



POWERFACTORY

PowerFactory What's New 2020

DIgSILENT GmbH, Germany

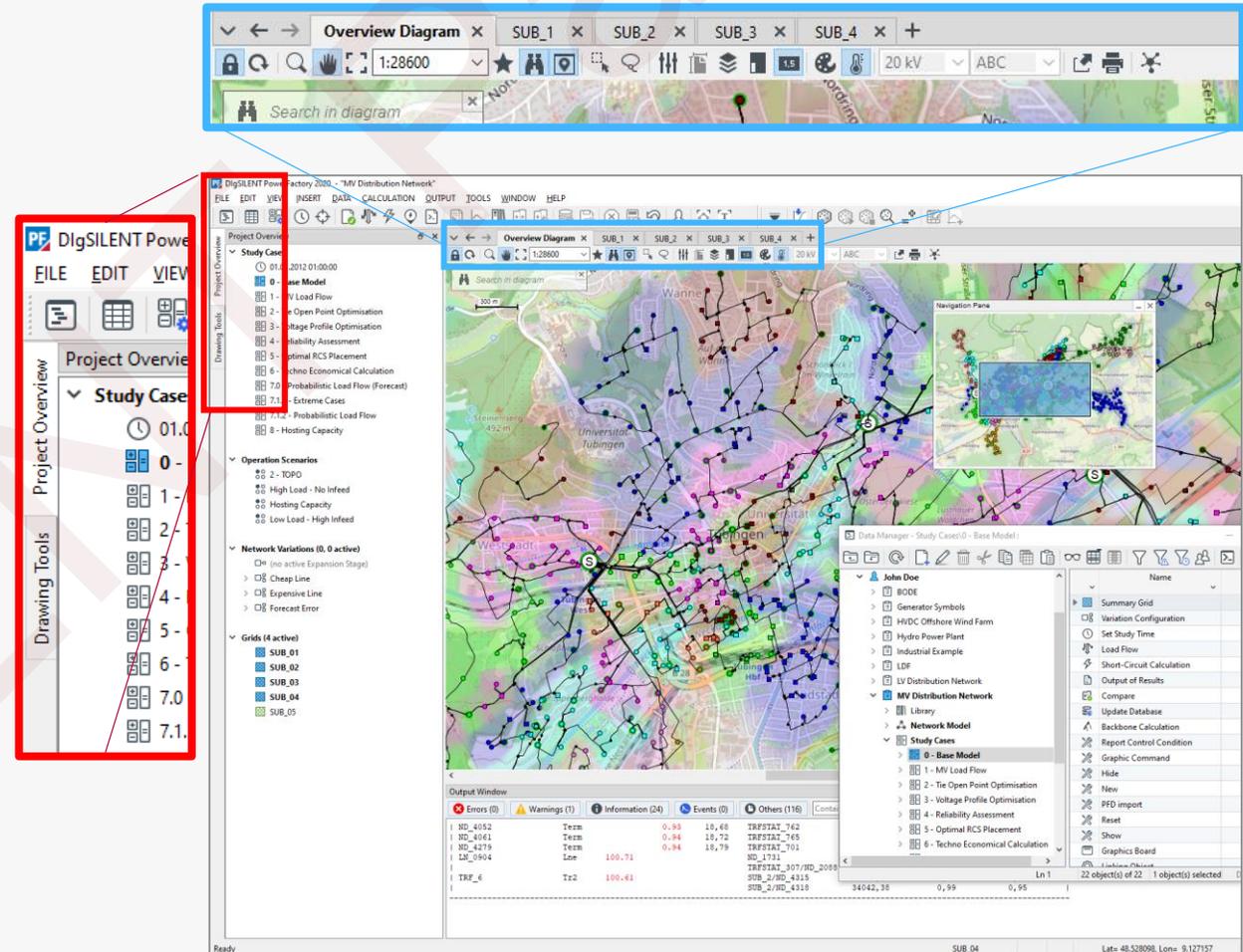
POWER SYSTEM SOLUTIONS
MADE IN GERMANY

User Interface

User Interface – Windows, Toolbars and Icons



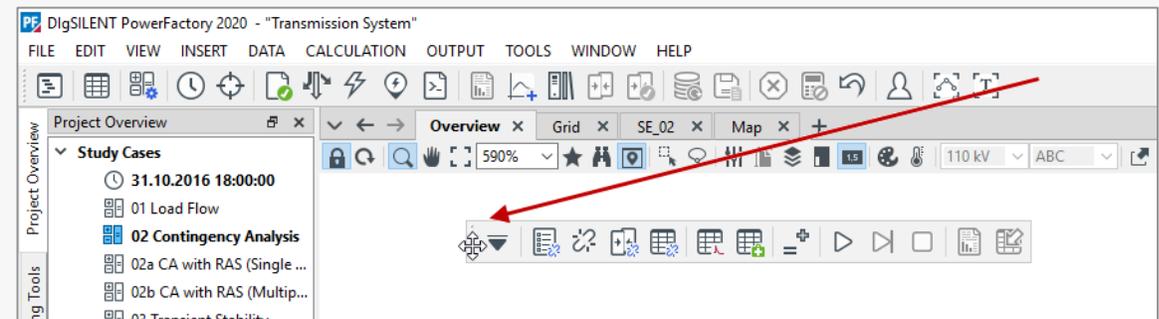
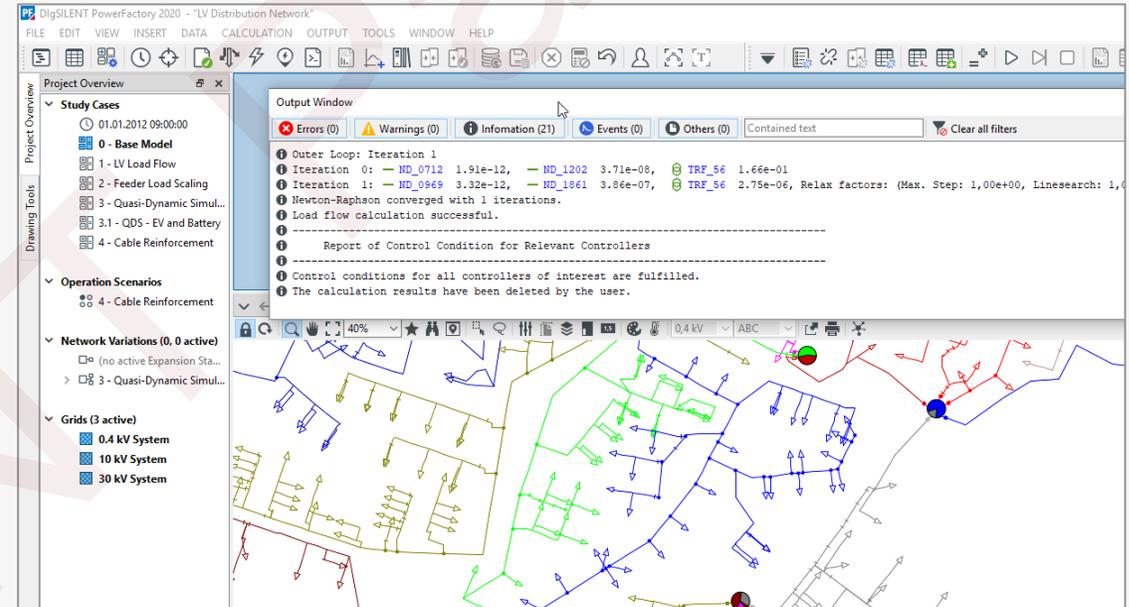
- **Default Windows Layout** modified for more ergonomic working
- **Tabbed Windows (left side)**
 - **Project Overview** and
 - **Drawing Tools**
- **Tabbed Windows for Graphics Board**
 - Tabs arranged in upper part
 - Easy browser-like navigation
 - Support of paging via mouse-wheel
 - Optionally use icons to easily distinguish
 - Diagrams
 - Substation diagrams
 - Block diagrams
 - Plots
 - ...



User Interface – Windows, Toolbars and Icons



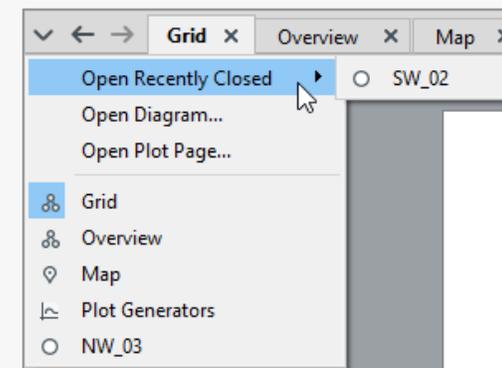
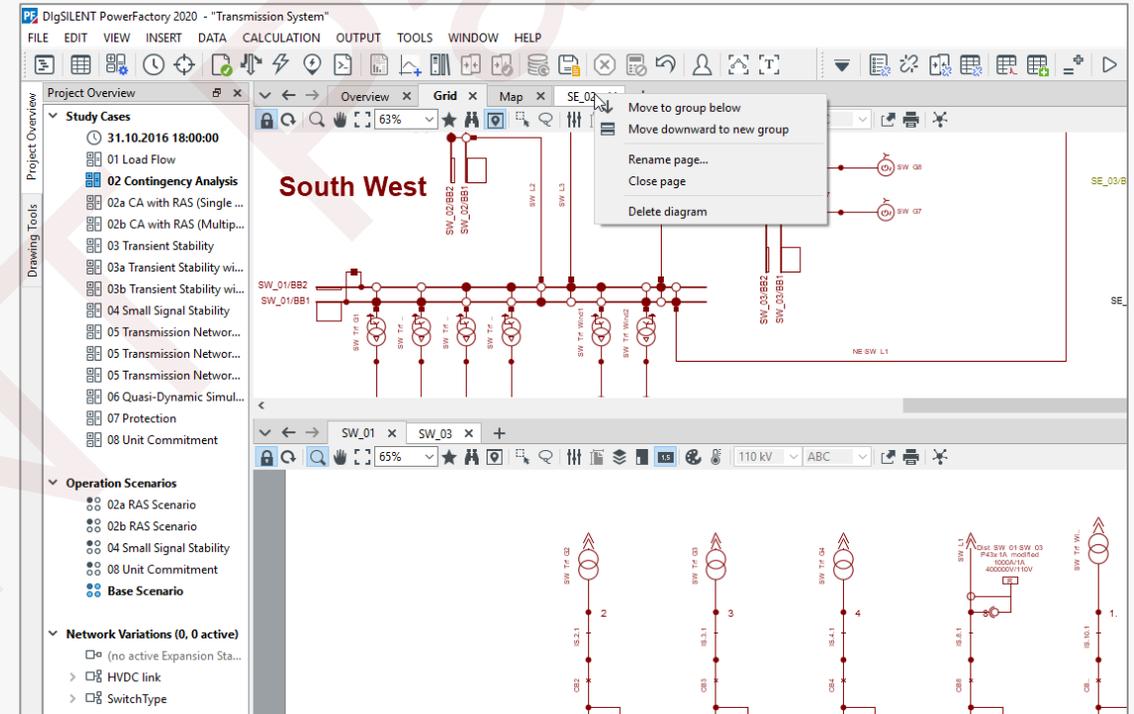
- All Toolbars and Tool Windows and are Dockable using Drag & Drop functionality
- Enabling easy customised window arranging
- Icons within the Data Manager and Network Model Manager have been harmonised
- Tool windows can be stacked (Project Overview and Drawing Toolbar)
- Application is now DPI aware



