kV - 3+1/C - 14 Awg'**

4.4. **Create reference power cable '0.6 kV - 3+1/C - 12 Awg'**

4.5. **Create reference power cable '0.6 kV - 3+1/C – 1/0 Awg'**

4.6. **Create reference power cable '0.6 kV - 3+1/C - 2/0 Awg'**

Reference Control Cable

4.7. **Create reference control cable '0.6 kV - 5/C - 14 Awg'**

Reference Grounding cable

4.8. **Create reference grounding cable '0.6 kV - 1/C - 14 Awg'**

Reference Instrumentation Cable

4.9. **Create reference instrumentation cable '0.6 kV - 3/Pair - 14 Awg'**

Typical I/O Set

4.10. a. Create typical I/O set and name it '**Motor St Sp I/O**'

b. Add 2 signals to the typical I/O set and name them, '**St**' and '**Sp**' (system i/o type = DI).

Reference Control Station

4.11. a. Create typical control station, and name it **'Motor Control Station St/Sp'**

b. Associate to the typical control station the reference control cable, '**0.6 kV - 5/C - 14 Awg**', and the reference grounding cable, '**0.6 kV - 1/C - 14 Awg**'.

c. Associate to the typical control station, the typical I/O set, '**Motor St Sp I/O**'

Reference Local Panel

4.12. a. Create typical local panel, and name it, '**Local Panel LP**'

b. Create in the typical local panel, a circuit, and name it, '**LP CKT'**

c. Create in the circuit, disconnect switch, and name it, '**DS'**

Reference Junction Box

4.13. a. Create typical junction box, and name it, '**Junction Box JB**'
b. Create in the typical junction box, a circuit, and name it, '**JB CKT'**
c. Create in the circuit, disconnect switch, and name it, '**DS'**

Reference Instrument

4.14. a. Create typical instrument, and name it, '**RTD Surface Element**'
b. Associate to the instrument, the reference instrumentation cable '**0.6 kV - 3/Pair - 14 Awg**' , and the reference grounding cable, '**0.6 kV - 1/C - 14 Awg**'.

4.15 – 4.30 - Create plant wiring items in Electrical Index window

Cables

Power Cables

4.15. Create power cable and name it, '**PC-TS-001-1**', by copy the reference cable, '**6/10 kV - 3+1/C - 750 kcmil**'
4.16. Create power cable name it, '**PC-TS-001-2**', by copy the reference cable, '**6/10 kV - 3+1/C - 750 kcmil**'.
4.17. Create power cable name it, '**PC-SW-300-1**', by copy the reference cable, '**6/10 kV - 3+1/C - 750 kcmil**'.
4.18. Create power cable name it, '**PC-T-001-1**', by copy the reference cable, '**6/10 kV - 3+1/C - 750 kcmil**'.
4.19. Create power cable name it, '**PC-MCC-201-1**', by copy the reference cable, '**0.6 kV - 3+1/C - 350 kcmil**'.
4.20. Create power cable name it, '**PC-MCC-202-1**', by copy the reference cable, '**0.6 kV - 3+1/C - 350 kcmil**'.
4.21. Create power cable name it, '**PC-SH-100-1**', by copy the reference cable, '**0.6 kV - 3+1/C - 14 Awg**'.
4.22. Create power cable name it, '**PC-M-100-1**', by copy the reference cable, '**0.6 kV - 3+1/C - 12 Awg**'.
4.23. Create power cable name it, '**PC-M-101-1**', by copy the reference cable, '**0.6 kV - 3+1/C - 12 Awg**'.
4.24. Create power cable name it, '**PC-M-102-1**', by copy the reference cable, '**0.6 kV - 3+1/C – 1/0 Awg**'.
4.25. Create power cable name it, '**PC-M-103-1**', by copy the reference cable, '**0.6 kV - 3+1/C – 12 Awg**'.
4.26. Create power cable name it, '**PC-H-104-1**', by copy the reference cable, '**0.6 kV - 3+1/C – 2/0 Awg**'.

Control Station

4.27. a. Create control station name it '**CS-M-100-1**', by copy the reference control station,' Motor Control Station

St/Sp'.

b. Find the new control cable associated with the control station, and rename it to, '**CC-M-100-1**'.

c. Find the new grounding cable associated with the control station, and rename it to, '**GC-M-100-1**'.

d. Rename the I/O signal associated with the control station, and name them: '**CS-M-100-1_St**' and '**CS-M-100-1_Sp**'.

Local Panel

4.28. a. Create local panel name it '**LP-100**', by copy the reference local panel, '**Local Panel LP**'.

b. Rename the local panel circuit to '**CKT-100**'.

Junction Box

4.29. a. Create junction box names it '**JB-100**', by copy the reference junction box, '**Junction Box JB**'.

b. Rename the junction box circuit to '**CKT-100**'.

Instrument

4.30. **a.** Create instrument name it, '**INST-100-1**', by copy the reference instrument, '**RTD Surface Instrument**'.

b. Find the new instrumentation cable associated with the instrument, and rename it to, '**IC-INST-100-1**'.

c. Find the new grounding cable associated with the instrument, and name it, '**GC-INST-100-1**'.

Chapter 5

Propagating Default Data and Associations

This part deals with advanced procedures and operations that will save you time, enable the reuse of default engineering data and minimize the errors due to manual data entry.

Apply Options

The **Apply Options** allows creating and populating project items in Electrical Index with massive default equipment in batch operations.

The following apply options are available:

Equipment Profile

Lookup Tables
Typical Circuit
Control Station
Typical Schematic
Typical I/O Set

When applying any of these options, you need to select the enable check box found in the Apply option windows. Only one is allowed at a time (checking the flag on one tab resets any previously checked flag).You can apply set of items, by selecting set of items from **Electrical Index,** lower pane window and making multiple selections, or in the Tabular Editor by highlighting a subset of items from the table.

Apply Lookup Tables

Lookup Table (LUT) – Reference table you create in RDE, containing structure of
Key properties, in. And none key properties, out (result).

And **data,** values for the key and none key properties.

Function LUT on project item in Electrical Index, by using the apply LUT, used to search
For exact match between all key properties value, in LUT, and in project items. And according to the Search result, to update the none key properties value of the project item with the LUT
None key properties value.

Create the Lookup Table

From the Reference Data Explorer select Lookup Tables hierarchy folder, motors folder (or other Type).
Right-click to create new lookup table, name it '**3 Phase Motor LUT**'.
Select the '3 Phase Motor LUT', right-click and select common properties.

Note: You can have more than one Lookup Table for each equipment item type. The default look up table check Box is set to the default Lookup Table for that equipment item type.

Select the Structure tab.
In the edit section you select the properties that you would like to include in your '3 Phase Motor LUT'.
From the Property list, find the property that contains the info you need.
In caption, enter the name of the heading you would like to see.
From Input / Output, select Input to specify a key property, or select Output to specify none key property.

Note: It is very important that you pay particular attention to the Input / Output option.
When this look-up table is applied to an item, the program looks for an exact match of all the properties that are specified As key fields.

Set True value in Overwrite option to overwrite whatever value is already in the property.
Setting False will only write to empty properties.
Set properties and click the Add button. The definition window reflects the properties you have selected.
When you have selected several properties, you can arrange the Electrical Index order by using the Up and Down buttons. The Remove button removes the highlighted property.
Select the Data tab.
Select the arrow to the right of the property and select the appropriate values.
When you finish Click OK.

Apply the Lookup Tables

Applying look up tables may result in overwriting project data. One should be aware of this. The right timing on whether and when to commit this operation is an engineering decision and would be based on your project state and your workflow.
You should make sure that the item that have been selected for this operation have the key fields populated with data that will be recognized by your lookup table, otherwise, data will not be populated.

1. In the Electrical Index, expand the folder hierarchy by clicking the + icons or by double-clicking the Folders.
2. Navigate to the folder for the desired equipment type and do one of the following:
    - Expand the folder and select an item from the list.
    - Click the folder, and in the list view pane, hold Ctrl while you select more than one item.
3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the lookup table tab.
5. Select Enable lookup table.

6. Beside the lookup table box, click Find.
7. On the Find dialog box, click Find Now to display the available lookup tables.
8. From the list of lookup tables, highlight the lookup table that you want to apply.
9. Click OK.

Apply Typical Circuit

The purpose of this feature is to have a powerful way to create new circuits and internals or to replace existing circuits or internals.

Apply a Typical Circuit to an Item

1. In the Electrical Index, expand the folder hierarchy by clicking the + icons or by double-clicking the Folders.
2. Navigate to the folder for the equipment type that you require and do one of the following:
    - Expand the folder and select an item from the list.

- Click the folder, and in the list view pane, hold Ctrl while you select more than one item.

Tips

You can apply a typical circuit to all loads, all converting equipment items, and circuits.

You can also select more than one item by selecting a subset of item tags in the Tabular Editor.

3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the Typical Circuit tab.
5. Select Enable typical circuit.
6. Beside the Typical circuit box, click Find.
7. On the Find dialog box, click Find Now to display the available typical circuits.
8. From the list of typical circuits, highlight the typical circuit that you want to assign to the equipment.
9. Click OK.
10. Under Apply to, select one of the following options according to the rule the software uses to apply the typical circuit:

- **All items** – Applies the typical circuit to all the selected items.
- **Items with no typical circuit** - Applies the typical circuit only to items without an existing typical circuit. Use this option to add a typical circuit only to new items among the items that you selected.
- **Items with a different typical circuit from the selection** - Changes the typical circuit of the selected items to the current typical circuit. Use this option to add a typical circuit to items with a modified typical circuit definition.
- **Items with the same typical circuit as the selection** - Updates an existing typical circuit for the selected items.

11. Click Apply.

Notes:

- Applying typical circuit on item will not create the internal components if the item is not yet Associated with a circuit. In this case, only a reference to the typical circuit is maintained. You can verify which typical circuit is assigned to an item by opening the "Feeder Data" tab of The item.
- Circuit internals (also, typical circuit internals) must have a unique sequence (order) property, which determine the electrical index power path in the Electrical Index. Applying a typical circuit on an item must preserve the electrical relations (if existed before) Between the last internal component in the circuit and any other "external" object that was

Associated before (usually this would be a cable).

- Applying typical circuits is available upon selecting single or multiple items.
- Clear last applied typical circuit make it possible to clear pre associated typical circuit.
- The actual project items are created as per the typical circuit (you need to associate the load with a PDB – Bus and Cell in order to create them)

Guidelines and rules:

1. When assigning typical circuits, the system checks and prompts in case of discrepancy between the reference typical of the load and the circuit we are trying to associate it to. In case of a batch, the user is the decision-maker and he has the option to choose the scenario. No prompt will be issued in the batch apply. The "Apply" will govern and not the circuit.(still, the rules will govern- in case there are some motors that were not applied a "non all items has been successfully committed" message will be issued)
2. Associating a motor to a circuit that has no internals will result in creating the actual internals if there is a reference in the motor. If not, it will not generate anything. Internals will be created once the profile is applied on the load. The form of the load/motor will be updated to show this typical circuit.
3. Trying to associate a motor with a typical circuit on a circuit (by the drag and drop or applying a profile) that has different type of typical defined within it, will be preceded with a message: "Load and circuit internals are different- do you wish to override circuit internals? "Yes" or "Cancel" will tell the system how to proceed. If yes, the system will replace, as in the apply profile the internals of that circuit.

Reapplying a Typical Circuit

Typical circuits will replace the existing internal circuits and the Electrical Index components with the Reference Data Explorer components that constitute the typical circuit. Any existing electrical relations and association will be kept and preserved (so the Electrical Engineer will not be affected).
It will be up to the designer to make sure that what he is doing is right.

Associating and Applying Lookup tables to circuit internals

You can associate lookup tables with circuit internals, both at the RDE and in the EI.
This option gives you a great advantage in populating reference data to project protection and disconnect equipment.
The system allows you to associate LUT with reference circuit internal via the typical circuits as follows:
1. Create circuit breaker lookup table.

2. Associate the lookup table to typical circuit that has internal circuit breaker.

3. Create 2 feeder circuits in EI, using the typical circuit Feeder-1.
   Set data in the property grid for the circuit breaker to match the key filed of the lookup table (1 kW, 2 kW).

Note: You can also select more than one item by selecting a subset of item tags in the Tabular Editor.

4. Propagate the lookup table data by select the circuits and select Apply.

Note: To select both circuits, Feeder-1 and Feeder-2, you may use tabular editor (circuit item type).

Apply Control Station

Applying typical control station on loads will add control station, cables (instrumentation, control and grounding), and associate the cables and the load to the control station. Or replace existing control station, And cables, including their associations.

Apply a Typical Control Station on Item

1. In the Electrical Index, expand the folder hierarchy by clicking the + icons or by double-clicking the Folders.
2. Navigate to the folder for the desired equipment type and do one of the following:
   - Expand the folder and select an item from the list.
   - Click the folder, and in the list view pane, hold Ctrl while you select more than one item.

   Note: You can also select more than one item by selecting a subset of item tags in the Tabular Editor.

3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the Control Station tab.
5. Select Enable control station.
6. Click Add.
7. On the Find dialog box, click Find Now to display the available control station.
8. From the list of control stations, while holding Ctrl, highlight each control station that you want to Associate with the item.
9. Click OK.
10. Under Apply to, click all items.

    Tip

    If required, you can click Items with no control station to add control stations only to items that do Not have any existing control stations.

11. Under Action, click Add or Replace to determine how the software deals with control stations that Have the same name as existing control stations. This option applies only if you click all items.
12. Click Apply.

Notes:

- You can identify to which load the control station belongs to and what are the cables that are associated to it by opening the control station property dialog.

- You can view the control station associated with an item of electrical equipment by selecting Common Properties on the shortcut menu for the item, and on the dialog box that opens, selecting the Control & Signals tab.

- Reapplying control station, add control station, or replace existing control stations according to the selection of the 'Replace control stations' check box.
  Checking the replace control stations check box, deletes the existing control stations and associated Cables, and replaces them with new control station and associated cables.
  Any associations and relations of these items will remain as before, the To and From relations of The cables will be transferred to the new control stations and the cables. Any additional control Station cable will have its To side associated to the control station and its From side will not be Assigned.

- You can apply a typical control station to a load, converting equipment item, disconnect electrical equipment item, a generator, and a battery bank.

- If you select a reference control station that has one or more associated control/instrumentation/grounding cables, the software creates these cables in the control station that you add to the project item.
- If you apply control station to one or more items that are connected to circuits, the software associates the control station cables (only instrumentation and control) with the circuits automatically when you select the appropriate Options Manager setting. If you do not use the setting, you need to make the association manually.
- If you modify the components of a reference control station that already has a reference from an item, the software does not update the change in the reference until you next apply a profile to the item.

Apply Typical Schematic

You use apply typical schematic when you need to specify a typical schematic or to modify the associated typical schematics of a group of items. You can associate typical schematics to the following items:

Loads, converting equipment, circuits, disconnect electrical equipment, generators, battery banks and buses.

Apply a Typical Schematic to an Item

1. In the Electrical Index, expand the folder hierarchy Electrical Equipment > Loads by clicking the + Icons or by double-clicking the folders.
2. Select the Motors, Static Electrical Equipment, or Other Electrical Equipment folder and do one of The following:
   - Expand the folder and select an item from the list.
   - Click the folder, and in the list view pane, hold Ctrl while you select more than one item.
3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the Typical Schematic tab.
5. Select Enable typical schematic.
6. Beside the Typical schematic box, click Find.
7. On the Find dialog box, click Find Now to display the available typical schematics.
8. From the list of typical schematics, highlight the typical schematic that you want to assign to the item.
9. Click OK.
10. Under Apply to, select one of the following options according to the rule the software uses to Apply the typical schematic:

    All items
    Applies the typical schematic to all the selected items.

    Items with no typical schematic
    Applies the typical schematic only to items without an existing typical schematic.
    Use this option to add a typical schematic only to new items among the items that you selected.

    Items with a different typical schematic from the selection
    Changes the typical schematic of the selected items to the current typical circuit.
    Use this option to add a typical schematic to items with a modified typical schematic definition. 11. Click Apply.

Apply Typical I/O Set

You apply typical I/O set on item to create in a batch operation set of signals.
You can apply the I/O set on the following items:
Loads, Generators, Battery Banks, Converting Equipment, Circuit, Disconnect Electrical Equipment

Apply a Set of Signals to an Item

1. In the Electrical Index, expand the folder hierarchy by clicking the + icons or by double-clicking the Folders.
2. Navigate to the folder for the desired equipment type and do one of the following:
   - Expand the folder and select an item from the list.
   - Click the folder, and in the list view pane, hold Ctrl while you select more than one item.

   Tip
   You can also select more than one item by selecting a subset of item tags in the Tabular Editor.
3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the Typical I/O Sets tab.
5. Select Enable typical I/O sets.
6. Beside the Typical I/O sets box, click Find.
7. On the Find dialog box, click Find Now to display the available set of signals.
8. From the list of signal sets, highlight the set of signals that you want to assign to the item.
9. Click OK.
10. Under Apply to, select one of the following options according to the rule the software uses to apply The set of signals:

    All items
    Applies the set of signals to all the selected items.

    Items with no typical I/O sets
    Applies the set of signals only to items without an existing set of signals.
    Use this option to add a set of signals only to new items among the items that you selected.

    Items with a different typical I/O set from the selection
    Changes the set of signals of the selected items to the current set of signals.
    Use this option to add a set of signals to items with a modified typical I/O set definition.
11. Click Apply.

    Notes:
    - If you modify the components of a set of signals that already has a reference from an item, the software does not update the change in the reference until you next apply a set of signals or a profile to the item.
    - You can assign a new set of signals or change an assigned set of signals for an item at any time.

Apply Profile

The Apply profile maps the reference profile item properties, to the project item and creates additional items, as specified in the Profile.
If we use motor item type, then for a new motor, it will create new items, and when reapplying a profile on an existing motor, the operation will result in replacing the previously applied and or associated items with the items specified in the new applied profile.
The right timing on whether and when to commit this operation is an engineering decision and would be based on your project state and your workflow.

Apply a Profile to an Item

1. In the **Electrical Index**, expand the folder hierarchy by clicking the + icons or by double-clicking the folders.
2. Navigate to the folder for the desired equipment type and do one of the following:
   - Expand the folder and select an item from the list.
   - Click the folder, and in the list view pane, hold **Ctrl** while you select more than one item.

   Tip

   You can also select more than one item by selecting a subset of item tags in the Tabular Editor.
3. Click Tools > Apply Options.
4. On the Apply Options dialog box, click the Equipment Profile tab.
5. Select Enable equipment profile.

   Tip

   The default profile appears in the Create item based on profile box. You can select a different profile by Performing the following steps.
6. Beside Create item based on profile, click Find.
7. On the Find dialog box, click Find Now to display the available profiles.
8. From the list of profile, highlight the profile that you want to apply.
9. Click OK.
10. Under Apply to, select one of the following options according to the rule the software uses to Apply the profile:

    All items

    Applies the profile to all the selected items.

    Items with no profile

    Applies the profile only to items without an existing profile.
    Use this option to add a profile only to new items among the items that you selected.

    Items with a different profile from the selection

    Changes the profile of the selected items to the current profile.
    Use this option to add a profile to items with a modified profile definition.

    Items with the same profile as the selection

    Updates an existing profile for the selected items.

