POWERFACTORY

PowerFactory 2024

What’s New

PF2024

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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***Welcome to PowerFactory 2024*!**

In this year's *PowerFactory* release we have, as always, improvements across all aspects of the software, from the user interface right down to the most detailed equipment models.

PowerFactory 2024 puts much focus on enhancements for easier use of *PowerFactory*. This includes faster access to commonly used functionalities via user-configurable hotkeys and a customisable Quick-Access menu; details of these new features can be found in section 3.2. Options for the graphical representation of grouping objects and controllers likewise allow easy visualisations and access from any network diagram, while the automatic creation of detailed substation diagrams has been improved, as described in 2.2. In addition, the Data Manager and Network Model Manager can now be used in tabbed windows and docked into the main graphic window; see 3.1.

We would also like to highlight some of the extensions to our analysis functions. For the analysis of distribution networks in particular, the *State Estimation* now offers unbalanced calculations, and the *Low Voltage Load Flow* is supported within existing functionalities, such as *Hosting Capacity* (see 1.10), *Connection Request Assessment* (see 1.8) and *Cable Analysis*, which is also enhanced with various additional options, detailed in section 1.7.

The *Unit Commitment and Dispatch Optimisation* module has been extended to enable users to include curative redispatch, as described in section 1.9. The curative actions make it possible to bring a network back into normal operation mode after a fault has occurred. Therefore, the network can be operated in a cost-optimal way that still accounts for $n-1$ security.

More details on all these, and other analysis function developments, can be found in section 1.

Any analysis and simulation is always only as good as the underlying model. Knowing that, we always aim to give our customers all the tools needed to have the best possible model available. New power equipment models therefore have been introduced (see section 4) including the Multi-winding Transformer and additional models for PV installations. Many existing models have also been extended to add flexibility and facilitate the wide-ranging calculation options.

Finally, it is not just the *PowerFactory* model and analysis functionality itself that has new features: changes relating to scripting and interfaces are described in sections 5 and 6.

We hope you enjoy reading about all the new developments and we wish you continued success with *PowerFactory 2024*.

Your DIgSILENT team

Contents

1 Analysis Functions

1.1 *Load Flow Analysis*

1.1.1 Consideration of bay constraints in loading calculation

The bay's nominal current is now used to calculate a dedicated bay loading in the *Load Flow Analysis* and related calculations such as the *Contingency Analysis*. This bay loading is taken into account when evaluating the maximum branch loading, depending on the project settings. Bays are now coloured in the network graphics according to their loading.

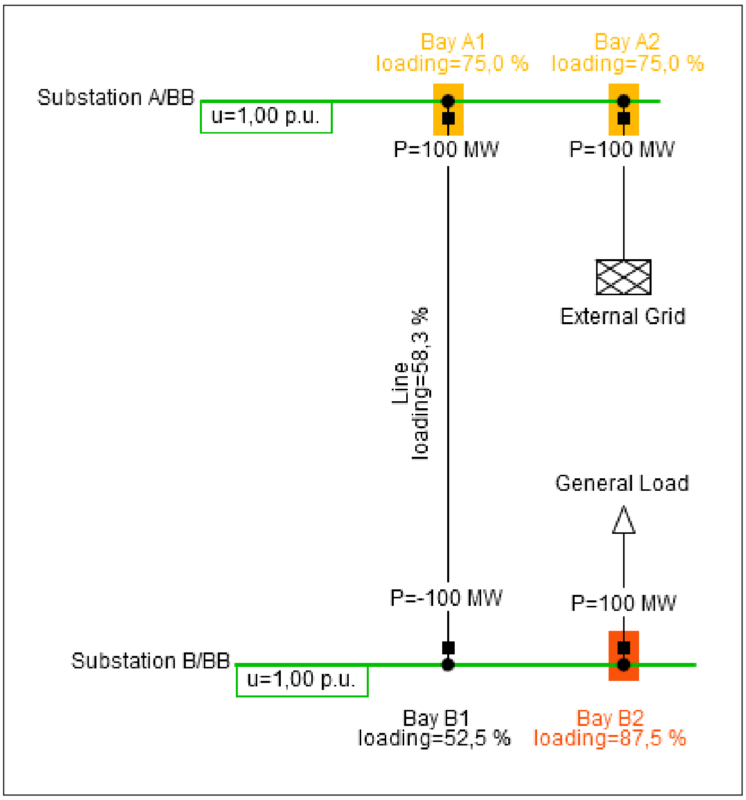

Figure 1.1: Bay loading colouring in schematic network diagram

1.1.2 Consideration of thermal ratings for busbars and bays

The existing thermal rating object in *PowerFactory* can now be linked to busbars and bays located within a substation. This enables the consideration of meteorological conditions when determining the loading of busbars and bays, and the introduction of short term ratings for bays. A meteorological station can be specified in the substation object (*ElmSubstat*).

1.2 *Short-Circuit Analysis*

1.2.1 Refactoring of the current iteration calculation in the *Complete Short-circuit* method

Following enhancement of the *Complete Short-circuit* method in *PowerFactory 2021*, where the method was aligned with Engineering Recommendation G74 issue 2 calculation approach, a re-engineering of the existing current iteration calculation has been carried out.

This iterative calculation is used to more accurately solve the non-linear problem that exists whereby the short-circuit current infeed of models that provide voltage support under fault conditions also depend upon the voltage deviation experienced by the model.

With *PowerFactory 2024*, the performance and application of this option has been enhanced as described below:

Limitation of constant current injection models

For models that can be configured to provide a constant current injection during Complete method short-circuit calculations, the current iteration approach now ensures that current injections from these models are constrained by the configured maximum current injection of the model, in accordance with the equations detailed in the corresponding technical references.

Evaluation of the operating point of Metal Oxide Varistor protecting series capacitors

For close up faults where higher fault currents are flowing, series capacitors may be bypassed by Metal Oxide Varistors (MOV) in order to protect the capacitor from high voltages. With *PowerFactory 2024*, it is now possible to more accurately evaluate the operating point of the MOV. Instead of considering the capacitor to be completely bypassed when the MOV is conducting, a linearised model of the MOV can be considered, where its impedance depends on its operating point. Since the operating point of the MOV is dependent on the voltage it is subjected to, which in turn depends on the current flowing through the series capacitor, a current iteration approach can be used to iteratively vary the short-circuit current until a solution emerges. Details of the approach can be found in the technical reference of the Series Capacitor.

1.3 *Contingency Analysis*

1.3.1 Phase angle assessment

The *Contingency Analysis* function is used to analyse the circuit loading and voltage impact of faults in a network. The results of each fault calculation, together with the base-case results, are stored in a result file. The size of this result file is managed by allowing the user to set limits to restrict the data being recorded to just the results that are significant.

Until now, the command has offered standard and advanced options relating to the recording of absolute values and step changes of loading and voltage. In *PowerFactory 2024*, additional recording options are available, to record results relating to voltage angle (*m:phiu*).

The results of interest are:

- **Voltage angle changes between base case and n-1 (or n-k):** This quantity is important for the identification of potential dynamic stability issues arising from the fault.
- **Voltage angle differences between line-end nodes:** This quantity, referred to as asynchronism, is significant when considering whether the outaged circuit should be reenergised and put back on load.

The new options are shown in Figure 1.2 below.

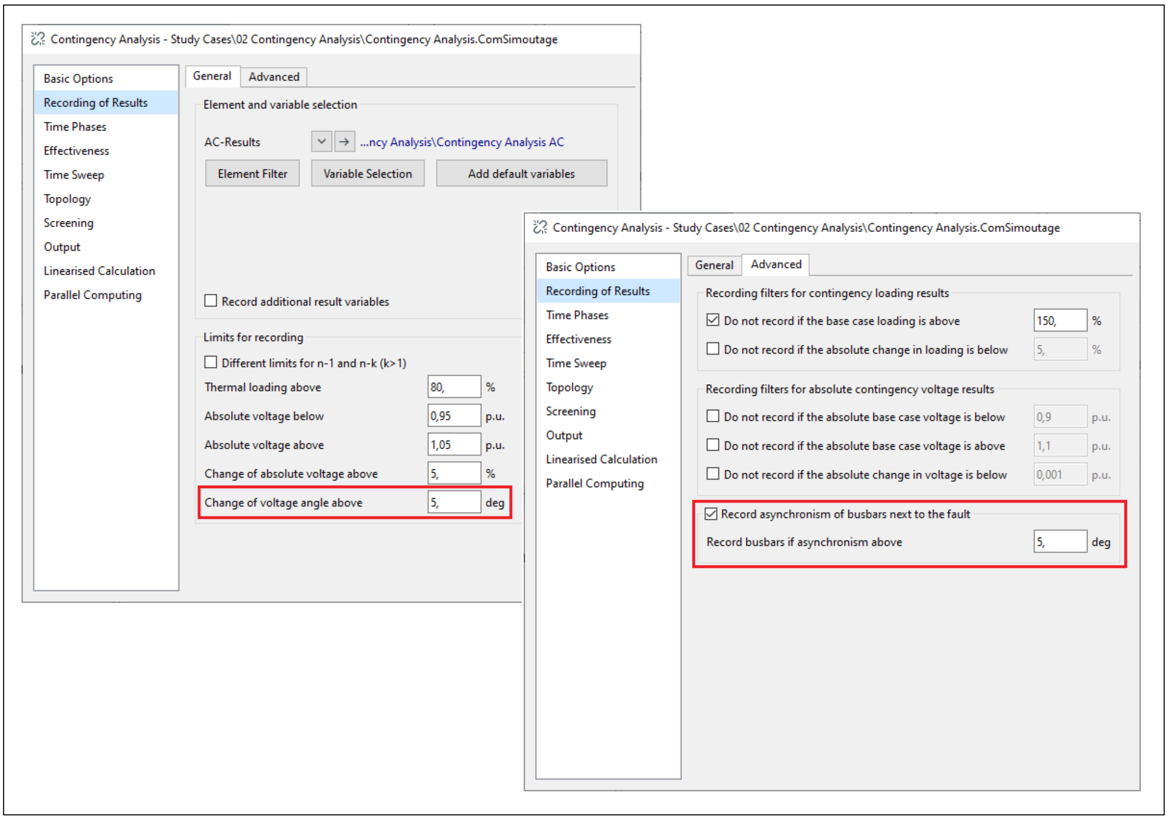

Figure 1.2: Voltage angle recording options in the *Contingency Analysis* command

Reporting of results

Additional reports are available.

The report for the recorded voltage angle step changes is shown in Figure 1.3.

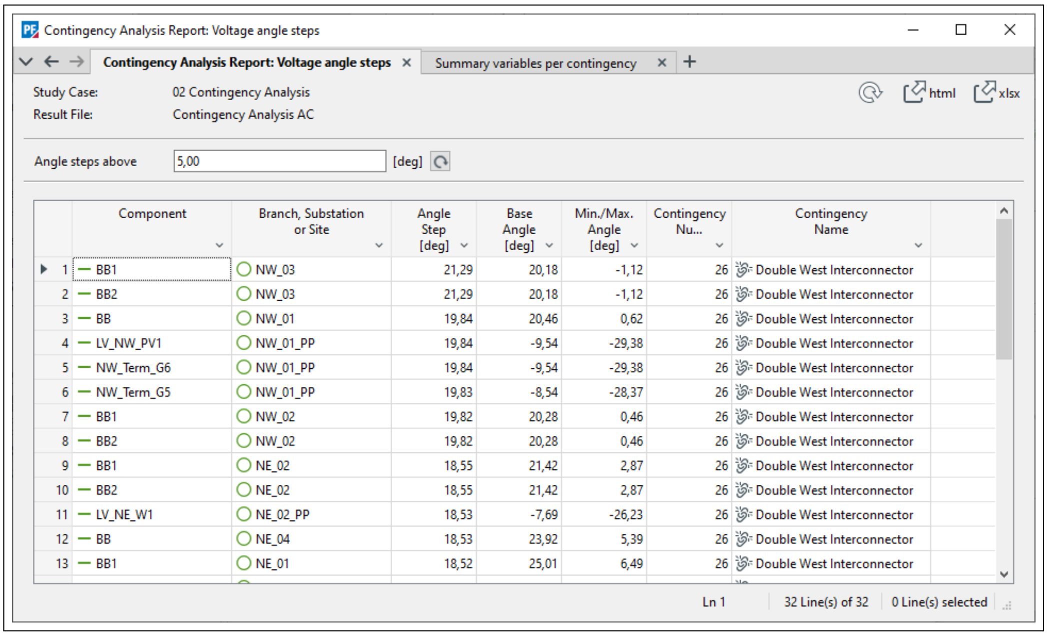

Figure 1.3: Report of voltage angle step changes

The reporting of voltage angle differences between line-end nodes is handled differently. The *summary variables per contingency* option is used in this case; when this option is selected, the maximum asynchronism is reported for each fault outage, as shown in Figure 1.4 below. Note that this quantity is not calculated for transformers, as large phase angle shifts are to be expected when transformers are faulted.

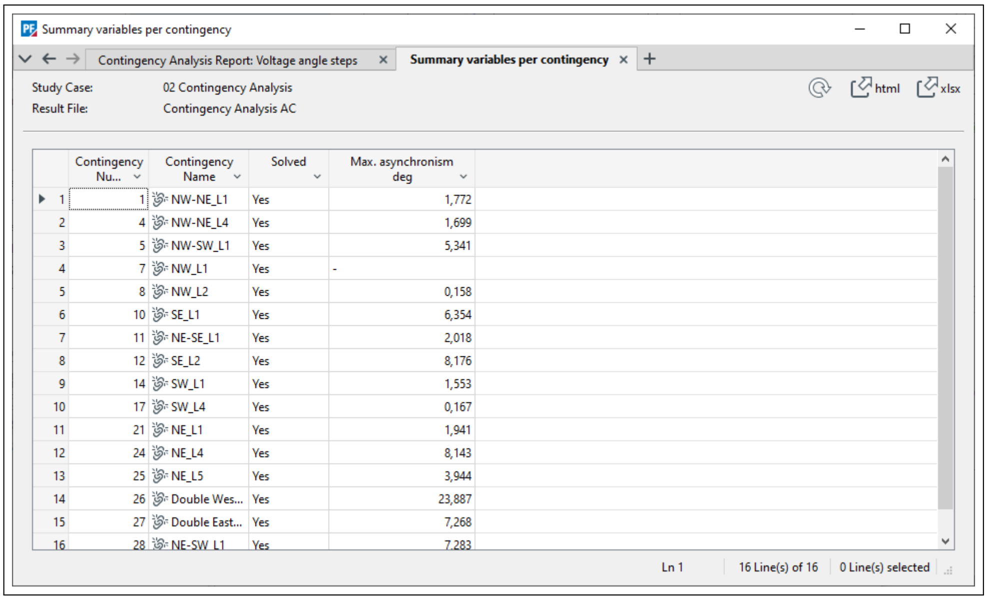

Figure 1.4: Summary report of maximum asynchronism per contingency

Remedial Action Schemes

The voltage angle step can also be used to act as a trigger in Remedial Action Schemes. The voltage angle step is available directly as a post-fault condition.

1.4 *Quasi-Dynamic Simulation*

1.4.1 QDSL enhancement for synchronous machines and static generators

In some cases it is necessary to control the voltage phase angle of a synchronous machine or generator directly. This can now be realised with QDSL models in *Load Flow Calculations* and *Quasi-Dynamic Simulations*, as the *Voltage Angle Setpoint* has been added as an available output parameter of the QDSL Load Flow Equations for Synchronous Machines (*ElmSym*) and Static Generators (*ElmGenstat*). Combined with the settings introduced in section 4.4.5, this means that it is also possible to control the voltage angle of several units at the same time.

1.5 RMS and EMT Simulations

1.5.1 Modelica language in *PowerFactory*

Backward initialisation

Modelica Model Types (*TypMdl*) now support backward initialisation in a similar way as DSL Model Types (*BlkDef*). As an example, a network model (e.g. Synchronous Machine) is initialised with a certain set point according to the load flow calculation. This set point is an input of the network model and can be connected to a controller; the controller is implemented using a Modelica Model Type. The output value of the controller has to be the same as the input set point of the network model to start the simulation at a steady state. It therefore should be known (i.e. backward) during the initialisation of the Modelica Model Type. The Modelica Model Type and its functionalities are enhanced to support such backward initialisation.

An example is illustrated in Figure 1.5, which also shows the data input pages. All output and input signals can now be initialised locally, i.e. in the model itself, or externally, i.e. by the model it is connected to. Setting this local or external initialisation of inputs and outputs is done under the column Initialisation in the sub-pages Inputs and Outputs. The Modelica Model Type edit dialog has a new page Local Initialisation to write the initialisation of the complete model. The page Local Initialisation is active if the Initialisation is set to Local for any of the inputs.

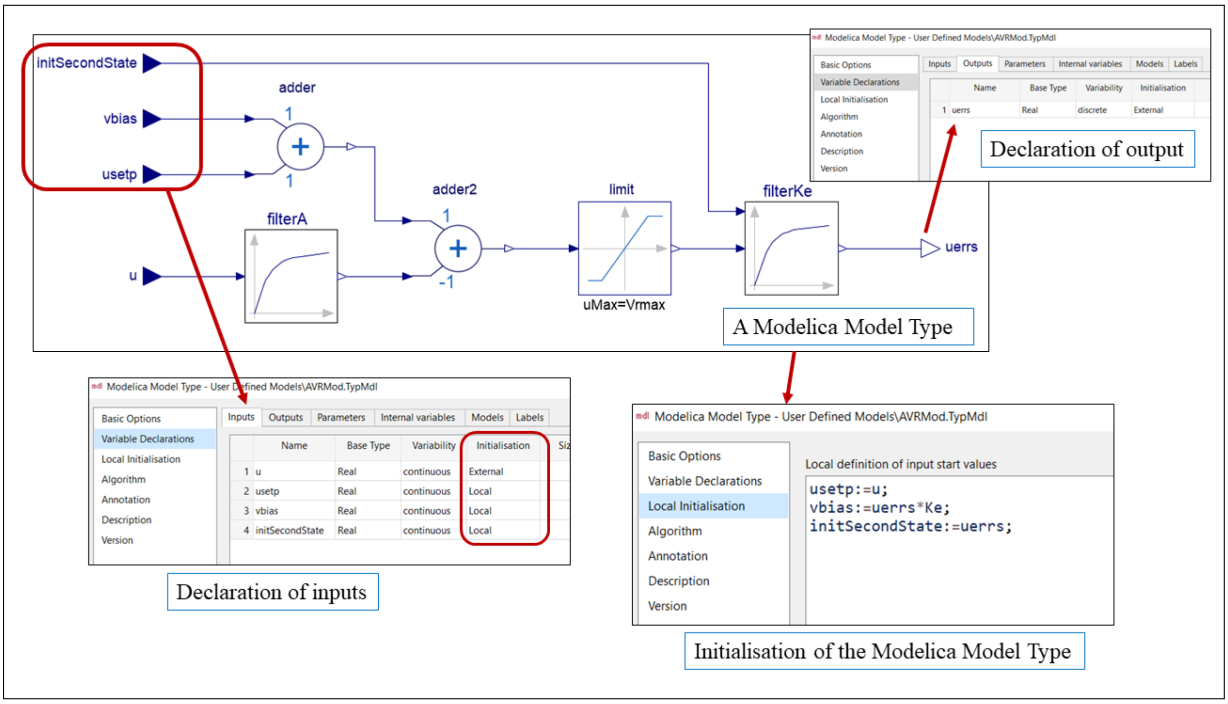

Figure 1.5: Use of backward initialisation in a Modelica Model Type

Support of parameterised size of arrays

It is now possible to configure the size of model inputs, outputs, parameters and internal variables based on model integer parameters. This way, increased flexibility is achieved, especially for dynamic models that need to represent a variable system size e.g. a generic state space model, or to control a variable number of similar power system components e.g. a wind power plant controller of n wind turbines, a controller of m mechanically switched shunt (MSS) units, each MSS having a number of shunt positions, or a controller for an HVDC-MMC Model with n levels. An example of a time-discrete state space representation of a dynamic system is provided in Figure 1.6.