User Interface – Split View



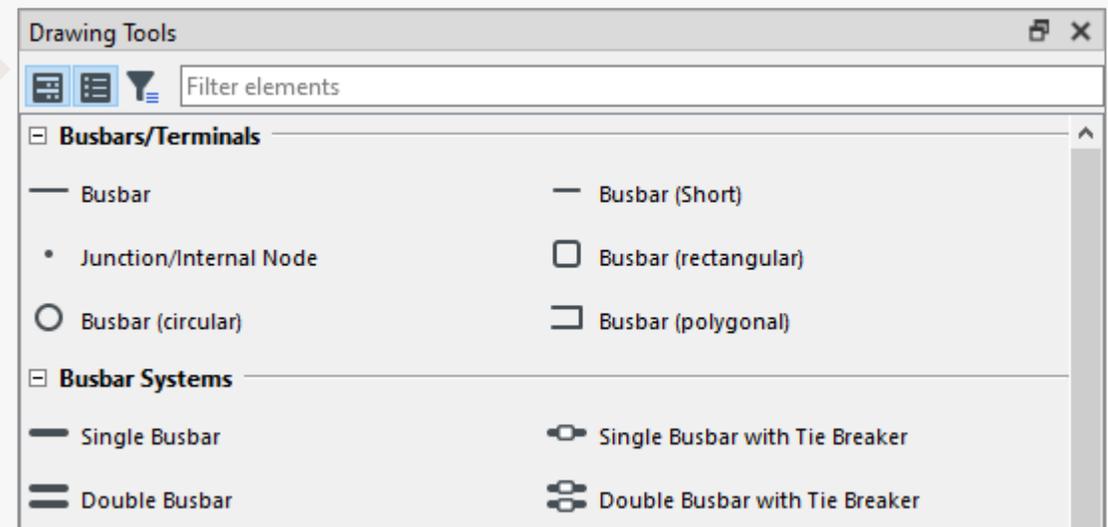
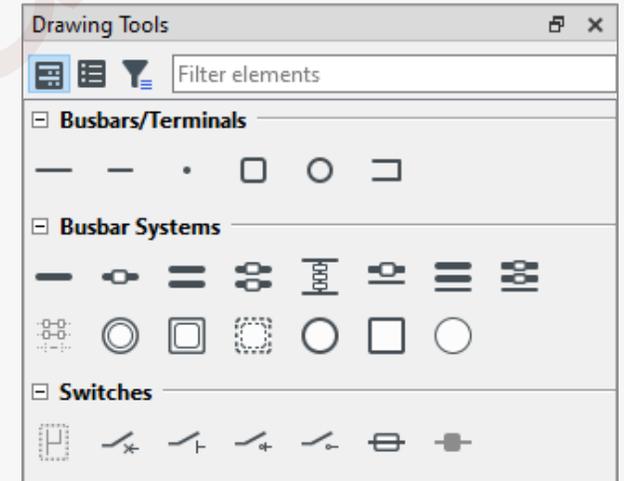
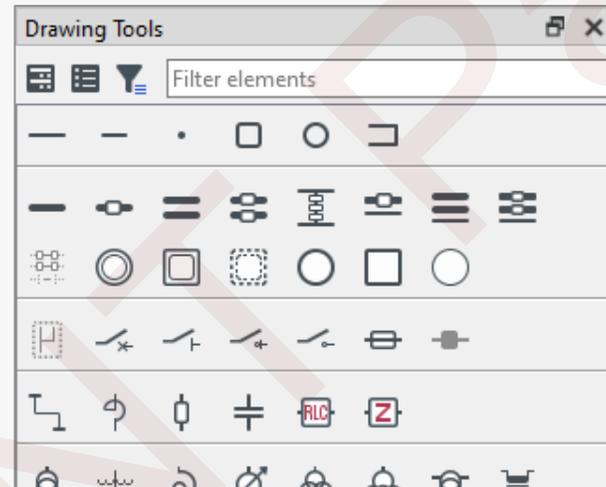
- Graphics Board supporting Split View
 - Horizontal
 - Vertical
- Enabling parallel view of:
 - Network graphics (Single Line, Geographic and Substation)
 - DSL Model Block Definitions
 - Scripts (DPL and Python)
 - Plots
- Easy and intuitive tab handling of diagrams and plots (plots are now also closable)



Network Diagrams and Graphic Features

Redesign of the Drawing Toolbar

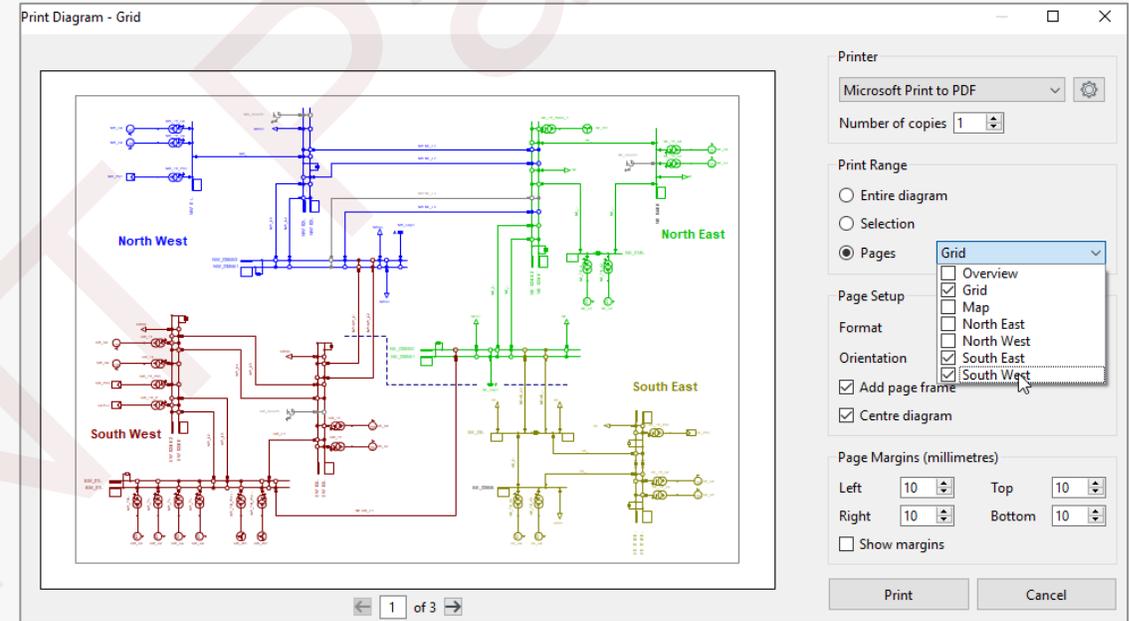
- Searching and Filter options
 - Search option for the drawing toolbar
 - Filtering based on categories allowing a faster overview about the available options
- Grouping and Sizing
 - Elements are newly grouped with enlarge or hide options for the individual groups
 - Names of the individual drawing options can be shown or hidden – making it easy to find what you are searching for
 - The drawing toolbar as an undocked floating window leads to a better usage of the space



Updated Printing Concept



- Enhanced Printing Concept
 - Enhanced printing concept
 - Allowing multi-page pdf creation of multiple diagrams
 - Option to select the diagrams to be exported
 - Page preview supporting multiple pages