11. Select the **Populate empty item properties** check box to overwrite null data values for target item properties with values that exist in the profile.
Clear the check box to leave the properties empty. (In all cases, the software does not overwrite existing values.)
12. Click Apply.

Notes:

- Applying a profile is a useful way of creating new items and populating large amounts of data in your project. When you apply the profile, the software automatically applies any definitions for typical circuits, control stations, typical I/O sets, and lookup tables that you define on the other tabs of the apply **Options** dialog box.
- After you apply a profile for which the software creates new items and relations successfully, the operation may still partially fail, for example if certain values of updated data conflict with a rule. In such cases, the software displays an error message and records the problem in the log file.
- When you apply a profile, the software replaces all formerly associated items with the items specified in the current profile including any values that you have modified. The software assigns new item tags according to the naming convention.

- If you apply a profile that contains a reference item to one or more project items, the software populates the properties of those project items with values copied from the reference item.
- If you modify the components of a typical circuit that already has a reference from an item, the software does not update the change in the reference until you next apply a typical circuit or a profile to the item.
- When an item has associated cables, and you connect the item to a circuit by applying a profile with a typical circuit, if there is more than one cable, the software associates the free ends of all the cables to the circuit.
- If you apply a profile for a reference motor with a heater to a project motor without a heater, the software adds a heater to the project motor.
- If you apply a profile for a transformer, the software applies the profile only if the reference and project transformers have the same number of windings and where the Number of Secondary property for the project transformer has a value of 1 or 2. If no value appears for this property, you must type one manually in accordance with the number of secondary windings in the transformer.
- If the item that you are applying a profile to is connected to a feeder circuit, the system replaces the circuit so that it matches the applied typical circuit as specified in the profile.
- If the item is connected to feeder equipment other than a circuit (such as a variable frequency drive, a transformer, or a battery bank), the software does not apply the profile.
- When you apply a profile to an item, the software can overwrite existing data. Since this process is not reversible, you should proceed with great care.

Assigning Loads to PDB

All electrical consumers and distribution equipment (PDB's) need power source. The power source must match the requirements of the supplied equipment, in voltage levels, current consumption and by providing suitable protection and control circuits.

- A load can be assigned and connected to one circuit only.
- A circuit may feed one or more loads or pieces of equipments.
- You can assign the load to a feeder circuit from more than one place:
  1. From the load common properties window.
  2. By drag & drop the load from Electrical Index to Electrical Engineer.
  3. By drag & drop the load within the Engineer.
  4. Using the Batch Load Association.

1. From the load common properties window

You can assign the load to PDB and Bus from the load common properties, Feeder Data tab.
There are three possibilities to assign the load from the load common properties:

- Pre-assign a load to a PDB and its bus without creating and connecting the load to a feeder circuit.

- Assign the load to an existing spare or other feeder circuit by selecting the circuit from the Appropriate list on the load common properties windows.

Note: Once you associate the load with a circuit, the feeder data becomes read-only. Further changes are possible only through the **Electrical Engineer**.

- Create a new feeder circuit on the fly by selecting the **Create circuit** check box, (you can also Select the **Create cell** check box if required.).
  This option automatically creates a new feeder circuit under the bus, populates the Circuit with the components specified in **Last applied typical circuit**, and connects the load to that Circuit. (If a load has an associated set of items such as a cable, a junction box, and so forth, the Uppermost associated item is connected to the circuit in the Electrical Engineer.)
  Clicking **Apply** or **OK** commits the operation. Clicking **Cancel** reverts to the previous setting.

2. By drag & drop the load from Electrical Index to Electrical Engineer

You can drag & drop the load, from electrical index windows, to a bus or a circuit in Electrical engineer windows.

3.By drag & drop the load within the Engineer

You can select load in electrical engineer windows, and drag & drop to another bus or circuit within electrical engineer windows.

4.Using the batch load association

Batch Load Association

It is common practice to associate loads with a PDB not one by one, but rather using a batch operation based on some common properties. For example, all the motors of Area 1 should be fed by MCC-100, bus A. The user needs a way of assigning loads by selecting a set of loads and associating all the tags to the same PDB and bus by means of a single command. Since this operation provides the total installed load values, it gives the user an ability to perform some iteration on the assignments without actually assigning the loads to final circuits. As with the forms, the user can perform a pre-assignment first by selecting a PDB and bus only, thereby adding the loads but not creating circuits. Alternatively, the user can create circuits on the fly automatically by selecting the **Create circuits** /

Create cell check boxes. To select a set of loads you select a set of tags (for example by using the Tabular Editor to select set of tags), and then click **Add Selected Loads**. The calculated values shown are the total calculated electrical quantities of all the assigned loads.

Load Balancing - can be done by using the move to cache functionality.
One of the biggest challenges in electrical design is to perform load balancing. This is an operation that is done at the early stages of the project, moving loads from one bus to another, watching the total bus load, until buses are evenly loaded.
SmartPlant Electrical supports this operation in the Batch load association form.
It is assumed that this operation is done in early stages of the project at which no feeder cables have been yet created between the loads and the feeder circuits and profiles have not yet been applied and populated and created massive data sets.
Suppose we want to move M3 from PDB-1, Bus-1 to Bus-2
In the batch load association, we select the load, M-3 and select the **Move to Cache** button, which will move the load to **Cached Loads** tab.

The load will appear in the **Cached Loads** tab

We will click on the Apply button to save the operation.
Select the PDB and bus where we want to move the load, select the load, and hit the 'Assign to Bus' button.

Select Yes to move the circuit.

Note: Select Yes, move the load with the upstream connected items (cell, feeder circuit, cable, etc.).

Lab 5

Look up table

5.1. **Create motor lookup table, name it '3 Phase Motor LUT Lab 5'**

Apply the look up table '3 Phase Motor LUT Lab 5' on motors M-100, M-101, M-102, and M-103

5.2. Associate motor M-100 with control station CS-M-100-1.
Note: The association is done from the control station common properties.

5.3. Associate motor M-100 with instrument INST-100-1.
Note: The association is done from the instrument common properties.

Chapter 6

Cable Sizing

Sizing power cable

Cables can be sized as stand-alone cables (not associated to loads or other objects). In this case, the user needs to provide sufficient electrical characteristics in order to perform the sizing calculation.
The same applies if the cable(s) are associated to loads.
It is important to understand that the cable sizing procedure is iterative. There are several procedures involved, but not always all these procedures are executed.

Notice about the following 2 parameters in the option manager in regard to cable sizing:

Maximum number of parallel cables — determines the maximum number of parallel cables that the software allows when performing sizing. If parallel cables are required for cable sizing and the calculated number of parallel cables exceeds the maximum, the software displays an appropriate message, and the sizing does not continue.

Minimum cross-section of parallel cables — determines the minimum conductor cross-section of parallel cables, with appropriate units that the software looks for when performing sizing. If parallel cables are required for cable sizing, the software performs the search for appropriate cables among reference cables with a cross-section of at least the value specified, even if cables of smaller cross-section also meet the requirement.

Let's set the values for those 2 parameters as appears in the following screen.

Option	Setting
Maximum number of parallel cables	6
Minimum cross-section of parallel cables	14 AWG
Naming method for parallel cable suffix	A, B, C ...
Parallel cable suffix input mask	00
Parallel cable separator	\
Allow the routing of parallel cables via different routes.	No
Apply temperature derating factor to cable sizing	No
Duplication of PDB internals	Keep source names
SAP interface	Disable
Archive documents	Disable
Consistency rules	Enable
Consistency rules for batch operations	Cancel current operation
Display NULL when macros retrieve no data	No
External analyzing software	ETAP
Project name in external analyzing software	
Include enhanced reports in schematics	No
Default SmartPlant Instrumentation domain name	
Connect cables of control station or instrument to equipment circuit	No
Use audit trail	No
Allow full access to As-Built	Yes
When merging a document into As-Built, set preferences for revisions that have identical revision numbers in As-Built and project	Reject the document
Claim mode	Exclusive only
KKS mode	No
Cable fill validation to follow NEC method	No
Exclude characters from PDB row naming type	
Report items to publish to SmartPlant	Main items and all related items
PDB layout vertical displays	Row sequence and names
Show item tag names without spaces in RAD documents	No
Sorting method for assigning cable drums to cables	Descending

To start the process of size cable select the power cable PC-0001 and enter the following values:

Select the perform sizing button.

In this case, the calculation information section indicates the present cable size ok.
At this stage the sizing required flag is clear.

Recalculate voltage drop on the fly

The software recalculates the voltage drop on the fly as long as the sizing required flag is clear, and

The recommended cross section is not changed. Changing one of the sizing data values or one of the length value triggers recalculation.

For example change the FLA to 15 A and the Starting current to 70 A will change the calculated % voltage drop to 0.959 and 3.387

The cable is still ok and the sizing required flag is still clear.
But change the starting current to higher value of 105A causes the software calculate another recommended cross section, and in the calculation information area , a message appears to let the user he needs to perform sizing to fit the recommended cross section.

Select the perform sizing button suggest the larger cable of 12 AWG

Select apply sizing to accept the new cable size.

Let change the cable length to 30 m (from design data tab). The software recalculates the voltage drop. The values were still within the range therefore it gives the ok message.

The following procedures are done for motors or loads in general when sizing a cable.

Ampacity Sizing

In this procedure the software looks for a cable that satisfies the de-rated ampacity. If the software cannot find a cable that can be used, it will try to assign parallel cables (starting from a minimum cable size defined in the options manager and up to a maximum number of allowable cables, also set in the option manager). Once the software finds the cable that matches the required de-rated ampacity, it will proceed to the voltage drop running validation.

Derating factors

The basic ampacity of the cable applies to standard conditions that the manufacturer specifies. Under actual operating conditions, such as a higher environmental temperature, or a location where several cables are routed close to one another, the ampacity changes. The derating and utilization factors take into account the operating conditions of the cable.

The software let you enter 3 separate values for the de-rating factor:

- **Derating factor** – Value between 0 and 1 which the software uses to calculate the cable derated ampacity under actual operating conditions. The software multiplies the basic ampacity by the derating factor to obtain the derated ampacity. A value of less than 1 means that the derated ampacity is lower than the basic ampacity and this will result in a requirement for a larger size cable.

- **Utilization factor** – Value between 0 and 1 to represent an additional factor that derates the cable ampacity. If you do not need to use this property, set the value to 1. The software multiplies the basic ampacity by this factor to obtain the derated ampacity.

- **Ambient temp. factor** – Value between 0 and 1 to represent a temperature factor that affects the derated cable ampacity. Higher ambient temperatures, the cable will be able to carry less current than it is

specified in its basic ampacity. The temperature effect can be calculated or taken from tables (NEC tables give these figures).For the software to apply this factor to the calculation, in the Options Manager, you must first set the value of the 'Apply Temperature Correction Factor to Cable Sizing' property to Yes; setting the value of the property to No is the equivalent of using a value of 1 for the temperature factor.

The overall derating factor (df) the software is calculated is:
df= (Derating factor **x** Utilization factor **x** Ambient temp. factor)

Voltage Drop (VD) at Running (VDN)

In this validation, the software validates the cable voltage drop percentage during normal full load current running conditions satisfies the maximum allowable cable voltage drop that is set by the user.

Voltage Drop at Starting Conditions (VDS)

In this validation, the software validates the cable voltage drop percentage during start of the motor satisfies the maximum allowable cable starting voltage drop that is set by the user.

Important: For loads other than motor (static), only the first and second procedure is carried out. This means that the system does not require the following properties "Power factor at starting", "Starting Current" and "Voltage drop [%] Allowable at starting".
The sizing program will recommend the required cable size from the family of cables that you Specify under cable specification and with the value that you select under conductor arrangement.

Important: The Reference Data Explorer catalog cables will be the source for the sizing and cable selection. It is important to make sure your cable catalog is full of all the standard cable sizes and configurations. If a specific size and arrangement is missing from the catalog, the sizing may find a different cable, which has a higher cross section.

Note: If there isn't any cable found with the specified construction or electrically suitable, the software needs to notify this to the user. The message should say clearly that the sizing of this cable was not successful and a proper cable was not found to satisfy the requirements.
When the cable is associated to a load (the "To" side is associated with the load), the cable should inherit electrical properties from the load. The automatic data transfer is valid for loads only. For other cables association this information needs to be entered manually.

Calculating Maximum cable length

As part of the sizing procedure, the system calculates and shows the maximum permissible cable length For that particular cable type that meets the voltage drop specifications.

Viewing All Possible Combinations and Acceptable Cable Sizes in Sizing Procedure

The system provides the user a window to identify all the recommended/acceptable cables that may be used for a specific data set of electrical parameters. The user will be able to select any of the recommended or acceptable cable configurations of the Electrical Index the single or parallel cables. Click the browse button adjacent the recommended cross section gives the user the whole range of possibilities to select from, the Electrical Index a single cable or an assembly of parallel cables of different sizes. Selecting a cable from this list will replace the current cable with the selected one.

Comment	Conductor Size	Number of Cables	Reference Cable Item Tag	Description
Recommended	**12 AWG**	**1**	**3/C-12AWG -(Power / NEC)**	
Oversized	10 AWG	1	3/C-10AWG -(Power / NEC)	
Oversized	8 AWG	1	3/C-8AWG -(Power / NEC)	
Oversized	6 AWG	1	3/C-6AWG -(Power / NEC)	
Oversized	4 AWG	1	3/C-4AWG -(Power / NEC)	
Oversized	2 AWG	1	3/C-2AWG -(Power / NEC)	
Oversized	1/0 AWG	1	3/C-1/0AWG -(Power / NEC)	
Oversized	2/0 AWG	1	3/C-2/0AWG -(Power / NEC)	
Oversized	4/0 AWG	1	3/C-4/0AWG -(Power / NEC)	
Oversized	250 kcmils	1	3/C-250 kcmils -(Power / NEC)	
Oversized	350 kcmils	1	3/C-350 kcmils -(Power / NEC)	
Oversized	500 kcmils	1	3/C-500 kcmils -(Power / NEC)	
Oversized	750 kcmils	1	3/C-750 kcmils -(Power / NEC)	
Oversized	1000 kcmils	1	3/C-1000 kcmils -(Power / NEC)	
Oversized	**14 AWG**	**2**	**600 V 3/C - 14 AWG**	
Oversized	12 AWG	2	3/C-12AWG -(Power / NEC)	
Oversized	10 AWG	2	3/C-10AWG -(Power / NEC)	
Oversized	8 AWG	2	3/C-8AWG -(Power / NEC)	
Oversized	6 AWG	2	3/C-6AWG -(Power / NEC)	
Oversized	4 AWG	2	3/C-4AWG -(Power / NEC)	
Oversized	2 AWG	2	3/C-2AWG -(Power / NEC)	
Oversized	1/0 AWG	2	3/C-1/0AWG -(Power / NEC)	

Fault Short Circuit Cable Sizing

Check the 'Use short circuit cable sizing' flag, include an additional step in the sizing algorithm- to match the fault short circuit current values imposed by the network to the cable short circuit capabilities. The algorithm is based on the following formula:

$$\left(\frac{I}{A}\right)^2 t = K \times \log_{10} \frac{T_2 + \beta}{T_1 + \beta}$$

I = Short Circuit current [Amperes]. This is the maximum permissible (allowable) short circuit current that the conductor can withstand.
A = Conductor area [Circular-mils]. See appendix at the end of this document for additional information.
t = Time of short-circuit [Seconds]. This value is determined by the time it take the protective devices to disconnect the power. Some standards use fractions of the frequency. Sometimes, this time is assumed to be 5 or 10 seconds.

K coefficient = constant

Material	K
Copper	0.0297
Aluminum	0.0125

β coefficient = constant. Depends on the conductor material as follows:

Material	β
Copper	234.5
Aluminum	228

T_2 = Maximum allowable short-circuit temperature in Degrees Celsius. This property is the temperature at which the cable-insulation starts to damage. These temperatures have been established for various materials of insulation as follows:

Material	**Temperature T2** [°C]
PVC	150
XLPE	250
Silicon Rubber	350

T_1 = Maximum operating Temperature in Degrees Celsius. Values are given below:

Material	**Temperature T1** [°C]
PVC	75
XLPE	90
Silicon Rubber	90

The above listed tables are defined in the **Reference Data Explorer** under the Conductor look-up tables.
In the **Cable** form there is a 'Short circuit' section, related to this topic.
To use this option, user selects the use short circuit cable sizing check box and fills in values for duration And fault current.

Select the perform sizing to get the result.

The required minimum cross section area in cmils will be calculated. The software will recommend a cable with a cmils cross section equal or larger than this minimum calculated.
Project cables and conductors will be automatically updated with the short circuit data of the conductors look up tables. Creating project cables, by dragging from the Reference Data Explorer or in Index or through profiles will apply automatically conductor look up table data, if exists in the project conductors and populate the above mentioned properties with look up data
These properties are read/write enabled in Index, but user shall be instructed that the short circuit sizing procedure will use data from look up tables and will not look at the project conductor property value any time the system will perform the short sizing calculation, the look up table data and values will be used. Changes made in project cables conductor of the above properties data will NOT set the "sizing required
Flag." In case look up data is missing the system will issue a message upon trying to perform a short circuit sizing

Apply the result will set the new cable size.

Clear the short circuit check box, resize and apply the result will return to the previous size.

Sizing power cable connected to load

Let set for the motor M-1 the following values.

Connect cable PC-0001 from PDB-1, Bus-1, Feeder-1 to motor M-1.

Open the cable PC-0001 common properties, sizing tab.

Notice the values copied from the load M-1.
Perform and apply sizing.

Protection settings

Allows you to specify cable sizing based on the rated current for a protection device such as a fuse or circuit breaker, rather than using the load current.

Include protection device - Select to specify the rated current of the protection device for use in sizing calculations. Clear to use the load current value.

Properties Copied from Loads

The following properties that are copied from the load (static or motor) to the cable may affect the size of the cable:
Supply (AC/ DC)
Number of phases
Rated Voltage
Full Load Current
Starting Current (for motors only).
Use code factor (for motors only).
Power Factor at full load.
Power Factor at Starting (for motor only).
Auto Restart (flag)

Required Data for Sizing and Selection

For successful cable sizing, the following information is required:
Conductor Arrangement
Estimated Length and/or Design Length – the software needs at least one of them. If both are defined, the software will use the "Design Length" which is the most accurate length.
Supply (AC or DC)
Number of Phases (applies only if AC supply)
Rated Voltage
Use code factor/code factor (valid for motors only).
Power Factor at full load (0 < value < 1)
Power Factor at Starting (0 < value < 1), (only for motors= LRC Power Factor)
Routing (InAir or UnderGround)
Full Load Current
Starting Current (valid for motors only for voltage drop at starting validation)
Auto Restart flag (currently not in use by the algorithm)
Voltage drop [%] Allowable at Running
Voltage drop [%] Allowable at Starting (for motors only)
Derating factor (0< value < =1), default value = 1 (default can be changed in data dictionary)
Utilization factor (0< value < =1), default value = 1 (default can be changed in data dictionary)
Ambient temp factor (0<Value <=1) default value = 1 (default can be changed in data dictionary)
If not all the information that should apply is provided, the software should notify the user to fill in the missing information. For example, "Enter a value for 'Code factor." Message is displayed when this property is missing (need to verify all required properties).

Refresh Load - Changes in Electrical Data of Load

The refresh load allows updating any information derived from a load connected to the cable.
This button is available when the load data changes since the previous time of sizing of the cable or when you perform cable sizing for the first time.