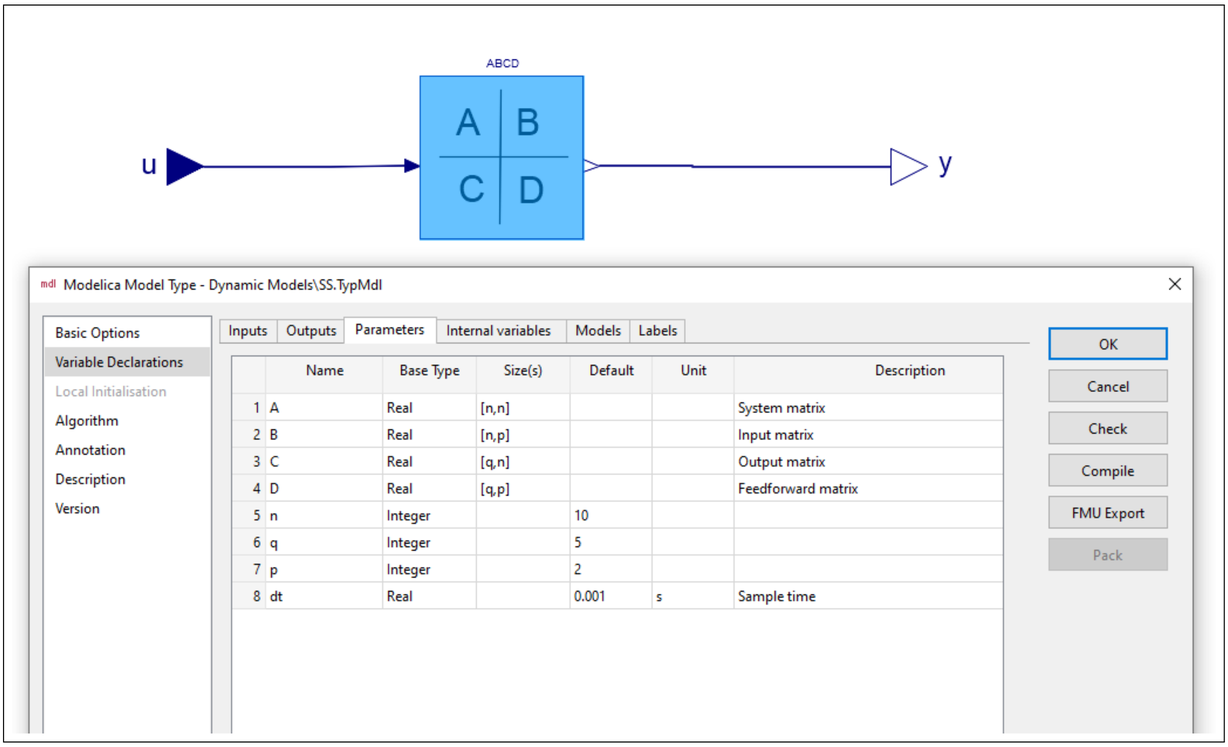

Figure 1.6: Example of a generic state space model of variable size

Support vector of components

It is now possible to create complex models by taking advantage of the vector of components concept. This functionality allows users to use simple blocks intended for processing scalar inputs/outputs and create blocks that are applicable for vector inputs/outputs. A simple example is shown in Figure 1.7, where two vector inputs of size 3 are applied to a product block (which is intended for scalar inputs) and a per-phase instantaneous power calculation is obtained as a vector size 3. Each *Modelica Component* dialog now has an entry field called *Size(s)*, where the size of the vector of components (integer number) can be entered. In the trivial case of components representing model inputs/outputs (in example, inputs u_abc and i_abc as well as output p_abc), the *Size(s)* field represents the size of the variable (e.g. keep empty for a scalar, or enter an integer number n for a vector signal of size n).

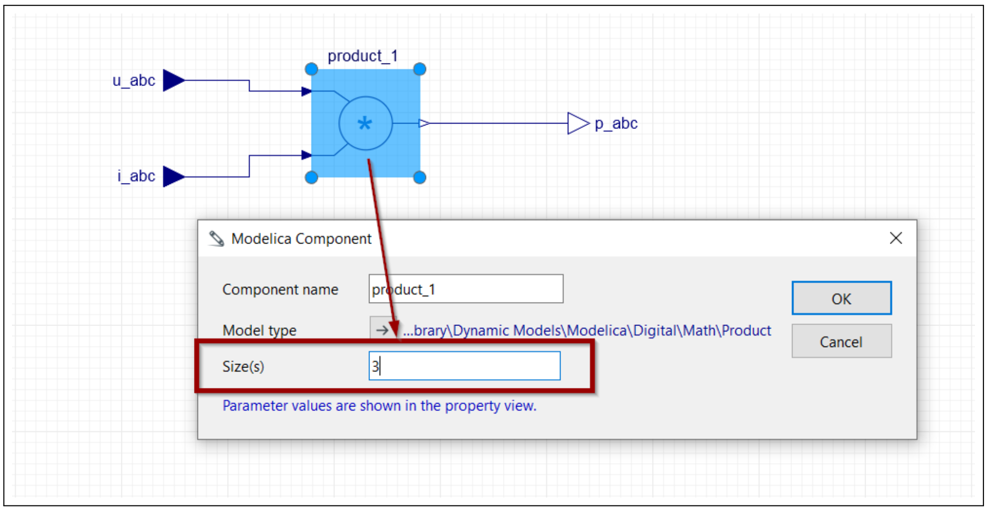

Figure 1.7: Example of a simple per-phase instantaneous power calculation

Support of conditional components

It is often the case that the structure of a dynamic controller model depends on various configuration parameters. It is therefore advantageous to be able to customise this structure depending on certain conditions applicable to model parameters, which can be regarded as configuration parameters.

PowerFactory 2024 addresses these needs by introducing the support of Modelica conditional components for model inputs and outputs. For example, Figure 1.8 shows a simple integrator block that can be customised to support an external reset input signal or an external initial conditions signal depending on the value of given configuration parameters.

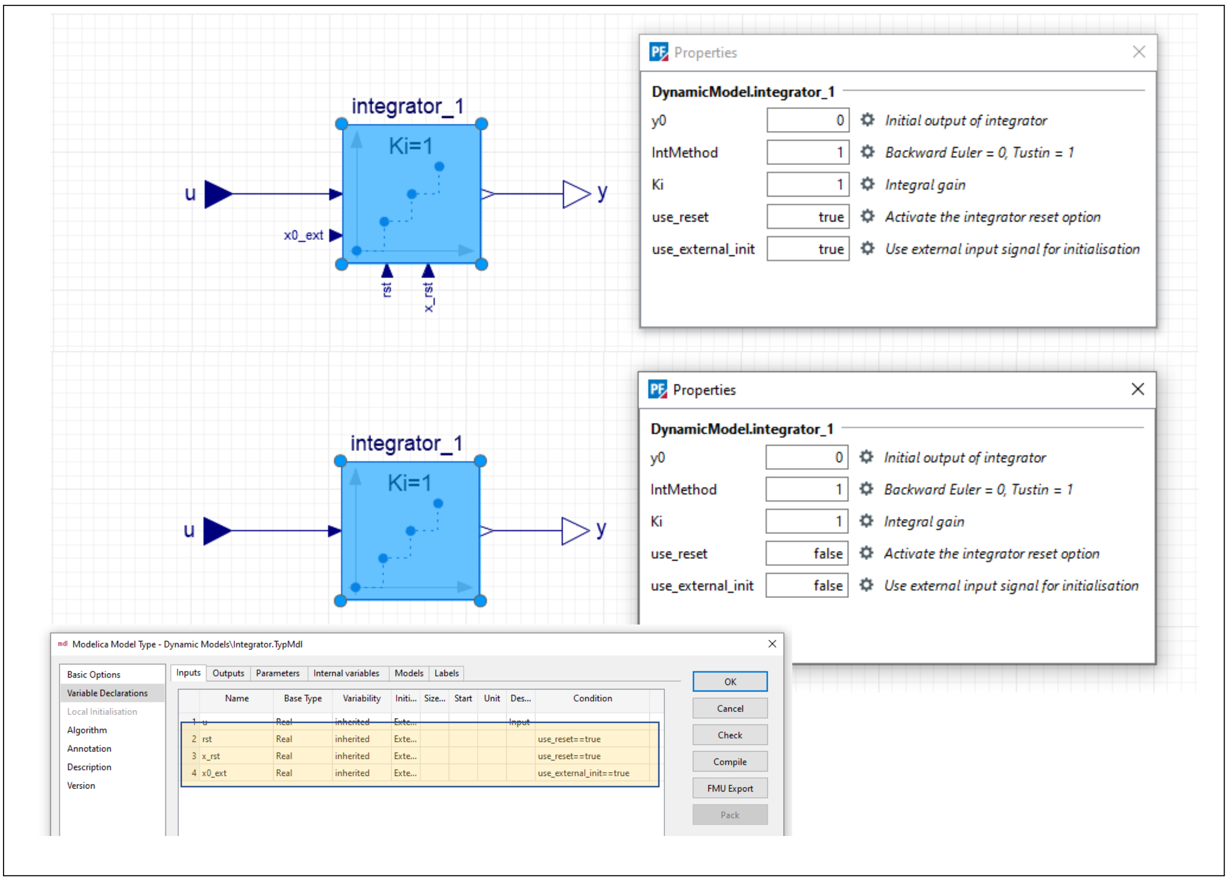

Figure 1.8: Enhancement of an integrator block by means of conditional components functionality

Support of *while* statements

In *PowerFactory 2024*, *while* loops are supported in the context of algorithms. Various applications may require it, such as individual capacitor balancing functions in HVDC-MMC systems, optimal power dispatch algorithms within Wind/Solar Power Plants and on-line controller tuning algorithms.

Further improvements to the Modelica diagrams

A number of improvements are included in *PowerFactory 2024* to enhance the graphical modelling environment for Modelica models. The improvements are detailed in Section 2.1.

1.5.2 *Internal Co-simulation*

Automatic *Co-simulation* region detection and definition

The workflow of the single-domain (RMS-RMS, EMT-EMT) internal *Co-simulation* function has now been enhanced by allowing the automatic detection and definition of *Co-simulation* regions within a power system model. This is a particular advantage for users with large networks where the number of regions and the identification of boundary elements is not straightforward.

The function uses advanced heuristics in determining an optimal network split irrespective of the network size and topology, while still allowing users to set various criteria on the region selection, e.g. number of regions, minimum travel time of valid boundary elements, etc.

The automatic region detection function is readily available in the *Initial Conditions for Co-Simulation* command dialog, via the **Partition Network** button (*Single/Multiple Domain page* → *Regions tab*→ *Network partitioning pane*).

Depending on the options selected in the *Network partitioning pane*, the function is able to consider as *boundary branches* any AC line within the power system model, irrespective of whether it has been configured as a lumped or as a distributed-parameters line model. This feature is highly useful when users wish to increase the performance of a monolithic (whole-network) simulation by means of parallelisation (using the *Co-simulation* engine), while avoiding the additional effort of manually defining the *Co-simulation* regions.

Simplified plotting procedure for *Co-simulation* results

When executing a *Co-simulation*, a result file is generated for each region of the network. These result files are stored as sub-result files in one single main result file. In previous versions it was necessary, when plotting results, to identify the correct sub-result file corresponding to a certain network element, among a potentially large number of sub-result files.

In *PowerFactory 2024*, when plotting results of a *Co-simulation*, users do not need to identify the sub-result file any more, but can simply select the main result file and then proceed with the element and variable selection. *PowerFactory* automatically searches and identifies the correct location of results within the main result file. As such, the procedure of presenting results is identical for both the monolithic simulation (RMS or EMT) and the co-simulation.

1.6 *Arc-Flash Hazard Analysis*

1.6.1 EPRI calculation method

With previous *PowerFactory* versions, the Lee method as used by *PowerFactory*'s implementation of the IEEE 1584 Arc-Flash Calculation was the only approach available for the determination of arc incident energy for voltage levels higher than $15kV$. For some applications it is perceived that this method produces overly conservative results. For this reason, and in response to user demand, *PowerFactory 2024* has introduced the EPRI (Electric Power Research Institute) calculation method. The EPRI method is designated by EPRI and is thought to produce more accurate results for certain applications. Although aimed at high voltage applications, the method is applicable at all voltage levels. Unlike the other *Arc-Flash* methods in *PowerFactory*, it has been implemented so as to consider single phase to ground short circuits when evaluating arcing currents, which are the more commonly encountered fault type in high voltage networks.

In accordance with the method, parameters can be specified at all accessible locations corresponding with the expected arc length, an applicable statistical correction factor and a working distance.

1.7 *Cable Analysis*

1.7.1 *Cable Sizing* calculation options

Several developments have been made to the *Cable Sizing* calculation command, as described in the following sections.

Load flow options

While in previous versions the *Cable Sizing* was always done according to the load flow calculation in the modelled network, new options have been added for sizing cables:

- *Standard Load Flow*: The default option according to the linked *Load Flow* command.
- *Low Voltage Load Flow*: The *Low Voltage Load Flow* based on coincidence definitions can be used to size cable types with a more conservative approach.
- *User defined current*: For each investigated cable a user-defined current can be defined, for a very simplified sizing approach without using a load flow calculation.

The recommendation of new cables types allows the possibility to include *Short-Circuit Calculation* constraints as well. The investigated faults and their durations can be flexibly adjusted by the user.

Calculation of derating factors

The standard VDE 0276-1000 for medium-voltage cables is introduced into the *Cable Sizing* command, allowing the user to size cables and determine derating factors according to that standard.
In addition, the calculation of derating factors has now been integrated into the sizing process and does not have to be executed separately, which makes the calculation much more convenient.

New options for recommendation process

A number of new options have been introduced to the recommendation process of new cable types to offer greater flexibility. Figure 1.9 shows the updated process, with the options as follows:

New constraints 1 can be considered and verified for each selected cable:

- Maximum voltage drop along a cable
- Maximum short-circuit current

Downsizing 2 is now allowed for cables that do not violate the initial constraints. This allows the user to optimise oversized cables to required cross-sections.

Additional verification options 3 are available for the sizing process to cover real restrictions:

- When parallel lines are considered, the maximum number of cables in the same trench can be defined.
- The availability of cable types can be defined to indicate whether they are in stock or not.
- The terminals at the line ends can be considered, in order to limit the installation of parallel lines, e.g. when coupling sleeves are represented by terminals.

Previously, the focus was on higher cross-sections to comply with constraints, but now different options are available 4 to optimise the cable sizing:

- The option *Cross Section* prioritises higher-cross sections before considering parallel lines.
- When prioritising *Parallel Lines*, the installation of parallel lines with the same cross-section as the existing one is preferred.
- Optimising the *Costs*, including cable types and installation costs, finds the optimal solution where both options of increasing the cross-section and adding new parallel lines are taken into account.

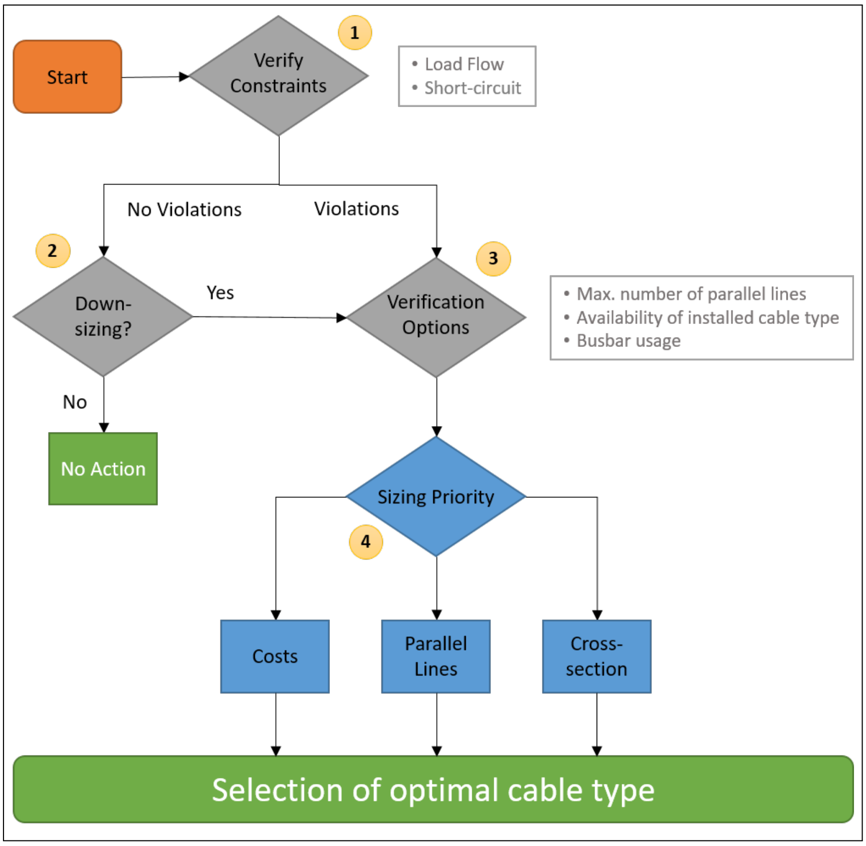

Figure 1.9: *Cable Sizing* process to find the optimal cable type

1.7.2 *Cable Sizing* reports

The *Cable Sizing* reports, previously produced as ASCII reports in the Output Window, are now generated by default in PDF format. It is possible to export the reports from *PowerFactory*, either as PDF documents or in other commonly used formats.

1.7.3 *Cable Ampacity* enhancements

The modelling of cable installation in the Cable Layout object has been improved to cover more configurations.

- Cable systems or phases of a cable system can now be flexibly installed in separate ducts as illustrated in Figure 1.10.
- When cables are located in ducts, it is now possible to fill the duct with a user-defined material.
- For cables buried in trenches, options have been added to define up to three different soil layers.

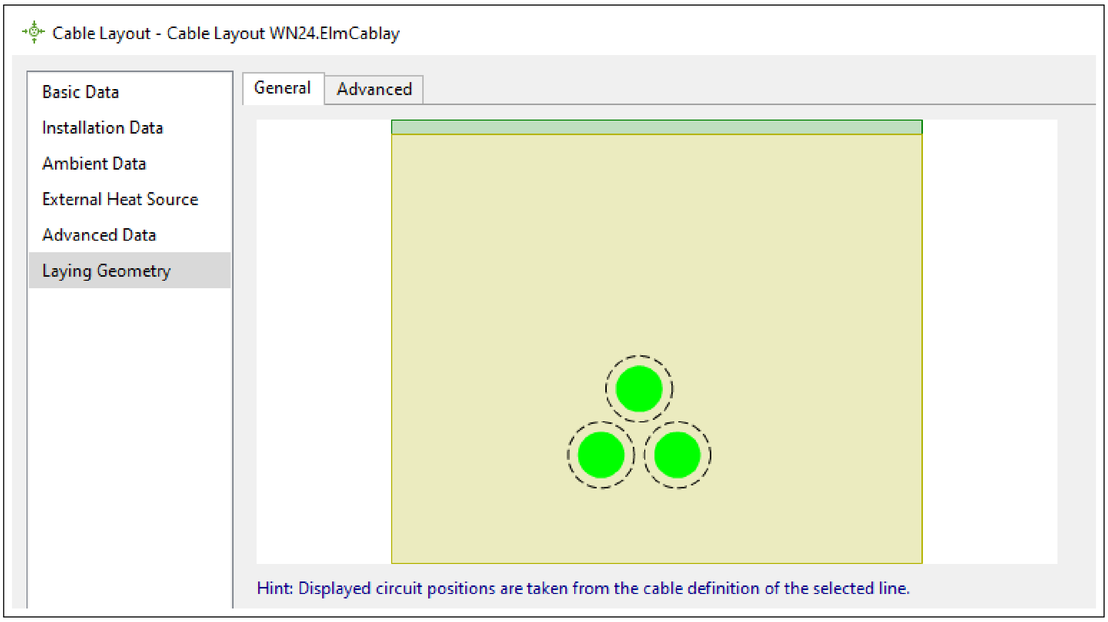

Figure 1.10: Single core cable with each phase located in separate duct

To give the user more insight, additional quantities are given in the results to verify the calculation. In particular, the exact temperatures at the different isolating layers are provided. This allows the user to monitor the surface temperature of a cable to verify its impact on the surrounding soil.