Area Interchange Diagrams

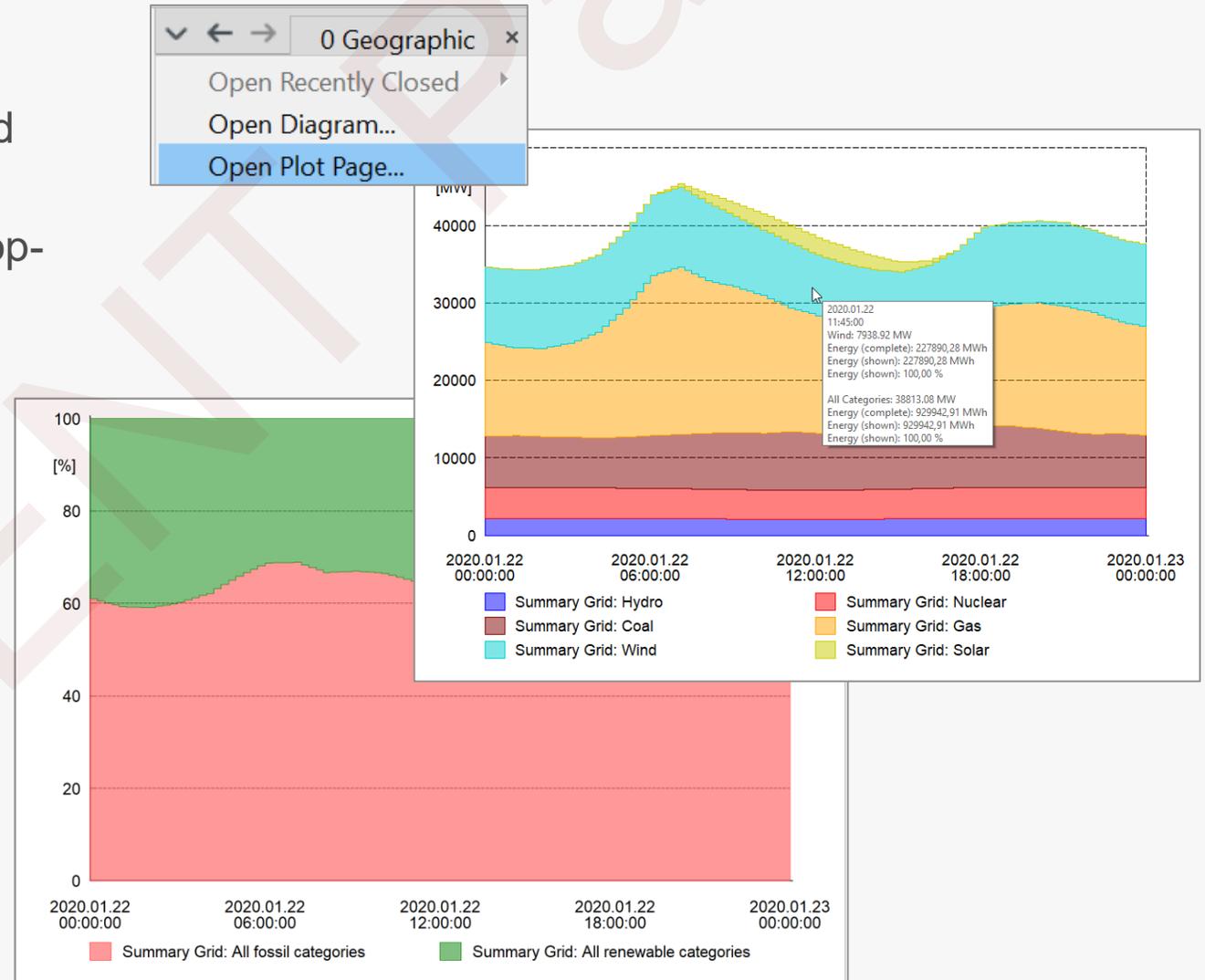
- Visualisation of the interchange between grids, zones and areas
- Automatic adaption of the arrow width based on load flow results
- Flexible and user definable design



Permanent Plots



- Permanent Plots
 - Allowing pre-defined plots to be closed and reopened
 - Opening is possible using the new drop-down menu
- New Plot designs
 - Energy Plots
 - Pots according to primary resource

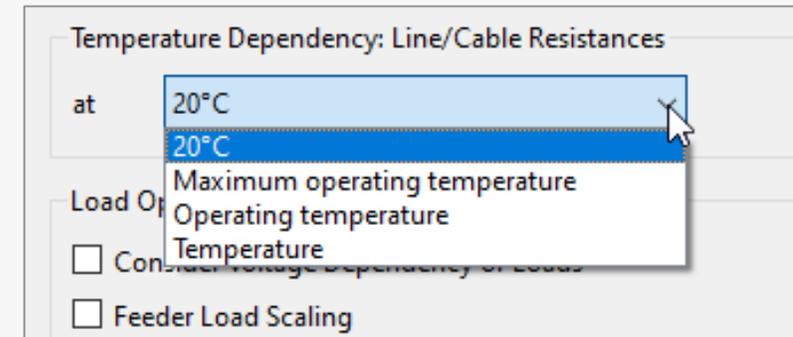
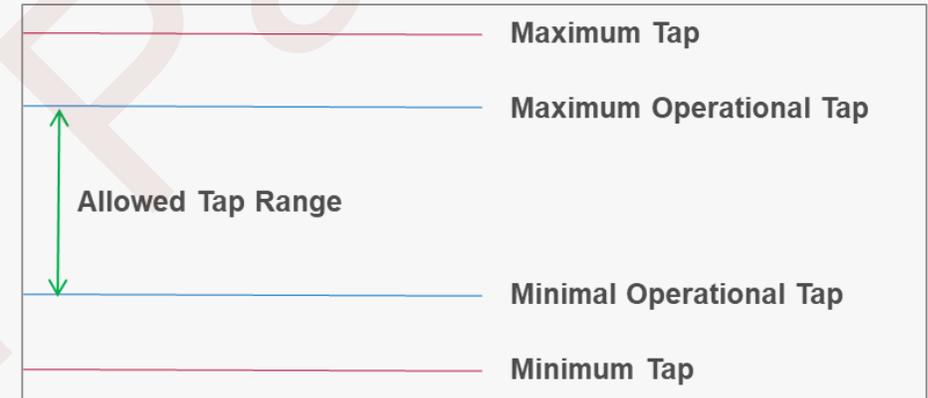


Analysis Functions

Load Flow Analysis – Operating Tap Limits and Temperature



- Operating Tap Limits of Transformers
 - Allowing tapping margins for transformers based on operational guidelines
 - Consideration of margins for emergency situations
- Temperature Dependency
 - Load Flows can now be run, considering:
 - User-defined temperatures
 - The individual maximum operating temperature of each line



Contingency Analysis – Contingency Definition



- Dynamic Contingency Definition
 - Automatic detection of relevant equipment based on pre-fault load flow conditions (e.g. loading or voltage)
 - Triggered by user-defined criteria
 - Can be combined with static contingency definitions
 - Beneficial for time sweep contingency analysis to restrict on critical time instants
- Dispatch Events as Post-Fault Actions
 - Support of absolute power changes
 - Support for Ward-Equivalents

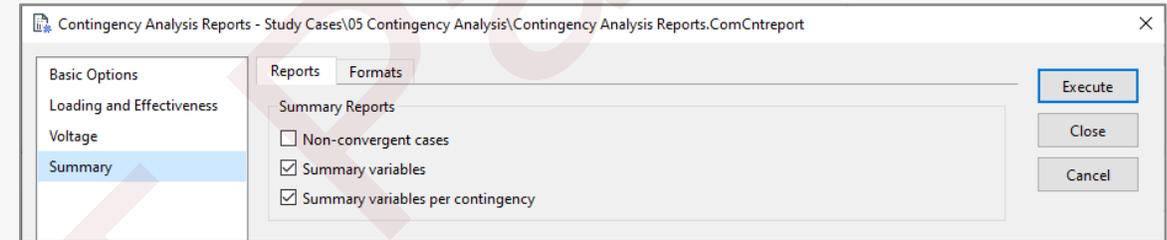
The screenshot displays the 'Contingency Analysis' configuration window. It is divided into two main sections: 'Static contingencies' and 'Dynamic contingencies'. The 'Static contingencies' section includes buttons for 'Show', 'Add Cases/Groups', and 'Remove All', along with a status message: '26 of 26 contingencies are currently considered (0 not analysed)'. The 'Dynamic contingencies' section is checked and shows a filter set named '... gency Analysis\Filter Set'. Below this, there is a 'Consider Rem' checkbox and a gear icon for configuration. A modal window titled 'Filter Set - Study Cases\02 Contingency Analysis\Contingency Analysis\Filter Set.IntFiltset' is open, showing a 'Name' field with 'Filter Set' and a table of filters.

	Filter SetFilt	Ignore	Object Filter	Expression
1	Branch_loading	<input type="checkbox"/>	*.AllBranches	c:loading>80.00

Contingency Analysis – Contingency Reporting



- Contingency Reporting Dialog
 - Redesign of the report selection dialog
- Contingency summary reporting
 - Summary results over all contingencies
 - Getting the grid impact at a glance:
 - Solved
 - Caused Islanding
 - Caused Blackout
 - Caused Substation Split/Merge
 - Number of Loads Lost
 - Load Lost [MW/Mvar]
 - Number of Generators lost
 - Generation Lost [MW/Mvar]