You may also perform this operation in batch, for all the power cables that the Electrical Index loads have been updated by select all the cables (lower pane window) you would like to update, and from action menu select cables, and select the command 'Refresh Load Data for Power Cables'.

Power Systems

DC Systems

SP- Electrical cable sizing support DC power systems.
DC (Direct current) systems are not commonly used in power industry. These systems will be used in indoor machines usually. DC power requires special motors and usually used in machines where very high precision is required.

AC Systems

AC Single Phase Systems

This type of cable sizing is supported by SP-Electrical.

AC stands for Alternating Current. The cable sizing supports single phase and 3 phase systems.

AC Two Phase Systems
We do not support cable sizing of ac other than 1 or 3 phases.
Whenever the user attempts to size a cable that the number of phases is other than 1or 3 the system will issue a message (when trying to perform the sizing):
"Number of phases must be the Electrical Index the 1 or 3, please correct ".

AC Three Phase Systems
This type of cable sizing is supported by SP-Electrical.
Three-phase systems are the most commonly used power systems in the industry.

Batch Sizing of Cables

In order to perform batch sizing: Select multiple cables in the **Electrical Index** or tabular editor -> Actions -> Cables -> Batch size cables.

Let size in batch cables PC-0001 and PC-0002.
PC-0001 already connected to M-1. Let connect PC-0002 to M-2.

Open common properties screen for motor M-2 and enter the following data.

Open common properties screen for cable PC-0002

Select 'Refresh Data' to copy data from motor M-2.

Enter the rest of the required data.

From **Electrical Index** lower windows select both cables PC-0001 and PC-0002.
From Actions menu select -> Cables -> Batch size cables.

The dialog collects all the selected cables and performs the sizing. If everything goes OK and the sizing passes without any missing data, the recommended sizes are populated in the grid.

If there is missing data that prevents the system from sizing the cable(s), the "Comment" column states there is missing data. If data is missing, all that you need to do is right-click the cable record to open the Cable Common Properties form and add the missing data.
To apply sizing, check the select check box for each cable you need to perform the sizing, and hit Apply Sizing.
The batch sizing process is usually necessary upon a change in cable design parameters or change in loads, where sizing of individual cables would be time consuming.

Replacing Cables

Replacing project cables is possible in two ways: manual replacing cable and batch replace.
The rules that should apply are as follows:
When a cable is replaced by another catalog cable, it should get the cable characteristics of the newer catalog cable: voltage rating, temperature ratings, ampacity, reactance and resistance, formation, sizes, materials etc.
Replacing a project cable by another should retain project data of the original cable:
Name and service, Design data: Procurement, from/to, associations to objects, and sizing results.
Any other cable property defined by the project that does not pertain to the catalog cable construction or technical specification.

From **Electrical Index** lower windows select both cables PC-0001 and PC-0002.
From Actions menu select -> Cables -> Replace Cables

In case there are parallel cables, all these cables are replaced as per the selected cable
Construction (number of conductors, size, and formation) is adjusted according to the new selected cable.

If you replace cable that already sized. You will need to resize it.

Earth Loop Impedance Calculations in Cable Sizing

The Earth loop impedance is defined as the total resistance seen by the source of current when clearing a faulty current to the earth. The earth loop impedance is an important safety factor since it determines what will be the highest possible potential at the point of the fault to earth. IEC regulations restrict this voltage to be no higher than 50 volts, therefore, EPC are requested to calculate this value on a per cable basis and make sure that the protective device for the circuit, fuse or circuit breaker protection values and settings are such that nor time nor earth potential will exceed codes, and will be able to clear the faulty current in a predetermined time.
The calculation is done on a per cable basis and it includes both the cable armor earth impedance (in case the armor is the earthing path) and any external to the cable impedance that is present from the power source through the final load and back to earthing point.
The following illustration shows how a short circuit current flows through an earth fault:

Verify the typical power cable, '3/C-12AWG -(Power / NEC)' has values for the armor reactance, and armor resistively.

Replace the typical cable for power cable PC-0001 with the typical '3/C-12AWG -(Power / NEC)'.
Set the design length for power cable PC-0001, and for grounding cable GC-0001 to 80 m.
PC-0001 is connected from Feeder-1 to M-1. Do the same connection to GC-0001

Run sizing for PC-0001 and verify good result.

In order to calculate the earth loop impedance select the Earth Loop Impedance tab.
Check the earth loop impedance calculation is required. Select use cable armor. Enter value for the external loop impedance and select the calculate button. When done with the calculation select apply.

The calculation is based on the following formula:

Earth Loop Impedance when using armor as the earthing path

$$Z_s = Z_e + \{ L*sqrt(Ra**2+Xa**2) + L\sqrt{R^2+X^2} \}/(1000*N_c)$$

Earth Loop Impedance when using a separate grounding cable as the earthing path

$$Z_s = Z_e + (Lgnd*sqrt(Rgnd**2+Xgnd**2))/1000+(L*sqrt(R**2+X**2))/(1000*Nc)$$

Where:

- Z_s - Earth loop impedance in ohms
- Z_e - External impedance in ohms
- L - Length of cable in meters
- N_c - Number of parallel cables
- Ra - AC resistivity of armor in ohms per kilometer
- Xa - AC reactance of armor in ohms per kilometer
- R - AC Resistivity of power cable in ohms per kilometer
- X - AC Reactance of power cable in ohms per kilometer
- Lgnd - Length of grounding cable in meters
- Rgnd - AC resistivity of grounding cable in ohms per kilometer
- Xgnd - AC reactance of grounding cable in ohms per kilometer

The calculation is based on the earth path formed by the cable armor metal sheet, or, of a separate grounding cable associated to the “to” side of the load.

To calculate loop earth impedance when using **separate grounding cable.**
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Check the earth loop impedance calculation is required. Select use separate grounding cable. Enter value for the external loop impedance and select the calculate button. When done with the calculation select apply.

Glands

Reference cable glands created in the **Reference Data Explorer**

With the use of the following UI specify the major gland data:

While the General tab defines its certification and type basic properties, the Details Tab specifies the more detailed dimensions.While the inner and outer dimensions provide information on the size of cables that it can accommodate, the Armor clamp flag, when checked means that this gland is suitable for armored cable (has metal armor)

You may associate reference glands to reference cables in the **Reference Data Explorer** from the Connections tab:

This will allow creating the project cables already fit with some default glands.
Dragging a ref cable or performing apply option that involves cables will create project glands.
Project Cables can be associated with reference glands on a one to one basis and in batch.

Lab 6

6.1 Size the project power cable '**PC-M-100-1**'

6.1.1. Enter the following data.

6.1.2 Perform sizing. If the result recommend on change to different cable size, apply the change.

6.1.3. Verify the sizing required flag is clear.

6.1.4. Change the design length from 30 m to 50 m (from design data tab) and verify it recalculate the Voltage drop.

6.1.5. Verify the sizing required flag is clear.

Chapter 7

Reports

Reporting is the process of retrieving information from the database and displaying the information as formatted output. At any time during the design creation process, you can create a report. Each report consists of a Microsoft Excel workbook and a report definition, which describes the data to collect and how to organize the data in the workbook.
Each report you create is based on an item type. This item type serves as the starting point for collecting data for your report. Examples of item types include motors, cables, control stations, and buses. Several default report templates already exist; however, reports are fully customizable. You can create your own reports that contain the information you want to see in a format you choose.

Report Writer

The Smart Plant Electrical report writer lets you quickly and easily creates and modifies reports. The report writer runs with Microsoft Excel and therefore allows all formatting to be done with Excel formatting commands: for example, drawing lines, sorting column data, and inserting objects. When you edit the Smart Plant Electrical report, you use an add-on Smart Plant Reports toolbar to define and map properties in the database to a specific column in the Excel file. This toolbar also lets you filter the database information, sort the information, and format the column header information.
You open the report writer from the reports menu, which let you create new reports, modify existing reports, delete reports, and run the reports, plant report, or user-level reports (my report).
Plant reports are saved normally in a network directory (option manager specifies the network directory location)
My reports are saved normally locally on the user machine (\Profiles\<username>\My Reports).
The software stores the reports that you generate on your local computer in the windows directory under \Profiles\<username>\My Reports\Output.

Creating New Report Templates

To create a new report template, click Reports > New.

The Report dialog box lets you create a new report from by selecting the Blank value for the Source template. You can also select any existing report to use as a template or starting point for a new report of that item type. All reports stored for the project and the reports stored for the current user are displayed in this list.

You can define three report types for a new report: Fixed format, Tabular format, and Composite format.

Fixed format. For a report that is defined as fixed format, each item that you select for the report is printed on a separate sheet with no repetition of data. The fixed format type is similar to the instrumentation spec. sheet reports.

Tabular format. A tabular report prints all of the items selected on a single sheet. Most of the Smart Plant Electrical delivered reports is defined as tabular format.

Composite format. A composite report is a combination of fixed format and tabular format. The first sheet is fixed format and contains the data common to the items on the subsequent sheets. The subsequent sheets have the specific item data. For example, a pump vendor report would have the vendor's name and information on the first sheet, and the listing of the pumps from that vendor on the second sheet.

If you click Add to project reports, the report is stored in the project reports location defined in Options Manager. If you do not click this checkbox, the report is stored in the user report directory. By default, the user report directory is located in your user name profile directory.

Smart Plant Reports Toolbar

After you create or modify the report, Microsoft Excel is opened, and the Smart Plant Reports Custom Toolbars is displayed in the worksheet.

The toolbar lets you define attributes that are available to the report and define the sorting criteria for this data. The toolbar also lets you filter the data for a specific value or range of values. You define the report header information here as well as map the defined attributes to specific cells.

When you click Define on the toolbar, a dialog box is displayed, allowing you to create, edit, and remove items in the report tree view.
When you click Define on the Define Report Contents dialog box, a list of attributes is displayed for that report item. From this dialog box, click Sort to sort by one or by multiple attributes in ascending or descending order. The Filter tab allows discrimination on a certain value or values for the property.
Items and Properties that can be used in the Reports
Defining items and the properties that you wish to see in your report is procedure that
Requires knowledge in the data model of Smart Plant Electrical.
There can be reports that are very easy to retrieve the required data and there are such that are more complex. The available list of items and related properties available is based on the data model associations, and you may need to select a single item type or use a chain of item types- all depending on your needs.

Create a custom report that retrieves properties from motor item type

1) From Reports menu select New.
2) In the new report template types in the following values and click ok.

3) Select yes to edit the report now.

4) Select define in Smart Plant report tool bar (MS Excel -> Add-Ins -> Define).

5) Select the motor in the define report contents window and select define.

6) From the properties tab, select the properties, 'Item Tag', 'Motor Rated Power', and 'Rated Voltage'.

7) Select ok and return to define Report contents.

8) Select close and return to the excel.

9) In excel, create the headers for the 3 properties (cells A5, B5 and C5).

10) Below each cell (A6, B6 and C6) map the 3 properties, by select the appropriate cell, select

Map properties

and pick the property.

11) Save the excel report

and close.

Running custom Report

1) From Reports menu select New.

2) In the plant report list select My first Motors Report and select ok.

	A	B	C	D	E	F
1						
2						
3						
4						
5	Motor Tag	Rated Power	Rated Voltage			
6	M-100	1 hp	460 V			
7						
8	M-3	1 hp	460 V			
9						
10	M-102	100 hp	460 V			
11						
12	M-101	10 hp	460 V			
13						
14	M-5	2 hp	460 V			
15						
16	M-1	1 hp	460 V			
17						
18	M-2	1 hp	460 V			
19						
20	M-103	10 hp	460 V			
21						
22	M-6	2 hp	460 V			
23						
24	M-4	2 hp	460 V			
25						
26						
27						

Report Options

Options on the Smart Plant Reports toolbar define the report header and basic information in the body of the report. The Report Options dialog box applies only to tabular and composite reports because the fixed report prints each set of data on a different sheet.

Skip lines between rows defines the number of lines between each printed row of data. Rows in report header define the basic report information. Project name, unit name, date, report title, and company logos are examples of information that goes in a report header. This information is printed on each page of the report. Also, if any of the information mapped in the header changes, the software prints a new page with the header information. Because a page break occurs if the value for an attribute changes in the report header, the basic report information (attributes) should not be mapped in any rows in the report header. Otherwise, every time a value changes in the header, the information prints on a new page. In the example above, the mapping of attributes would begin in row 6 or after. You may cause the header to be displayed on each page by File-→Page setup and selected the Sheet tab to "row to repeat at top"

'Map Properties' sort order allows you to sort the properties in the report template. These properties are available when you click **Map Properties** on the report template toolbar.

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Editing Report Templates

To edit an existing report, click Reports > Edit. In the Edit Report Template dialog box, you can change the title and open the template in Excel for editing.

Deleting Reports

To delete existing reports, click Reports > Delete. Depending on how project permissions are set, you can delete a single report or multiple reports.

Running Reports

Reports >Plant report or My Report, and select the report you want to run.

Run Reports and Specify Items Through Tabular Editor

You can use the tabular editor to filter data when running the report.

Current selection - Produces a report containing the items currently selected in your current table. This option is not available if no table items are selected.

Entire table - Produces a report containing the contents of the Tabular Editor.
There is no need that the opened table will have properties matching the properties of the report. One property is enough.

Shipped Reports

Smart Plant Electrical provides you with more than 30 predefined reports (some of them more complex reports that might use embedded VB code to fetch and organize data) that user can customize or use as reference to create his own standard. The following list is a partial list out of the ones actually shipped:

I/O Signal List – with issue
Report that is intended for publishing signal data to Smart Plant Instrumentation. The report includes all I/O signals defined in the units of the current plant. This report provides the following information:

I/O signal tags
Description
I/O types
Host
Card
Channel
Address
CS tag
Reference instrument loop

I/O Signal and Equipment – with issue
Report that is intended for publishing signal and equipment data, or just equipment data to the integrated environment. The report includes all I/O signals and equipment defined in the units of the current plant. The report provides the following information:

I/O signal tags
Description
Equipment tags
Item type
I/O type
Host
Card
Channel
Address
CS tag
Reference instrument loop

Instrument and Cabinet Load List – with issue
Report that is intended for publishing instruments and cabinets that have been retrieved from Smart Plant Instrumentation as loads to the integrated environment. The report actually displays data for all electrical equipment types; however, when you use it for publishing data to the integrated environment, the software automatically selects data for instruments and cabinets only; you should not use a filter to do so. This report provides the following information:

Instrument / cabinet tags
Tag types
Description
Instrument rated power
Cabinet rated power

Electrical Load List
Report that you generate based on the load item type. The software retrieves the load tags with the relevant load tag data, such a rated power, brake power for motors, as well as values for efficiency, power factor, full load current, and so forth.

PDB Load Summary
Report that you generate based on a load item type. The purpose of this report is to provide a list of loads that are associated with power distribution boards, to sum the electrical kW, kVAR values of these loads and, based on the individual coincidence factors, calculate normal and peak consumptions that enable you to estimate the desired capacities that a particular PDB has to deliver.

PDB Load Summary – Consume Power Values
Report that displays consumed power values instead of rated power values. The rest of the report is identical to the PDB Load Summary report.

All Feeder Load Summary Report (Enhanced)
Summary of the loads that are connected to the buses of a power distribution board that you select in the **Electrical Index** or the **Electrical Engineer**. This report is based on either the consumed or rated power of the selected loads. The report provides a list of loads that are associated with power distribution boards, to sum the electrical kW, kVAR values of these loads, and based on the coincidence factors of the relevant buses or the individual loads; calculate normal and peak consumptions that enable you to estimate the desired capacities that a particular PDB has to deliver. The report sums the loads that are connected to the downstream buses. This ability to look for downstream loads that are fed from the selected bus is sometimes called "drill down" or "roll up".

Cable Take-Off
Report that provides a summary of all the existing project cable types, including the unsized cables.
The report specifics are as follows:

Provides technical details about the cable types.
Calculates the total estimated and design lengths of each cable type.
Calculates the lengths of single core conductor configuration cables based on the number of conductors
Of each cable.
Provides estimated cable lengths both in meters and feet.
Allows you to expand each cable type to view the individual cable tags.

Cable Schedule – with issue
Report that lists all the existing project cables for publishing to the integrated environment.
This report provides the following information:

Cable tag names
Cable types
Estimated and design cable lengths
Store part numbers
Cable origin and destination sides (the **To** and **From** cable sides).
The **To** and **From** information includes the tag of the electrical item that the cable is associated with.
If one of the cable sides is assigned to a PDB, the report displays the path of the circuit tag: PDB/ bus/(cell)/ circuit.

Cable Sizing Summary
Report that lists all the cable sizing input and output data for a specified power cable. You are required to create a filter for this report to display power cables only. This report is useful as a quick reference for your sizing considerations and criteria at any time during the life cycle of your project.
This report provides the following information:

Cable tag name.
Cable origin and destination sides (the **To** and **From** cable sides). The **To** and **From** information

Includes the tag of the electrical item that the cable is assigned to.
Input values such as load voltage, full load current, number of phases, and so forth.
Sizing results such as reference cable, conductor size, calculated voltage drop, and so forth.

Cable Wiring Schedule
Report that provides a list of selected cables and their conductors showing to which terminal strips and terminals the cables are connected. The report is based on the item type of the cables for which you want to generate a report.

Terminal Strip Schedule
Report that based on the terminal strip you select in the **Electrical Index**.

Terminal Strip Schedule-Panel
Report that based on the panel you select in the **Electrical Index**.

Drum Composition Report
Displays the cable assignments for each drum in your plant.

Segment Width Estimate
You can use the Segment Width Estimate report for calculating the tray widths and number of layers needed so that you can select appropriate reference cableway components.

Cableway Component Material Take off
Displays the quantity of items required for each type of reference cableway component when ordering items from the manufacturer.

Cableway Segment Schedule
Displays the list of cables in each cableway segment that makes up your cable routing.

Segment Fill Report
Displays the fill status and tray loading for each segment and indicates whether or not the segment is overfilled.

PDB Schedule
Report that you generate based on the circuit item type. The report specifics are as follows:

The report lists, for all the power distribution boards in the current plant, all the circuits, loads, circuit Internal components with the technical details of each circuit.
The report includes the associated schematic drawings.
The report uses a predefined filter to display the associated schematic drawings.

Power Distribution Panel Schedule
Report that is intended for single phase loads connected to distribution panels. The report specifics are as follows:

The report lists, for all the power distribution boards in the current plant, all the circuits, each with its Protection device type and current rating (the software supports a single protection device per circuit) And the loads associated with each circuit.
The report sorts the circuits by phase and then by circuit (all the circuits for phase 1, then phase 2, and Then phase 3).
The report calculates the following: Full load current for each phase, Total load current of the bus, Total kW per phase, Total kW per bus.
This report is not suitable for PDBs that include 3-phase loads.

Lab 7

Custom Report

7.1 Create custom plant report with the following parameters:

Source Template:	**Blank**
Report Name:	**Plant Power Cable Report**
Item type:	**Cable**
Report type**:**	**Tabular format**
Add to plant reports:	**[X]**
Report Options:	**Skip lines between rows 0** **Rows in report header 5** **'Map Properties' sort order = Ascending**
Attributes:	**Item Tag**, **Cable Category**, **Cable Specification**, **Cable Formation**, **Actual Length, Ref Equipment.Item Tag**
Filter:	**Power cables (Cable Category = Power)**

7.2. Save and close the report.
7.3. Run the report and check the result.
7.4. Close the report.
7.5 Run the report using the tabular editor and explore the 2 options you have when running report with tabular editor (current selection/entire selection)
7.6. Close the report.
7.7. Modify the report, and add sort on Item Tag (in ascending order). Save the change.
7.8. Run the report and check the result.