1.8 *Connection Request Assessment*

1.8.1 D-A-CH-CZ Edition 3 - high voltage

With *PowerFactory 2023*, Edition 3 of the D-A-CH-CZ guideline was added, covering low- and medium-voltage networks. *PowerFactory 2024* now also features the newly published guideline extension for high-voltage networks. The relevant voltage level of the D-A-CH-CZ guideline is automatically selected during the execution of the *Connection Request Assessment* by evaluating the junction point of the connection request that is either searched automatically or is user-defined in the *ElmConreq* element.

1.8.2 User-defined limits

The connection request standards provide methods for assessing the acceptability of connecting new loads and generation units. However, due to the individual needs and particularities of different grid operators, it may be necessary and useful to deviate from the recommended limits. With *PowerFactory 2024*, the possibility to select user-defined limits was therefore extended to include the latest versions of the VDE-AR-N 4100/4105 and VDE-AR-N 4110 standards. In Figure 1.11, the selection is shown using the example of VDE-AR-N 4110. Within the same dialog, the default values can be easily restored if necessary. The limits are included in the PDF report, so that adjustments can also be documented and traced at a later date.

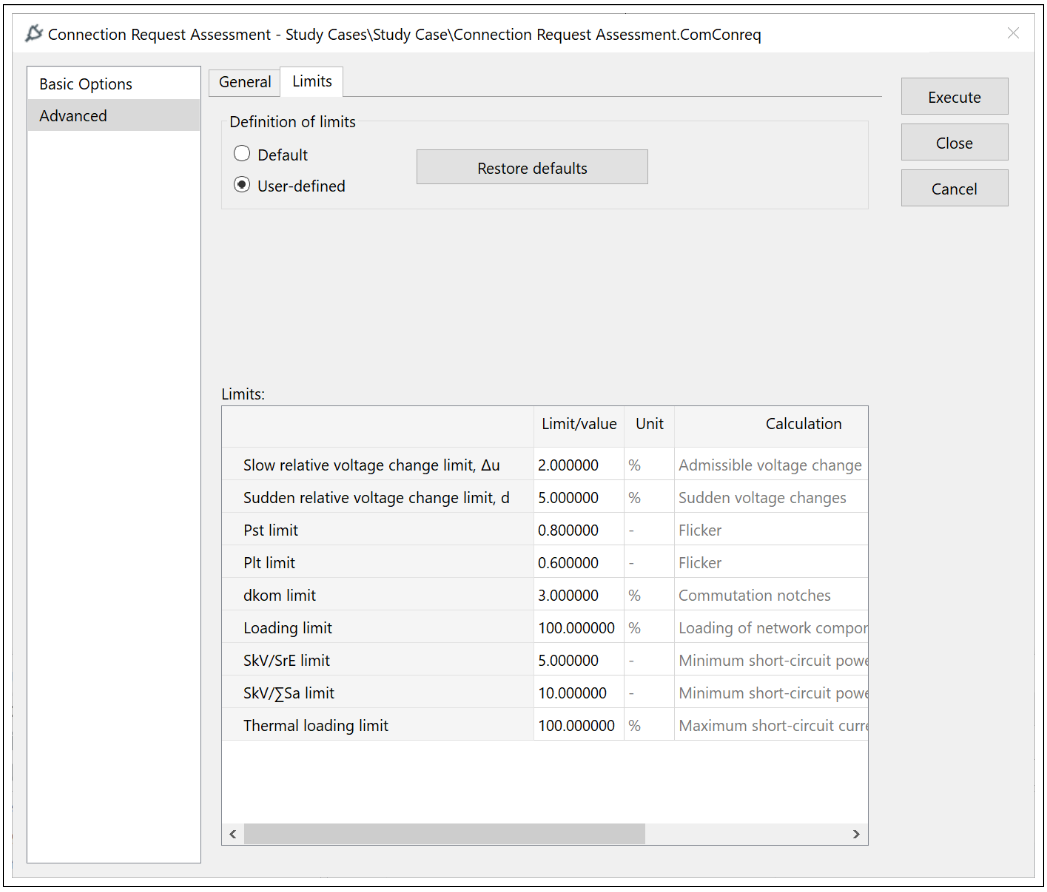

Figure 1.11: Selection of user-defined limits for the VDE-AR-N 4110 assessment

1.8.3 Calculation based on *Low Voltage Load Flow*

The *Low Voltage Load Flow* introduced in *PowerFactory 2023* can now also be used for the *Connection Request Assessment*. If this load flow calculation method is selected, it will be used in the calculation of voltage changes and the loading of network components.

1.9 *Unit Commitment and Dispatch Optimisation*

1.9.1 Support of curative redispatch

PowerFactory now supports the distinction between preventive and curative redispatch actions. The available control options are extended by a curative margin, which represents the possible deviation of a control from the optimised base case in a contingency. Available preventive and curative controls are active and reactive power controls of generating units and HVDCs, tap controls of transformers and shunts and load-shedding. For each individual controlling network element, it can be determined whether it is to be used for preventive and/or curative redispatch actions.

The result of the *Unit Commitment and Dispatch Optimisation* is therefore an optimised base case that satisfies all $n-0$ constraints and a set of curative post-fault actions for each contingency and time point. The network including curative controls can be operated with more relaxed constraints because of the additional control margins that can be used in different ways depending on the contingency.

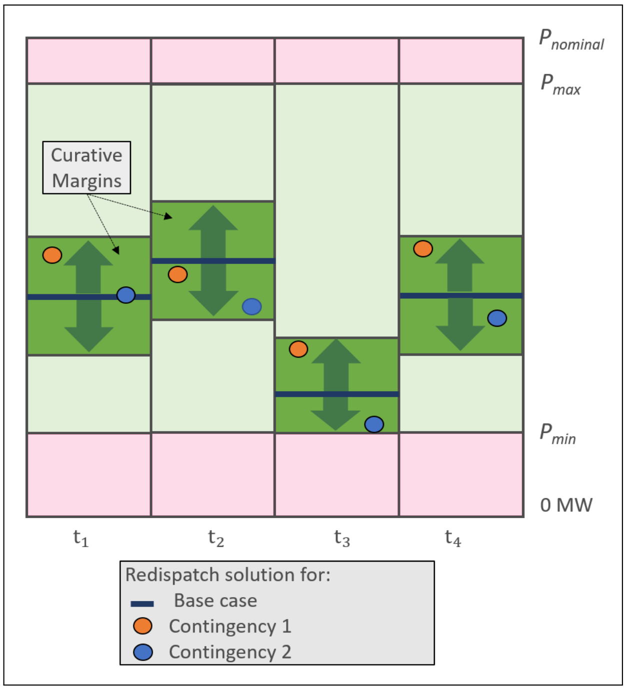

Figure 1.12: Visualisation of the operating margins of a thermal generating unit with curative control margin enabled

Figure 1.13 below shows the difference in the curtailment of a variable renewable energy source (VRE) in a purely preventive redispatch case (blue) and a redispatch including curative actions (green).

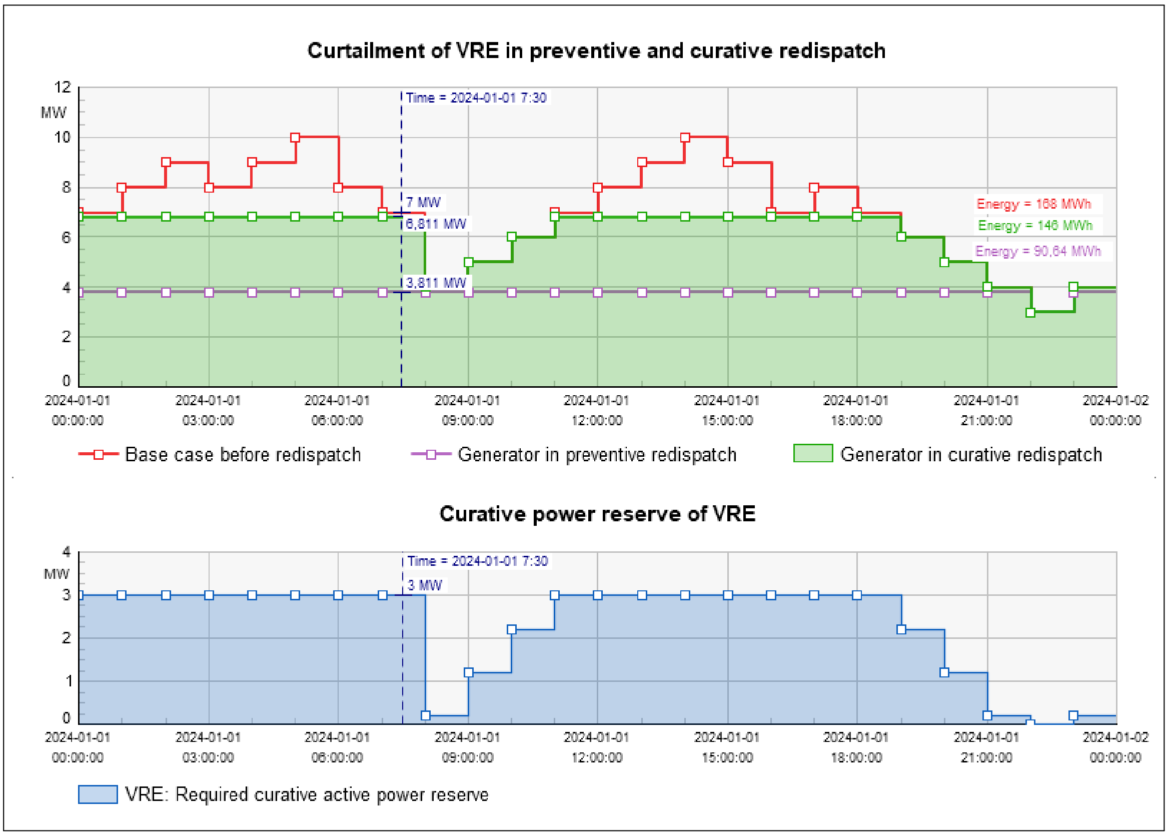

Figure 1.13: Infeed of a VRE in curative vs preventive redispatch and used curative power reserve

The maximum curative power margin of the VRE shown in Figure 1.13 is $3MW$. The generating unit can operate up to this additional margin compared to a preventive solution and less curtailment is required in this case. For other bidirectional controls, such as active power injection of thermal generating units and transformer tap changes, the curative actions can be applied in opposite directions for different contingencies based on the preventive solution.

A special report for curative redispatch actions is available for evaluating the results. The Curative Controls report provides the summary results as well as the individual actions for each control and each contingency.

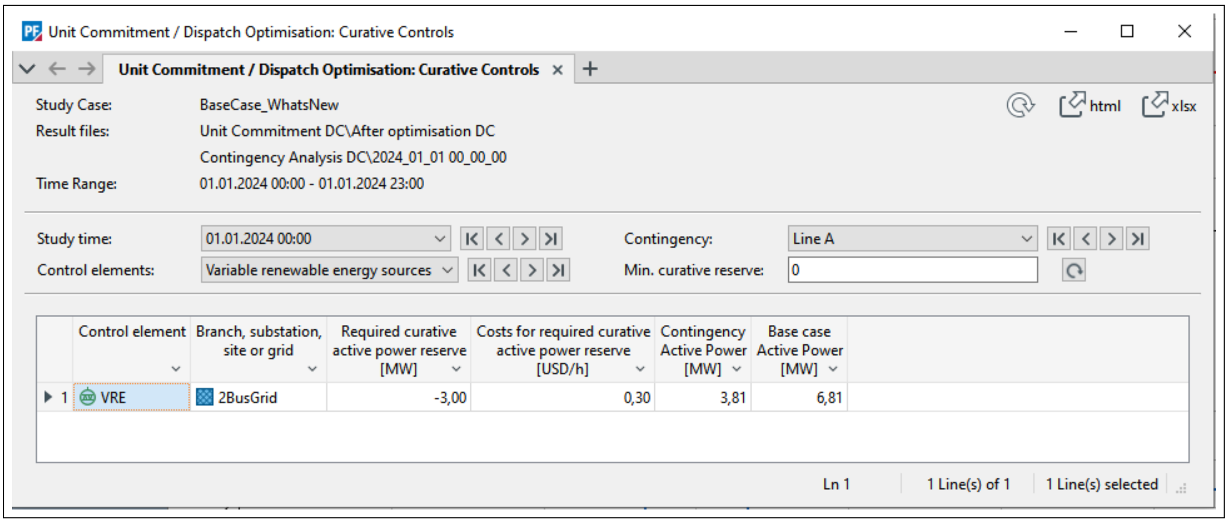

Figure 1.14: Curative redispatch report

1.10 *Distribution Network Tools*

1.10.1 Support of *LV Load Flow* in *Hosting Capacity*

The *Low Voltage Load Flow* introduced in *PowerFactory 2023* can now also be used for *Hosting Capacity Analysis*. When the spare load capacity is calculated with the *Low Voltage Load Flow*, a Low-Voltage load (*ElmLodlv*) will be connected to the terminals being investigated, instead of a General Load. For this Low-Voltage load, the Coincidence Definition can be selected, so that the coincidence with existing loads can be considered. Additionally, it can be decided whether the individual power of a single customer or the number of customers with this coincidence definition shall be increased by the *Hosting Capacity* tool, as shown in Figure 1.15. If “Customer number increase” is selected, the permissible number of customers at each terminal will be displayed as additional result variable in the tabular report.

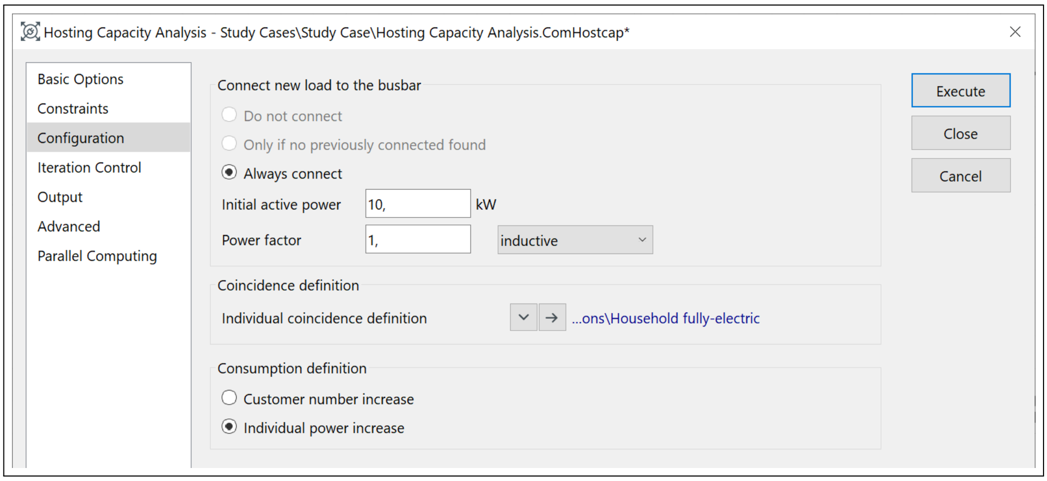

Figure 1.15: Configuration of the Low-Voltage Load

It is also possible to use the *Low Voltage Load Flow* as calculation type for estimating the capacity for distributed energy resources. In this case, the configuration of the generation unit to be connected remains the same as in previous versions, but coincidence curves are taken into account.

These developments have been complemented by greatly improved calculation performance.

1.10.2 *Tie Open Point Optimisation* reports

The *Tie Open Point Optimisation* reports, previously produced as ASCII reports in the Output Window, are now generated by default in PDF format. It is possible to export the reports from *PowerFactory*, either as PDF documents or in other commonly used formats.

1.11 *State Estimation*

1.11.1 Unbalanced *State Estimation*

State estimation has traditionally been used for transmission systems, where many redundant measurements exist. Bad data from the measurement equipment should be identified and treated in order to determine the most feasible currents and voltages within the grid. In particular, it has been a task for grid operation and has only required a symmetrical (balanced) calculation.

However, due to the constantly increasing number of distributed generation units and new loads, the challenges at distribution level are also increasing. At the same time, there are more and more measurement devices in distribution systems (e.g. advanced metering systems). This makes state estimation at distribution level possible. Due to the unbalanced load conditions in the distribution system, an unbalanced state estimation is therefore necessary. In addition to the classic use case, state estimation also becomes relevant for distribution system planning purposes in order to make realistic power assumptions.

The *State Estimation* module now also supports unbalanced calculation. With unbalanced *State Estimation*, unbalanced measurement values can be considered and unbalanced states are calculated.

The *State Estimation* command has been revised, as shown in Figure 1.16. In addition, to support the development, a number of measurement device models have been extended; details can be found in section 4.6.

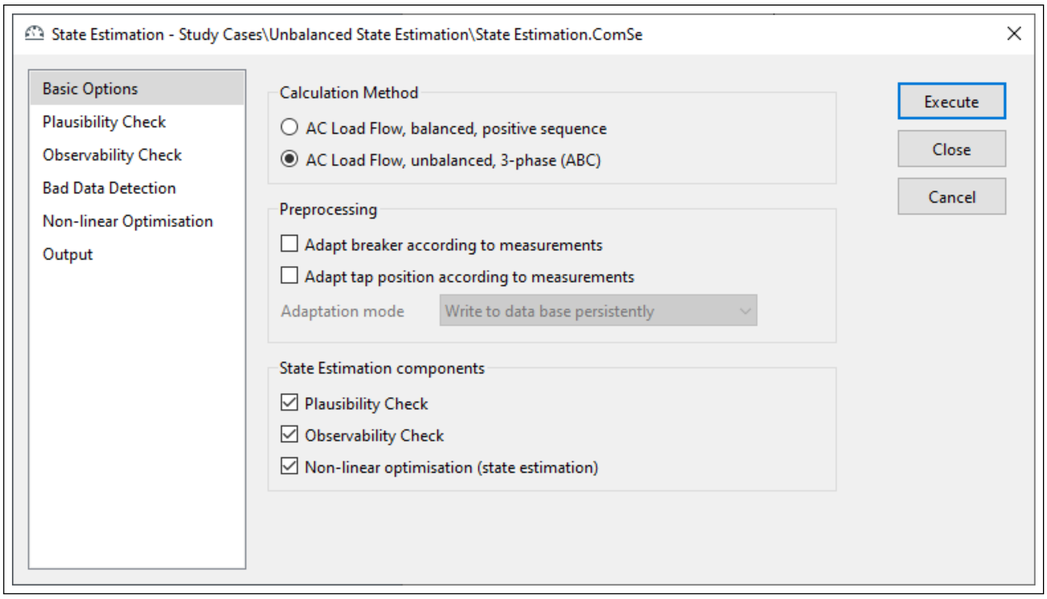

Figure 1.16: The *State Estimation* command dialog

1.12 Reports

1.12.1 Additional PDF reports

New PDF reports, to replace former ASCII reports, are now available for:

- *Cable Sizing*; see section 1.7.2
- *Tie Open Point Optimisation*; see section 1.10.2

1.12.2 Printing from PDF Viewer

The printing functionality for reports generated in the PDF Viewer has been improved. Printing now works in the same way as for graphics, with preview and setting options available in the print dialog. Prints can be generated using *File* → *Print...* or via the print icon in the PDF Viewer toolbar.

2 Network Diagrams and Plots

2.1 Modelica diagrams

Modelica diagrams have been further enhanced with a number of features, as detailed below.

2.1.1 Highlighting model errors

During the development of dynamic models, various modelling errors may inherently appear. Especially for complex model diagrams, the model developer may find it very difficult to quickly identify the location where these errors exist and need correction. Addressing these challenges, *PowerFactory 2024* automatically highlights problematic components and connections that users must correct. Many issues are now automatically detected, for example: invalid syntax in a component, wrong component configuration and invalid connections between components. Error debugging processes are thus greatly simplified, enabling users to create Modelica-compliant models more quickly and easily.

Two new buttons are available in the Model canvas toolbar:

- Check Model : Performs a model check of the model whose diagram is now shown, including subsystems.
- Highlight Invalid Components : Highlights (in red) the invalid model components. The button operates as a toggle, such that this highlight mode can be switched on and off depending on the button state.