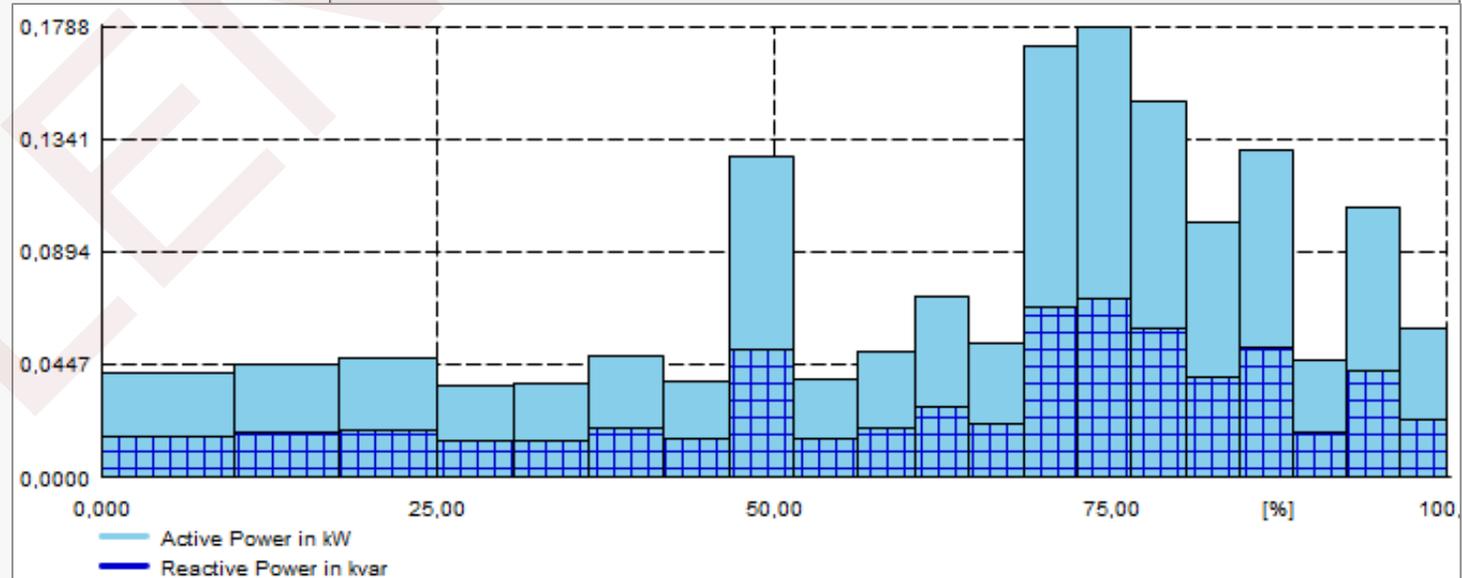
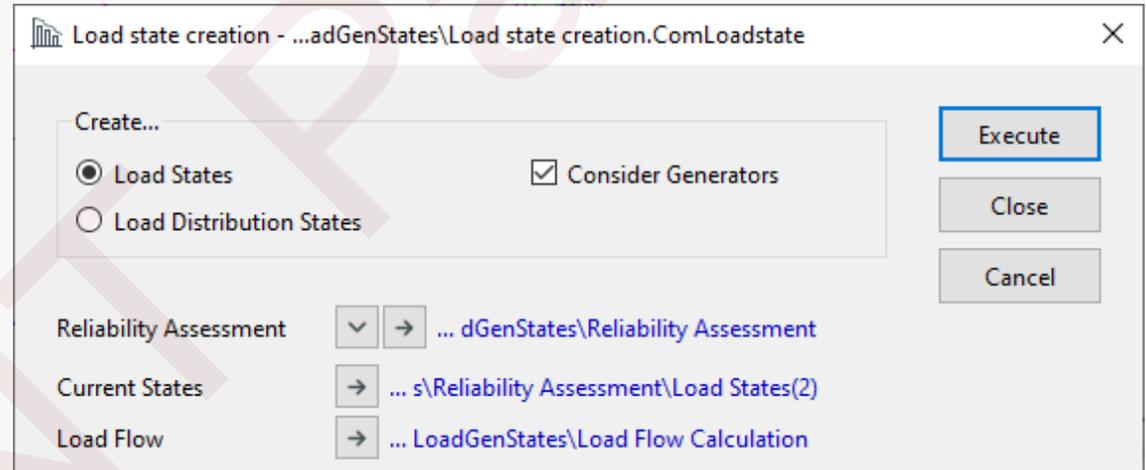
	Processed	Unsolved	Inactive	Causing Grounding	Causing Islanding	Causing Blackouts	Causing Substation Split or Merge	Causing Loss of Load	Causing Loss of Generat...
▶ Number of Contingencies	2345	0	0	0	0	0	0	0	0

Contingency Nu...	Contingency Name	Solved	Causes Islanding	Causes Blackout	Causes Substation Split or Merge	Number of Loads Lost	Load Lost MW	Load Lost Mvar	Number of Generators Lost	Generation Lost MW	Generation Lost Mvar
▶ 1	272 Ine_1001_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
2	273 Ine_1001_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
3	274 Ine_1001_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
4	275 Ine_1001_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
5	276 Ine_1002_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
6	277 Ine_1002_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
7	278 Ine_1003_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
8	279 Ine_1003_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
9	280 Ine_1004_31...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
10	281 Ine_1005_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
11	282 Ine_1005_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
12	283 Ine_1005_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000
13	284 Ine_1007_10...	Yes	No	No	No	0	0,000	0,000	0	0,000	0,000

Reliability Analysis – Dispatch Profiles



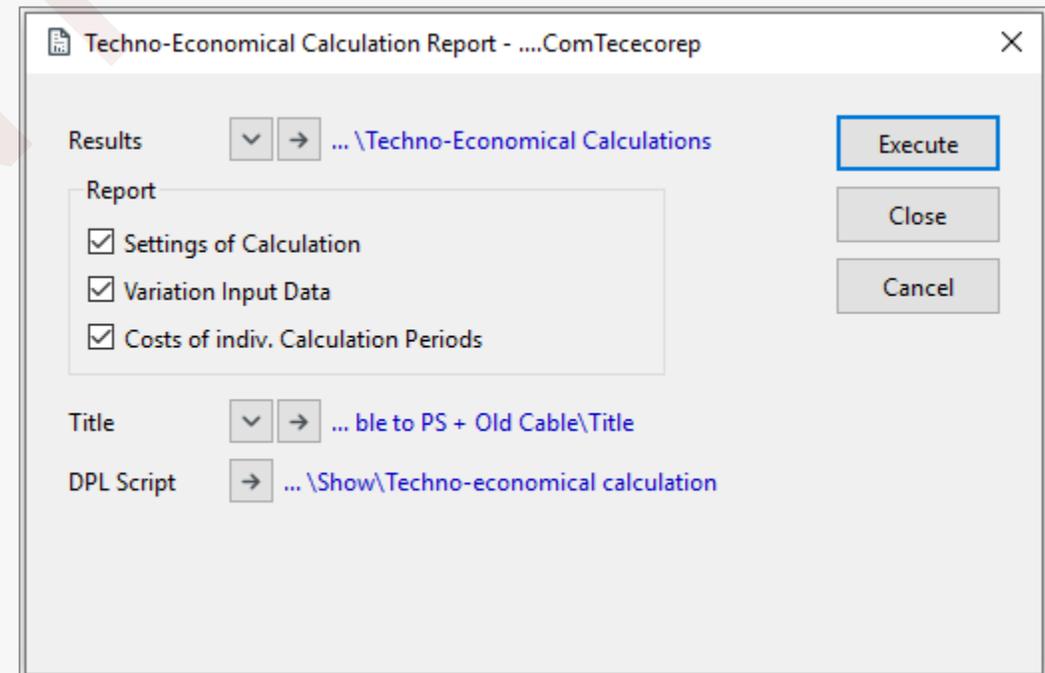
- Reliability assessment accounts now for Dispatch Profiles of generating units
- Counterpart to Load States was introduced
→ Generation States



Techno-Economical Calculation – New Reporting of Results

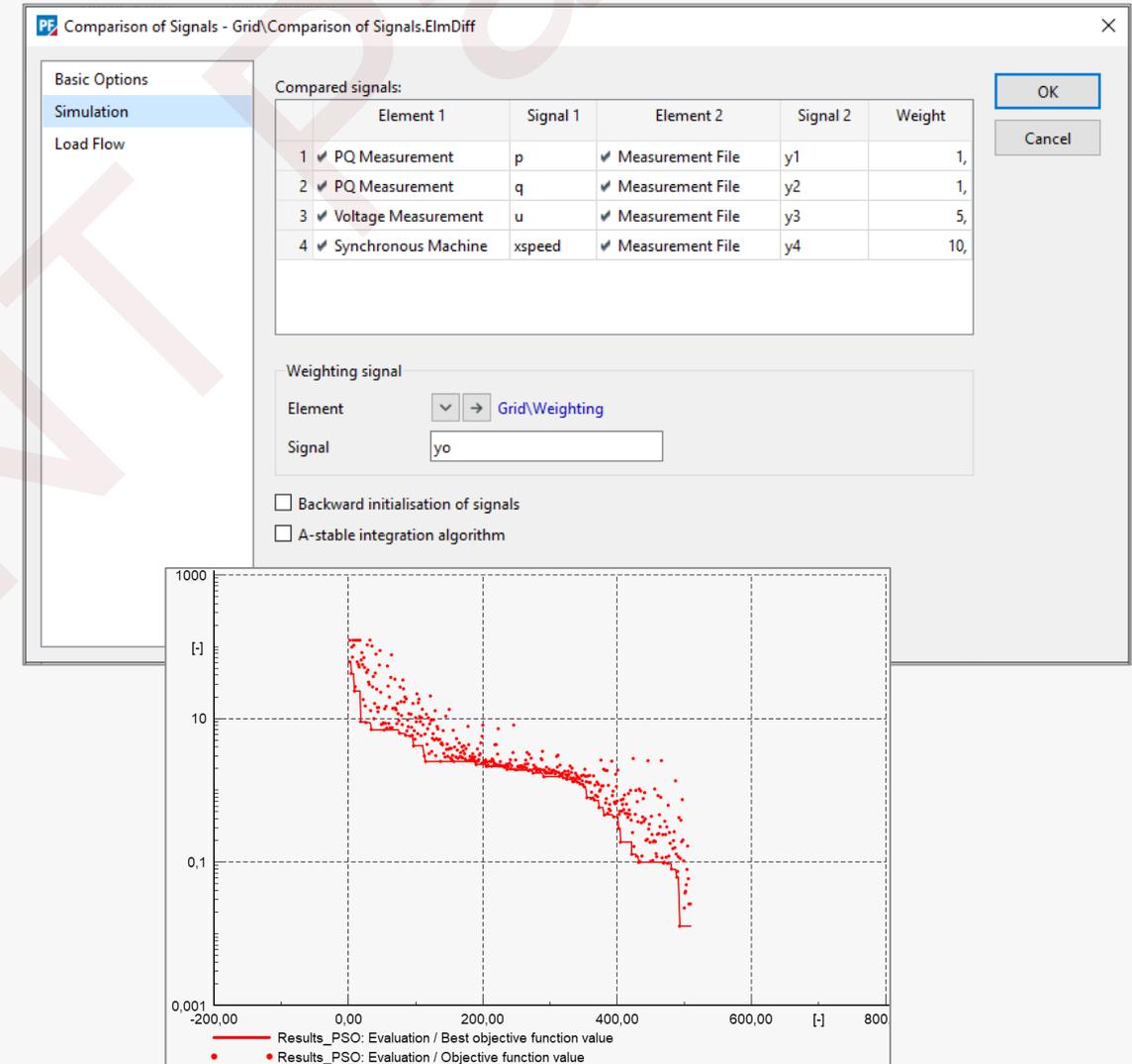


- Results analysis as report was revised
- Report can be assessed separately
- Dedicated icon in toolbox has been introduced
- No need for repeating whole Techno-Economical Calculation