Chapter 8

Electrical Engineer

Electrical Engineer module manages the electrical associations among equipment in the plant. The Electrical Engineer, combined with the Electrical Index as a source, provides for:

- Navigation through the electrical network.
- Connection between the power distribution equipment of the network infrastructure.
- Modification of relations between the power equipment (electrical flow of energy).

The Electrical Engineer shows any electrical entity that has at least one electrical relation.
In the root of the tree view, the Electrical Engineer shows entities which have electrical children but not parents.

The Electrical Engineer allows you to generate and display single line diagrams (SLDs) that show the electrical network distribution powered from an item selected in the Electrical Engineer.

The software synchronizes any new electrical relationships that you create in the Electrical Engineer with the Electrical Index. When creating a new item in the Electrical Index, the software also adds this item in the Electrical Engineer if appropriate (some items do not appear the Electrical Engineer).

The Electrical Engineer displays electrical items based on their electrical relationship. Therefore, a power source, for example, is always on a higher hierarchical level than a load. The following rules define which electrical items appear in the Electrical Engineer:

- The Electrical Engineer displays all electrical items that have at least one electrical association.

- Certain items appear automatically in the Electrical Engineer after you create them in the Electrical Index. These items appear in the Electrical Engineer even if they do not have any electrical Association. These items are offsite power supplies, generators, buses, circuits, battery banks, battery Chargers, transformers, UPSs, and current limiting reactors.

- The Electrical Engineer automatically displays power cables that the software creates when you Create a load or when you activate the Apply Option command to automatically associate that load With a feeder.

- For a multiple cable assembly, you can hide or display the individual cables by right-clicking the icon, And on the shortcut menu, clicking Show Multiple Cables. The software indicates the display toggle State by a check mark.

- Items that have no hierarchical parents appear at the root of the Electrical Engineer provided that they Feed other items.

- You can display item tags of buses, bus risers, and incomers together with the item tags of the Associated power distribution boards if you set your general preferences accordingly.

- You can open more than one instance of the Electrical Engineer.

Electrical association between equipment in electrical engineer, can be done by
Drag and drop operations from electrical index items to electrical engineer, or drag and drop operations
In the electrical engineer, follow certain rules.

In addition to the above, the Electrical Engineer provides the following functionality from the right-Click menu:

- **Expand All Sub-Items**
- **Show Only**
- **Show in a new window**
- **Show related items in a new window**
- **Find Item in Electrical Index**
- **Find Other Parents Items**
- **Rename an Item**
- **Open Common Properties**
- **Dissociate an Item from its Feeding Item**
- **Select Alternative Power Source**
- **Add cable**
- **Apply Options**
- **New SLD**
- **Open SLD**
- **Find in SLD**
- **Insert Power Cable**

Reference Electrical Engineer

You use the Reference Electrical Engineer to copy existing partial or complete power network structures by dragging items from one or more specified plants to the Electrical Engineer in the current plant. While working in your project plant, Smart Plant Electrical allows you to connect to another plant and open the Electrical Engineer from which you can drag a power network structure to the Electrical Engineer in your project. This way, any external plant can serve as a reference for your project plant. Such an external plant can hold numerous assemblies in its Electrical Engineer, from which you can drag an assembly to your project Electrical Engineer. As you copy an assembly to your project Electrical Engineer, the software automatically copies to the Electrical Index all the electrical items contained in the assembly as well as the items directly associated with the items displayed in the Electrical Engineer (for

example, a control station). Furthermore, the software copies the reference power cables and typical schematics to the Reference Data Explorer.
The rules that determine where you can drag certain items in the target Electrical Engineer are similar to the drag-and-drop rules for items that you drag from the Electrical Index and within the Electrical Engineer.

Important: Before connecting to a reference plant and opening its Electrical Engineer, make sure that you have been granted full access rights to that plant.

Lab 8

In lab 8 we going to make the connection in electrical engineer of the electrical equipments and wiring equipments we created in the previous labs and complete the on line diagram, '**S-001 Demo SLD**'.

Note: S-001 Demo SLD diagram appears in appendix can help you while you doing the lab.

8.1. Connect cable, '**PC-TS-001-1'** to offsite power supply, '**S-001'**

8.2. Connect cable, '**PC-TS-001-2'** to generator, '**G-001'**

8.3. Connect transfer switch, circuit, '**TS-001 Incomer 1'** to cable, '**PC-TS-001-1'**

8.4. Connect transfer switch, circuit, '**TS-001 Incomer 2'** to cable, '**PC-TS-001-2'**

8.5. Connect current limiting reactor, '**CLR-001'** to transfer switch, circuit, '**TS-001 Feeder'**

8.6. Connect cable, '**PC-SW-300-1'** to current limiting reactor, '**CLR-001'**

8.7. Connect switchgear, 'SW-300', circuit, '**SW-300 Incomer'** to cable, '**PC-SW-300-1'**

8.8. Connect cable, '**PC-T-001-1'** to switchgear, 'SW-300', circuit, '**SW-300 Feeder'**

8.9. Connect transformer primary, '**T-001'** to cable, '**PC-T-001-1'**

8.10. Connect cable, '**PC-MCC-201-1'** to transformer 'T-001', secondary, '**S-001-480 V'**

8.11. Connect cable, '**PC-MCC-202-1'** to transformer 'T-001', secondary, '**S-002-480 V'**

8.12. Connect MCC, 'MCC-201', circuit, '**MCC-201 Incomer B'** to cable, '**PC-MCC-201-1'**

8.13. Connect MCC, 'MCC-202', circuit, '**MCC-202 Incomer B**' to cable, '**PC-MCC-202-1**'

8.14. Connect cable, '**PC-SH-100-1'** to MCC, 'MCC-201', Bus, '120 V Bus A', Circuit, '**SH-100 Feeder**'

8.15. Connect space heater, '**SH-100**' to cable, '**PC-SH-100-1**'

8.16. Connect cable, '**PC-M-100-1**' to MCC, 'MCC-201', Bus, '480 V Bus B', Circuit, '**M-100 Feeder**'

8.17. Connect motor, '**M-100**' to cable, '**PC-M-100-1**'

8.18. Connect cable, '**PC-M-101-1**' to MCC, 'MCC-201', Bus, '480 V Bus B', Circuit, '**M-101 Feeder**'

8.19. Connect motor, '**M-101**' to cable, '**PC-M-101-1**'

8.20. Connect MCC, 'MCC-201', Bus, '480 V Bus C', Circuit, '**MCC-201 Bus Riser**' to MCC, 'MCC-201', Bus, '480 V Bus B', Circuit, '**MCC-201 Coupler**'

8.21. Connect cable, '**PC-M-102-1**' to MCC, 'MCC-201', Bus, '480 V Bus C', Circuit, '**M-102 Feeder**'

8.22. Connect motor, '**M-102**' to cable, '**PC-M-102-1**'

8.23. Connect cable, '**PC-M-103-1**' to MCC, 'MCC-201', Bus, '480 V Bus C', Circuit, '**M-103 Feeder**'

8.24. Connect motor, '**M-103**' to cable, '**PC-M-103-1**'

8.25. Connect cable, '**PC-H-104-1** to MCC, 'MCC-201', Bus, '480 V Bus C', Circuit, '**H-104 Feeder**'

8.26. Connect heater, '**H-104**' to cable, '**PC-H-104-1**'.

8.27. Connect MCC, 'MCC-202', Bus, '480 V Bus C', Circuit, '**MCC-202 Bus Riser**' to MCC, 'MCC-202', Bus, '480 V Bus B', Circuit, '**MCC-202 Coupler**'

Chapter 9

Single Line Diagram

Smart Plant Electrical generates the following single line diagram types:

1. Single Line Diagram for a PDB (automatically type SLD)

2. Single Line Diagram from Electrical Engineer (automatically type SLD)

3. Single Line Diagram from Blank template (Manual type SLD)

Single Line Diagram for a PDB (automatically type SLD)

Document that includes a Power Distribution Board (PDB) general arrangement drawing and a PDB schedule. The software generates a single line diagram for a selected PDB that contains all the PDB's buses, circuits, circuit components, and their inter-connections (bus couplings).

To generate **Single Line Diagram for a PDB**, do the following steps:

1. From Electrical Index, select PDB, 'SW-300'.
2. Right click on 'SW-300' and select '**Generate SLD'.**
3. In the Single Line Diagram Options, type 'SW-300' for document number, and set your Preferences.
4. Select **Generate** button to start generate the SLD.

5. To close the document, select file -> close or, select the 'X', close active window.
   Closing the document save the SLD in the Electrical Index, Document, Single Line Diagrams Folder.

Single Line Diagram from Electrical Engineer (automatically type SLD)

Main or key single line diagram of the electrical network for a selected set of items created according to the generation options that you predefine.

To generate **Single Line Diagram from Electrical Engineer**, do the following steps:

1. From Electrical Engineer, select:
   MCC, 'MCC-201', Bus, '120 V Bus A', Circuit, '**MCC-201 Incomer A**' and
   MCC, 'MCC-201', Bus, '480 V Bus B', Circuit, '**MCC-201 Incomer B**'
   Note: Use the Ctrl key to select both items

2. Right click, and select, '**New SLD**'.
3. In the Single Line Diagram Options, type '**MCC-201 Incomers A/B**' for document number,

And set your preferences.

5. Select **Generate** button to start generate the SLD.

5. To close the document, select file -> close or, select the 'X', close active window. Closing the document save the SLD in the Electrical Index, Document, Single Line Diagrams Folder.

Single Line Diagram from Blank template (Manual type SLD)

This option allows you to generate a single line diagram using a blank template. First you drag and drop the items you want in your SLD onto the template, positioning them were you want them to be. Then, you set the generation options to define the electrical items that serve as the initial points or sources of your SLD, define the SLD page and display settings, as well as the definitions for the display of circuits and circuit components. After generating the SLD, you can save the SLD as an internal drawing in the system or as an external drawing using the **Save As** command. You can generate as many SLD for the same item as needed. If you want to regenerate an open SLD drawing using different generation options, with the SLD open, click **Tools > Drawing Options**.

Note: Items available to drag into the balk template include buses, offsite power supplies, generators, battery banks, converting equipment (not contained within PDBs), and standalone disconnect electrical equipment.

To create new manual SLD do the following steps:

1. In Electrical Index, document folder, select Single Line Diagram folder and create new Document, name it '**MCC-201 Manual'.**
   Right click on the new document to open it.

2. Drag to the new template the following items:

MCC-201 busses, '**120 V Bus A**', '**480 V Bus B**', '**480 V Bus C**'

And transformer, '**T-001**'

3. Select from Tools -> Drawing Options

4. Set the preferences you need in the Single Line Diagram Options window.

To start running the SLD select the generate button.

5. To close the document, select file -> close or, select the 'X', close active window.

Closing the document save the SLD.

Notes: (1) You may add or remove items from being shown in SLD.
(2) In automatically generated SLD, user can not drag and drop items.
(3) Compare option is possible only between the same types of SLD's.

SLD symbols management

When generating an SLD, the software searches for a symbol for each electrical item that is included in the SLD source. Smart Plant Electrical supplies you with a set of default symbols that you can use in your drawings, or you can create your own custom symbols in Catalog Manager. After creating your symbols and defining them in the Options Manager, the software then uses the SLD symbols according to the following rules:

1. Smart Plant Electrical checks whether the items included in the SLD source are associated with Symbol files. Wherever such an association exists, the software uses the associated symbol file To represent the electrical item in the single line diagram. You associate an item with a Symbol file using the associate custom Symbols command from the Actions menu for an item That you select in the Electrical Index.

2. If the item is not associated with a custom symbol, Smart Plant Electrical checks if there is any symbology defined and uses it.

3. If the item is not associated with custom symbol, and there is no symbology defined. Smart Plant Electrical uses a symbol with a name that matches the item type name of the electrical Item to be included in the single line diagram. This symbol resides in the folder defined in the Default SLD Symbol Path location in Options Manager.

Managing SLD

The software allows you perform various actions with an open single line diagram. Apart from regular actions in a drawing such as zooming, selecting, saving, and so forth.

Moving items

You can select an item and drag it to another place in the drawing.
Save the document after reposition an item retains the position of the item the next time you open the document if the preferences set to retrieve last saved position of electrical items.

Aligning Drawing objects

You can align two or more objects vertically or horizontally.

SmartPlant Electrical - PlantBasic / Area1 / Unit1 - [Document40 - MCC-201 Manual]
File Edit View Actions Tools SmartPlant Reports Window Help
Align
SmartPlant Electrical - PlantBasic / Area1 / Unit1 - [Document40 - MCC-201 Manual]
File Edit View Actions Tools SmartPlant Reports Window Help

Modifying item properties
When selecting an electrical item in SLD document, the item also selected in the property grid window, where you can modify the item properties.

Modifying symbol color, width, and pattern
You can change symbol color, width and pattern from option manager, define item type symbology.
Note: Advanced symbol customization, and creating new symbol done by catalog manager.

Annotations and Redlining
You can mark up single line diagram using text or symbols as annotations. The software saves annotations in the same layer as the graphical elements of the drawing.
You can add text, symbols, lines, curved lines, circles, rectangles, and watermarks as annotations.

Redlining appears in a separate drawing layer and you can hide and display redlining as you require. When opening single line diagram that contains redlining items, the software automatically displays the drawing in redlining mode. You can switch back to regular mode and modify the drawing as needed. The software saves the existing redlining items regardless of whether you open the drawing in redlining mode or not. You can add text, symbols, lines, curved lines, circles, rectangles, and watermarks as redlining.

Saving an SLD as an External File
You can save the SLD from the file menu as external file.

Printing an SLD

While the SLD document is open, you can print the document from the file menu.

Bus wrapping

When using single line diagram for PDB (available **only** in SLD for PDB in Electrical Index). You can force bus breaks (bus warping). To demonstrate it lets build new PDB and name it MCC-2 with one incomer circuit and 8 feeder circuit.

Generate SLD for MCC-2 from electrical index.

In the buses tab check the force bus breaks and set 4 in the maximum number of feeders per bus section to display. And generate the SLD

SLD on multiple sheets

When using single line diagram for PDB. You can create multiple sheets SLD. This option becomes available when you generate SLD for PDB and you select **Force bus breaks** to open addition option called 'Use multiple sheets' where you enter the maximum number of feeders to allow on each row of the drawing.

To demonstrate it lets use the same MCC-2. From electrical index select MCC-2 and generate SLD.

While the document is open, select tools and drawing option. Select buses tab, check the bus breaks, set 4 for maximum number of feeders per bus section to display, check the use multiple sheets and generate.

- When forcing bus breaks, all incomers for each bus are drawn on the first bus section only.
- Where two buses are connected by a coupler-riser, the software does not force a bus break across the connection. Instead, the software draws the first bus section and then counts from the riser on the second bus section before forcing the break.

Lab 9

9.1. Verify in file -> preferences -> SLD tab
That the option 'Retrieve last saved position of electrical items' is selected.

9.2. Generate automatic SLD type, from Electrical Engineer.
Start from the offsite power supply, '**S-001**', the generator, '**G-001**', the incomer circuit, '**MCC-201 Incomer A**', and the incomer circuit, '**MCC-202 Incomer A**' to get the 'S-001 Demo SLD'
Name the document, '**S-001 Demo SLD**' and save.
Close the document.

9.3. Open the document '**S-001 Demo SLD**', and add new revision P0.

9.4. Save the open SLD document using the option save as, and save it as external PDF file Format. Name the external pdf file, '**S-001 Demo SLD External.pdf**'

Chapter 10

Schematics

A schematic is a graphical representation of wiring and motor control systems. You create a schematic by assembling it from typical blocks.
A block is a graphical representation of an electrical item. Blocks are parts of a complete drawing. To create a block, start by creating an entire drawing in Catalog Manager or any CAD application such as Smart Sketch, AutoCAD, or Micro Station. Once the complete drawing is ready, you select a part of the drawing and turn it into a block.
You can generate schematics for the following item types:

- All loads
- All converting equipment.
- All disconnect equipment (except metering equipment).
- Circuits
- Buses
- Generators
- Battery banks

The software can generate a schematic by retrieving data for power related items from one block or several blocks. If your generated schematic drawings contain the same information (that is, the information repeats itself in identical sections of different schematic drawings), you should consider creating a schematic block for the repeated parts so that this single block can be used by several other schematic drawings. Note that you can create schematic drawings that include several sheets. Multi-sheet schematics are mostly used when you need to display complex electrical equipment for which a single sheet is not enough to show all the relevant wiring details of the equipment.
After creating a block, you define the macros for that block. A macro is the smart text that you attach to the block graphic. The software retrieves this smart text from the database and attaches it to the block, thus making it part of the block file. You can create your macros in Catalog Manager, Smart Sketch, AutoCAD, or Micro Station.
Also, you must attach your blocks to templates. A template contains the definition for the desired title block, border, and page size. You attach your blocks to templates in Catalog Manager, Smart Sketch, or any other CAD application.
Before generating a schematic drawing, you create a typical block and a typical schematic that you will attach to a load for which you want to generate a schematic drawing.

Typical blocks

Typical block associated with drawing file (block or symbol) and it's the basic element for Typical schematic. There are several ways to create a block/symbol. Let's look at the following drawing.

You will notice that there are 2 groups of symbols called Block 1 and Block 2. The border makes Block 3. Assume, for the sake of this discussion, that this was a representation of how you wanted your schematics to appear, except with a variation on block 1, which we will call Block 1A. The easiest way to create your symbols would be to make 4 copies of this drawing (one for each block that you want to make a symbol from – Blocks 1, 1A, 2, and 3). Delete everything else from the particular drawings except the graphics that you want to see on that symbol.
So Symbol #1 (a drawing of just the graphics needed for Typical Block #1) may look like this:

Symbol 1A may be some variation on this set of graphics. Symbol 2 may look like this

Of course, you will make a template out of the Block #3, which may look like this:

Notice the relationship between the placement of these Blocks and the 'Point of Origin'. This is how the software places the symbols or blocks in the correct physical relationship to each other and to the sheet.
Once the symbol files are prepared, you can save them in whatever format you are working.
Then all that is left is to add your macros and create a Typical Block from that Symbol File.
The above is true for all types of drafting packages.

Create a Typical Block

1. From RDE select Typical Block folder > right click -> New Typical Block
2. Give it a Name
3. Open Common Properties of the new block.
4. Select a block type.
5. Browse to the drawing file and select the symbol/block you need.
6. Select Apply or OK.

You can view the block at any time by clicking the **View** button.
If you want to create another block while you are in this window, just select add and creates another one.

Create a Typical Schematic

1. In the **Reference Data Explorer**, right-click the **Typical Schematics** folder, and then click **New**.
2. Type a name of up to 80 characters for the typical schematic.
3. Right-click the schematic and click **Common Properties** to open the **Typical Schematic** dialog box.
4. Select template.
5. Select **Add** to add a typical block (you can add 1 or more blocks).
6. To finish select Apply or OK.

You can view the typical schematics at any time by clicking the **View** button.