Figure 2.1 shows typical output when the Highlight Invalid Components check is carried out on a faulty model. The errors are listed in the output window and the invalid components highlighted in red.

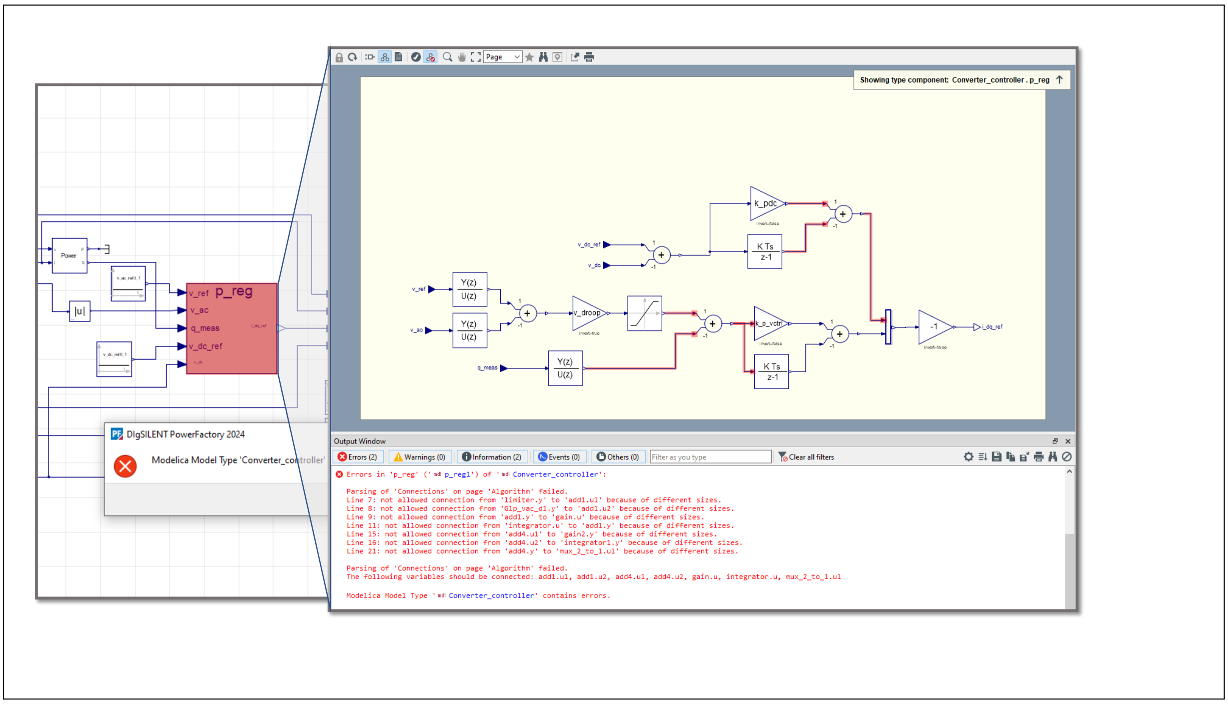

Figure 2.1: Highlighting errors in Modelica diagrams

2.1.2 Improved handling of *Type Instances* and *Submodels*

The terms *Type Instance* and *Subsystem* are used for (1) library components deployed in a model and (2) parts of a model grouped into one block, respectively. It is now easy to convert a *Type instance* into a *Subsystem* and vice-versa, by making use of the context menus, as shown in Figure 2.2 below.

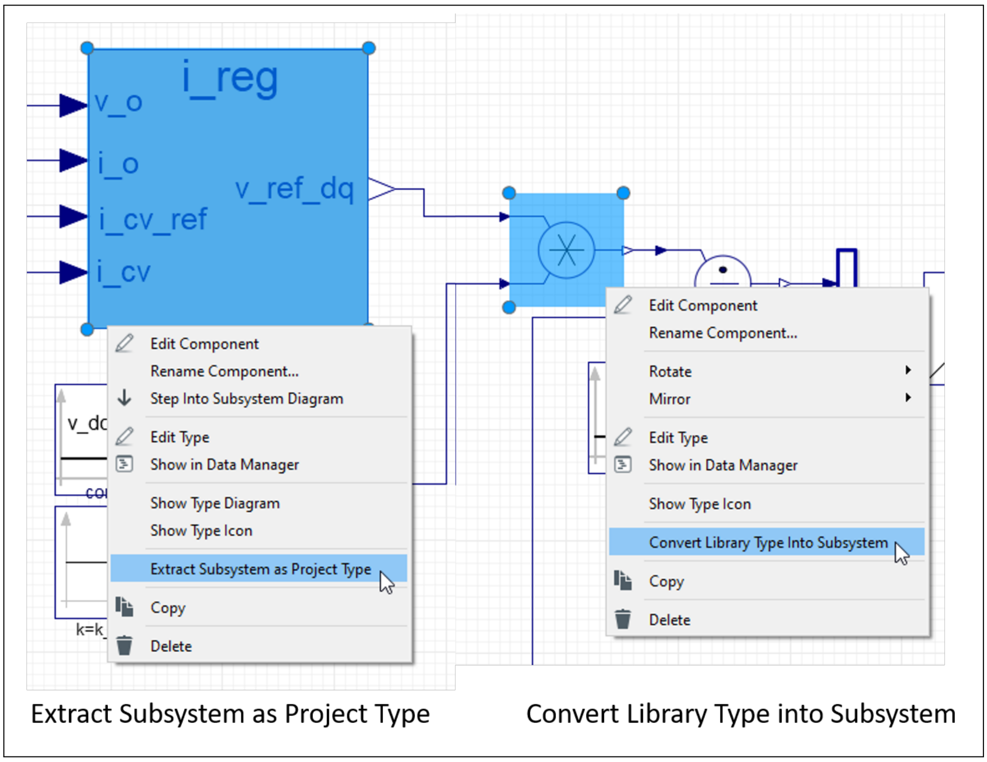

Figure 2.2: Right mouse click context menu options for improved handling of Modelica blocks

2.1.3 Parameter expressions in *Properties* view of components

Parameter expressions can now be entered within the *Properties* view of components for any model parameter. Any Modelica-compliant parameter expression that is supported in the Modelica Algorithm pages can also be used in this way, as illustrated below in Figure 2.3. This can greatly simplify modelling by reducing the number of blocks required.

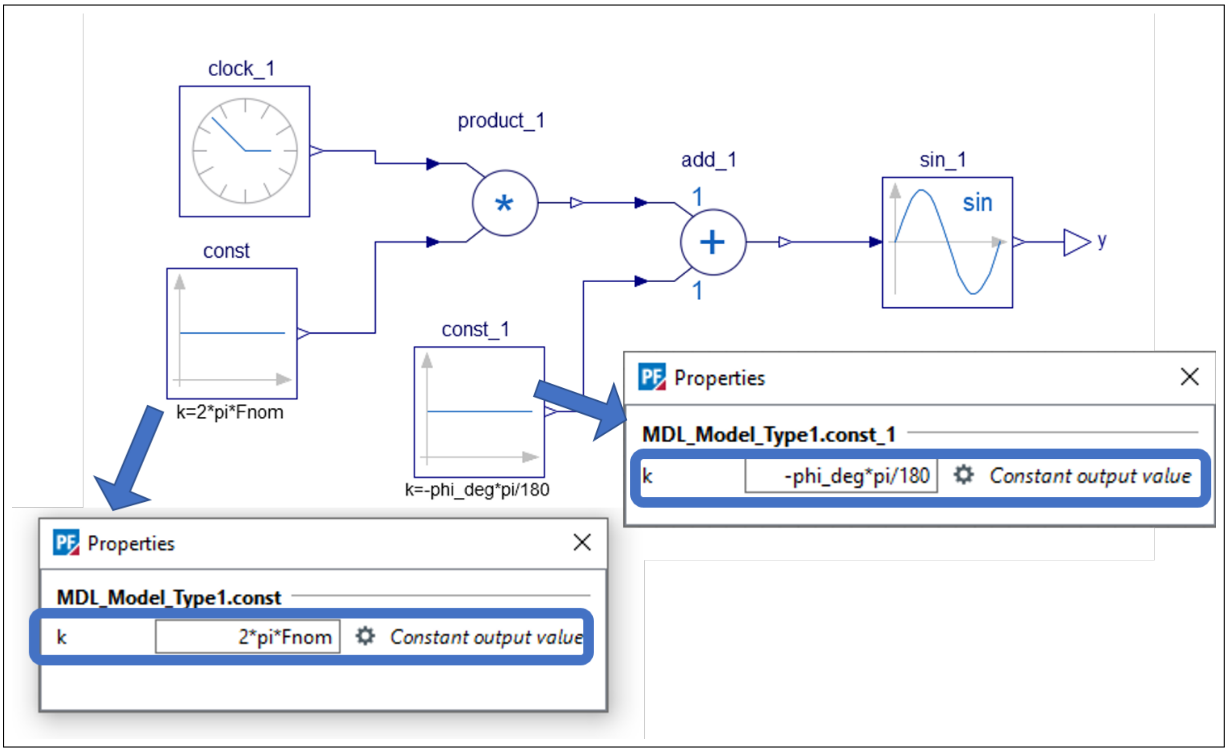

Figure 2.3: Support of parameter expressions within the *Properties* view of components

2.1.4 Rotation of Type Instances and Subsystems

The appearance of graphically-defined Modelica models can now be further customised by allowing *Type Instances* and *Subsystems* to be rotated and mirrored within the corresponding diagrams.

2.1.5 Simplified routing of signals using labels

PowerFactory 2024 includes support of signal labels, making it easier to connect blocks placed at various locations.

For this purpose, the *ReceiverLabel* and *SenderLabel* components are introduced in the category *Labels* of the *Drawing Tools*. Any number of *SenderLabels* can be added in a diagram. Each of them can be connected with a signal in the diagram. Likewise, any number of *ReceiverLabels* can be created in a diagram. Each *ReceiverLabel* can then be linked with one of the already defined *SenderLabels*, from a drop-down list of available signals, thus allowing the transfer of signals from the *SenderLabel* input to the *ReceiverLabel* output. This is illustrated in Figure 2.4 below.

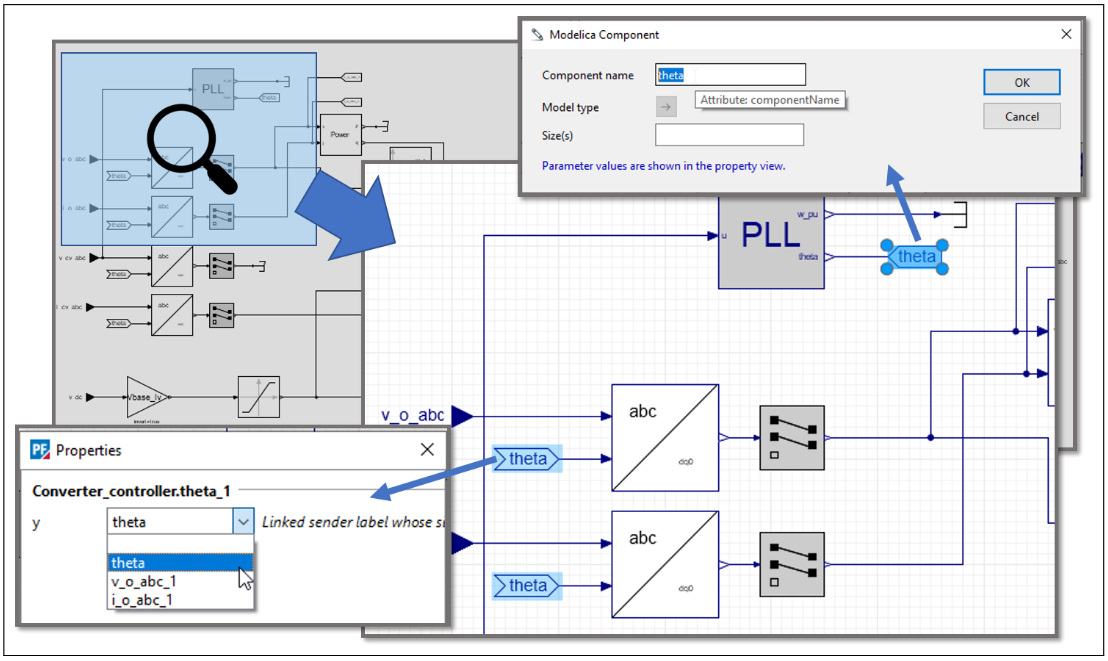

Figure 2.4: Support of signal labels for Modelica

2.1.6 Support of annotation images

It is now possible to include images in a Modelica Diagram, as shown in Figure 2.5. A dedicated toolbar icon within the *Drawing Tools* is provided for this purpose. The images can either be external or embedded entirely within the Modelica model, the latter being a good option for model portability.

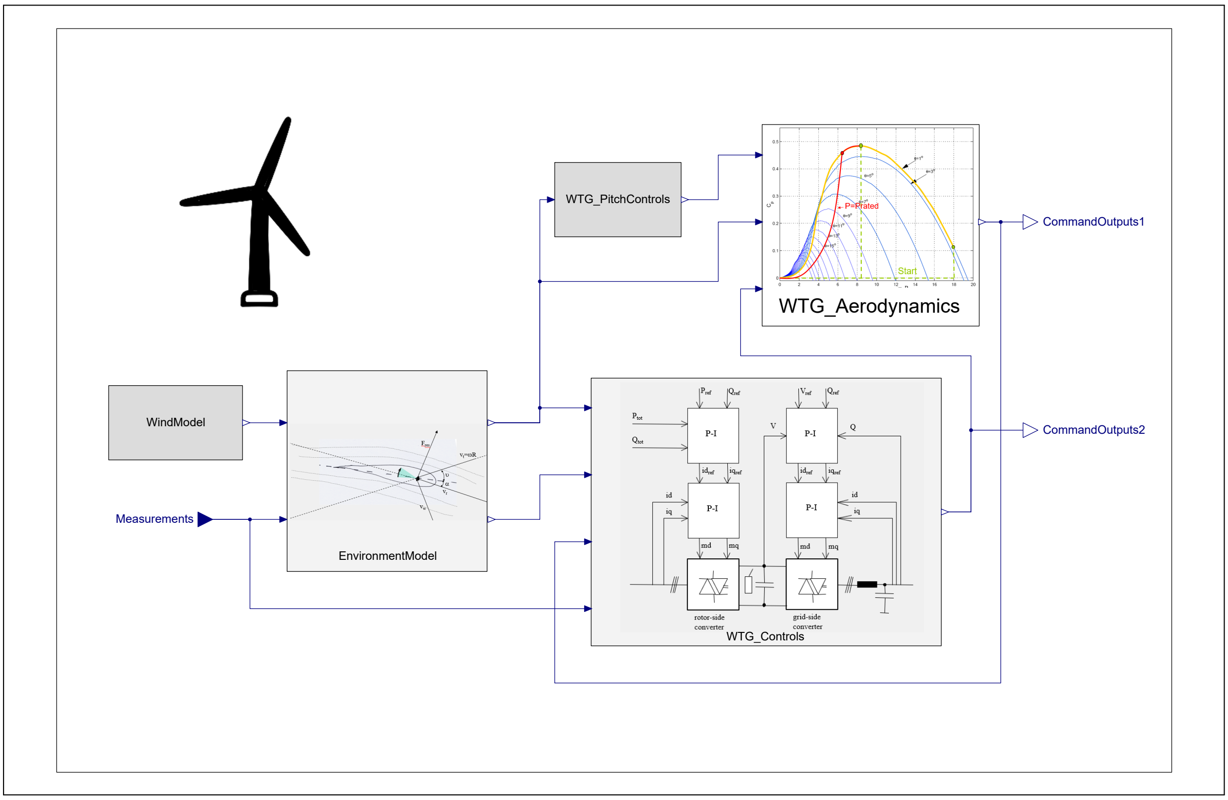

Figure 2.5: Support of annotation images

2.2 Other Diagram developments

2.2.1 Auto-layout of substation diagrams

PowerFactory 2024 comes with a new layout algorithm for substations, sites, branches and terminals in diagrams. Some of the new functionalities are:

- Recognition of busbar systems
- Ordering of bays
- Minimisation of overlapping

These enhancements make the substation and site graphics look more like typical diagrams, reducing the amount of manual correction needed and the time required for such changes.

2.2.2 Extensions of the Drawing and Diagram Layout Tools

In *PowerFactory 2024*, it is possible to show graphical representations of all the network elements, even user-defined ones (created using Data Extensions). This means that now, elements such as load flow controllers, Towers and Boundaries can be shown in the diagram with new icons, as shown in Figure 2.6. Existing elements can be inserted into the diagram via drag and drop from *Data Manager* or *Network Model Manager* or inserted using the Diagram Layout Tool, and most can also be created graphically using the drawing tools.

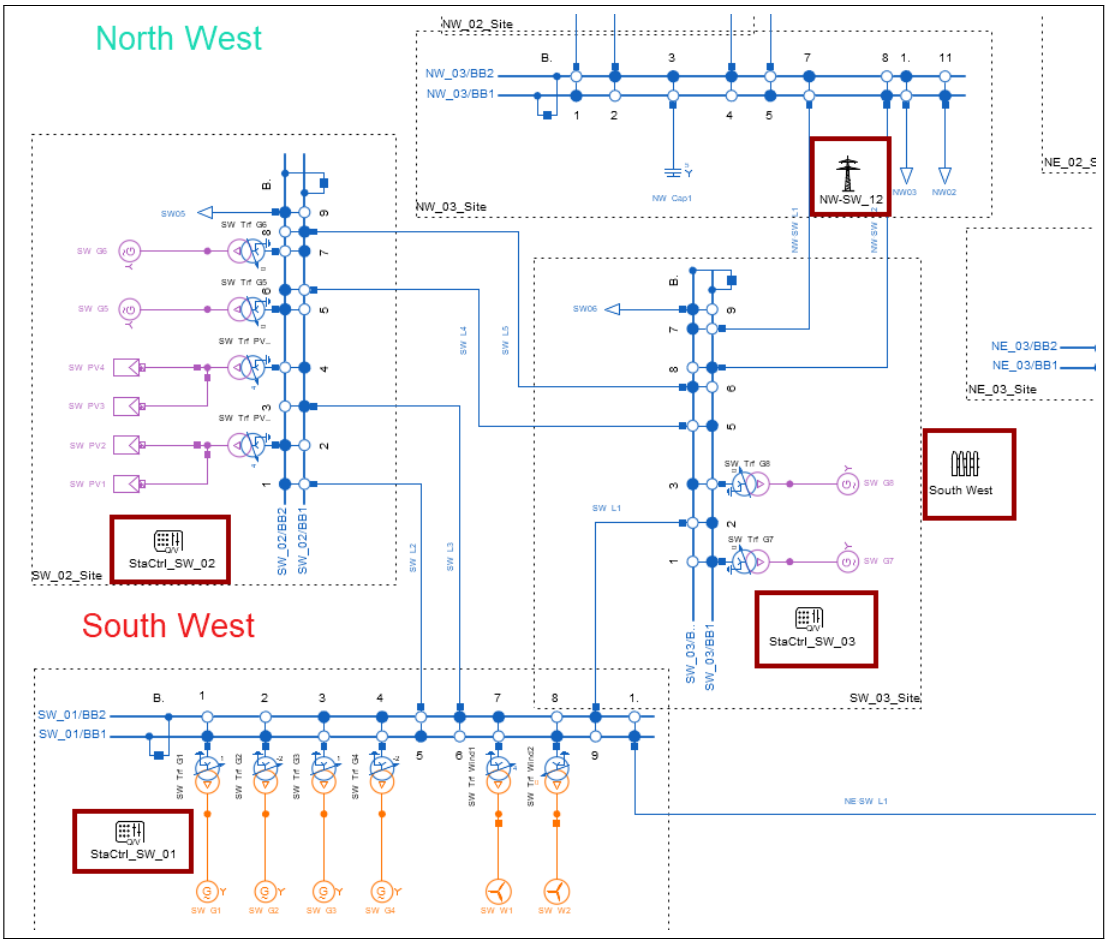

Figure 2.6: Single Line Diagram showing additional elements

Related elements are highlighted when hovering over their respective symbols, as shown in Figure 2.7 for a feeder.