Parameter Identification – Redesign of the Parameter Identification

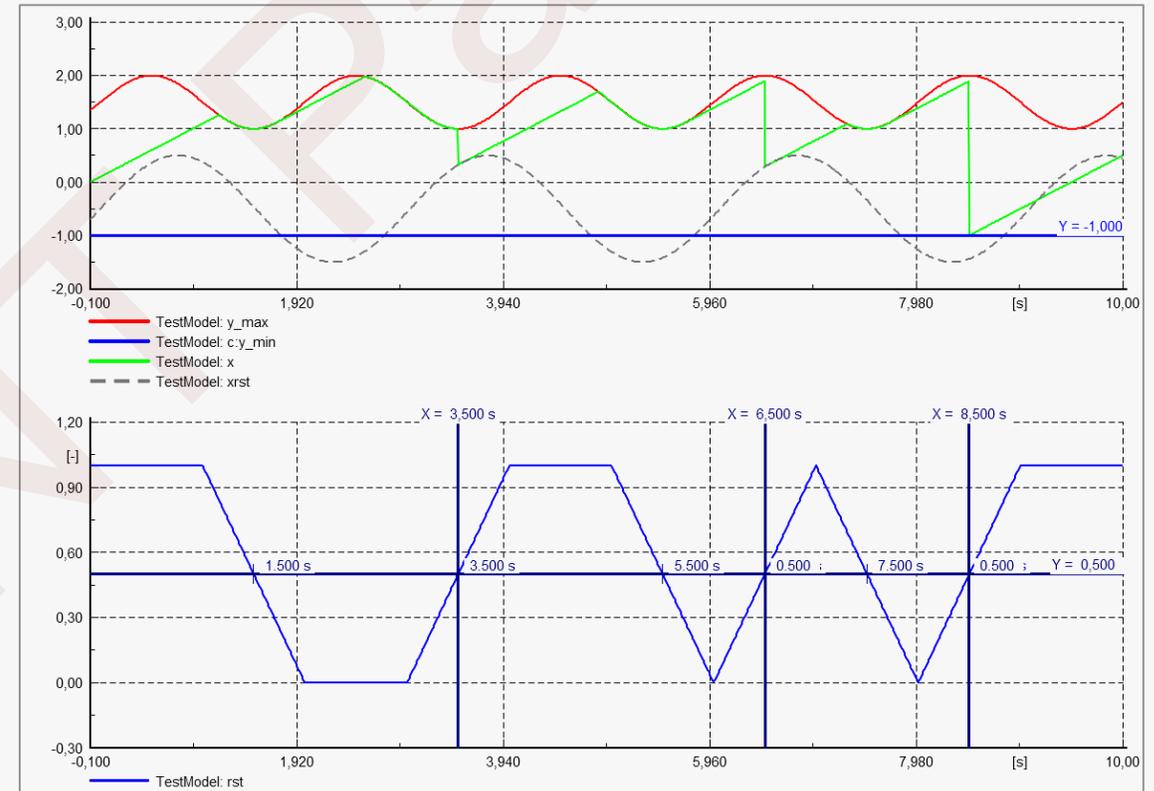
- New optimisation methodologies
 - Swarm intelligence algorithm
 - Pattern search methods
 - Global optimisers
 - Gradient based optimisers
- Smart stop criterion for faster calculation
- Improved definition of reference curves
- Full support for bounded and unbounded optimisation problems
- Result recording applied after each iteration



DSL – “reset” procedure



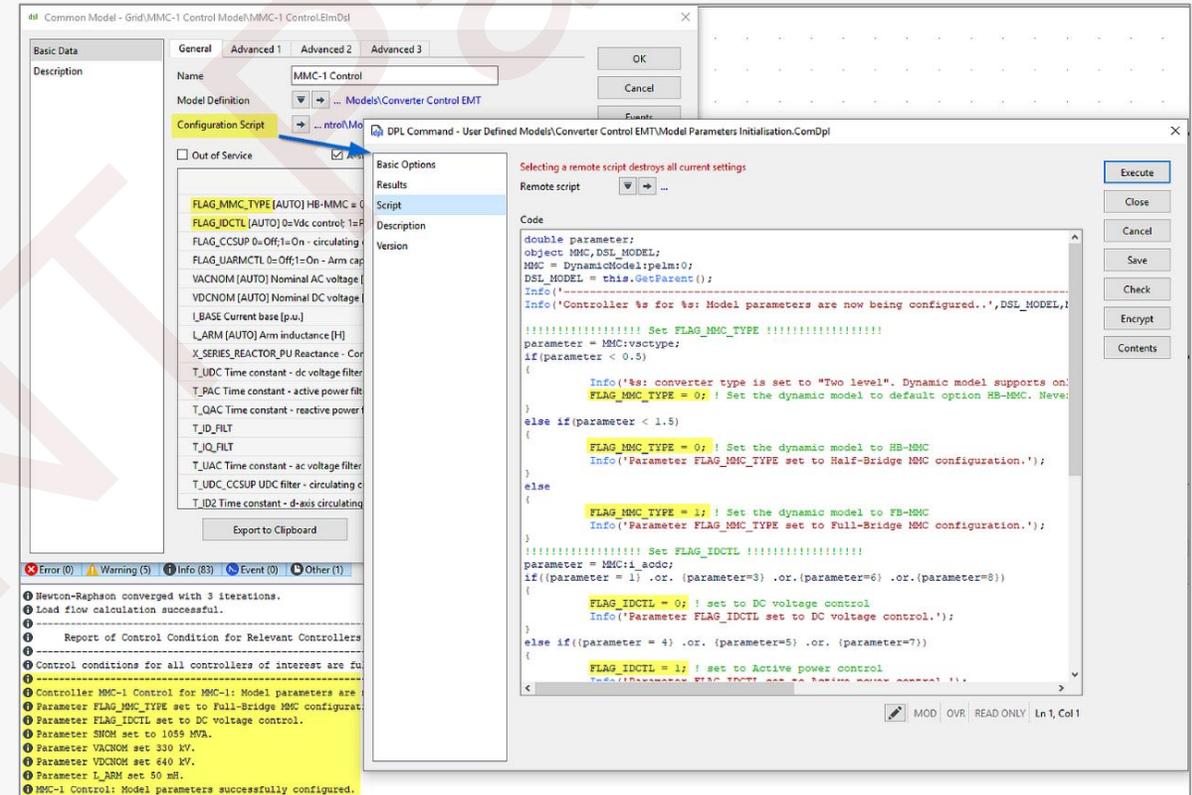
- Resets a variable upon the rising edge crossing of a variable
- Used to change DSL **state and internal variables**
- Similar with the DSL **event()** procedure
- Can be used in **DSL macros**



DSL – script based initialisation



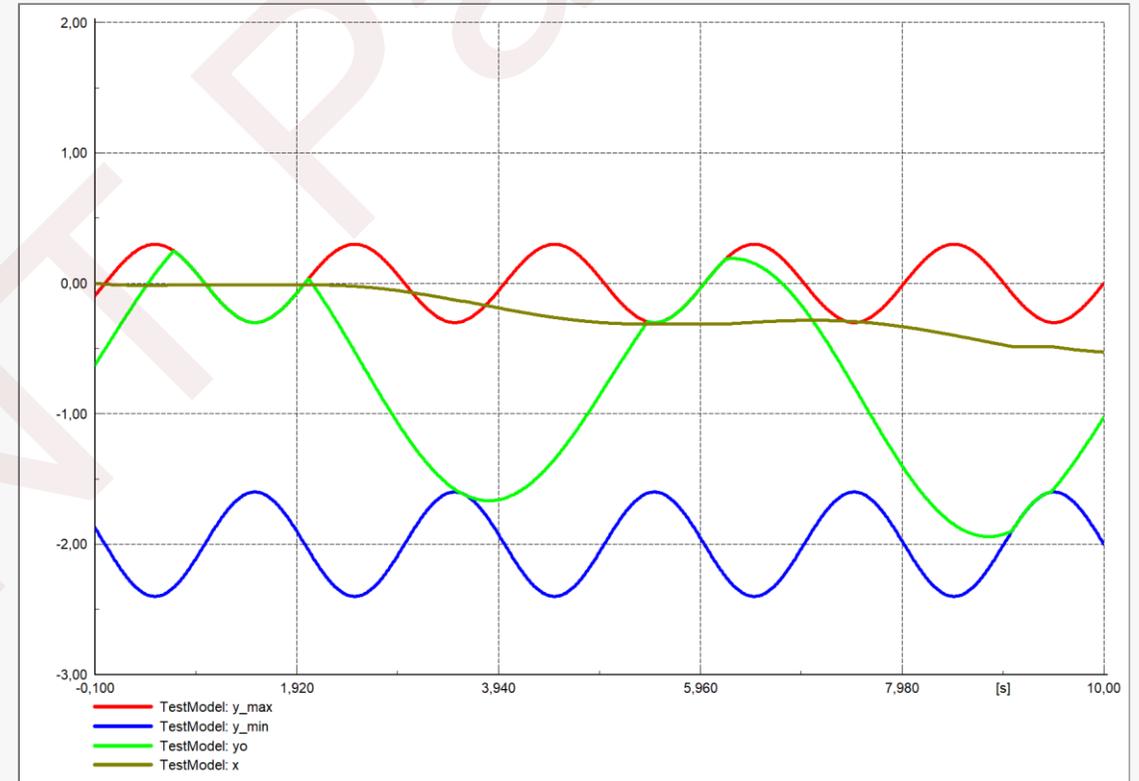
- **Configuration Script** based on DPL
- DSL Model parameters can be **configured**
- Any **load flow results and data model information** can be used for configuration
- Among others, **execution of commands is forbidden**
- Generation of user defined **output window messages**