When this typical schematic is used to create a schematic of a particular motor, the macros will be replaced with specific data from that particular motor.
Create a Schematic Drawing in Smart Plant Electrical
Creation of a drawing block file (sym, dwg or dgn), using the **Electrical Index** the integrated Smart Plant Electrical Catalog Manager or by using any of the following independent software: Smart Sketch, Auto Cad or Micro Station. In the block file, the user will draw its graphics (as expected to appear with the **Electrical Index** correct displacement from page origin) and in addition set of required Smart Text labels or "macros", later on, to be replaced by Smart Plant Electrical system with relevant data from the Smart Plant Electrical database, according to the attached object.
Create a new typical block item in the **Reference Data Explorer**.
Edit the new typical block item properties, to attach it with a relevant drawing block file (one or more).
Create a new typical schematics item in the **Reference Data Explorer**.
Edit the new typical schematics properties to attach it with a relevant the **Reference Data Explorer** typical block item (one or more).
Set each typical block sequence (in case two or more blocks of same item type are used that typical schematic e.g. two Control Station blocks etc).
Assign a typical schematics to a load using apply option from **Electrical Index**.

Generate the schematics from **Electrical Index**.

Electrical Index 1
Electrical Equipment
Loads
Motors
New Space Heater
New Signal
Generate Schematic...
Apply Options...
Duplicate
Rename...
Find in Electrical Engineer
Find in SLD
Show in New Window
Show Related Items in a New Window
Associate Custom Symbols...
Delete
Common Properties...
Associated Drawings...
Wiring Equipment
Process Equipment
Documents
SH-100

Generate Schematic
Typical schematic:*
Motor Type A
Item tag:
M-100
Drawing name:
M-100
Blocks
Macros
Unresolved Items
Block Type
Item Name
Block Name
X
Y
Circuit
M-100 Feeder
Motor Feeder Circuit A
0
0
ControlStation
CS-M-100-1
Control Station type A
0
0
Motor
M-100
Motor type A
0
0
Block details
Block type:
Circuit
Item name:
M-100 Feeder
Block name:
Motor Feeder Circuit A
Sheet number:
0
OK
Cancel
Help

Generating Schematics in Batch Mode

You can generate your schematics in batch by simply selecting a number of motors the **Electrical Index** the in the tabular editor or in the lower pane of the **Electrical Index**:

The following dialog box appears:

You can save the generated schematics as external CAD files in any commercially available CAD format and have them printed on the fly.

Macros

You place macros on each block (or symbol) to retrieve relevant information from the database. The macro name describes where (what table/attribute) it will find the information. If you place a Macro called 'Motor.ItemTag' in a symbol or block, then create a Schematic (or SLD that uses that symbol), the program will replace the macro with the 'Data' in the database from the table 'Motor', attribute 'ItemTag'. This particular Macro happens to be the attribute that contains the name of the motor. So, when this Macro is placed in block (or symbol), and a Schematic (or SLD) is created for a particular motor, the program gets the name of the motor and places it in the drawing. The formatting of the text put in the drawing is the same as the formatting of the Macro.

Macro Syntax

The macro text has to contain the Smart Plant Electrical item name, its required property name, and a sequence number, according to the following syntax:
&[ItemTypeName].[Property].[Sequence]
For example, to specify a name (item tag) of a motor, the text label has to be:
&Motor.ItemTag.1
If a particular block contains several items of the same item type (that is, several cables, control stations, and so on), you have to use the sequence number to ensure item uniqueness.

Annotations and Redlining

- You can mark up schematic drawings using text or symbols as annotations. The software saves annotations in the same layer as the graphical elements of the drawing
- Redlining appears in a separate drawing layer and you can hide and display redlining as you require. If a drawing has more than one sheet, you can create redlining and hide or display it independently for each sheet. Therefore, while working in redlining mode, you cannot access any items in the main drawing layer. The software saves the drawing with the redlining items. When opening schematic that contains redlining items, the software automatically displays the drawing in redlining mode. You can switch back to regular mode and modify the drawing as needed. The software saves the existing redlining items regardless of whether you open the drawing in redlining mode or not. You can add text, symbols, lines, circles, rectangles, and watermarks as redlining.

Create Templates (template for Schematic and SLD)

1. From File menu select **New** -> **Template**.

2. From **File** menu select **Sheet Setup** and select the required page size.

3. From Edit menu select Insert Symbol, and browse to your template folder to select a symbol template and select open.

4. Click on the document area to inset the symbol.

5. Drag the symbol to match the template area.

6. Select file -> save and name the template AwideClass.spe

Lab 10

Create and generate motor schematic

10.1. Create 3 typical blocks

Motor Block 1
Create new typical motor block
Block Name = **Motor Block 1**
Block Type = **Motor**
File Name = **MotorTypeA.sym**

Circuit Block 2
Create new typical circuit block
Block Name = **Circuit Block 2**
Block Type = **Circuit**
File name = **FeederCircuitA.sym**

Control Station Block 3
Create new typical control station block
Block Name = **Control Station Block 3**
Block Type = **Control Station**
File name = **ControlStationA.sym**

10.2. Create Typical Schematic

Create new typical schematic
Typical Schematic Name = **Motor Schematic 3 Blocks**
Template = **AWide.spe**
Blocks = **Motor Block 1**
Circuit Block 2
Control Station Block 3

10.3. Generate schematic

Generate schematic for motor, 'M-100' using typical schematic, '**Motor Schematic 3 Blocks**'. View the result and save the document.

Notes: Apply the typical schematic, **Motor Schematic 3 Blocks**' to motor, M-100 using the apply Option (apply schematic) before you generate the schematic.

Close the document.

Open the schematic document, 'M-100' and add new revision, P0.

Save the open schematic document using the options save as, and save it as external PDF file Format. Name the external pdf file, '**M-100.pdf**'

Chapter 11

Associating external Documents

Associate documents

You define a document reference by adding a reference to the list of document references. You can then associate this reference with an external file. The software adds this association by storing the file path in the database.

After you define external document references, you select one or more electrical items and associate them with external documents. You can associate an electrical item with a document reference or with an external file that is linked to the document reference. The software allows you to associate single or multiple electrical items with the same external document. Also, you can associate the same external file with multiple items in the software.

Define a Document Reference

Let define the document 'SPElectricalUsersGuide.pdf' as a document reference.

To associate the new reference document, select one or more electrical item you want to associate with the '**SPElectricalUsersGuide**'reference document.

For example select **MCC-1**, and select action and associate documents.

Select electrical document for document category and other electrical documents for document type and select add.

Find and select the '**SPElectricalUsersGuide'** to associate it.

To view the associated documents, select the open button.

Miscellaneous Drawings

The software allows specifying miscellaneous drawing and saving it as document in the database. You can create miscellaneous drawings from drawing created in Smart Sketch or other CAD application.
The miscellaneous drawing document uses regular Smart Plant electrical template and can be revised.
The path for miscellaneous drawing set in the option manager.

Path for miscellaneous drawings	\\adler4500\SPFiles\SPSite\PlantBasicRefData\Miscellaneous Drawings

To create new miscellaneous drawings do the following steps:

1. Select the Miscellaneous Drawings folder, right click, and select New Miscellaneous Drawings.

2. Select template and enter document number and select OK.

3. From edit menu, select insert, symbol, and in the select symbol file windows select the symbol, '**ControlStationC3.sym**' and select open.

4. Make a click on the open document.

5. Reposition the inserted symbol and save.

Lab 11

Associate Document and Miscellaneous drawing

11.1 Define new document reference.
Document Category = **Electrical Documents**
Document Type = **Other Electrical Documents**
Reference Document Name = '**Motor Type C**' (using the external file,'**MotorTypeC.sym**')
11.2 Associate the reference document, 'Motor Type C', with the Motor, 'M-100'.
11.3 Open the reference document 'MotorType C' for motor 'M-100'

11.4 Create miscellaneous drawing and name it '**Control Station D**'.
Use '**AWide.spe**' for template, and insert the drawing '**ControlStationD.sym**' as the inserted symbol.

Note: Template = \ Electrical Reference Data\Templates\AWide.spel
Symbol = \Electrical Reference Data\Symbols\Schematic Blocks\ControlStationD.sym

Chapter 12

Archiving Documents

Smart Plant Electrical allows archiving the following documents:
SLD, Schematic, PDB Layout Drawing, Wiring Diagram, Cable Block Diagram, and registered Report.
Archive documents make it possible to archive and compare between revisions.
To enable the archiving option, make sure the option 'Archive documents' in option manager under general settings is enabled.

Archive documents	Enable

Once the archiving option is enabled, the software automatically archives every added or modified revision whether you did it for single document or used the Global Revision feature for Multiple documents.

To work in archive document mode and use the compare feature for SLD do the following:

1. Open option manager and enable the archive document in general setting windows, and save the Change.
2. Reopen Smart Plant Electrical (you must restart SPEL after enable archive documents in option Manager)
3. Generate SLD for PDB-1 from EI, and name it, 'PDB-1'

4. Close the document and save it.

5. Open the document, 'PDB-1', (from electrical index, documents folder, single line diagrams folder). While the SLD document is open, select the document, 'PDB-1', (from electrical index, documents Folder, single line diagrams folder.), select right click, and select, 'document properties'. In the document properties window, select **New** and add new revision details and click **OK**.

Note: Working in archived documents enabled checks the 'Archived' column in the document properties.

6. Close the document.
7. Change M-1 motor rated power from 1 hp to 1.5 hp.

8. Select the document, select right click, and select 'Compare Documents'.

9. In compare document window select revision PO and select the compare button.

Compare Documents
Document number:
PDB-1
Multi-tag typical schematic:
Description:
Revisions
Associated Items
Revision method:
P0,P1,P2...
Archived
Revision Number
Revision Date
Created By
Checked By
P0
1/18/2011
yadler
ya
View
New
Delete
Compare
Cancel
Help

Bus-1
PDB-1
Feeder-1
CKT-46
CB-1
PC-0001
3 x 12 AWG
PC-0002
3 x 14 AWG + 1 x 14 AWG
M-1
M-2
1 hp
Bus-2
PDB-1
Feeder-2
Feeder-3
CKT-47
CB-2
16 A
CB-3
25 A
M-3
PC-0001
3 x 12 AWG
PC-0002
3 x 14 AWG + 1 x 14 AWG
M
M
M-1
1.5 hp
M-2
1 hp

Global revisions

The ability to assign a specified global revision to a set of documents is a powerful and important feature often requested by those who need to issue deliverables packages all at once, all in same or in a specified revision number.

There are several options that can be used in conjunction with this feature, and these can be seen in the Global Revision Dialog. To open the global revisions dialog, select 1 or more documents you would like to revise, and select Global Revision from action menu.

Add Revision add new revision to all selected documents. The system will add a new revision (P0, P1 type; A, B, C type; 1, 2, 3 type, or any "other" type). The system will identify the requested method and if needed will modify the method window accordingly.

Upgrade revision upgrade the selected set of documents to next higher revision level to each document. This opens a selection window from which user selects the method of revisions for documents that have no revision method yet defined or the revision method is "other"

Delete last revision delete only the last revision of the selected set of documents.

Delete All revisions delete all document revisions.

Register Report

When you create an Excel report in Smart Plant Electrical, you can enable revisions for the report by registering it. If you create a report for an item type where the data be published, for example, instrument, cabinets or signal runs, you also need to register the report and enable publishing. When you register a report, it appears under Document > Registered Report in the Electrical Index. Note that you can associate an electrical item with registered report. Also, you can compare the current data with the data in an archived revision of a simple registered report.

To register the plant report, 'Electrical Load List', do the following:

1. Select Register Report from the Actions menu.
2. From the register report common properties window, select the 'Electrical Load List', for The report template. Name the document, 'Electrical Load List'. Select OK to generate the document.

To revise registered reports do the following:

1. Select the document from the registered reports folder,
   Select right click and select open.

Item Tag	Description	Type	Full Load Current	Rated Power	Brake Power	Duty	Demand Factor	At Demand		Consumed Power		
								Power Factor	Efficiency	Active	Reactive	Apparent
H-1		Heater	155.0 A	100 kW		Continuous	0.9	0.9	0.9	100.00 kW	48.43 kVAR	111.11 kVA
H-104		Heater	120.3 A	100 kW		Continuous	1	1	1	100.00 kW	0.00 kVAR	100.00 kVA
H-2		Heater				Continuous						
M-1	1 hp 460 V AC Motor	Motor	3.4 A	1.5 hp	0.8 hp	Continuous	0.533	0.747	0.829	0.72 kW	0.64 kVAR	0.96 kVA
M-100		Motor	1.5 A	1 hp	0.75 hp	Continuous	0.75	0.66	0.82	0.68 kW	0.78 kVAR	1.03 kVA
M-101		Motor	12.4 A	10 hp	6.8 hp	Continuous	0.68	0.759	0.9	5.63 kW	4.83 kVAR	7.42 kVA
M-102		Motor	113.2 A	100 hp	80 hp	Continuous	0.8	0.854	0.95	62.80 kW	38.26 kVAR	73.54 kVA
M-103		Motor	12.4 A	10 hp	6.8 hp	Continuous	0.68	0.759	0.9	5.63 kW	4.83 kVAR	7.42 kVA
M-2		Motor	2.3 A	1 hp	0.8 hp	Continuous	0.8	0.632	0.814	0.73 kW	0.90 kVAR	1.16 kVA
M-3		Motor	0.9 A	1 hp		Continuous						
M-4		Motor	1.9 A	2 hp		Continuous						
M-5		Motor	1.9 A	2 hp		Continuous						
M-6		Motor	1.9 A	2 hp		Continuous						
OEE-1		Other Electrical Equipment				Continuous						
SH-100		Heater	0.8 A	100 W		Continuous	1	1	1	0.10 kW	0.00 kVAR	0.10 kVA

2. While the document is open, select the document from electrical index, right click and select document Properties.
3. In the document properties window select new, type in addition information and click OK.

Document Properties
Document number:
Electrical Load List
Multi-tag typical schematic:
Description:
Report item type:
Load
Document main item type:
Load
Revisions
Associated Items
Revision method:
P0,P1,P2...
Archived
Revision Number
Revision Date
Created By
Checked By
P0
1/18/2011
yadler
ya
View
New
Delete
OK
Cancel
Help

Document Properties
Changes saved successfully to database.
OK

Revision: P0
By: yadler
Date: 1/18/2011

Electrical Load List

Item Tag	Description	Type	Full Load Current	Rated Power	Brake Power	Duty	Demand Factor	At Demand		Consumed Power		
								Power Factor	Efficiency	Active	Reactive	Apparent
H-1		Heater	155.0 A	100 kW		Continuous	0.9	0.9	0.9	100.00 kW	48.43 kVAR	111.11 kVA
H-104		Heater	120.3 A	100 kW		Continuous	1	1	1	100.00 kW	0.00 kVAR	100.00 kVA
H-2		Heater				Continuous						
M-1	1 hp 460 V AC Motor	Motor	3.4 A	1.5 hp	0.8 hp	Continuous	0.533	0.747	0.829	0.72 kW	0.64 kVAR	0.96 kVA
M-100		Motor	1.5 A	1 hp	0.75 hp	Continuous	0.75	0.66	0.82	0.68 kW	0.78 kVAR	1.03 kVA
M-101		Motor	12.4 A	10 hp	6.8 hp	Continuous	0.68	0.759	0.9	5.63 kW	4.83 kVAR	7.42 kVA
M-102		Motor	113.2 A	100 hp	80 hp	Continuous	0.8	0.854	0.95	62.80 kW	38.26 kVAR	73.54 kVA
M-103		Motor	12.4 A	10 hp	6.8 hp	Continuous	0.68	0.759	0.9	5.63 kW	4.83 kVAR	7.42 kVA
M-2		Motor	2.3 A	1 hp	0.8 hp	Continuous	0.8	0.632	0.814	0.73 kW	0.90 kVAR	1.16 kVA
M-3		Motor	0.9 A	1 hp		Continuous						
M-4		Motor	1.9 A	2 hp		Continuous						
M-5		Motor	1.9 A	2 hp		Continuous						
M-6		Motor	1.9 A	2 hp		Continuous						
OEE-1		Other Electrical Equipment				Continuous						
SH-100		Heater	0.8 A	100 W		Continuous	1	1	1	0.10 kW	0.00 kVAR	0.10 kVA

Lab 12

12.1. Register the plant report, ‘Cable Schedule’. Name the document, ‘Cable Schedule’.
12.2. Add new revision, P0 to the new document ‘Cable Schedule’.

Chapter 13

Miscellaneous Features

Calculate Bus Loads

Calculating bus loading means summing up all the loads that are connected to a particular bus. When calculating the total loads connected to a bus, the software calculates the bus totals, stores the individual subtotals in the database as calculated properties and then makes these calculated properties accessible for reporting.

Lets calculate the bus load for MCC-201, Bus, '480 V Bus B'

Select the bus, '480 V Bus B' and select, Actions -> Calculate Bus Loads -> Selected PDB or Buses

The software collects and processes the data and stores the result in the database under the bus and the circuit.

Properties

Bus - 480 V Bus B

Bus Material	
Busbar Arrangeme	
Calculate By High	
Comp Rolled up C	6.31 kW
Comp Rolled up C	9.19 kW
Comp Rolled up C	5.61 kVAR
Comp Rolled up C	6.12 kVAR
Comp Rolled up Ir	0 kW
Comp Rolled up Ir	0 kW
Comp Rolled up Ir	0 kVAR
Comp Rolled up Ir	0 kVAR
Comp Rolled up P	6.31 kW
Comp Rolled up P	9.19 kW
Comp Rolled up P	8.443 kVA
Comp Rolled up P	11.041 kVA
Comp Rolled up P	0.747
Comp Rolled up P	0.832
Comp Rolled up P	5.61 kVAR
Comp Rolled up P	6.12 kVAR
Comp Rolled up F	6.31 kW
Comp Rolled up F	9.19 kW
Comp Rolled up F	8.443 kVA
Comp Rolled up F	11.041 kVA
Comp Rolled up F	0.747
Comp Rolled up F	0.832
Comp Rolled up F	5.61 kVAR
Comp Rolled up F	6.12 kVAR
Comp Rolled up S	0 kW
Comp Rolled up S	0 kW
Comp Rolled up S	0 kVAR
Comp Rolled up S	0 kVAR
Comp Rolled up S	0 kW
Comp Rolled up S	0 kW
Comp Rolled up S	0 kVAR
Comp Rolled up S	0 kVAR

User can use the calculated values in tabular editor.

Total count: 14 Item type: Bus Layout: Bus Data

	Item Tag	Comp Rolled up Continuou	Comp Rolled up Continu	Comp Rolled up Contir	Comp Rolled up Continu
1	Bus-2	0 kW	0.75 kW	0 kVAR	0 kVAR
2	480 V Bus B	6.31 kW	9.19 kW	5.61 kVAR	6.12 kVAR
3	480 V Bus C	0 kW	0 kW	0 kVAR	0 kVAR
4	480 V Bus C	168.43 kW	186.78 kW	43.09 kVAR	49.84 kVAR
5	4.16 kV Bus	6.31 kW	9.19 kW	5.61 kVAR	6.12 kVAR
6	460 V Bus	0 kW	0 kW	0 kVAR	0 kVAR
7	120 V Bus A	0 kW	0 kW	0 kVAR	0 kVAR
8	MCC-2 BUS 460 V	0 kW	0 kW	0 kVAR	0 kVAR
9	480 V Bus B	0 kW	0 kW	0 kVAR	0 kVAR
10	FSB-1	0 kW	0 kW	0 kVAR	0 kVAR
11	4.16 kV Bus	6.31 kW	9.19 kW	5.61 kVAR	6.12 kVAR
12	Bus-1	1.45 kW	2.36 kW	1.54 kVAR	3.88 kVAR
13	120 V Bus A	0.1 kW	0.1 kW	0 kVAR	0 kVAR
14	Bus-1	0 kW	0 kW	0 kVAR	0 kVAR

And you can also use the calculated values in reports.