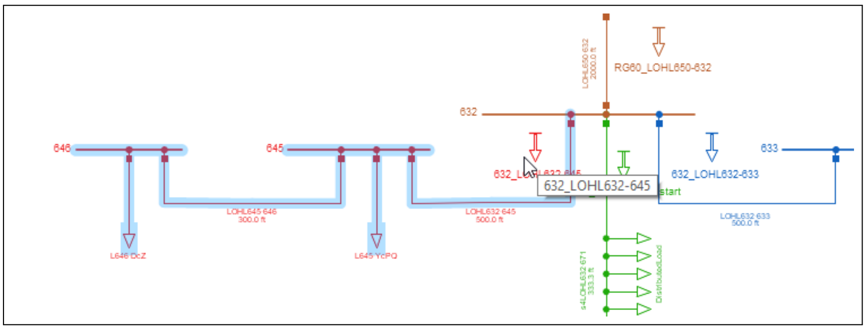

Figure 2.7: Single Line Diagram with a highlighted feeder

To include this new functionality, the following tools have been changed:

Drawing Tools: there are new elements and categories on this window, as shown in Figure 2.8:

- Towers and Cable Systems in the category *Lines, Cables and Series Impedances*: the line couplings and cable systems can be defined by using the corresponding icon in the drawing toolbox and then selecting the lines/cables.
- New *Load Flow Controllers* category: to include new station, power frequency, shunt and tap controllers.
- New *Measurements Devices* category: to include new current, voltage, power and PLL phase/frequency measurements.
- New *Network Grouping* category: grouping elements, for example Zones, Areas, Owners and Feeders, can be defined graphically by selecting the corresponding icon and then the group of elements that belongs to the group.

The visibility of the elements is defined in the *Net elements* layer.

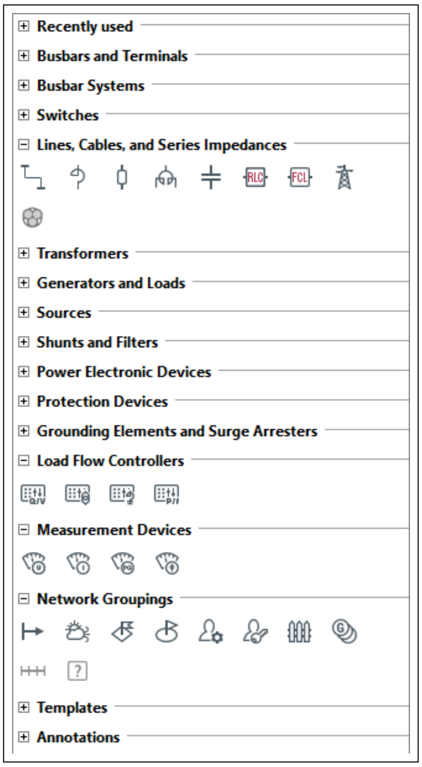

Figure 2.8: New categories and elements in the Drawing Tools

Diagram Layout Tool: includes a new option on the *Basic Options* page on the *Insert elements into current diagram* and a new *Miscellaneous* page, where the graphical representations of the following elements can be included in an existing diagram (see Figure 2.9):

- Areas
- Zones
- Boundaries
- Operators
- Owners
- Feeders
- Towers
- Cable systems
- Load flow controllers
- Measurement devices
- User-defined elements

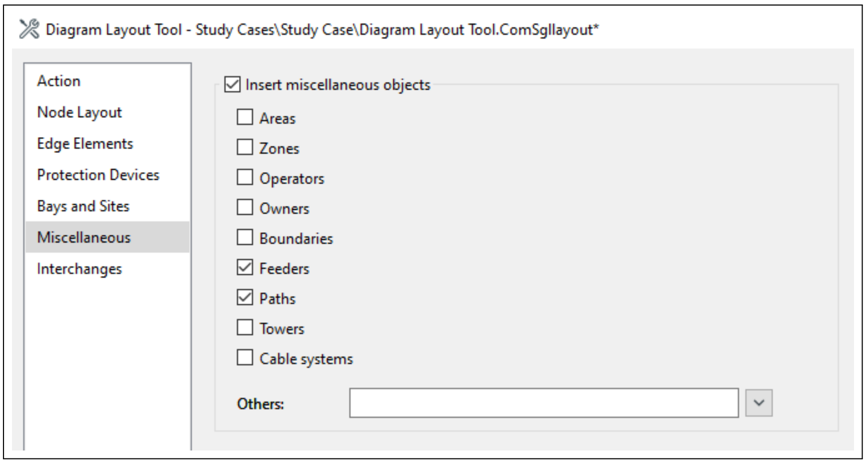

Figure 2.9: Page *Miscellaneous* on the Diagram Layout Tool

2.2.3 Smooth option for polylines and polygons

The appearance of polylines and polygons can now be further customised by selecting the "Smooth" option. This makes their definition more flexible, allowing the creation of more complex figures An example is provided in Figure 2.10 below, where smooth curves have been generated using polylines.

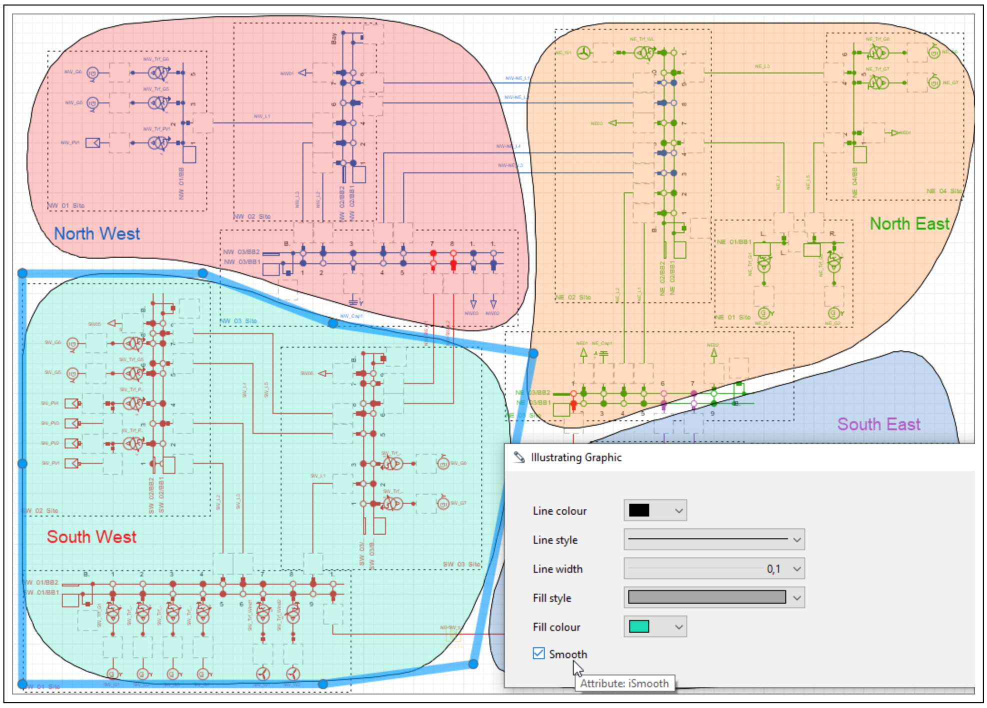

Figure 2.10: Support of smooth curves in diagram objects

2.2.4 Poster-size printing

PowerFactory 2024 includes in the *Print Diagram* dialog an option to print the diagram as a poster. The user selects the available paper size and the diagram will then automatically be divided up accordingly and printed on several sheets.

2.2.5 Support of smooth curves in model icons and diagrams

The appearance of polylines and polygons can now be further customised by selecting the “Bezier” smooth option. An example is provided in the snapshot below, where smooth curves can be generated using polylines.

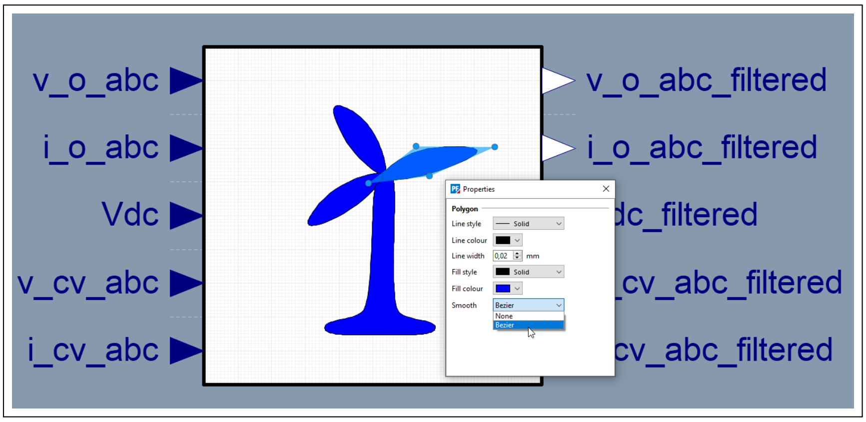

Figure 2.11: Support of smooth curves in diagram objects

2.3 Plots

2.3.1 Protection plots

The redesign of the plot functionality, started in *PowerFactory 2021*, includes, in the latest version, the time-overcurrent plot and the biased current differential plot. The new plots use independent object dialogs to configure data series selection, axis, title or legend settings. The user can simply click on the plot component to access its settings.

In the time-overcurrent plot, the direction, characteristic and sub curves to be shown can now be selected for each element separately, as shown in Figure 2.12.

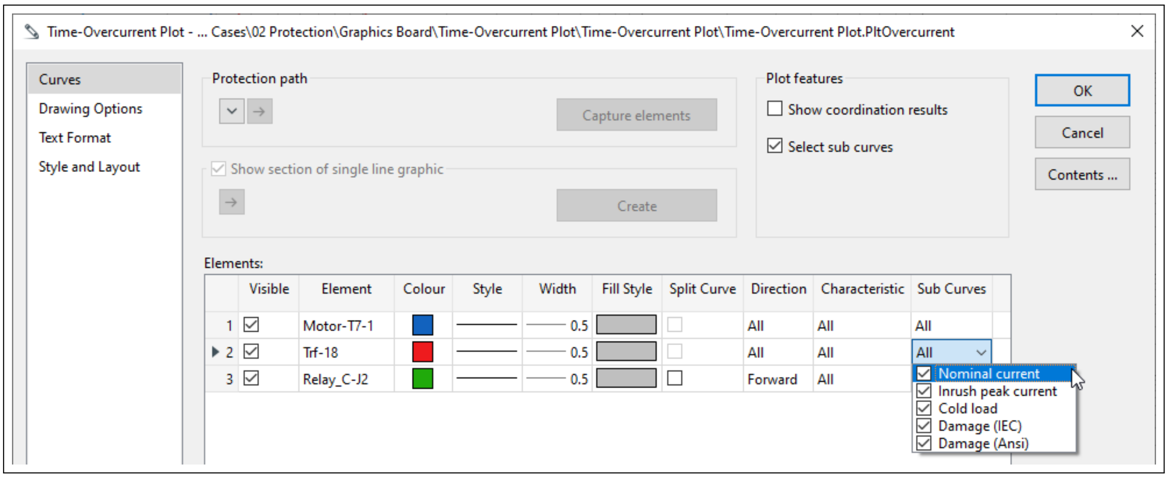

Figure 2.12: Time-overcurrent plot. Sub curves options

2.3.2 Harmonic distortion plot limits

The list of harmonic limits selection for harmonic distortion plots has been extended according to following standards:

- DIN EN 50160:2011
- DIN EN 50160:2020
- EN 50160:2010
- EN 50160:2019 (EN 50160:2010 + Cor.:2010 + A1:2015 + A2:2019 + A3:2019)
- IEC 61000-2-2:2002
- IEC 61000-2-12:2004
- IEC TS 62749:2020
- IEEE Std 519-2022
- IEEE Std 1547-2018
- IEEE Std 2800-2022

3 Handling and Data Management

3.1 *Data Manager* and *Network Model Manager*

3.1.1 Docking of *Data Manager* and *Network Model Manager*

Users will be familiar with the separate windows that are presented when the *Data Manager* and *Network Model Manager* are opened from the main toolbar.

Now, these two windows have the same possibilities as other “floating windows”. Tabs in these windows can be docked into the main graphic window alongside existing tabs, as shown in Figure 3.1 below, or moved from one floating group to another.

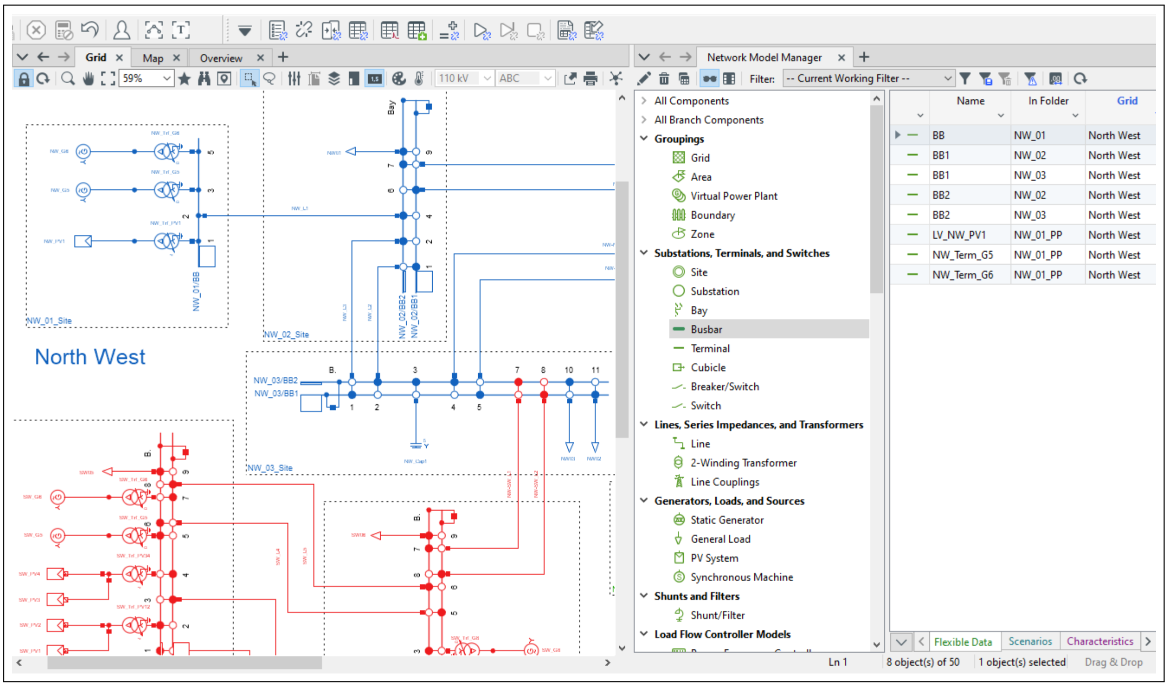

Figure 3.1: *Network Model Manager* docked into main graphic window

By default, the *Network Model Manager* and *Data Manager* will open as tabs in the same floating window. This is part of a general logic that is applied to ensure that tabs in floating windows are by default grouped together according to their type. However, the user has the flexibility to freely organise tabs in fixed or docked groups in whatever way is convenient.

Note: By default, the *Data Manager* and *Network Model Manager* can only be opened once, but the legacy behaviour of multiple instances can be allowed by selecting the relevant options on the *Data/Network Model Manager* page of the *User Settings* dialog.

Although only one instance each of the *Data Manager* and *Network Model Manager* will be opened by default, it is still possible to duplicate *Data Manager* and *Network Model Manager* tabs, and rename them.

3.2 User-defined Hotkeys and Quick Access

3.2.1 User-defined hotkeys

Users familiar with *PowerFactory* may already make use of the inbuilt hotkeys, such as F10 for running a *Load Flow Calculation*. Now, user-defined hotkeys have been introduced, enabling individual users to create their own hotkeys for standard commands and other actions.

The *Edit Hotkeys...* dialog, accessed from the main menu via Tools or from the User Settings (Profile page), is shown in Figure 3.2. Hotkeys can be assigned, edited or removed here, with an option to reset to the default values.

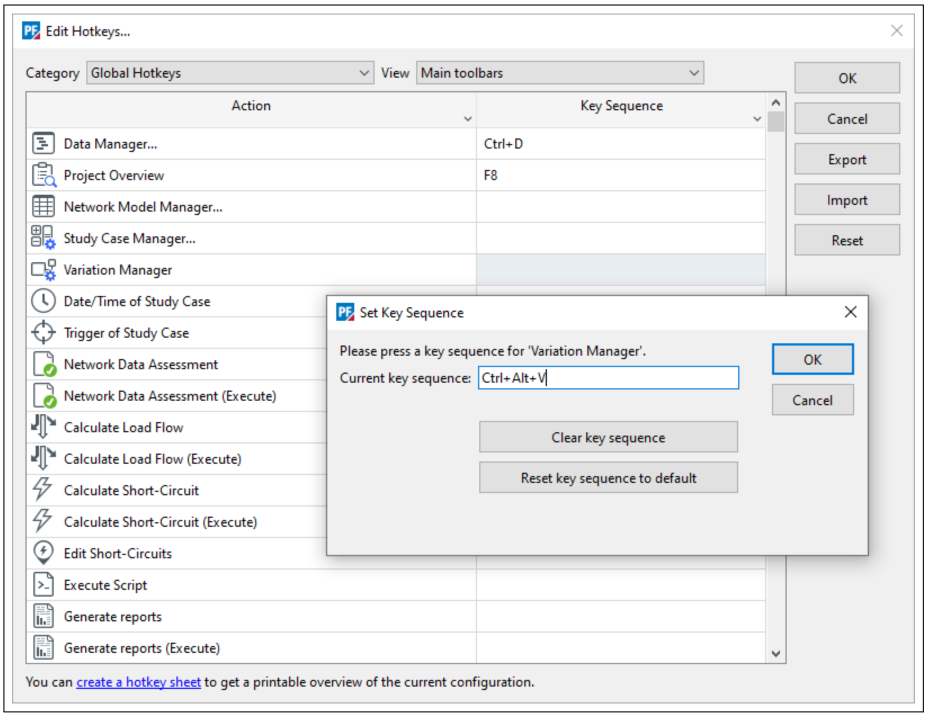

Figure 3.2: The *Edit Hotkeys...* dialog

The hotkeys are classified into two categories according to their scope:

- **Global**: These are available throughout the application, independent from current window, offering access to global functions such as those in the toolbar or application menus.
- **Context-dependent**: These hotkeys are applicable only if a specific window or control (context) is currently active.

The list of context-dependent actions can be seen in Figure 3.3.

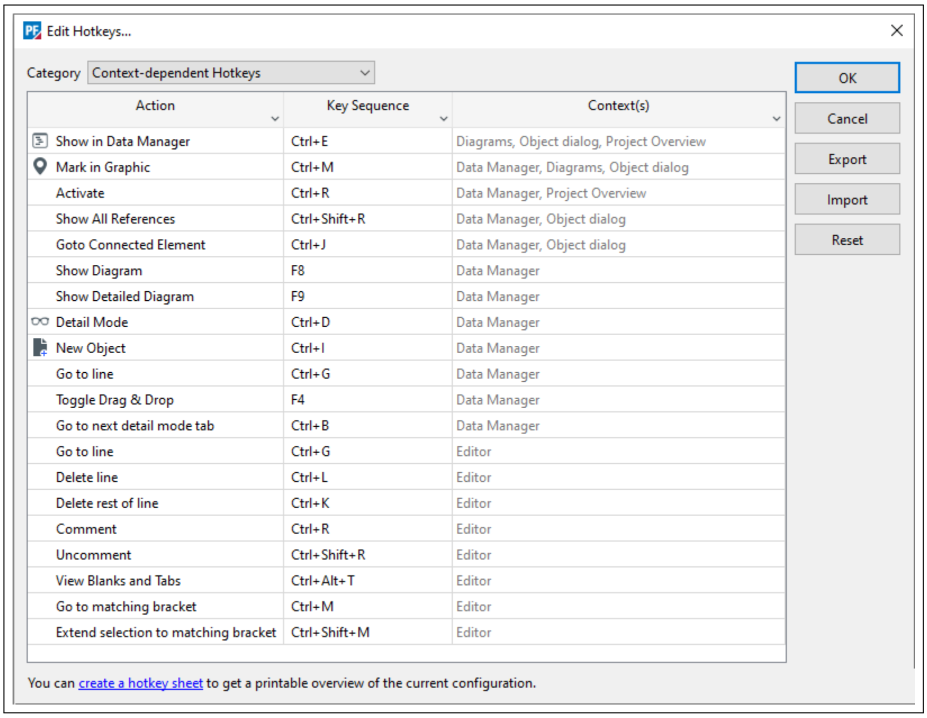

Figure 3.3: Context-dependent hotkeys

There is a third category:

- **Fixed Hotkeys**: This is a list of pre-defined hotkeys, which cannot be edited. These are hotkeys that are commonly the same in all Windows applications, e.g. Ctrl+C for Copy.