DSL – PI regulator with variable non-windup limits



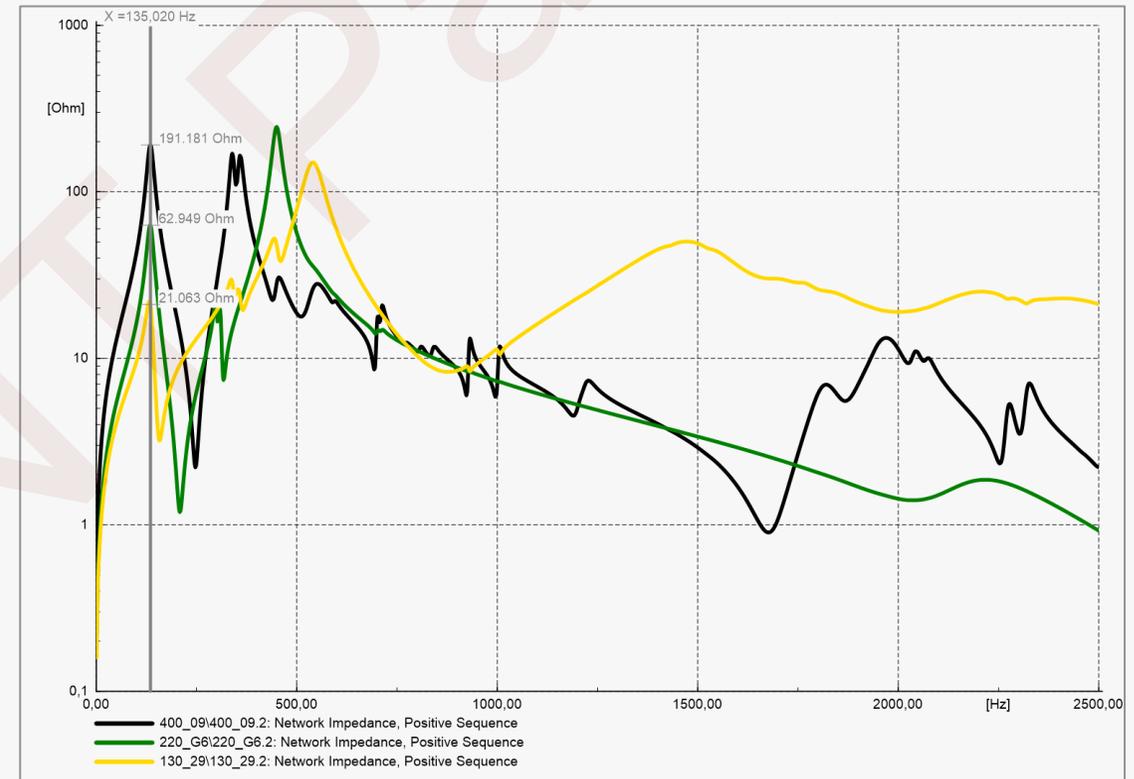
- DSL function **picontrol()**
- PI controller based on IEEE 421.5
- With **variable limits**
- Extends functionality of already existing **picontrol_const()** - which has constant limits



Frequency Sweep – no Load Flow initialisation



- Additional option for network impedance frequency sweep
- Load flow initialisation of the network not required
- Significant performance improvement for large networks, especially for contingency analysis



Frequency Sweep – New result variables



- Network impedance calculation without network capacitances
- Evaluation of impact of capacitive components on network impedance
- Additional calculation triggered when corresponding result variables are selected

Modal/Eigenvalue Analysis

Protection

Arc-Flash Analysis

Cable Analysis

Power Quality/Harmonics

Frequency Sweep

Connection Request D-A-CH-CZ

Connection Request BDEW/VDE

Connection Request VDE 4110

Tie Open Point Opt.

Voltage Profile Optimisation

Variable filter

Variable Set: Currents, Voltages and Powers

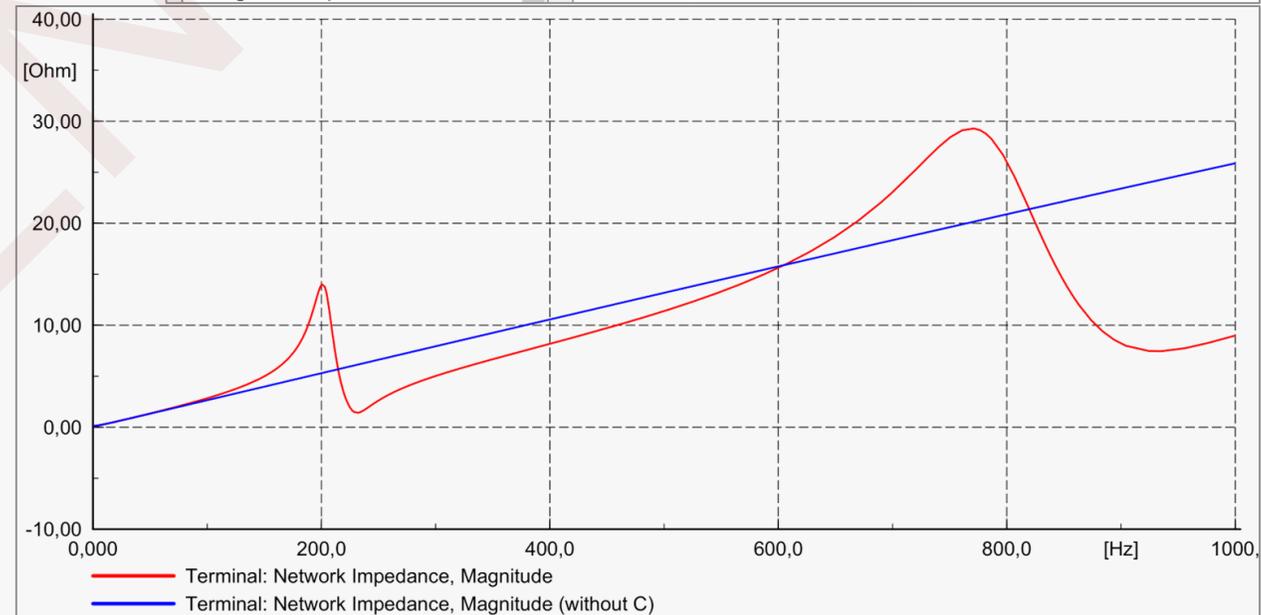
Variable Name: *

Bus and Phase:

Representation: Balanced

Available Variables

Name	Unit	Description
<input checked="" type="checkbox"/> Rnc	Ohm	Network Resistance (without C)
<input checked="" type="checkbox"/> Xnc	Ohm	Network Reactance (without C)
<input checked="" type="checkbox"/> Znc	Ohm	Network Impedance, Magnitude (without C)
<input checked="" type="checkbox"/> phiznc	deg	Network Impedance, Angle (without C)



Harmonic Load Flow – Positive sequence option



- Enhancement of Harmonic Load Flow calculation for Balanced Network Representation
- Harmonic orders, which naturally appear in the negative sequence are treated as being in the positive sequence

Harmonic Load Flow - Study Cases\Study Case\Harmonic Load Flow.ComHldf

Basic Options
IEC 61000-3-6
Advanced Options

Network Representation

Balanced Only positive sequence
 Unbalanced, 3-phase (ABC)

Calculate Harmonic Load Flow

Single Frequency
 All Frequencies

Nominal Frequency 50, Hz
Output Frequency 50, Hz
Harmonic Order 1,

Harmonics LDF and Frequency Sweep – Temperature dependency



- Harmonic Load Flow and Frequency Sweep consider temperature setting from assigned Load Flow Initialisation
- Frequency Sweep without initialisation allows user defined temperature setting (same options available as in the Load Flow)

The screenshot shows a software interface for configuring a Frequency Sweep. It includes several sections:

- Network Representation:** Radio buttons for "Balanced, positive sequence" (selected), "Unbalanced, 3-phase (ABC)", and a checkbox for "Load Flow Initialisation".
- Impedance Calculation:** Input fields for "Start Frequency" (1 Hz), "Stop Frequency" (1000 Hz), and "Step Size" (0,01 Hz), with a checked checkbox for "Automatic Step Size Adaptation".
- Temperature Dependency: Line/Cable Resistances:** A dropdown menu is open, showing options: "Temperature" (selected), "20°C", "Maximum operational temperature", and "Operational temperature". To the right, a temperature value of "20, degC" is entered.
- Frequency Settings:** Input fields for "Nominal Frequency" (50 Hz), "Output Frequency" (50 Hz), and "Harmonic Order" (1).
- Result Variable:** A dropdown menu showing "Temperature" as the selected variable.