Bus Load Calculation Report

Bus	Con Act Load	Con Rec Load	Int Act Load	Int Rec Lc	Peak Act	Peak Rec	Peak Apr Load
Bus-2	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
480 V Bus B	6.31 kW	5.61 kVAR	0 kW	0 kVAR	6.31 kW	5.61 kVAR	8.443 kVA
480 V Bus C	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
480 V Bus C	168.43 kW	43.09 kVAR	0 kW	0 kVAR	168.43 kW	43.09 kVA	173.855 kVA
4.16 kV Bus	6.31 kW	5.61 kVAR	0 kW	0 kVAR	6.31 kW	5.61 kVAR	8.443 kVA
460 V Bus	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
120 V Bus A	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
MCC-2 BUS 460 \	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
480 V Bus B	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
FSB-1	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA
4.16 kV Bus	6.31 kW	5.61 kVAR	0 kW	0 kVAR	6.31 kW	5.61 kVAR	8.443 kVA
Bus-1	1.45 kW	1.54 kVAR	0 kW	0 kVAR	1.45 kW	1.54 kVAR	2.115 kVA
120 V Bus A	0.1 kW	0 kVAR	0 kW	0 kVAR	0.1 kW	0 kVAR	0.1 kVA
Bus-1	0 kW	0 kVAR	0 kW	0 kVAR	0 kW	0 kVAR	0 kVA

Dual Power Source Equipment

Smart Plant Electrical allows specifying two power sources for equipment:
A primary source and an alternative source.
Example of dual source power supplies include:
A motor fed by supplies on two separate buses.
A variable-frequency drive fed by the two secondary of a 3-winding transformer.
An uninterruptible power supply fed by a main input with battery back-up.

The user needs to define a second or alternate power source for electrical equipment by selecting the equipment in the electrical engineer that has one main power source already defined.

Right click and select alternative power source.
This command will invoke a second Electrical engineer instance, from which user will select the alternate power source.

The following conditions should be met for this operation to be successful:
The equipment is not already connected to an alternate feeder
The destination power source is a valid parent (power cable, feeder circuit, etc).

Exercise

In this exercise we shall learn and accomplish the following:

- How to connect a variable frequency drive to a main power source, coming from a VFD feeder circuit.
- How to connect a second power source supplying the VFD from a power transformer.
- Generate a single line diagram for this configuration.
- How to dissociate the second power source.
- Switching and modifying the second power source.

Step 1 – Create and connect the VFD to the Main Power Source.

1.1. Create new PDB and name it 'PDB-2'.
1.2. To the PDB add bus and name it, 'PDB-2 BUS'.
1.3. To the bus, add cell, and name it, 'F2A', with feeder circuit with the same name.
1.4. Create new Variable Frequency Drive (VFD), and name it 'VFD-2'.
1.5. Connect the VFD-2 to feeder circuit F2A.

Step 2 - Connect a Second, Alternate Power Source for VFD-2

2.1. Create new power cable and name it, 'T-1-PC-VFD-2'
Note: use typical cable '3+1/C-12AWG -(Power / NEC)'
2.2. Connect the transformer T-1 to Offsite power supply S-1.
Note: If T-1 (2 winding transformer) and S-1 don't exist, than create them.
2.3. Connect the cable T-1-PC-VFD-2 to transformer T-1.

2.4. Creating the alternate feeder branch to the VFD-2 by select the VFD in electrical engineer, and select right click, select alternative power source.

2.5. In select alternative power source windows select the cable T-1-PC-VFD-2 and click OK to make the alternative connection.

The "(#)" sign indicates that this is an alternative power source branch
If we look at the VFD common properties:

Step 3 - Generate the SLD for this configuration.

From electrical engineer, select the PDB-2 BUS and with CTRL key hold also the Offsite power supply S-1 and generate new SLD.

Notice: 1. To change the alternate source. Select in electrical engineer the VFD, VFD-2 or the cable, T1-PC-VFD-2. Right click, and select change alternative power source.
This will open once more the select alternative power source screen, and allow you to Navigate to an alternative feeder.

2. To dissociate the alternative power source. Select the final element itself, in our case it is the FVD and select right click dissociate.

Rules

The following rules will apply:

Case A - Equipment has both primary and alternative power source and alternative is connected via a cable or a longer multi item branch.

The instance that connected to primary power source can be dragged or dissociated as usual. All operations on the items with regards to his feeder will be assumed as operations on its primary power source.

To edit/change the alternative power source will be as follows:

The instance of "equipment" that is connected to an alternative power source can only be dissociated in the engineer (the system will identify the alternative power source from the primary). User will have to select the item in the engineer and dissociate. The only place along the chain of the feeder that can be broken (dissociation taking place) by the user is the equipment itself and not any of its branch items.
The "Cable" (or any item in the feeder chain), connecting between alternative power source and "equipment" cannot be dissociated or dragged.

For re-connecting of the branch to another alternative power source the user will have to use the response Engineer window again.

Case B - Equipment is connected to alternative power source only, no primary is connected.
"Equipment" and its "Cables or branch items" (if exists) are connected to Alternative Power Source only.
All actions that are not using the "select alternative power source" command will be interpreted by the system as regular operations on the primary power source, so, Dragging "equipment" to any other branch will add a main power source, leaving alternative power source untouched.
Dragging or dissociating of "Cable" in an alternative power source branch is not allowed. The "Cable" can be re-connected using response window.

Case C - Equipment has no power source at all, just connected to a feeder cable (after apply for example)
"Equipment" doesn't have any feeding equipment but has a "parent Cable or something else".
"Equipment" can be connected to alternate power source using response window, "Cable" can be dragged to any valid power source creating a new main power source for the "Motor"

Delete an Item that Feeds an Alternative Power Source
The system does not allow you to delete an item that is in the path of the alternative power source feeding electrical equipment, only after the electrical equipment has been dissociated from its immediate upstream item that feeds it.

Dissociate Alternative Power Sources
The dissociation of the alternative power source will be also from the engineer, by the use of the "Dissociate" command.
Dissociation will be possible only at the final element and not along any of its feeder items.
Dissociating primary source will not affect its alternative and vice versa.

Rules in Operations that Involve Circuits
All the operations and activities that deal with circuits on equipment will be acting on the main feeder and not on the alternative circuit.

Associating an item to a alternative source
The alternative source will not be required to match the last applied typical circuit of the item.

Applying typical circuit
Applying typical circuits on a dual input connected item will affect only its main feeder circuit, not the alternative circuit.

Single line diagrams
For the purpose of proper handling in the SLD, the dual input equipment would need to have a special symbol that will have 3 connection points, to handle both the 2 inputs (loads, instruments and cabinets) and 2 inputs + one output for the converting equipment types.

The 3rd connection point of the symbol will be dedicated for the Alternative Power source
The SLD algorithm will position the dual input item so that its main feeder point will be positioned first, and the system will run the connector from its alternate feeder to the alternative connection point at the equipment.

Load Summary reports
Since the "All feeder report " load summary may count the load twice in case the load is fed from 2 different user will have to disconnect the circuit by setting the Circuit mode parameter to disconnect.
In case user doesn't do that, the load summary will count the load twice.
The drill down report will assume that circuit is connected unless Circuit Mode=Disconnect

Batch load association
The batch load association, when operated in normal mode (not drill down); will not count the load in case the circuit is feeding the load as alternative power source. The load will be accounted for in batch load association only for circuits that feed the loads as primary power sources.
The All Feeder mode will take the load into account in both cases, provided the alternative power source feeder circuit is not in disconnected mode.

Metering and Protection Relay in SLD

Current transformer and potential transformer (in-line) appear automatically in SLD, where Ammeter, Voltmeter, Multimeter, and Protection relay appear only when SLD options, show
Metering and relaying equipment is checked.

Let's create circuit that has:

- Circuit breaker
- Current transformer
- Protection relay

And have them shown in SLD following with reposition them and interconnect the logical lines.

Generate the SLD and reposition the items.

Activate the connection mode to light the red auxiliary connection points and connect them as needed:

To disconnect and remove relations simply right click on the relation line---→Disconnect.
Saving the drawing will save it with the set of auxiliary relations.
Opening a new SLD drawing with the same item selected will show the metering equipment and the relations.

Note: You may use the auxiliary connection points and lines for any other purpose of showing any relation across Items. Each relation must have its own 2 auxiliary connection points. You may not connect 2 relations to the Same connection point.

Moving disconnect electrical equipment in and out of circuit

This feature enables the user to move disconnect electrical equipment from being internals to a circuit, to being standalone ones, external to the circuit, and vice versa.

Let's demonstrate this feature.

Create PDB and name it 'MCC-3' with bus 'MCC-3 BUS', and a feeder circuit 'F2A'. Create a circuit breaker, 'CB-3' within the circuit. Create a standalone current transformer, 'CT-3' and connect it to feed a downstream PDB, 'LP-1'.

Let's first move the CB-3 out of the feeder circuit F2A.
Open the circuit common properties and in the associated equipment tab select the CB-3
Click 'Move out' (or CTRL + M) which results in clearing the circuit internals group and moving CB-3 out of the circuit, and insert it between the feeder circuit and the current transformer CT-3

And moving it in the index under the free standing circuit breakers.

Let's now move the CT-3 into the incomer circuit.
From Electrical Engineer, select CT-3, right click to move it into the circuit

A prompt will be issued:

Selecting yes will result in moving CT3 into the incomer circuit.

Inserting power cables in between equipments

In case two pieces of electrical equipment are logically interconnected in the electrical engineer user can insert a power cable in between.Let's create a power cable in between the feeder circuit F2A and the circuit breaker CB-3.

Select CB-3 in the electrical engineer; right click to select the 'Insert Power Cable' command.

User can specify a reference cable from cable library.

Or only specify cable construction.

Selecting ref cable determines what will be the ref cable of the project cable that will be created and inserted. Let's use the 'specify construction' option, and click ok to create the project cable.

Cable Management System

Cable Routing

Smart Plant Electrical cable routing allows you to set up a model of the cable routing in your plant.

The cable routing support the following activities:

1. Creation of a library of reference items for Trays, Conduits and Miscellaneous cableway Components.
2. Assignment of Project segments to reference cableway components.
3. Defining Predefined cable routes.
4. Connectivity of segments in between themselves.
5. Assignment of cables to cableways using the following methods:
    - Manual segment to cable assignment
    - Copying predefined routes to cables
    - Copying of one cable route to another cable.
6. Batch cable routing using manual, copy route and copy from other cable route.
7. Segregation level definitions and validations
8. Segment fill validation (conventional method or NEC method).
9. Segment weight validation.
10. Option to interface with SP3D to exchange cable routing data.

The cable routing start with create reference cableway components. These are catalog components for which you can specify manufacturer's data. The software allows you to specify one of three possible categories of reference cableway components: trays, conduits, or miscellaneous. You can make space reservations by defining cableways and segments (the physical conduits) in your plant, and later associate the segments with reference components. Alternatively, you can specify the reference components for the segments at the time when you create them. After you define the cableways and segments in your plant, you can assign cables to specific routing paths, singly or in batch mode.

The software allows you to create predefined routing paths as a way of specifying physical relationships between cableways. You can specify the cableways in a routing path first, and then later define the segments.

You must define a segregation level for the cables you intend to route, as well as for the cableway segments. Assignment of segregation levels allows you to specify separate groups of cables that you would not normally route together along the same path, for example, high and low voltage cables.

Cable Routing Lab

We will create 3 cableways, with the Electrical Index segments, specify tray types, defines predefined routes and perform cable routing, as per the following equipment layout:

Step 1 - Create typical tray

1.1.Create reference tray in the RDE and name it **Ladder Tray 12"x1.5"** so we can use it for project segments.

1.2. Right-click on the reference tray and select common properties to open the common properties windows and enter the following values:

Step 2 - Create cableways infrastructure

2.1. In the Electrical Index, select Wiring, Cableways and create 3 cableways
Cableway Blue
Cableway Pink
Cableway Violet

2.2. Right-click on 'Cableway Blue' and create segment '**BL-1**'

2.3. Right-click on segment BL-1 to open its cableway segment common properties windows.

2.4. In the reference component section select the find button and pick the reference tray, 'Ladder Tray 12"x1.5"'. It will populate the reference tray values to the segment. In the segregation level select list select power, and select the apply button.

2.5. Right click on select segment BL-1 and select duplicate.

Name the new segment '**BL-2**'

2.6. Right click on segment BL-2 and select common properties to view the data.

2.7. In the same way continue create the entire segments within the 3 cableways

Note: In this exercise we use the same reference tray for all the 7 segments.

Step 3 - Create Predefined Routes
We have 4 areas in which the motors are located, let's create 4 predefined routes, which we shall use later to route the cables to the motors.

3.1. Select from action menu, cables and predefined routes

This will open the routing definition screen:

3.2. Click **New** to create a new predefined route, R-1, from MCC-4 to Area A (for motors MO-3, MO-4).

3.3. Repeat this procedure to create the other routes
R-2 MCC-4 to Area B (for motors MO-1, MO-2).

R-3 MCC-4 to Area C (for motors MO-5, MO-6)

R-4 MCC-4 to Area D (for motors MO-7, MO-8, MO-9).

At this stage we should have the 4 predefined routes.

Step 4 – Create electrical network including the cables.

4.1. Open common properties of typical motor, '**M<10hp**' and modify it to match the following screen:

4.2. Open common properties for motor profile '**M<10hp**'.
In the 'associated cables and cable assembly' section, remove the typical cable '**3/C - 25 mm^2 - (Power / mm^2)**', and add instead, the typical cable '**3+1/C-12AWG -(Power / NEC)**'.
And from 'typical control station' section, remove both control stations ('Emergency Stop Station', and 'Start Stop Station type A').
It should match the following screens:

4.3. Enter the following data to the typical cable '**3+1/C-12AWG -(Power / NEC)**':

Design Length = 80 ft, Tail 1 = 1 ft, Tail 2 = 1 ft, Spare length = 1 ft.
Outside diameter = 9.8 mm
Weight per length = 187 Kg/1000 m

4.4. In Electrical Index, create new PDB and name it 'MCC-4.
Add to MCC-4 bus and name it 'MCC-4 BUS'.

4.5. From Electrical Index, select the motor folder. Right click, and select Apply Options.

In the apply option profile, equipment tab, check the 'enable equipment profile' check box.
In the number of items to create, enter '9'.
In the create item based on profile field, using the find button, select the profile 'M<10'.
To start run the apply and create the 9 motors select the apply button.

4.6. The apply creates 9 new motors, connected to 9 new power cables.

Rename cables and motors →

4.7. Open the 'batch load association' screen and select for power distribution board, 'MCC-4', and for bus, 'MCC-4 BUS'.
Add to the associated load the 9 motors, 'MO-1' to 'MO-9'. In the 'create circuits and cells' part, check both options, 'create circuit', and 'create cell'.
To start the association process select the apply button.

Rename circuit and cell (cell should be same as circuit)

→

Step 5 – Route the cables

According to the equipment layout, the cables should be routed as in the following table

Cable Name	From	To	Predefined Route	Route
PC-MO-1	MCC-4/F2A	MO-1	R-2	**Cableway Blue/BL-1|Cableway Pink/P-1**
PC-MO-2	MCC-4/F2B	MO-2	R-2	**Cableway Blue/BL-1|Cableway Pink/P-1**
PC-MO-3	MCC-4/F2C	MO-3	R-1	**Cableway Blue/BL-1/ Cableway Blue/BL-2**
PC-MO-4	MCC-4/F2D	MO-4	R-1	**Cableway Blue/BL-1/ Cableway Blue/BL-2**
PC-MO-5	MCC-4/F2E	MO-5	R-3	**Cableway Blue/BL-1|Cableway Pink/P-1/ Cableway Pink/P-1|Cableway Violet/V-2**
PC-MO-6	MCC-4/F2F	MO-6	R-3	**Cableway Blue/BL-1|Cableway Pink/P-1/ Cableway Pink/P-1|Cableway Violet/V-2**
PC-MO-7	MCC-4/F2G	MO-7	R-4	**Cableway Blue/BL-1|Cableway Pink/P-1/ Cableway Pink/P-1|Cableway Violet/V-1**
PC-MO-8	MCC-4/F2H	MO-8	R-4	**Cableway Blue/BL-1|Cableway Pink/P-1/ Cableway Pink/P-1|Cableway Violet/V-1**
PC-MO-9	MCC-4/F2J	MO-9	R-4	**Cableway Blue/BL-1|Cableway Pink/P-1/ Cableway Pink/P-1|Cableway Violet/V-1**

5.1. To route cable PC-MO-1, open its common properties screen and select design tab.

You can choose from 3 possible options of how to route cable from its common properties.

First option would be manually pick the cableway and the segment from a drop down list.

Second option would be by select predefined route.

Third option would be by copy the route from another cable.

We will use the second option to route the cable.

Make sure the 'select predefined route' radio button is checked, and select the find button to select The predefined route R-2

Cable Common Properties [PC-MO-1]
General
Design Data
Connections
Sizing Data
Earth Loop Impedance
Procurement
Drum definition
Locked to drum
Drum:
Find...
Unassign
Pulling area:
Cable routing
Select predefined route
Copy route from cable
Segregation level: *
Power
Find...
Save as New Route...
Seque
Cableway
Segment
Length
Segment fill
Add
Remove
Insert
Up
Down
Design data
Use external routing length
Estimated length:*
Design length:*
Routing length:
External routing length:
External routing path:
OR
80 ft
OR
0.0 m
Note that the software uses ONE of the above values (where the order of preference is 1.Routing length; 2.Design length; 3.Estimated length) as the length in the actual length of cable:
Tail 1:
Length:
Tail 2:
Spare length:
Actual design/installed length:
1 ft
80 ft
1 ft
1 ft
25.3 m
Installed data
Marked length - side 1:
Marked length - side 2:
Installed length:
Compare to Reference...
Find
Tag:
Find Now
New Search
Equipment type:
Cable Routing
Layout:
OK
Cancel
Apply
Help
Properties
Show only properties that have data values
Property
Value
Identification
Description
Electrical Equipment Class
Electrical Equipment Sub Class
Electrical Equipment Type
Equipment Type Identifier
KKS Component Classification
KKS Component Numbering
KKS Equipment Unit Additional Code
KKS Equipment Unit Classification
Results
No.
Item Tag
Equipment Type
2 R-1 Cable Routing
3 R-2 Cable Routing
4 R-3 Cable Routing
1 R-4 Cable Routing
4 Cable Routing items found.

Notice: To calculate the cable actual length (13.1 m) the software use the routing length if exists, and not The design length.

5.2. Repeat the same steps you did for cable PC-MO-1 to route cable PC-MO-2.

5.3 To route the remaining 7 cables let's use the batch cable routing feature that can save us time. Open the tabular editor, using cable for item type and 'Default cable List' for layout.

In the tabular editor, set the following custom AutoFilter for item tag.