The functionality includes checks to prevent the fixed hotkeys from being used, and to warn users if they are about to overwrite existing hotkeys.

At the bottom of the *Edit Hotkeys...* dialog, there is an option to create a hotkey sheet. This generates a PDF report of all the hotkey assignments, including the fixed hotkeys.

Users also have the possibility of assigning hotkeys to their own commands, such as scripts. This is done by adding such commands to the *User-defined Tools* toolbar, then assigning hotkeys to each toolbar entry.

Although the configuration of hotkeys is a user-specific setup, an export/import option allows users to share these definitions.

3.2.2 Quick Access

All users have their own workflows, based on business processes and personal preferences. In order to allow everyone to make these workflows as efficient as possible, a Quick Access feature has been introduced. This feature, by default itself accessed via Ctrl+Q, is a way for the user to easily select actions or commands that are frequently used.

Users can define their own Quick Access list as shown in Figure 3.4.

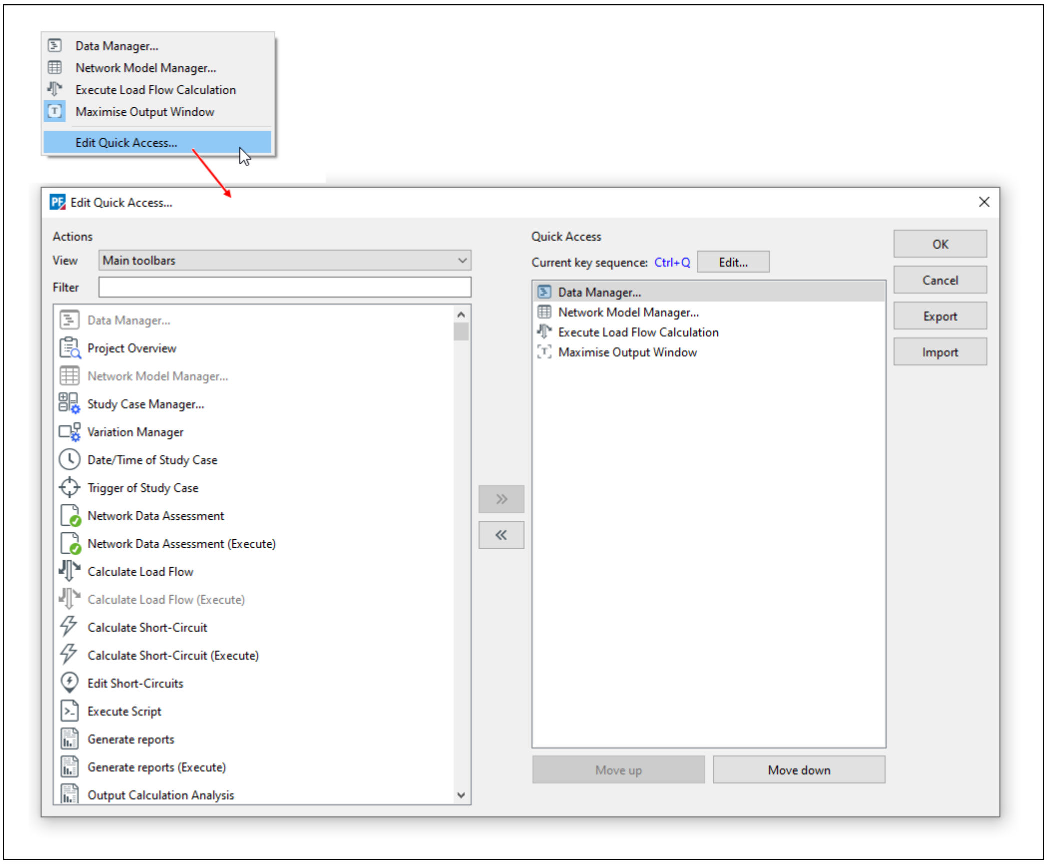

Figure 3.4: Using and configuring Quick Access options

As for the hotkeys configuration, it is possible to export and import the Quick Access configuration, allowing sharing of consistent settings between users.

3.3 Attribute Selection

The Attribute Selection functionality, previously referred to as Variable Selection, is accessed through the *IntMon* dialog. It is used in *PowerFactory* whenever object attributes need to be selected by the user, for example in a Flexible Data page, or when choosing result variables to be recorded during a simulation. It has now been updated in order to make it more intuitive and easier to use.

A typical Attribute Selection dialog is shown in Figure 3.5. In this example, variables relevant to a *Load Flow Calculation* are being selected for a Flexible Data page for synchronous machines. This illustrates the following features:

1. A drop-down list allows the user to select the Attribute Group (the category of data items).
2. The Calculation drop-down list corresponds to the pages of the element dialog.
3. A filter field allows for easy searching for relevant attributes.
4. Where appropriate, bus and phase selection are shown.

Items can be selected or deselected in the top panel and the currently selected items are shown in the lower panel, and also on the Editor page.

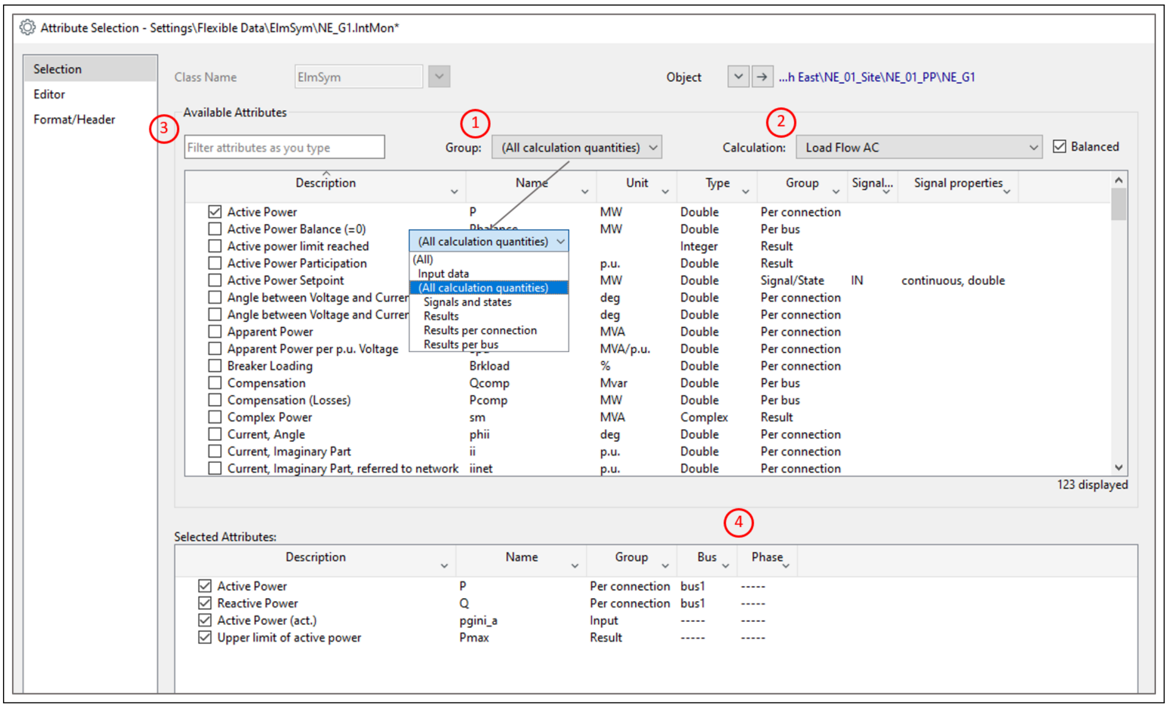

Figure 3.5: Attribute Selection dialog

3.4 Database

3.4.1 Database performance improvements

A *PowerFactory* installation where users share a common multi-user database (so-called *PowerFactory* Team Edition) is a highly effective way of working when many users need to access and share common data and projects. However, restrictions in data transfer caused by network latency and bandwidth, coupled with potentially very large databases, can result in suboptimal performance.

As part of ongoing work to enhance the performance of the multi-user database, particularly in cloud environments, a number of improvements have been put in place. These will also benefit users of local databases.

Clearing unresolvable references

Projects that have very large numbers of unresolvable references can take a long time to activate, as each reference must be individually searched for. An option to “Clear Unresolvable References” already existed in earlier versions of *PowerFactory*, but it has now been incorporated as an automatic part of project activation, without any noticeable loss of performance.

Database tuning

Some modifications have been made to drop or optimise indexes in Oracle and PostgreSQL multi-user databases, as well as in local databases; this should result in improved performance for database activities such as project import and merge processes. (Some of these changes were already available for SQL Server databases since *PowerFactory 2023 SP5*.)

3.5 Results

3.5.1 Redesign of result file

For many calculations, the results are recorded in a result file, which until now was stored in a proprietary binary format, generally sparsely populated according to recording options selected by the user. The *PowerFactory* result object (*ElmRes*) refers to this result file, which is typically stored in the workspace directory.

Now, the result file will be written in an open database format (SQLite). This allows post-processing based on direct file access to be more easily implemented.

All existing scripting functionality for accessing result files from within *PowerFactory* remains the same. Therefore, existing scripts for post-processing of result files can be used without any changes being required.

4 Power Equipment Models

4.1 New Models

In this section, all new models or elements are described. In section 4.2 onwards, readers will find details of improved modelling capabilities that have been delivered as enhancements to existing models.

4.1.1 Multi-Winding Transformer *NEW MODEL*

A model of a Multi-Winding Transformer has been added. Until now, the maximum number of transformer windings that could be modelled in *PowerFactory* was four (the *ElmTr4* model). With the new Multi-Winding Transformer (*ElmTrmult*), transformers with 5 to 15 windings can now also be modelled as shown in Figure 4.1.

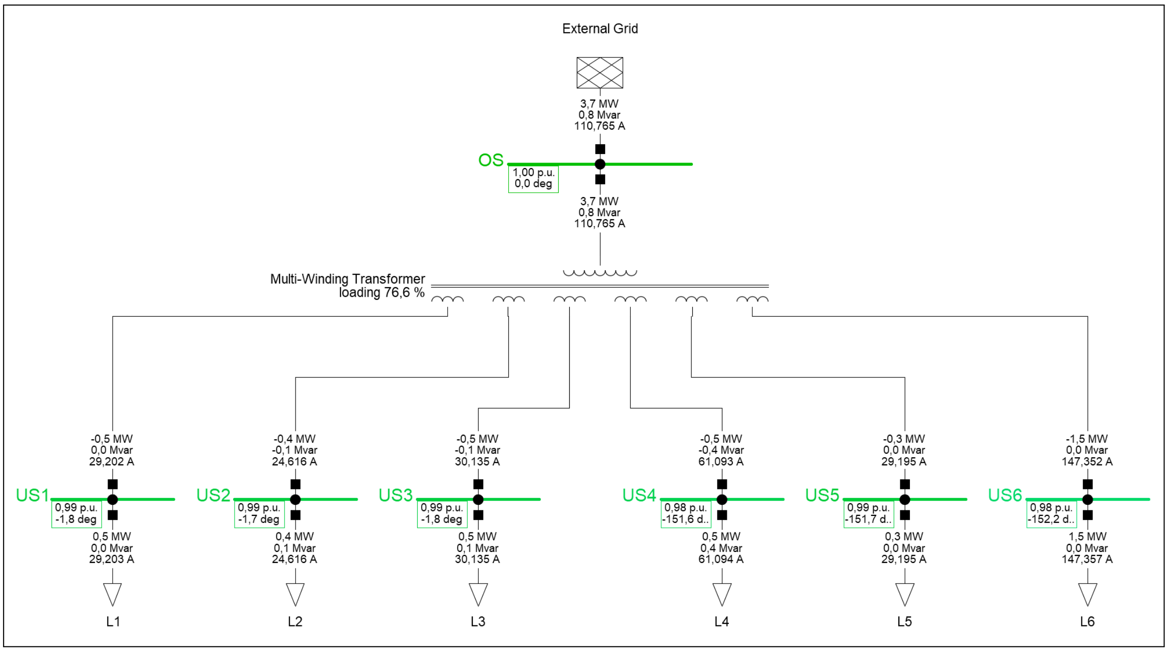

Figure 4.1: Multi-Winding Transformer in a network model

In the new model, the number of windings can be changed and is now one of the input parameters; see Figure 4.2. The electrical parameters of the transformer are defined separately for each winding in the associated new transformer type *TypTrmult*. A special feature here is the leakage reactances, which can either be entered in the “Complete” mode, where they are defined for each pair of windings (e.g. W1 - W2), or in the “Simplified” mode, where a value is defined for each winding (e.g. W1). The use of saturation and hysteresis is also supported in the new model.

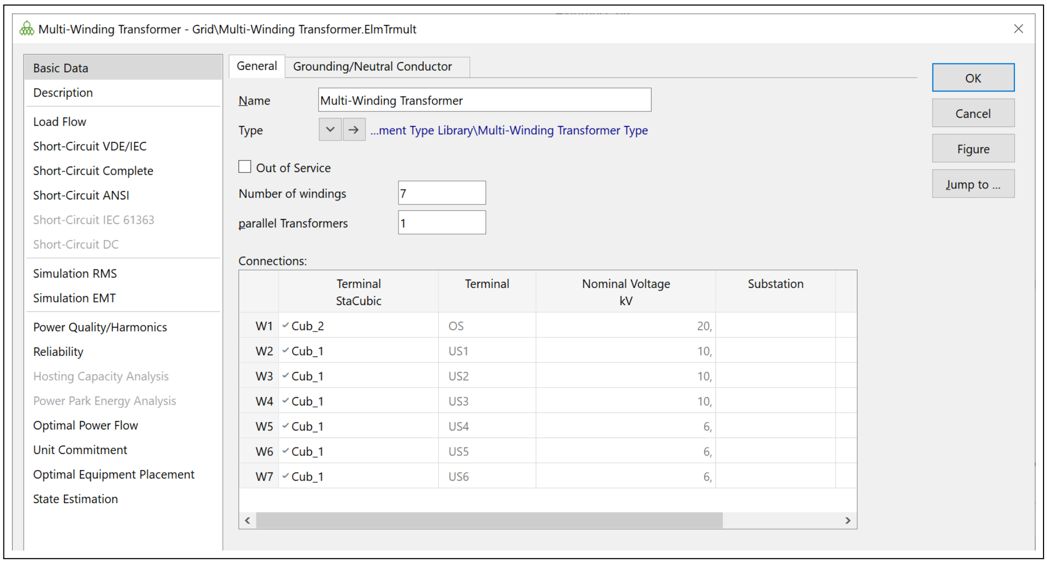

Figure 4.2: Dialog of the Multi-Winding Transformer

4.1.2 PV MPP Tracker *NEW MODEL*

A maximum power point (MPP) tracker controller, namely, “MPPT Controller” (*ElmPvmpp*), is added. The model is suitable for both *Load Flow Calculations* and RMS and EMT simulations. For simulations, the built-in tracking algorithms supported by the new model are *Perturb and Observe* and *Incremental conductance*. The edit dialog of the model is shown in Figure 4.3

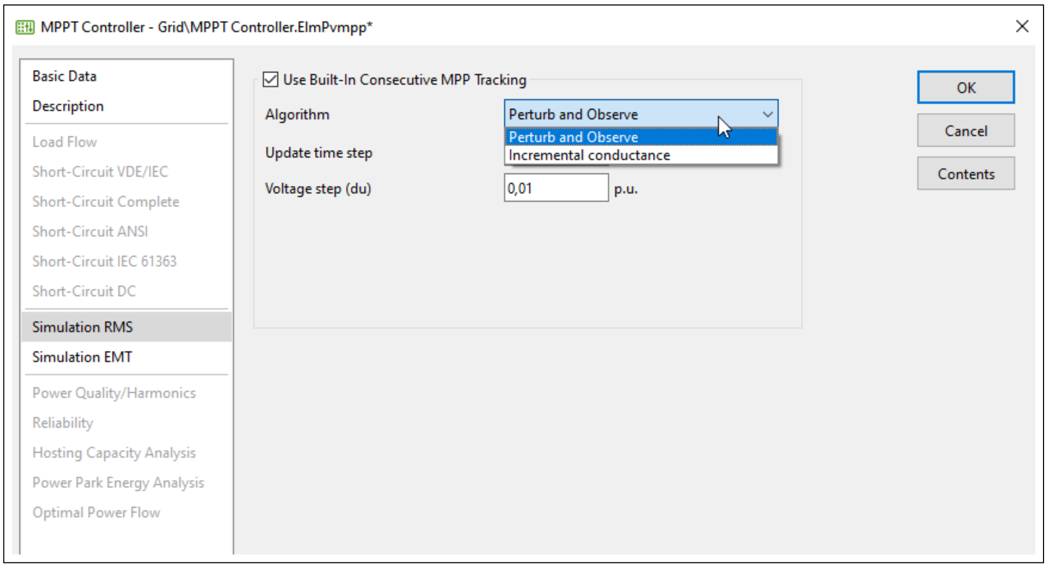

Figure 4.3: Edit dialog of the MPPT Controller (*ElmPvmpp*)

4.1.3 PV Panel *NEW MODEL*

A new PV Panel model (*ElmPvpanel*) with two DC terminals is added, allowing explicit modelling of the DC side. The element can either represent a single PV panel or multiple parallel strings of serial PV panels, and is associated with a PV Panel Type (*TypPvpanel*). A single PV Panel element connected between two DC terminals is shown in Figure 4.4.

The active power model can be based on one of two options:

- Solar calculation
- Radiation on PV panel

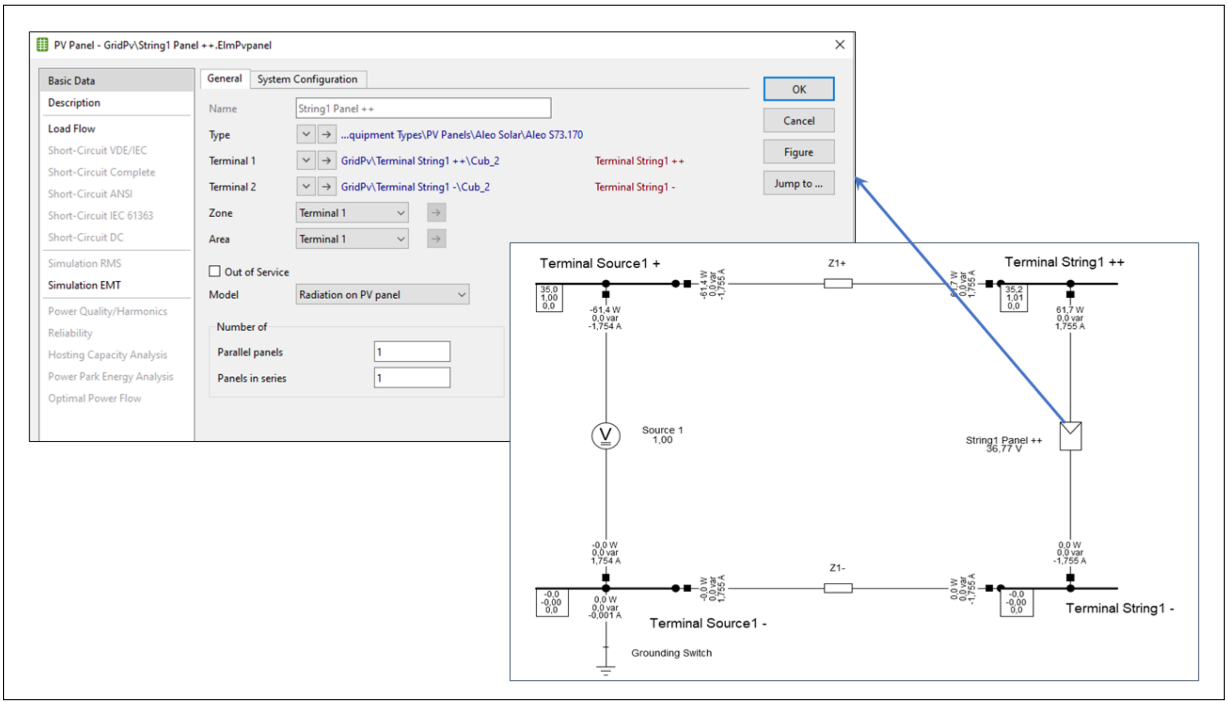

Figure 4.4: The PV Panel (*ElmPvpanel*) element in a network

4.2 Lines, Cables and Series Impedances

4.2.1 Consideration of shunt conductance

Shunt conductance can now be directly modelled inside a Tower Type (*TypTow*); see Figure 4.5. In addition, a shunt conductance can be modelled in a Line Coupling element (*ElmTow*), if there is more than one circuit defined in the Tower Type (*TypTow*) or a Tower Geometry Type (*TypGeo*) is referenced.