Protection Coordination Assistant



- User defined settings rules:
 - Individual keyword-based rules
 - Full flexibility using equations
 - Option to calculate angles for circular characteristics based on:
 - Zone 1 impedance angle
 - Angle based on the summation of line impedances for the individual zones
- Coordination Assistant Reporting:
 - Enhanced tabular report
 - Detailed result view
 - Option to write back results to the relays

Protection device	Zone	Direction	Polygonal Reactance [pri.Ohm]	Polygonal Resistance (Ph-Ph) [pri.Ohm]	Polygonal Resistance (Ph-E) [pri.Ohm]	Polygonal Time delay [s]	Circular Impedance [pri.Ohm]	Circular Angle [deg]	Circular Time delay [s]
1 Dist_NE_01-NE_02	1	Forward	17,000	9,064	16,564	0,000	17,072	84,744	0,000
	2	Forward	26,031	9,895	17,395	0,300	26,141	84,744	0,300
	3	Forward	33,708	10,601	18,101	0,600	33,850	84,744	0,600
	Overreach	Forward	24,000	9,708	17,208	0,000	24,101	84,744	0,000
	Dir. Backup	Forward	---	---	---	1,200	---	---	1,200
	Non-dir. Backup	Non-directional	---	---	---	1,500	---	---	1,500
2 Dist_NE_01-NE_04	1	Forward	10,61	10,61	10,61	0,000	10,670	84,744	0,000
	2	Forward	19,61	19,61	19,61	0,300	19,739	84,744	0,300
	3	Forward	31,91	31,91	31,91	0,600	32,074	84,744	0,600
	Overreach	Forward	15,00	15,00	15,00	0,000	15,063	84,744	0,000
	Dir. Backup	Forward	---	---	---	1,200	---	---	1,200
	Non-dir. Backup	Non-directional	---	---	---	1,500	---	---	1,500
3 Dist_NE_02-NE_01	1	Forward	17,00	17,00	17,00	0,000	17,072	84,744	0,000
	2	Forward	26,03	26,03	26,03	0,300	26,141	84,744	0,300
	3	Forward	33,70	33,70	33,70	0,600	33,850	84,744	0,600
	Overreach	Forward	24,00	24,00	24,00	0,000	24,101	84,744	0,000
	Dir. Backup	Forward	---	---	---	1,200	---	---	1,200
	Non-dir. Backup	Non-directional	---	---	---	1,500	---	---	1,500
4 Dist_NE_02-NE_...	1	Forward	21,250	9,455	16,955	0,000	21,340	84,744	0,000
	2	Forward	39,844	10,041	16,416	0,300	40,012	84,744	0,300

Arc Flash Hazard Analysis



- Supporting new Standards:
 - Support of new IEEE 1584-2018 standard
- Advanced reporting:
 - Overview results for all calculated components
 - Intermediate results table per relevant element

The screenshot displays the Arc-Flash Analysis software interface. The main window shows a table of results for various accessible locations. A red arrow points from the 'Supply/3' entry in the main table to a detailed view window.

Accessible Location	Substation	Bolted Fault Current [kA]	Arcing Current [kA]	Arc Duration [s]	Incident Energy [J/cm ²]
1 - 3	Supply	11,301	10,477	0,920	51,340
2 - 4	Supply	11,474	10,622	1,695	95,948
3 - 10		10,778	9,965	0,540	28,807
4 - 12		10,790	9,976	0,605	32,309
5 - 13		10,654	9,851	0,340	17,939
6 - 15		10,840	10,021	0,145	7,784
7 - 16					

The detailed view window for 'Supply/3' shows the following data:

	Bolted Fault Current [kA]	Arcing Current [kA]	Arc Duration [s]	Incident Energy [J/cm ²]	Flash Boundary [mm]	PPE-Category
Full arc current	11,301	10,580	0,920	50,621	3972	3
Reduced arc current	11,301	10,477	0,920	51,340	4008	3

Voltage Profile Optimisation – Supported Models



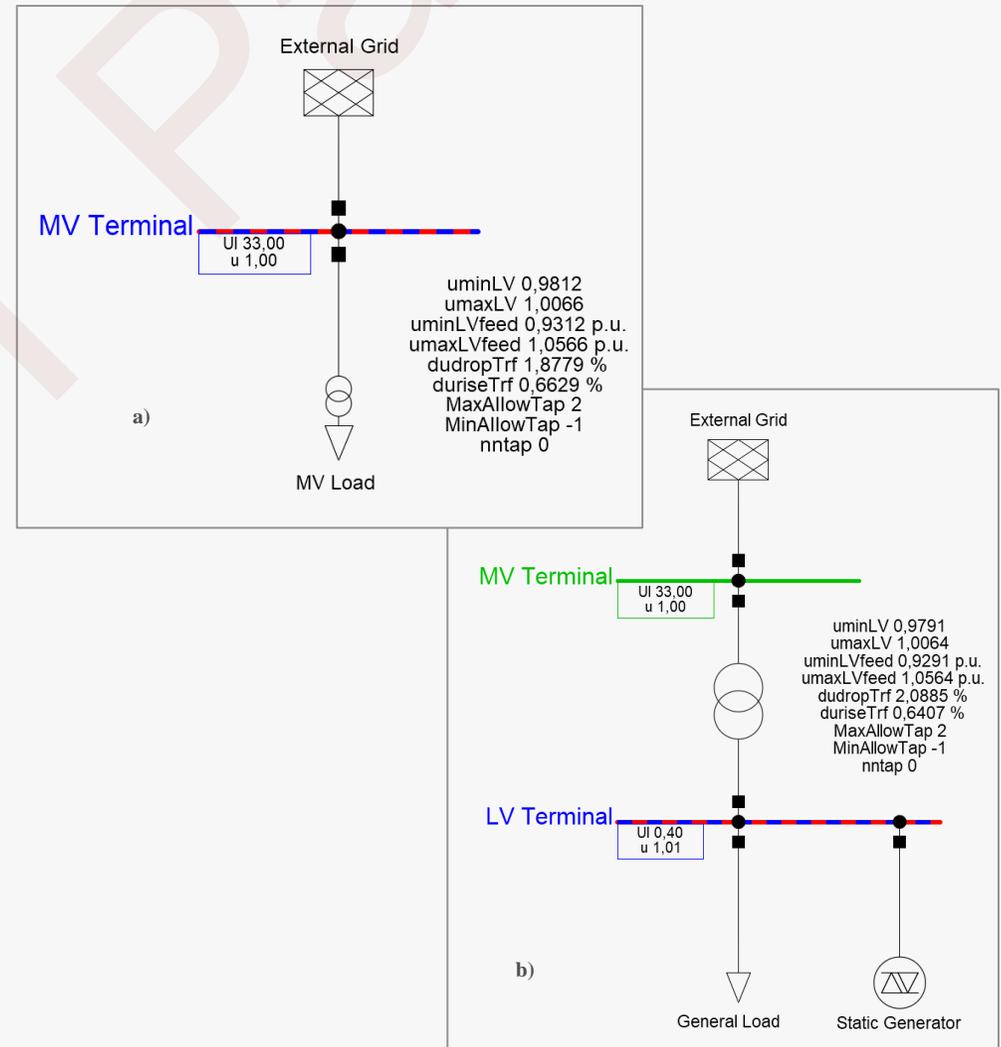
- Possible Configurations for the Voltage Profile Optimisation:

a) Medium Voltage Load

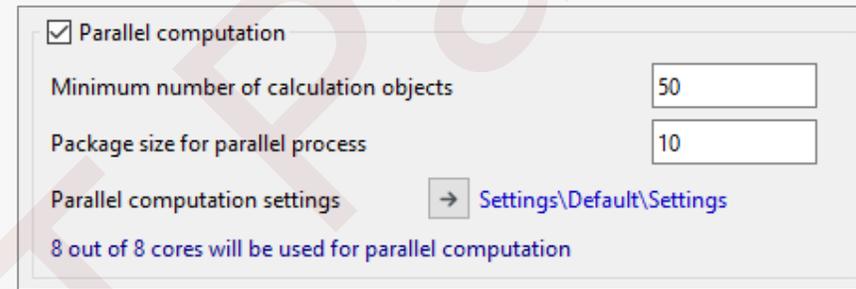
- With built-in distribution transformer in type
- Load share and generation specified in MV load
- Max. voltage drop/rise in LV network

b) Distribution Transformer + Loads / Generators

- LV network modelled
- One aggregated load containing max. voltage drop/rise in LV network
- Whole LV network modelled in detail (voltage drop/rise considered based on load flow)
- All load and generation models in PowerFactory are supported (except MV load)



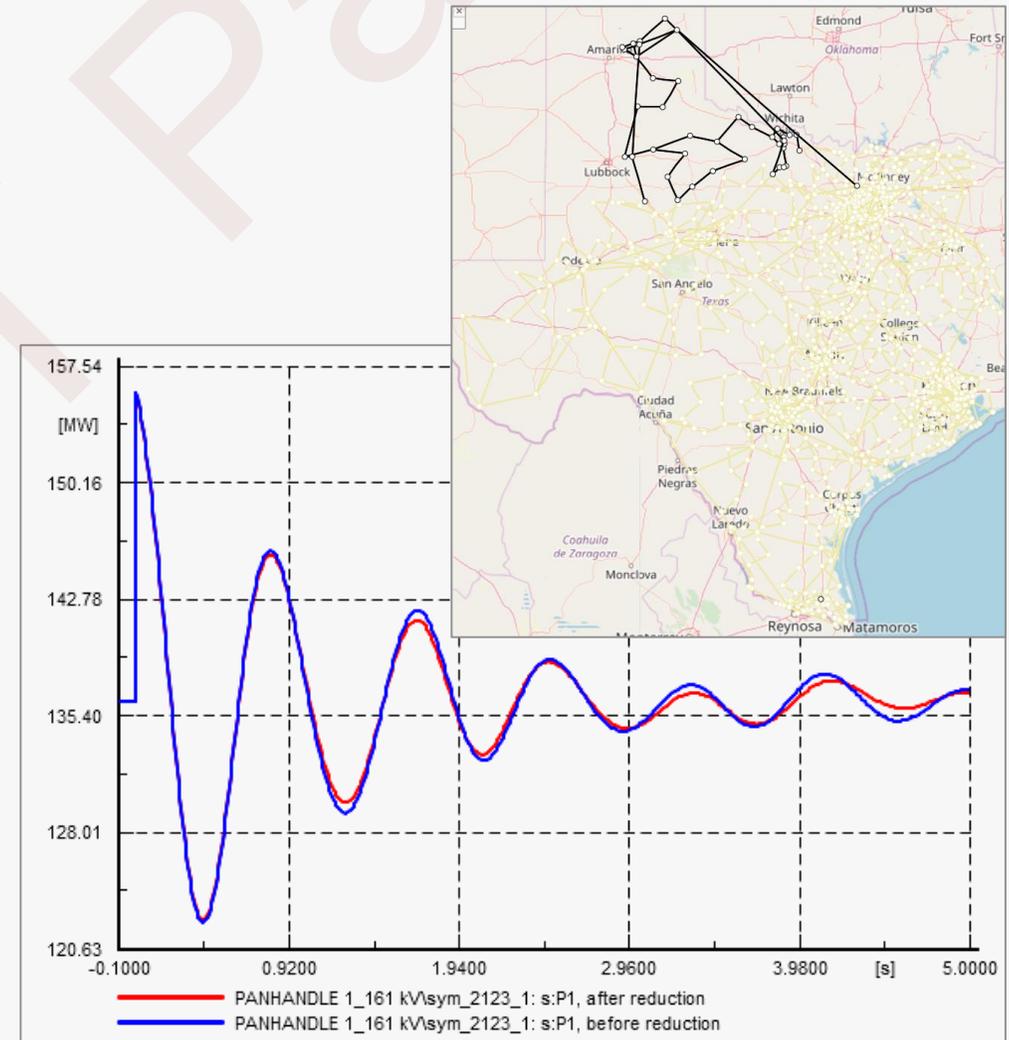
- Parallel Computation
 - Several cores can be used for the calculation
 - Leads to a significant reduction in the calculation time
- Presentation of results in geographic diagrams
 - Circles can be displayed around sites, substations, secondary substations and nodes
 - Size of circles represents the connectable amount of power