Tip: AutoFilter to bring only cable start with PC-MO

From the table, select cables 'PC-MO-3', and 'PC-MO-4'

From Actions menu, select cables and Batch Cable Routing option.

The **Batch Cable Routing** dialog box opens with the 2 selected cables shown in the grid:

Select the 2 cables. Select the **Select predefined route** radio button and then click **Find**
And find and select the route R-1, similar steps as you did when you routed manually the previous 2 cables just this time, you do it for one or more cables in a batch.

5.4. Repeat the steps you did for route cables PC-MO-3 and PC-MO-4 to route the remaining 5 cables.
PC-MO-5, PC-MO-6 using route R-3
PC-MO-7, PC-MO-8, PC-MO-9 using route R-4.

Step 6 - Generate a Segment Fill Report

Let's generate the segment fill report and see the loading of the segments.

1. In the **Electrical Index**, select the **Cable Ways** folder:
2. Click **Reports -> Plant Reports**.
3.Select the Segment Fill Report:

Cableway	Segment	Type	Size	Allowable area	Accumulated area	Accumulated outside dimeters	Number of layers	Allowable load	Accumulated load	Criteria	Overfill
Cableway Blue	BL-1	Tray	0.3048		6.75 cm^2	88.2 mm	1	100.0 kg/m	1.8 kg/m	Auto	Ok
	BL-2	Tray	0.3048		1.50 cm^2	19.6 mm	1	100.0 kg/m	0.4 kg/m	Auto	Ok
Cableway Pink	P-2	Tray	0.3048		3.75 cm^2	49.0 mm	1	100.0 kg/m	1.0 kg/m	Auto	Ok
	P-1	Tray	0.3048		5.25 cm^2	68.6 mm	1	100.0 kg/m	1.4 kg/m	Auto	Ok
Cableway Viole	V-1	Tray	0.3048		2.25 cm^2	29.4 mm	1	100.0 kg/m	0.6 kg/m	Auto	Ok
	V-2	Tray	0.3048		1.50 cm^2	19.6 mm	1	100.0 kg/m	0.4 kg/m	Auto	Ok
	V-3	Tray	0.3048				1	100.0 kg/m		Auto	Ok

Cable Routing Validation Rules

The following validations are carried out while performing cable routing:
Segregation level of the cables and route must match.
Segment fill validation bases on the selection in the calculation criteria select list.

Auto This is the SPEL default. It bases on whether the tray is **covered**.
If **covered**, the validation is base on **area** (the total available area of the cross section of the tray).
If **uncovered**, the validation is base on **width** (the total available width of the tray, multiplied By the number of allowed layers).

Area The validation bases on the total available **area of the cross section of the tray**

Width The validation bases on the total available **width of the tray multiplied by the number of Allowed layers.**

Cableway Segment Common Properties [BL-1]
General
Associated Cables
Item tag:*
BL-1
Cableway:
Cableway Blue
Description:
Data quality:
Category:
Tray
Segregation level:
Power
Notes:
Reference component
ladder Tray 12"x1.5"
Find...
Dissociate
Length:
20 ft
Diameter:
Width:
12 in
Depth:
1.5 in
Adjacent segments
From segment:
End
To segment:
BL-2
Segment fill
Calculation criteria (Conventional validation):
Auto
Allow overfill
Covered
Fill [%]
28.94
Maximum area:
116.13 cm^2
Allowed area:
Maximum weight:
100 kg/m
Allowed weight:
100.0 kg/m
Fill factor:
1
Accumulated area:
6.75 cm^2
Weight factor:
1
Accumulated weight:
1.8 kg/m
Number of layers:
1
Accumulated diameter:
88.2 mm
Allowable width:
304.8 mm
Derating factor:
OK
Cancel
Apply
Help

Cableway Segment Common Properties [BL-1]
General
Associated Cables
Item Tag
Formation
Weight / Length
Outside Diameter
PC-MO-1 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-2 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-3 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-4 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-5 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-6 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-7 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-8 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
PC-MO-9 3 x 12 AWG + 1 x 12 AWG 187 Kg/1000m 9.8 mm
OK
Cancel
Apply
Help

NEC Cable Tray and conduit fill validation

Smart Plant Electrical allows you to change the tray fill and conduit validation criteria and follow NEC method. To switch to NEC validation method, you should set in the option manager, in the General settings, the flag, '**Cable fill validation to follow NEC method**' to **Yes**.

General Settings (1)

Option	Setting
Maximum number of parallel cables	6
Minimum cross-section of parallel cables	14 AWG
Naming method for parallel cable suffix	A, B, C ...
Parallel cable suffix input mask	00
Parallel cable separator	\
Allow the routing of parallel cables via different routes.	No
Apply temperature derating factor to cable sizing	No
Duplication of PDB internals	Keep source names
SAP interface	Disable
Archive documents	Enable
Consistency rules	Enable
Consistency rules for batch operations	Cancel current operation
Display NULL when macros retrieve no data	No
External analyzing software	ETAP
Project name in external analyzing software	
Include enhanced reports in schematics	No
Default SmartPlant Instrumentation domain name	
Connect cables of control station or instrument to equipment circuit	No
Use audit trail	No
Allow full access to As-Built	Yes
When merging a document into As-Built, set preferences for revisions that have identical revision numbers in As-Built and project	Reject the document
Claim mode	Exclusive only
KKS mode	No
Cable fill validation to follow NEC method	Yes
Exclude characters from PDB row naming type	
Report items to publish to SmartPlant	Main items and all related items
PDB layout vertical displays	Row sequence and names
Show item tag names without spaces in RAD documents	No
Sorting method for assigning cable drums to cables	Descending

This will replicate the validation currently implemented in SP3D into SPEL and is based on NEC tray fill code and values in NEC tables.

Setting this parameter will be for the whole project and override any rule of the covered or uncovered, by area or width. The tray fill validation rules will be strictly according to the algorithm that follows the NEC 2005 Handbook.

The NEC rules for tray fill validation are based on data taken from Article 392.9 and 392.10 and the related tables that appear in these sections.

Basically, the rules are based on the following primary parameters and the various combinations of them:

- The voltage rating the cable is carrying (currently this is set to the insulation rated voltage). NEC divides the voltage to two groups, 2000v and below OR above
- Single core or multi core cables arrangement. The code doesn't address a mixture of these 2 categories of cables; therefore SPEL doesn't support such a mixture either.
- Is there a mixture of power and non power carrying cables (instrumentation, control, grounding)
- Type of tray on which cables are laid; whether it is ladder, Ventilated trough, Solid Bottom, Ventilated channel, solid channel
- Conductor sizes
- Tray dimensions

For each of the possible combinations of the above mentioned parameters NEC tabulates one of the following criteria:

- The allowable number of layers OR
- The allowable Fill Area OR
- The allowable tray width percent

All the limiting numbers of the allowable width and cross sectional areas are in fixed hard coded in SPEL program.
Note: NEC fill %fill calculation occurs only if the segment is associated to a reference raceway component.

Whenever the Options Manager is set to NEC fill validation the raceway trays components Common Properties is slightly modified as shown:

Cable Drums

Smart Plant Electrical provides for the management of cable drums. You can create cable drums and assign one or more cables to a cable drum. The cable drum assignment feature helps you to plan cabling tasks and optimize cable drum use. It also allows you to determine cable lengths so that you can purchase cables while minimizing a shortage or surplus of cable at the end of the project.

Manual Assignment

When assigning cables to drums manually, you associate a drum with a specific reference cable. You can define multiple drum sizes for each reference cable. These drum sizes are based on various cable lengths that a drum can hold. Once you associate a drum with a reference cable that has multiple drum sizes, you can select the most appropriate drum size for a particular drum.

Automatic Assignment

When assigning project cables to drums automatically, the software optimizes the cable assignment. Smart Plant Electrical optimizes this assignment based on the drum sizes, the maximum percentage of free cable length on the drums and the scrap cable length that you have defined for each reference cable that you select for drum assignment.

You perform automatic cable assignment by using the **Assign Drums to Cables** wizard. When using the wizard, you define the assignment parameters by selecting the following:

- All the available reference cables or just one specific reference cable.
- One or more pulling area.

The wizard will then assign all the project cables that comply with these parameters. Furthermore, the software will optimize cable assignment to the drums based on the drum sizes, the maximum percentage of free cable lengths on the drums, and the scrap cable length that you have defined for each reference cable that you selected in the wizard.

Although the order may vary, the following activities are essential elements in cable drum assignment for a given pulling area:

- Create reference cables and define sets of cable lengths so that you can optimize cable assignment to drums.
- Create project cables based on the reference cables.
- Create cable drums for all of the reference cables used in the pulling area.
- Assign all of the project cables in the pulling area to cable drums.

Cable to Drum Assignment lab

The cable drum assignment feature helps you to plan cabling tasks and optimize cable drum use. It also allows you to determine cable lengths so that you can purchase cables while minimizing a shortage or surplus of cable at the end of the project.

In this lab we will use the automatic cable to drum assignment wizard to assign 9 project cables to drums.

1. Create new 5 pulling areas (Area 1, Area A, Area B, Area C, and Area D).

2.Set drum size minimum to 10 m and maximum to 100 m for the reference power cables ‘3+1/C-12AWG -(Power / NEC)’.

3.Set pulling area for each of the 9 project cable according to the following table.

Project Cable			Reference Cable
Item Tag	**Actual Length**	**Pulling Area**	**Item Tag**
PC-MO-1	13.1 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-2	13.1 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-3	13.1 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-4	13.1 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-5	25.3 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-6	25.3 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-7	25.3 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-8	25.3 m	Area 1	3+1/C-12AWG -(Power / NEC)
PC-MO-9	25.3 m	Area 1	3+1/C-12AWG -(Power / NEC)

4. Select from action menu, Cables, and 'Assign Drums to Cables' option.

5.Select next to open the drum and cable option and select the following options:

Include assigned cables – Complete revamp in the design and start the assignment from scratch. This will result in first dissociation of the assigned cables from the drums.

Create new drums - Create new drums in case the operation fills up all existing drums and still cables are left to be assigned, otherwise, these cables will be left untouched waiting for new drums to be created manually.

Delete empty drums - In case the auto assignment shuffles results in empty drums, they will be deleted

Select all reference cables - Handle all the cables of all types in the project, otherwise, only for the selected type of cable

Based on the defined cable set, the system will present the cable for assignment available

for selection

Note: Cables without value for actual length or pulling area cannot be selected and might stop you from continue to the next step.
If cable data is missing. Select the cable and select common properties that will allow you to fill in the missing data.

6. Select next.

Cable Tag	Cable C...	Cable S...	Cable F...	C...	Actual ...	Pullin...	Cable Drum ...	Total ...
PC-MO-9	Power	Power -...	3 x 12 ...		25.0 m	Area 1	NewDrum_1	100.0 m
PC-MO-8	Power	Power -...	3 x 12 ...		25.0 m	Area 1	NewDrum_1	100.0 m
PC-MO-7	Power	Power -...	3 x 12 ...		25.0 m	Area 1	NewDrum_1	100.0 m
PC-MO-6	Power	Power -...	3 x 12 ...		25.0 m	Area 1	NewDrum_1	100.0 m
PC-MO-5	Power	Power -...	3 x 12 ...		25.0 m	Area 1	NewDrum_2	77.0 m
PC-MO-4	Power	Power -...	3 x 12 ...		13.0 m	Area 1	NewDrum_2	77.0 m
PC-MO-3	Power	Power -...	3 x 12 ...		13.0 m	Area 1	NewDrum_2	77.0 m
PC-MO-2	Power	Power -...	3 x 12 ...		13.0 m	Area 1	NewDrum_2	77.0 m
PC-MO-1	Power	Power -...	3 x 12 ...		13.0 m	Area 1	NewDrum_2	77.0 m

Notice: The cable sorted before assigned to drum. By default, it sorted in a descending order. There is a flag in option manager, general settings called 'sorting method for assigning Cables drums to cables'. The flag has 2 values that control the sorting method.

Descending - The cables are sorted from the highest actual length to the lowest.

Alternate - It start with the highest actual length, than the lowest actual length. Continue with the 2nd highest actual length, than the 2nd lowest actual Length and continue in the same alternate order.

Cables have been assigned to corresponding drums, from the longest to the shortest. The system needs to accommodate and take into account that the actual cable on the drum (total cable length on drum) must includes the spare and scrap cable length.

Total actual length assigned - Displays the sum of the actual length value of all the assigned cables.

Total cable length on drum - Displays the total length of the assigned cables on the current drum. The software calculates this value by adding up the **Total actual length assigned**, **Spare percentage on drum,** and **Scrap cable**

length values of the current drum. You can assign more cables to this drum so long as this value does not exceed the value of the **Maximum drum capacity** property.

Procurement status
A select list that let you lock the 'total length to order'.
Once select from the select list 'order'. The 'total length to order' becomes a fixed value which
Cannot be changed. In such a situation the drum cannot be deleted and this value is used from
Now on in a drum wizard session if recalculating or reshuffling existing drums.

Spare Status
Procurement property of the drum that allows you to define the current drum as spare. Defining a cable drum as spare entails the following:

- The cable drum becomes reserved and the software does not assign it to any cable.
- You cannot delete a spare cable drum.
- You cannot modify the **Total cable length to order** value.
- You cannot define a drum as spare if it is assigned to a cable. You have to cancel all the cable assignment by clicking **Remove** in the **Assigned cables** group box.

Locked /Cable Tag
Allows you to lock a cable to the current drum. Note that locking a cable to a drum makes it impossible to unassign this cable from the assigned drum or change the assignment to another cable drum. You can unlock the drum from the current cable by clearing the **Locked** check box, or clear the **Lock to drum** check box on the **Design Tab** of the **Cable Common Properties** dialog box.

Batch cable dissociation from drums

This option allows you to select a number of cable drums and dissociate them from the assigned cables. This can be useful, for example, when after assigning all cables to drums, you need to change the length of a cableway or segment.

In the Electrical Index, expand the folder hierarchy Wiring Equipment > Drums.

Select the drums that you require in the Item Tag pane.

Do one of the following:

- On the main toolbar, click Action > Cables > Batch Cable Dissociation from Drums.
- Right-click the selected drums and then on the shortcut menu, click Batch Cable Dissociation from Drums.

In the dissociation prompt, click Yes to confirm the dissociation.

Cable splices in drums

Cable splices in drums allow you to manage the cable's drumming with length more than maximum drum capacity. There are often situations in which cable lengths are very long, exceeding the standard

maximum cable allowable on drum. The solution that would be normal practice would be to order these cables as cut-lengths, and using splices to connect the cut lengths.
Smart Plant Electrical cable splices in drums automating the procedure of defining the number of splices based on the drum maximum capacity per cable and cut virtually the cable.

Cable splice lab

1. Set drum size minimum to 100 m, and maximum to 400 m for the reference power cable '3+1/C-350 kcmils -(Power / NEC)'.

2. Create in electrical index 2 project cables as appears in the following table:

Project Cable			Reference Cable
Item Tag	**Design Length**	**Pulling Area**	**Item Tag**
PC-1240	1240 m	Area 1	3+1/C-350 kcmils -(Power / NEC)
PC-120	120 m	Area 1	3+1/C-350 kcmils -(Power / NEC)

3. Run the assign drums to cables wizard.

Once the wizard opens, enter the data as shown:

The 1240 meter long cable has 3 splices (4 cuts or pieces). The cable assign to 4 different drums.

The shortest cut sharing the same drum with another short cable that could fit in one drum.

Looking at the drums common properties forms:

Cable PC-1240 is one cable that has been virtually cut 3 time to make 4 splices/pieces:

Cable splices cannot be removed from the drum and need to be accessed via the cable common properties. To see this in the cable common properties select the long cable, PC-1240

Select the view button open cable splices windows.

Un-assigning the cable from the drum will eliminate the splices and the virtual cable cuts.
User may customize the cable schedule report to include the information about the cable being spliced by using the new property “Number of Splices”
The drum composition report will show each of the cuts on its drum.

Cable Block diagrams

Cable Block Diagrams (CBDs) provide a graphical representation of the interconnection of all control, power, instrumentation, and grounding cables, and their related equipment such as power distribution boards (PDBs), generators, motors, and so forth, within your plant. They show the project cable flow between the various cabinets and equipment of your project.

Cable block diagrams are used in the preliminary planning stages of the project life cycle to verify the destination panels for cables as no wiring connections or terminations are needed at this early stage of your project. A CBD is also used for ordering made to order (MTO) cables at the feed stage of your project, and later after completion of your project as part of the maintenance program to show the location of all major cables, panels, junction boxes, and so forth. Use the same equipment and cables in more than one drawing.

SmartPlant Electrical allows you to drag and drop items from the **Electrical Index**, **Electrical Engineer**, and **Reference Data Explorer** to your drawing, and position them exactly where you want. The software creates a representation of existing cables on the fly, or you can manually connect cables between item connection points. SmartPlant Electrical checks any connection to make sure that it is legal and informs you if there is a problem.

The path of the symbols for cable block diagrams is defined in Options Manager:

Cable block diagram symbol path	\\adler4500\SPFiles\SPSite\PlantBasicRefData\Symbols\CableBlock

Create Equipment in CBD from typical on the fly

1. In EI create new PDB, and name it 'MCC-5'. Add bus and name it 'Bus A'. Add cell and name it 'FA2'.

2. In EI, select the cable block diagrams folder. Right click to create new cable block diagram and name it CBD-1.

3. Select CBD-1, right click and select Document Properties.
   From the document properties screen you can select the template, and choose what cable category to show.

4. Select OK to close the document properties screen. Select CBD-1, right click and select open.

5. From RDE, drag the typical circuit 'Motor Feeder<10hp' into the open drawing. It will open circuit dialog box where you need to select what PDB, Bus and cell you want to associate the new project circuit. Select MCC-5, Bus A, and F2A and select OK.

In the circuit item tag, enter 'F2A' for the circuit name.

6. In RDE, create new typical VFD and name it VFD-1.
7. From RDE, drag VFD-1 into the drawing.

   In the VFD item tag dialog box enter VFD-150.

8. From RDE, drag the typical power cable, '3+1/C-12AWG -(Power / NEC)' into the drawing.

   In the cable item tag dialog box, enter PC-150A

9. To connect the cable between the circuit and the VFD. Select the cable, to expose the connection point.

Select on one side of the cable, and drag it, to one of the feeder's connection point.

Repeat the same step to connect the other side of the cable.

Note: To dissociate cable connection. Select the cable to expose its connection points. Select connection point in the side you want to dissociate, and move it from the connection point.

Notice that creation new equipment, and connection done in the CBD can be seen in EI and EE immediately.

10. Save and close the document.

Note: As we saw in the above example, SmartPlant Electrical enables the user to locate a circuit as a legitimate item on a cable block diagram. Any circuit type can be dragged on the Cable Block Diagram and be connected with other equipment with cables. Each circuit can be dragged on the drawing if its Power Distribution Board is not on the drawing. On other hand, a PDB cannot be dragged on the drawing if one of its circuits is already located on the drawing. Placing circuit allow to have better granularity and ability to show only the cables that are related to a single load with its related equipment and the cables.

Cable Block Diagram for cables already pre-assigned

11. In EI, create new motor, 'M-150' using typical motor, 'M<10hp'.
12. In EI, create new power cable, 'PC-150B' using typical cable, '3+1/C-12AWG -(Power / NEC)'.
13. Open cable PC-150B and from connection tab make the connection from VFD-150 to motor M-150.