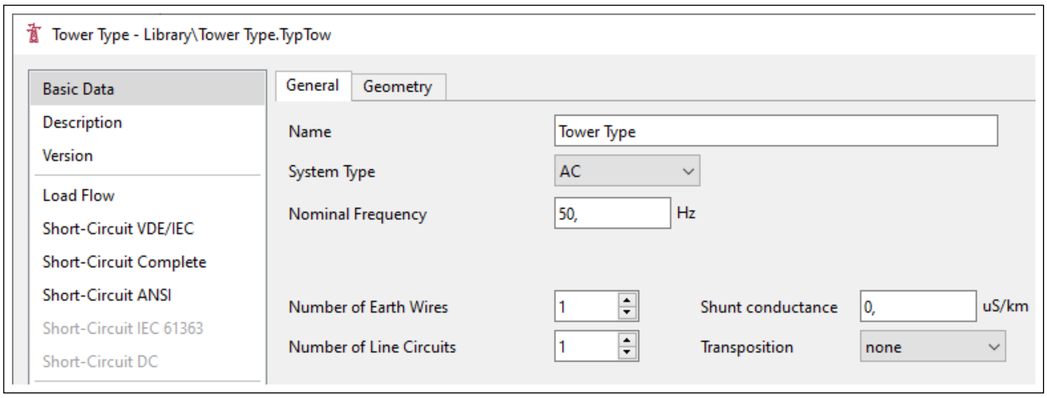

Figure 4.5: Dialog of the Tower Type

4.2.2 Tower Type natural potential coefficients matrix

For a Tower Type (*TypTow*), the feature *Calculate* will now also output the "Natural Potential Coefficients" matrix. With that matrix it is possible to calculate the "Natural Admittance Matrix".

4.2.3 New circuit positions mode for cable systems

There is a new option to set the circuit position of circuits in a Cable Definition object (*TypCabsys*). In addition to the previous phase coordinates input there is an automatic equidistant assignment, allowing to set standard flat or trefoil formations. Figure 4.6 shows an example for three circuits.

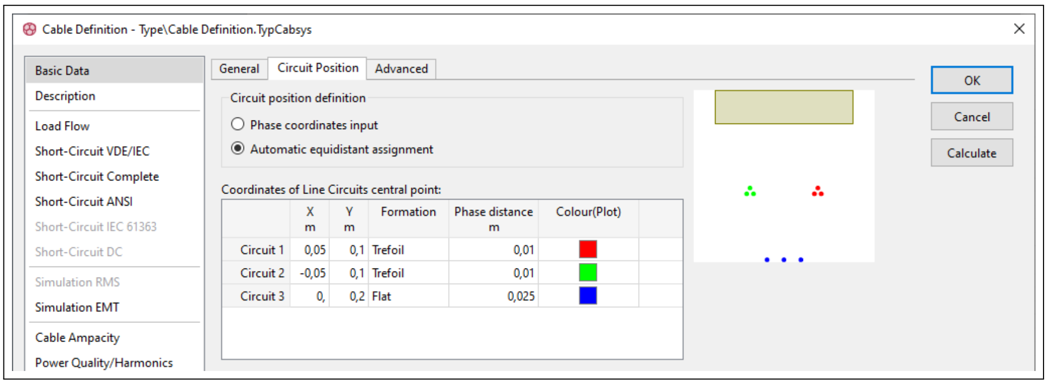

Figure 4.6: Circuit positions defined via the Cable Definition dialog

4.2.4 Duplex Reactor enhancements

The Duplex Reactor model has been enhanced with the addition of two new input parameters to more accurately represent measurement data available from manufacturer data sheets.

Previously, the equivalent circuit considered only a reactance in the branch impedance associated with the common terminal, neglecting the resistance associated with this coupling path. The model now allows this resistance to be considered.

The construction of real duplex reactors is such that the positive and zero sequence reactance of the windings can differ. In order to better represent the real behaviour of a duplex reactor in unbalanced studies, the ratio of the zero sequence reactance to the positive sequence reactance of the model can now be specified.

4.3 Transformers

4.3.1 Step-Voltage Regulator

Unbalanced tap signals of a Step-Voltage Regulator (*CalVoltreg*) are now available for *QDSL* and the unbalanced *State Estimation* (see section 1.11.1).

4.4 Generators and Loads

4.4.1 Q(V)-Characteristic of Static Generator as reference

The available $Q(V)$-Characteristic of a generator can now be defined by its dedicated object, as presented in Figure 4.7. This object is stored in the library and can be linked to all generators with the same characteristic.

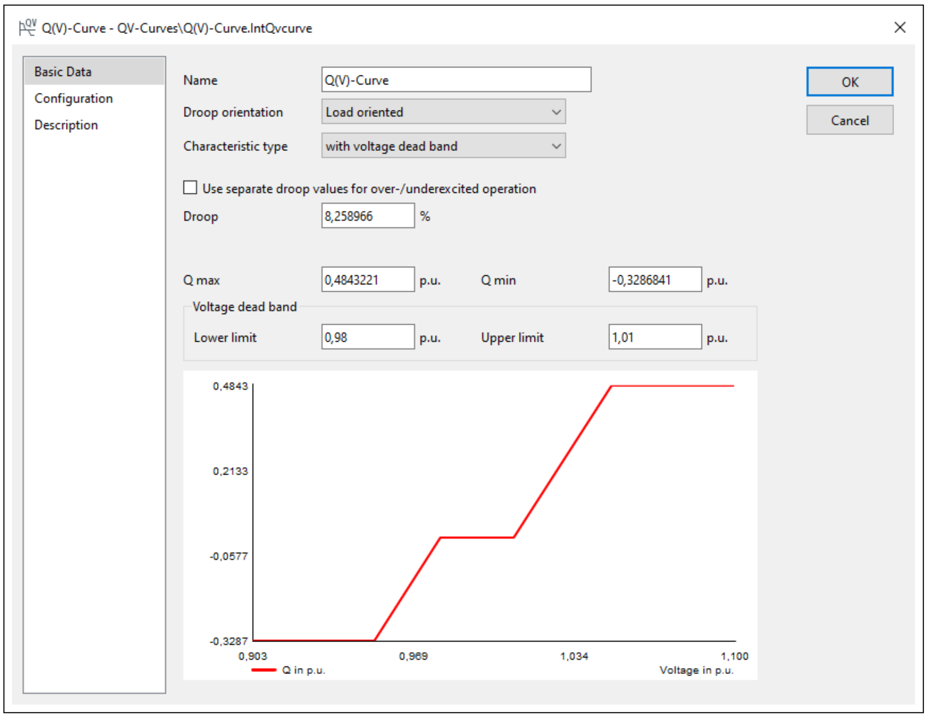

Figure 4.7: New $Q(V)$-Characteristic object

4.4.2 Q(P)-Characteristic

The $Q(P)$-Curve *IntQpcurve* used with the option $Q(P)$-Characteristic in the generators have two enhancements: (a) It is possible to define the "Polynomial" curve in p.u. (options available on the page Configuration), and (b) Orientation can now be Load or Generator-oriented. As a default, the characteristic is generator-oriented. The edit dialog of a $Q(P)$-Characteristics with a generator-oriented *Polynomial* curve in p.u. is shown in Figure 4.8. As for $Q(V)$-Characteristics, $Q(P)$-Characteristics can be applied to multiple elements.

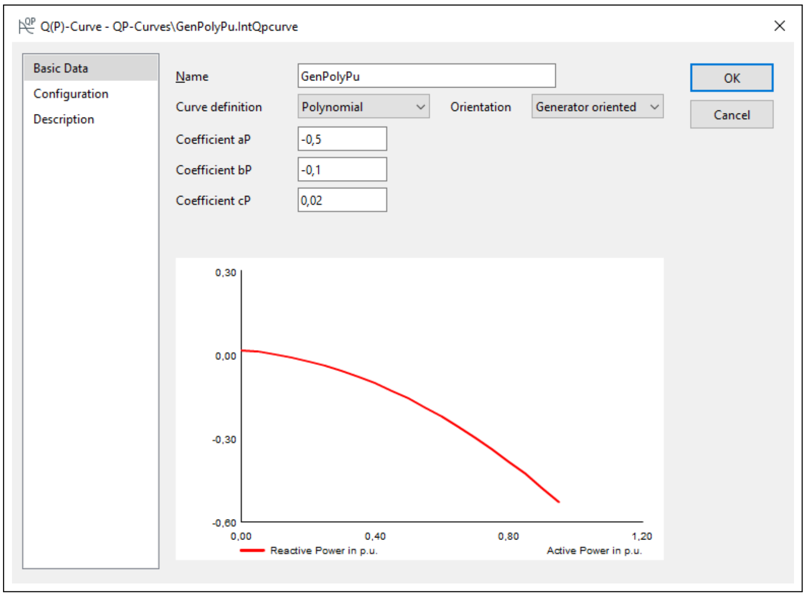

Figure 4.8: Edit dialog of a $Q(P)$-Characteristic (*IntQpcurve*)

4.4.3 GENQEC synchronous generator

A new synchronous machine model, namely, the GENQEC model, has been added. The WECC-approved model for RMS simulation is based on a white paper from the WECC Modeling and Validation Subcommittee[1]. In *PowerFactory 2024*, in addition to the GENQEC RMS model, also an EMT version of the model has been implemented. The GENQEC model can be selected in the Synchronous Machine Type (*TypSym*) as shown in Figure 4.9.

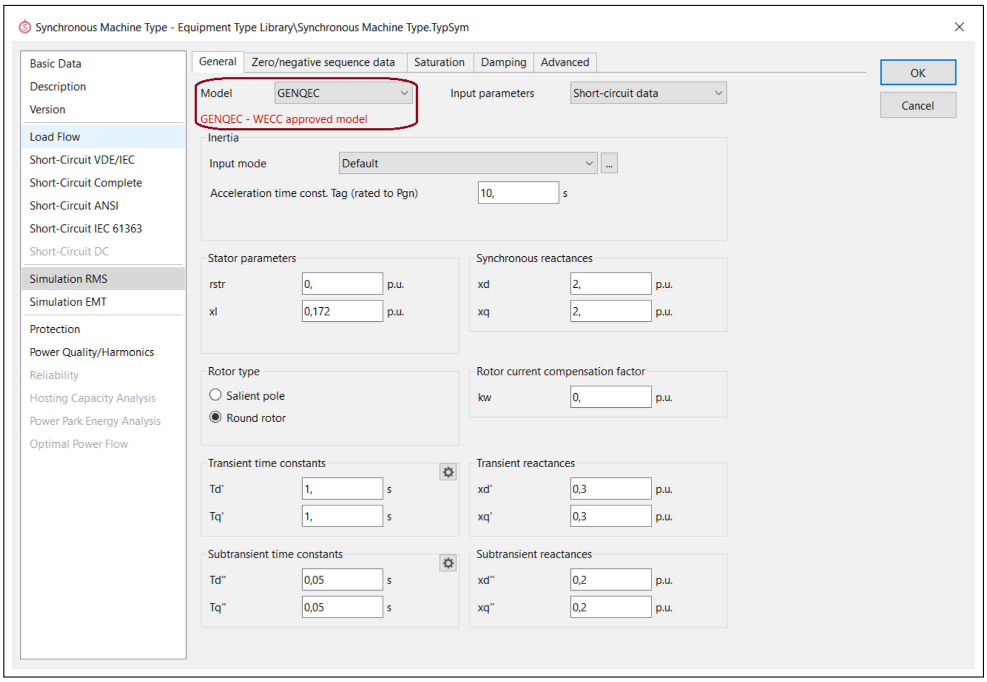

Figure 4.9: Edit dialog of the Synchronous Machine Type GENQEC

[1]WECC PPMVDWG, White Paper on GENQEC Model in Power System Studies, August 12, 2021

4.4.4 Synchronous generator saturation representation

In the synchronous generator type (*TypSym*) (see Section 4.4.3), the same magnetic saturation function output can be applied to both d-axis and q-axis stator inductance terms. Therefore, the saturation options selection drop-down list of the Synchronous Machine Type *TypSym* now supports one additional option, *d- and q-axis equal (flux magnitude)*, as shown in Figure 4.10. Using this option, the saturation factors of both the d- and q-axis are the same.

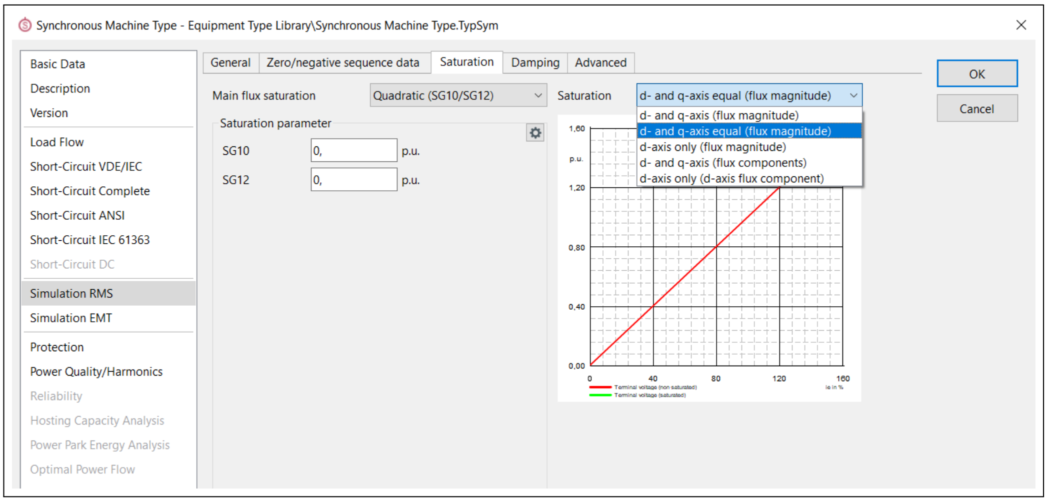

Figure 4.10: Options for calculating the saturation factors in a Synchronous Machine Type (*TypSym*)

4.4.5 Forced voltage angle control of reference machines

In some cases it is necessary to control the voltage phase angle of a machine or generator directly, for example if grids with different frequencies (e.g. 50 and 16⅔ Hz) are coupled by two synchronous machines. To account for this, a new option "Forced voltage angle control" has been added for Synchronous Machines *ElmSym* and Static Generators *ElmGenstat*, accessible if the element is set as a reference machine. In addition, the voltage angle can also be set via QDSL models, as described in section 1.4.1.

4.4.6 selection of reactive power control for loads

Similar to generators, additional local controllers for the reactive power are introduced to loads to specify different types and behaviours. The following options are available:

- "Const. Q": constant reactive power according to the operating point
- "$Q(P)$-Characteristic": reactive power characteristic dependent on the active power set point of the load
- "$Q(V)$-Characteristic": reactive power characteristic dependent on the local voltage

Both the $Q(P)$- and $Q(V)$-Characteristic can be defined by dedicated objects stored in the library. An example is shown in Figure 4.7.

4.4.7 EMT Simulation: R,X input signals for loads

A new option "Variable resistance, inductance and capacitance via input signals", located on the EMT page of the General Load Type (*TypLod*) has been introduced for the EMT model of the General Load (*ElmLod*). This allows the control of the resistance, inductance and capacitance per phase. Additional calculation quantities for all loads (*ElmLod*, *ElmLodmv*, *ElmLodlv*) in the EMT simulation have been added in order to show the resistance, inductance and capacitance per phase.

4.4.8 Dynamic Composite Load Model according to WECC

According to the WECC Dynamic Composite Load Model (CMPLDW), a new load type is supported. The load type name is "WECC Composite Load Type - CMPLDW" (*TypLodwecc*), shown in Figure 4.11.

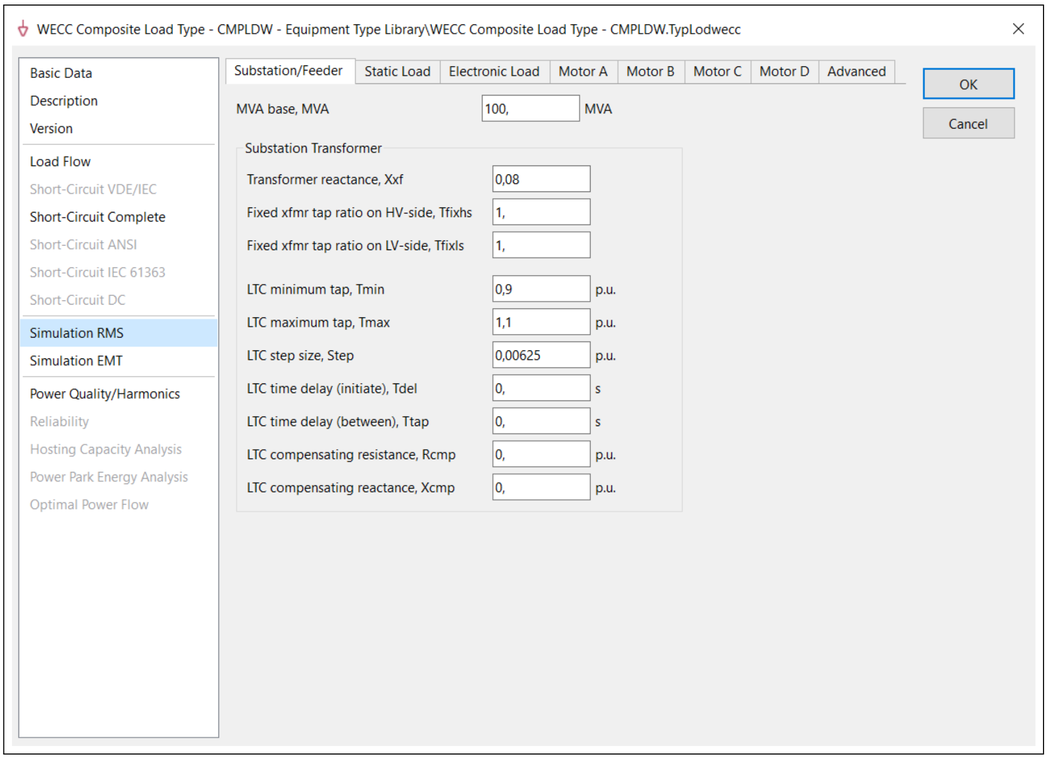

Figure 4.11: Edit dialog of the WECC Composite Load Type - CMPLDW (*TypLodwecc*)

4.4.9 Phase-wise scaling factors for loads

With the *Estimate Scaling Factor* flag of a General Load (*ElmLod*), Low-Voltage Load (*ElmLodlv*) or an MV Load (*ElmLodmv*) selected, each of the three phases will be estimated according to a phase-wise scaling factor within a *State Estimation* calculation (see section 1.11.1). These phase-wise scaling factors are also available for *QDSL*.

4.4.10 LV load model enhancement

The *Low-Voltage Load* (*ElmLodlv*) now supports the unbalanced input for a 2ph-N phase technology; see Figure 4.12.