14. Open CBD-1.

The system shows the "reference to" equipment on cables that have connections at their open sides. (In the case the equipment at the open side is not in the drawing)
You may also select the macro and move it to a new place and save its position. Notice that when you select a macro, its cable gets highlighted- this would be useful in a drawing which has many cables and data and one may get confused which label belongs to what cable.

15. From EI, drag motor, M-150 into the open drawing.

16. Save and close the document.

Create and connect control station and cabinet.

17. Open CBD-1.
18. From RDE, drag to the open drawing the following typical items;

    Typical Cabinet, ‘Cab-1’.

    Typical Control Cable, ‘5/C- 2.5 mm2- (Control)’.

    Typical Control Station, ‘Emergency Stop Station’.

    Notice: The typical CS comes with one control cable, and one grounding cable.

19. Reposition, name and connect the new item in the drawing according to the following screen:

20. Save and close the document.

Special Notes

2 connection types used in CBD:

- 'Connection Point' type, for power category cables.
- 'Non-Power Connection Point' type, for all the other cable category types.

Selecting cables of one category will highlight only those connection types that match the cable type. Furthermore, each symbol has a definition of the connection ***point side, 1 or 2*** which coincides with the power flow of the point. Side 1 means the point at which power flows in, and side 2 corresponds to the point at which power flows out.

The system allows you to connect to each of the points, based on the SmartPlant Electrical rules for cable sides, depending on the cable category. Power cables have the convention of side 1 being the side at which power flows in (connect to the upstream) and side 2 corresponds to the side at which delivers power, exiting the cable.
For non power cables, there is no such limitation and each side of the cable can connect to any item type.

Connecting power category cables

The system has been designed smartly so that it identifies if the cable should be connected to side 1 of the cable or side 2, based on the item type, as the system behaves in the Electrical Engineer
Trying to violate or connect to an invalid point type will prompt a warning message or prevent you from connecting the cable against the rules
Only connection points will be illuminated when selecting power cables to connect

Connecting non power cables

From the Cable form - Connecting a non power cable from the form will follow the following rule:

Side 1 of the cable (the "from" side) will be automatically connected and presented in the CBD connected to the first available non power connection point type side 2
Side 2 of the cable (the "to" side) will be connected and presented in the CBD connected to the first available non power connection point type side 1

Trying to violate or connect to an invalid point type will prompt a warning message or prevent you from connecting the cable against the rules

Only non power connection points will be illuminated when selecting non power cables to connect

Connecting the cables in the CBD - Connecting non power cables on the graphical environment will be done according to the selected connection point side. User selects the equipment he wants to connect the cable to, and depending on whether he selects a non power connection points side 1 or 2, the cable will be connected to the "to" or to the "from" side of the cable. Trying to connect the other side of the cable to a point type similar to the other side already connected will not be allowed and the system will warn you with messages say:

"The 'To' side of cable 'Cable-1' is already connected to another equipment"

Connecting to Transformer

Transformers are special type of items as they include also one or two related transformer components. Due to this special item type the software has been designed accordingly, to cope with this situation.
In the transformer symbol for CBD, connection point with *side 1* is interpreted by the system as the connections for the primary winding. Connection points defined as *side 2* are interpreted as being defined for the secondary and, if the case is a 3 winding transformer, since the system does not know to which of the secondary the user wants to connect the cable there will be a system prompt that the user needs to confirm:

Filtering the CBD on cable category

In case there is a mix of cable categories on a CBD, and you want to focus on a certain category, you can filter the CBD by defining this in cable properties form.

1. Right click on cable block diagram CBD-1 and select document properties.
2. In the document properties windows, select only the ‘Power’ ,’Display cable types in cable block diagram’ section.

3. Open the cable block diagram CBD-1.

4. While the drawing open. Bring up the document properties, and change back the filter to the default (all the 4 cable categories are selected). Select OK to close the document properties.

Notice about the option called '**Display only cables connecting two visible items'** — With this option selected, cables of the selected cable types are displayed in the cable block diagram only if they connect between two items that are actually visible in the drawing; if only one of the items is visible, the cable is not displayed. Clear this check box to display all cables of the selected types.

Addition CBD features

- **Reconnect cable in a different place along the line**

  Allow you to reconnect the cable in different place along the symbol line.

- **Move macros**

  Allow you to move symbol's macro, and keep the new position.

- **Scale a symbol**

  Allow you to scale symbol in CBD drawing, and keep the new scale.

- **Print and Save option**

  User can print out CBD document.

  User can save the document also as an external file.

  The save as format could be one of the following:

  *.SPE (can be views with SPEL or SSK)

  *DWG

  *DGN

  *DXF

  *DGN

- **Annotations and Redlining**

You can mark up CBD document using text or symbols as annotations. The software saves annotations in the same layer as the graphical elements of the drawing.

Redlining appears in a separate drawing layer and you can hide and display redlining as you require. The software saves the drawing with the redlining items. When opening a drawing that contains redlining items, the software automatically displays the drawing in redlining mode. You can switch back to regular mode and modify the drawing as needed. The software saves the existing redlining items regardless of whether you open the drawing in redlining mode or not. You can add text, symbols, lines, circles, rectangles, and watermarks as redlining.

- **Revision**

  The software allow you to add revision to CBD document.
  The software also allow you to use global revision for CBD documents
  and perform a number of revision activities for a group of selected documents.

- **Compare an Archived Document with a Current Document**

The software allows you to archive cable block diagrams in your SmartPlant Electrical database. This option then makes it possible to compare an archived version of a document with the data in the current version of that document.

Wiring Diagram

Wiring diagram let you produce dynamic cable termination diagram.
The wiring diagram capability includes:

- Create terminal strips for all type of equipment, where applicable.
- Create, within the terminal strips, terminals
- Connect and terminate cable wires between equipments
- Manage both cable and conductor sides 1 and 2 (wires have 2 sides, each side can be labeled differently)
- Create wiring diagrams
- Creation of termination reports
- Retrieve connectivity data into schematics

Wiring Diagram module manages interconnections between equipment, external to PDBs or the main equipment, where the internal circuit wiring will still be handled by the typical schematics, module, and the cable terminations will reach up to and including the circuit strips.

Symbols for Wiring Diagram

Symbols for wiring diagram are stored in the path defined in the Options Manager:

Wiring diagram symbol path	\\adler4500\SPFiles\SPSite\PlantBasicRefData\Symbols\Wiring

This directory contains various symbols that the wiring engine expects to get.

The system tries to present the wiring symbol of an item on a wiring diagram by first searching to see whether there is a custom symbol for the wiring of the object. In case there is not, the system will pick the symbol as defined in the symbology, for that specific item type, in case no symbol has been defined for the item type, it will select the default symbol as defined in the “wiring symbols” directory.

SPEL is shipped with default wiring symbols for terminal strip, terminal and first terminal. This will allow generating wiring diagrams out of the box without any further customization.
The minimum set of symbols required is: first terminal and terminal, cable, set and conductor (SPEL ship these as defaults).

SPEL can terminate only those cables that have already been associated to equipment at their sides.

Creating terminals and terminal strips in equipment

Individual terminals creation in Index

1. From EI, select the terminal strips folder of motor M-1
2. Right click to create new terminal strip, name it TB-1

3. Right click on TB-1 and create new terminal, name it 'R-1'

4. Using duplicate option continues and add another 4 terminals.

Using typical strip configuration

1. Create new terminal strip configuration in RDE.

2. Right click on the new configuration, select common properties, and type in the following configuration.

3. In EI, select motor M-2.
4. Create new terminal strip for M-2 and name it TB-1
5. Right click on TB-1, and select common properties.
6. Select the find button.

7. Find the strip configuration, '5 Terminal Strip Config', and select it.

Find
Tag:
Find Now
New Search
Equipment type:
Ref Terminal Strip Config
Layout:
OK
Cancel
Apply
Help
Properties
Show only properties that have data values
Property
Value
Identification
Description
Electrical Equipment Class
Electrical Equipment Sub Class
Electrical Equipment Type
Miscellaneous
Comply with Naming Convention
Sequence in Group
Process
File Name
Results
No.
Item Tag
Equipment Type
1
5 Termnilas Strip Config
Ref Terminal Strip Config
1 Ref Terminal Strip Config items found.

Terminal Strip Common Properties [TB-1]
Terminal strip tag:*
TB-1
Description:
Terminal Strip Configuration
Total number of terminals:
5
First terminal:
1
Find...
Terminal strip pattern:
Sequence
Prefix
Numbered
Incremented
Suffix
1
R-
2
S-
3
T-
4
N-
5
G-
Add
Remove
OK
Cancel
Help

Connection type

The next RDE item that is needed for wiring is "**connection type",** and it relates to how the conductors/cores should connect to the terminals upon trying to connect a cable to a terminal strip:

Create Connection Type - From RDE, select Connection Types folder. Right click, and select New Connection Type.

Create connection type that connecting one and skip one terminal.

Skip = Number of terminals that a wire should skip and connect to, terminals counted from the starting terminal user specifies/points when landing the cable on the strip. Skip 2 in the above configuration, for example means that 2nd wire will be connected to the 3rd terminal (based on user starting to connect the cable from first terminal of the strip)

Active Side Conn - The actual side of the terminal on which the user is landing the cable.

Opposite Side Conn- The opposite side of the terminal on which the user is landing the cable.

Note: There are no typical fully wired objects in RDE. No ability to define a completely wired assembly.

Wiring project items

1. In EI create 2 cabinets, 'MC-100' and 'PLC-30'.
2. Create strip 'TB-1' to each of the cabinet.

3. In EI, create control cable, 'CC-2000' from typical cable '3/C- 10 AWG - (Control)'.

4. Connect cable CC-2000 from MC-100 to PLC-30.

5. Create new wiring diagram (WD) and name it 'WD-1'.

6. Right click on WD-1 and select open.

7. Drag the MC-100 and PLC-30 into the drawing.

8. To make the connection, do the following steps:
   1. Select both strip.

   2. Select Activate Connection Mode button.

   3. Select the cable that connects this equipment (CC-2000),and move your cursor over the wiring diagram.

   4. Select the first terminal of the left equipment strip, at its connection point at the right side and click on the blue circle.

After connecting on the first terminal, drag the cursor with the cable over to the next equipment on the right side and land it on the first terminal. Select the "Custom connection" again and finish the connection.

To move a wire/set from one terminal to another you need to disconnect it and reconnect (right click on the wire or on the set or on the cable and select "disconnect")

5. Save the document and close it.

Note: The number of conductors that one can connect to a terminal depends on the number of connection points available on that terminal (as defined in the terminal symbol in catalog manager)
To connect 2 conductors to a terminal one needs to define the terminals having 2 connection points at each side, like this:

Each terminal also has addition connection point to connect a jumper.

To connect jumper in PLC-30, TB-1 between terminals N-4 and G-5 open the wiring diagram WD-1.

1. Open the document and select activate jumper mode

2. Select the first jumper connection point.

3. Select the second jumper connection point and finish the connection.

4. Save the document and close.

Batch cables sides' termination

This feature supports performing a wiring operation on a set of cables that share the same pattern of wiring; a good example for that would be the ability to terminate all the control cables associated to 10 hp motors. Make sure that you have few motors sharing the same connectivity. For this, you may create the same type of strips of 2 sets of motors connected to feeder circuits and cables connecting them to the circuits. For example motors 'M-1','M-2', feeder circuits 'Feeder-1','CKT-46', and cables PC-0001,PC-0002.

Note: Make sure the 2 motors and the 2 circuits contains terminal strip.

Select cables PC-0001 and PC-0002

From actions menu select cables and 'Batch Cable Connection' to open the batch cable connection screen. Type in the following settings and select ok to apply the connection.

Note: Be sure to select the right cable active connection sides otherwise the conductors will be shown terminated on the wrong side.

Let's now see the actual connection made by the system. Either open a new wiring diagram or use the previous one. Drag the 2 motors and the 2 corresponding circuits to the wiring diagram and see that they have been connected according to the specified strips and connection patterns.

Wiring Shipped Reports

Cable wiring schedule

This report is based on the cable item type and retrieves and lists the selected cables with their conductors showing to which strip and terminal they are connected.

Cable Tag: CC-2000
Description:
Specification: Control
Formation: 3 x 10 AWG

INTERGRAPH

Revision:
By:
Date:

Cable Wiring Schedule

From			Conductor				To		
Equipment Item Tag	Strip Name	Terminal Name	Name	Set	Color	Polarity	Terminal Name	Strip Name	Equipment Item Tag
MC-100	TB-1	R-1	CONDUCTOR - 1				R-1	TB-1	PLC-30
	TB-1	T-3	CONDUCTOR - 2				T-3	TB-1	
	TB-1	G-5	CONDUCTOR - 3				G-5	TB-1	

Terminal strips schedule

Report that based on the terminal strip you select in the Electrical Index.
Don't select specific item type and run the report.

PDB: PDB-1
Bus: Bus-1
Equipment: Feeder-1
Type: Circuit
Description:

Revision:
By:
Date:

Terminal Strip Schedule

Cable	Set	Wire	Polarity	Color	Terminal Strip	Terminal
PC-0001		CONDUCTOR - 1			TB-1	R-1
PC-0001		CONDUCTOR - 2			TB-1	S-2
PC-0001		CONDUCTOR - 3			TB-1	T-3
					TB-1	N-4
					TB-1	G-5

Terminal strips schedule- Panel

Report that based on the panel you select in the Electrical Index.
Don't select specific item type and run the report.

	A	B	C	D	E	H	I
1							
2	Panel: MC-100					Revision:	
3						By:	
4	Type: Cabinet		INTERGRAPH			Date:	
5							
6			Terminal Strip Schedule - Panel				
7	Cable	Set	Wire	Polarity	Color	Terminal Strip	Terminal
8	CC-2000		CONDUCTOR - 1			TB-1	R-1
9						TB-1	S-2
10	CC-2000		CONDUCTOR - 2			TB-1	T-3
11						TB-1	N-4
12	CC-2000		CONDUCTOR - 3			TB-1	G-5
13							

Parallel Equipment

SmartPlant Electrical allows you to define a parallel relationship between equipment items. With the Parallel Equipment Assistant UI, the user select the equipment with their parallel relation. After the relation has been established, the equipment can be place in CBD and they will appear as connected in parallel.

Parallel connections of equipment items in a cable block diagram

Let's look on CBD-1 drawing we created before.

Let's see how to add second motor and define it as a parallel equipment.

1. From EI, create new motor, M-151, by duplicate motor M-150.

2. From EI, create new cable, PC-151, by duplicate cable PC-150B.
3. Click Actions > Manage Parallel Equipment.
4. Select the Add button in the Parallel Equipment Assistant.
5. In the parallel equipment definition, select M-150 for item 1 and M-151 for item 2.

6. Select OK to close the Parallel Equipment Assistant. In EI and EE, a special indicator appears next to the equipment items that are connected in parallel.

7. Open CBD-1, and drag to the drawing the new motor M-151 and the cable PC-151.

8. Select cable PC-151, and from the parallel pairs drop down select 'M-150-M-151, In'.

9. Select one side of the cable and connect it to M-150 and the other side to M-151.

Let's also generate SLD and see how the parallel motor appears.

Auxiliary Contact (AC) – an Item Type which is a child item of Disconnect Electrical Equipment (DEE). Each AC should have a relationship to its parent item.

Relation between auxiliary contact to electrical equipment

1. From EI, create motor, M-250 with space heater, SH-250.
2. From EI, create main PDB, 'PDB-4', with bus, 'BUS-4A'.
3. Under BUS-4A create feeder circuit,'CKT-4A1'.
4. Under the feeder circuit create contactor, 'CTR-250'.
5. Under the contactor, create AC, 'AUX-250'.
6. Add second bus, 'BUS-4B'.
7. Under BUS-4B create feeder circuit, 'CKT4B1'.

8. Create 3 power cables, 'PC-M250', PC-SH250', and 'PC-AUX250'.

9. Connect cable PC-M250 to circuit CKT-4A1.

10. Connect cable PC-AUX250 to circuit CKT4B1.

11. Find in EI the AC AUX-250, and drag it into EE on cable PC-AUX250

12. Connect cable PC-SH250 to AC AUX-250.

13. Connect motor M-250 to cable PC-250.

14. To generate SLD of the system we created. Using the Ctrl key, select in EE buses BUS-4A and BUS-4B and generate SLD

Single Line Diagram Options
General
Page Settings
Circuits & Internals
Buses
Related Equipment
Miscellaneous
Control station options
Show control stations associated with equipment
Control stations symbol displacement:
X:
Y:
Units:
16
0
mm
Space heater options
Show space heaters next to associated motors
Space heater symbol displacement
X:
Y:
Units:
8
0
mm
Metering and relaying equipment options
Show metering and relaying equipment
Metering equipment first symbol displacement:
X:
Y:
Units:
12
8
mm
Vertical displacement:
12
Auxiliary contact options
Show auxiliary contacts next to disconnect equipment
Auxiliary contact symbol displacement
X:
Y:
Units:
8
0
mm
Parallel equipment settings
Horizontal distance:
Vertical distance:
Units:
20
20
mm
Generate
Cancel
Help

PDB-4
BUS-4A
PDB-4
BUS-4B
CKT-4A1
CKT-4B1
PC-AUX250
3 x 12 AWG + 1 x 12 AWG
CTR-250
AUX-250
PC-M250
3 x 12 AWG + 1 x 12 AWG
PC-SH250
3 x 12 AWG + 1 x 12 AWG
M
M-250
SH-250
Sheet 1

Document Revision History

- Rev. 0. Initial Release of SmartPlant Electrical version 1.0.0.0. Basic Training Doc. #DELE2-TB-100001A (JUN-18-2002)
- Rev. 1. match to release 1.0.3.8 (AUG-06-2002)
- Rev. 2. match to release 1.0.4.5
- Rev. 3. match to release 01.05.00.08 (APR-14-2003)
- Rev. 4. structure change and match to release 02.00.00.00 (SEP-03-03)
- Rev. 5. Updates and enhancements to match version 03.00 (AUG-1-2004)
- Rev.6. Updated for version 03.05.00.26 (SEP-1-2005)
- Rev. 7. Updated for version 03.05.00.26 (MAR-1-2006)
- Rev. 8. version 03.05.00.26 (JUL-20-2006)
- Rev. 9. Version 04.00.01.07 (APR-24-2007)
- Rev. 10. Version 04.01.02.10 (SEP-10-2007)
- Rev. 11. Version 04.01.02.10 (OCT-21-2007)
- Rev. 12. Version 04.01.03.07 (NOV-9-2007)
- Rev. 13. Version 05.00.00.18 (NOV-30-2008)
- Rev. 14. Version 06.00.01.06 (MAY-25-2009)
- Rev. 15 Version 06.00.02.34 (OCT-28-2009)
- Rev 16 Version 06.00.03.0234 (JAN-21-2011)

Appendix A
S-001 Demo SLD

SLD Generated from Electrical Engineer

Using Ctrl Key, select the following 4 sources to generate the SLD
- S-001
- G-001
- MCC-201 Incomer A
- MCC-202 Incomer A

REV	DATE	BY	CHK	DESCRIPTION

REVISIONS

SmartPlant Electrical

INTERGRAPH

DRAWN BY:			PROJECT NO:
APPROVED BY:			DRAWING NO: S-001 Demo SLD
APPROVED BY:			Last Rev:
APPROVED BY:			Page of