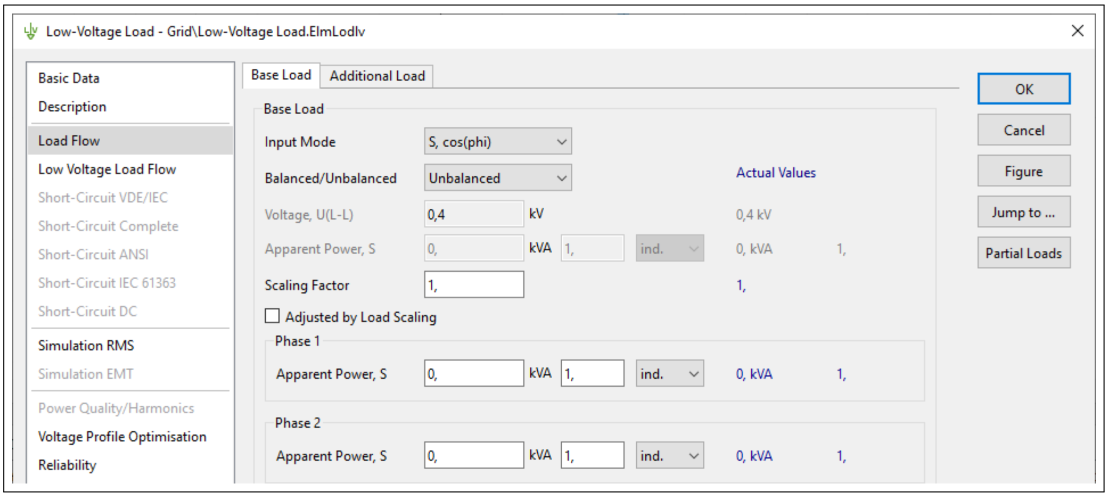

Figure 4.12: Edit dialog of the *Low-Voltage Load* with 2ph-N phase technology

4.5 Power Electronic Devices

4.5.1 DC-DC converter

The control model of the DC-DC Converter (*ElmDcdc*) now allows the control of the DC voltage on either side of the terminals to which the converter is connected. In this control mode, a built-in controller for RMS and EMT simulation is also available, as shown in Figure 4.13.

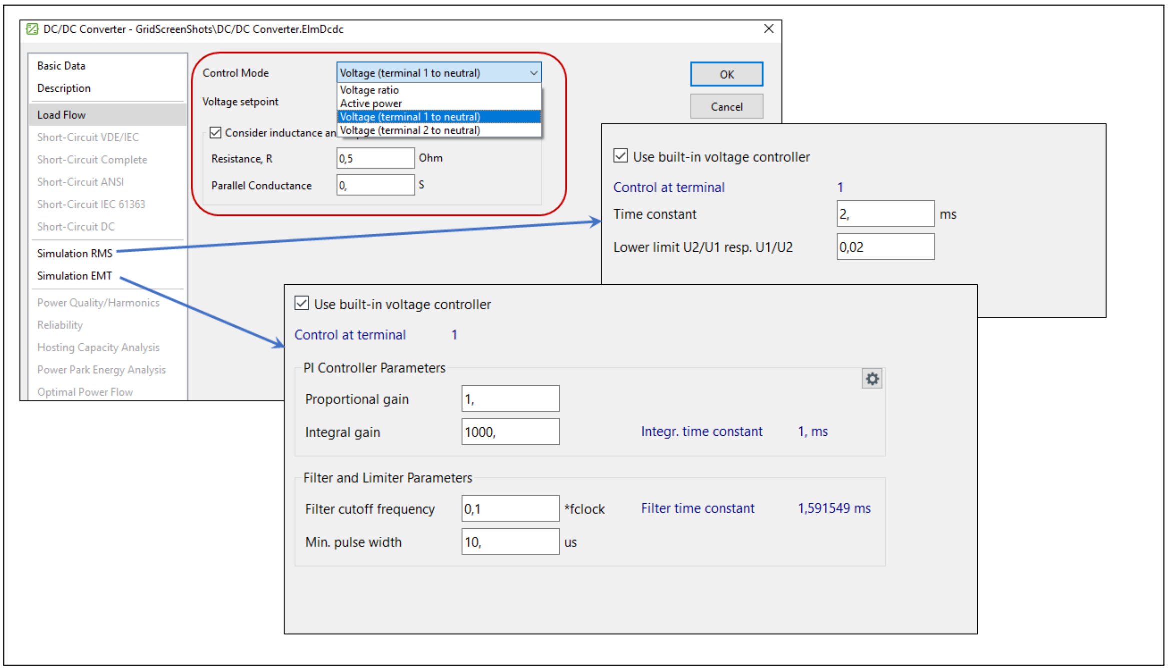

Figure 4.13: Voltage control mode selection in the dialog of DC-DC converter (*ElmDcdc*) and dialog for built-in controller in pages Simulation RMS and Simulation EMT.

4.6 Measurement Devices

4.6.1 Unbalanced measurements

For the *State Estimation* function (see section 1.11.1), the following additional data inputs are supported through various measurement devices:

- (External) P-Measurement (*StaExtpmea*)
- (External) Q-Measurement (*StaExtqmea*)
- (External) I-Measurement, current magnitude (*StaExtimea*)
- (External) V-Measurement, voltage magnitude (*StaExtvmea*)
- (External) Tap-Position Measurement (*StaExttapmea*)

The first four elements, i.e. P-,Q-,I- and V-Measurement, now support unbalanced measurements in addition to the balanced ones. For unbalanced measurements, the V-Measurement element offers Line-Line and Line-Ground options. The edit dialog of the P-Measurement (*StaExtpmea*) with the option balanced and unbalanced measurement is shown in Figure 4.14. The Tap-Position Measurement (*StaExttapmea*) element is enhanced to support Step-Voltage Regulator (*ElmVoltreg*) in the Remote Measurement Point (see Figure 4.15) and the page Error Status is active with a detailed error description.

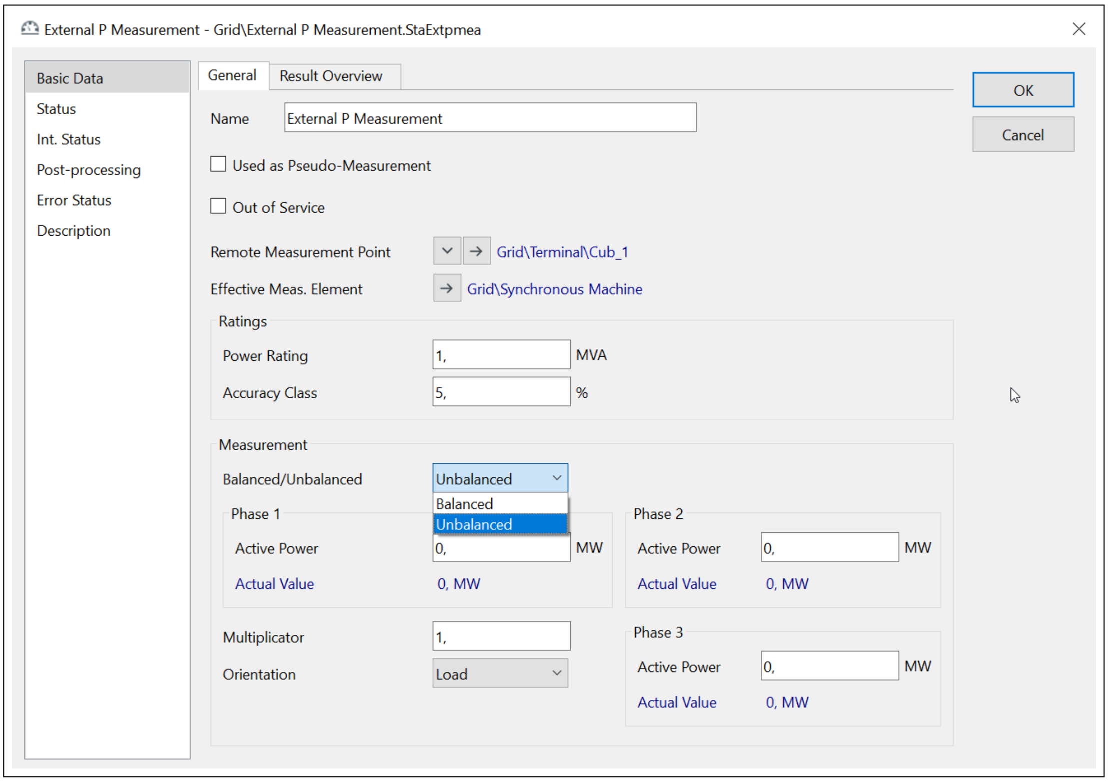

Figure 4.14: Edit dialog for an external P Measurement (*StaExtpmea*)

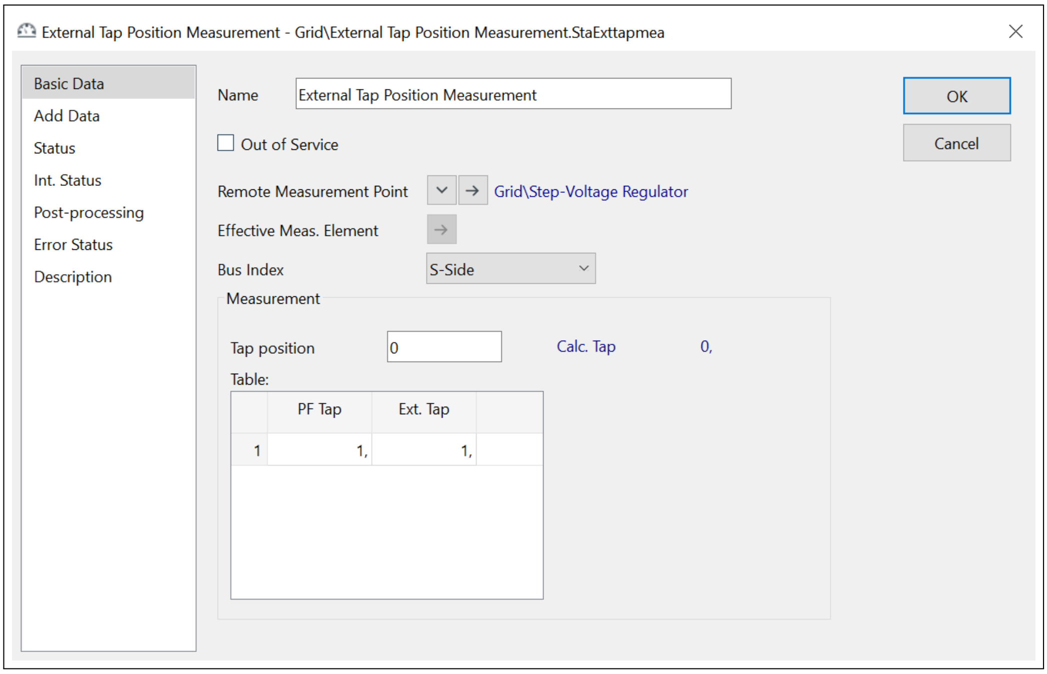

Figure 4.15: Edit dialog for an external Tap Position Measurement (*StaExttapmea*)

4.7 Protection Devices

4.7.1 Relay model library

The relay library has been extended with new relay models for *PowerFactory 2024*. All new models are supplied with documentation and *StationWare* mapping table data. The new relay models are:

- ABB REM615
- ABB REU615
- ABB RED615
- Siemens 7SL8x
- Siemens 7SD8x

4.7.2 Fault loop signals handling

Signals with loop information, for example “s:yloop” of starting units or “s:fwdphph” and “s:revphph” of distance directional units, now store the loop information differently, resulting in more intuitive handling and readability.

The retrieval of the information about a fault loop in order to build a relay logic based on loop signals is now more convenient. To achieve this, there are functions available for “RelLogdip” objects.

Detailed information can be found in the corresponding Technical References.

5 Scripting and Automation

5.1 Python

5.1.1 Python version

Python 3.12 has been released, and with *PowerFactory 2024*, Python 3.12 is supported and will be selected as default Python version. Former versions 3.10, 3.9 and 3.8 are also still supported and can be selected within the configuration, but Python 3.7, having reached end-of-life, is not.

For information about the changes of Python 3.12, please refer to the official Python release notes.

5.1.2 Python virtual environments

In Python it is possible to create virtual environments, each with their own packages installed in their site directory. A virtual environment is created on top of an existing Python installation, called the "base" Python, and may be optionally be isolated from the packages in the base Python. It is also possible to create a requirements file, which describes the content of a virtual environment and makes it easily deployable.

In *PowerFactory 2024*, Python virtual environments are now supported.

6 Interfaces and Converters

6.1 CIM CGMES Converter

6.1.1 Support of additional network elements

With *PowerFactory 2024*, additional elements are supported for the CIM to Grid and Grid to CIM conversion.

Tower Geometry Type: The Grid to CIM conversion now also supports line couplings with a Tower Geometry Type (*TypGeo*) in addition to the already supported Tower Type (*TypTow*). The line coupling is converted to a CIM MutualCoupling object.

Additional unbalanced network elements: CGMES import and export for unbalanced network elements has been improved to support additional network elements. 1- and 2-phase CIM EquivalentInjections are now converted as loads. Another newly supported unbalanced network element is the 1PH PH-N shunt, which is converted to CIM LinearShuntCompensators. Unbalanced network elements are only supported with CIM profile *CGMES 3.0* selected.

SynchronousMachine of "condenser" type: CIM SynchronousMachine objects of the type "condenser" will now be converted to synchronous machines with the plant category set to "Reactive Power Compensation". This will help the user to identify the synchronous condenser within the *PowerFactory* network model.

6.1.2 New scripting function: SearchObjectsByCimId()

There is a new Python and DPL functionality to search for elements by CIM RDF ID. The function SearchObjectsByCimId() returns a list of all objects with the corresponding CIM RDF ID. This is useful when working with large grids where all or most elements have a CIM RDF ID.

6.2 PSS/E Converter

The PSS/E import converter now supports import of models exported from PSS/E v35.

ABOUT DIGSILENT

DIgSILENT was founded in 1985 and is a fully independent and privately owned company located in Gomaringen close to Stuttgart, Germany. DIgSILENT continued expansion by establishing offices in Australia, South Africa, Italy, Chile, Spain, France, the USA and Oman, thereby facilitating improved service following the world-wide increase in usage of its software products and services. DIgSILENT has established a strong partner network in many countries such as Mexico, Malaysia, UK, Colombia, Brazil, Peru, China and India. DIgSILENT services and software installations are used in more than 170 countries.

POWERFACTORY

DIgSILENT produces the leading integrated power system analysis software PowerFactory, which covers the full range of functionality from standard features to highly sophisticated and advanced applications including wind power, distributed generation, real-time simulation and performance monitoring for system testing and supervision. For various applications, PowerFactory has become the power industry's de-facto standard tool, due to PowerFactory models and algorithms providing unrivalled accuracy and performance.

STATIONWARE

StationWare is a central asset management system for primary and secondary equipment. In addition to handling locations and devices in a user-definable hierarchy, the system allows manufacturer-independent protection settings to be stored and managed in line with customer-specific workflows. It facilitates the management of a wide variety of business processes within a company and centralises the storage of documents. StationWare can be integrated seamlessly into an existing IT environment and the interface with PowerFactory enables the transfer of calculation-relevant data for protection studies.

MONITORING SYSTEMS

Our Power System Monitoring PFM300 product line features grid and plant supervision, fault recording, and power quality and grid characteristics analysis. The Grid Code Compliance Monitoring PFM300-GCC system also offers compliance auditing of power plants with respect to grid code requirements. This monitoring and non-compliance detection provides the complete transparency and assurance required by both plant operators and utilities.

TESTING AND CERTIFICATION

The DIN EN ISO/IEC 17025 accredited DIgSILENT Test Laboratory for NAR Conformity carries out measurements in accordance with FGW TR3 on the operational type 1 generation plant (directly coupled synchronous machines). These measurements are carried out in accordance with the "individual verification procedure" as required by the German grid connection guidelines VDE-AR-N 4110/20/30. DIgSILENT has many years of international expertise in the field of generation and consumption/load systems testing. The in-house developed and produced measuring systems enable the testing laboratory to offer customised measuring solutions for a wide range of power plants and applications.

SERVICES

DIgSILENT GmbH is staffed with experts of various disciplines relevant for performing consulting services, research activities, user training, educational programs and software development. Highly specialised expertise is available in many fields of electrical engineering applicable to liberalised power markets and to the latest developments in power generation technologies such as wind power and distributed generation. DIgSILENT has provided expert consulting services to several prominent PV and wind grid integration studies.

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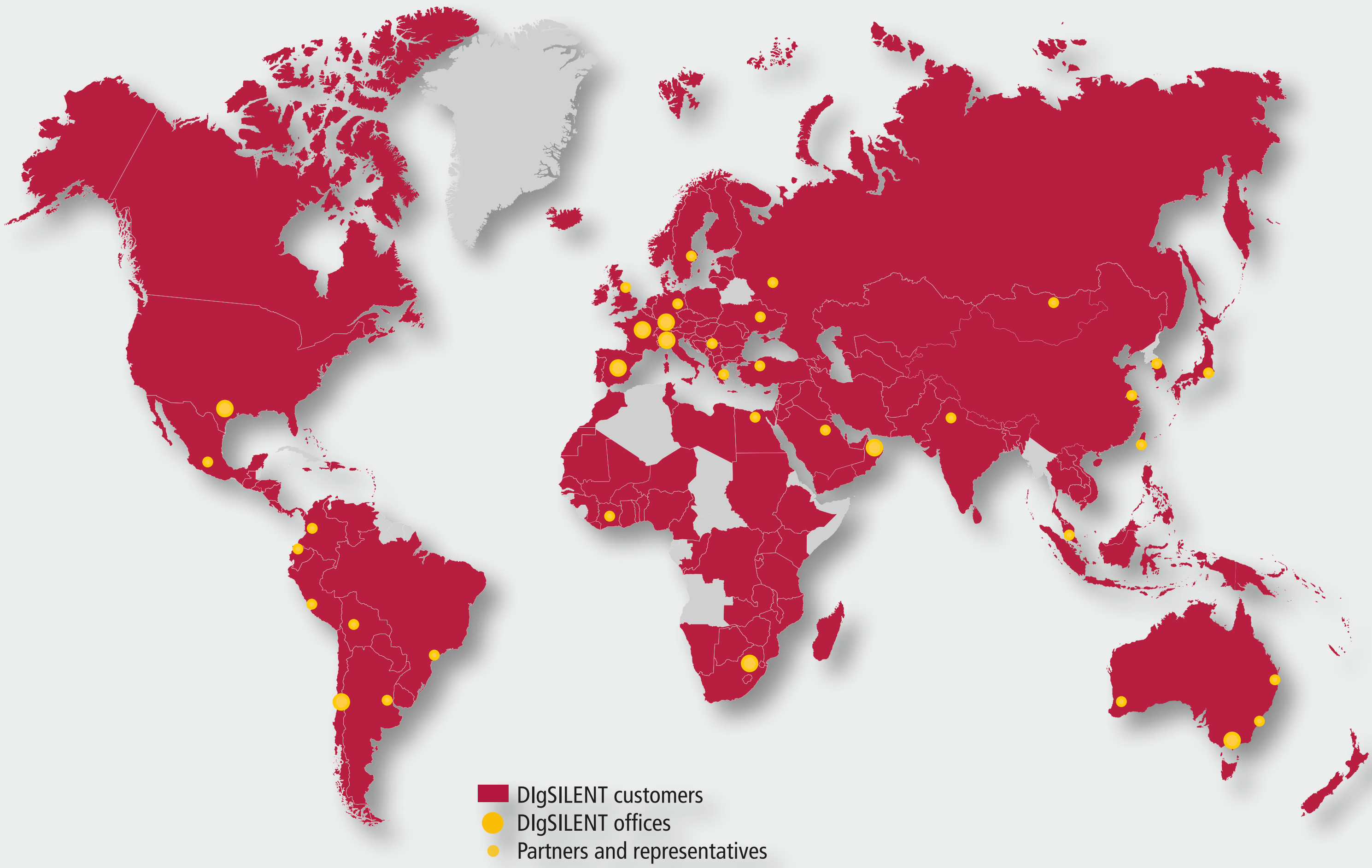

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