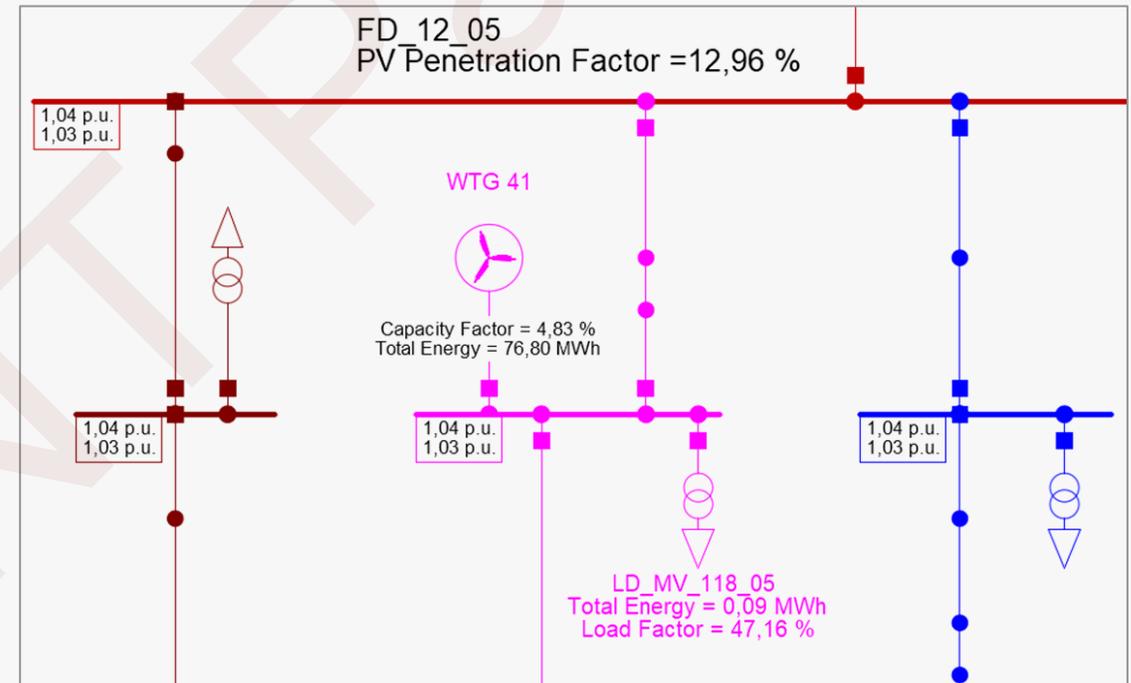
Dynamic Network Reduction



- Reduction of a large scale network to a small region while retaining the dynamic behaviour of the whole system.
- Parameter identification internally used
- Performance and handling improvements
- Confidential network parts and models can be reduced for data exchange



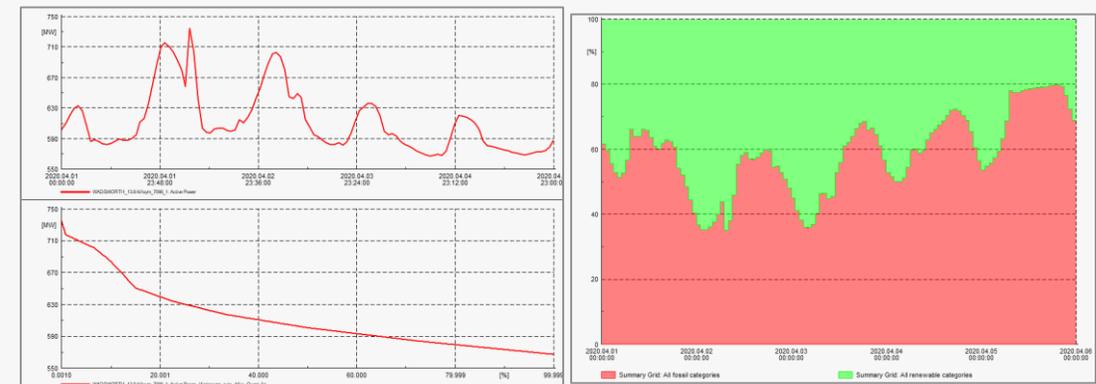
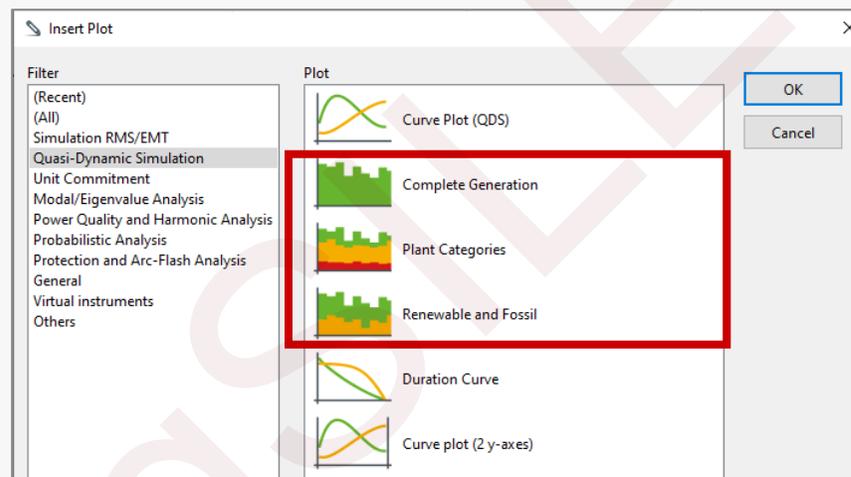
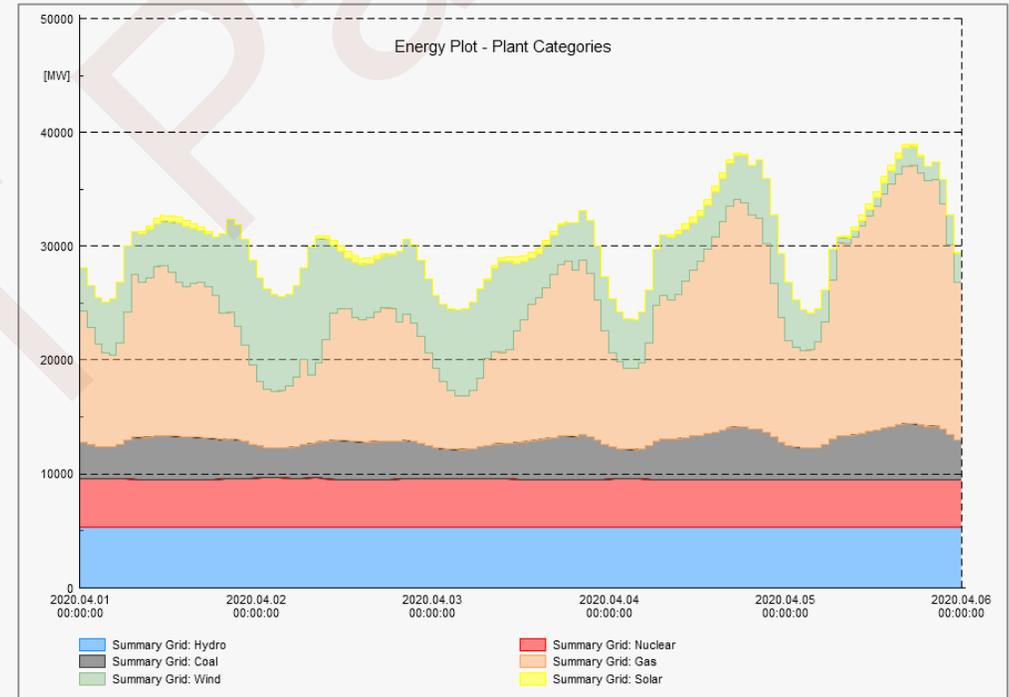
- New result variables:
 - **Capacity Factor:** Ratio of the actual to the maximum possible electrical energy of a generator
 - **Load Factor:** Average load divided by the peak
 - **PV Penetration Factor:** Ratio of the total peak PV power to the peak load apparent power of a feeder
 - **Maximum Reverse Power:** Quantifies the maximum power export of a feeder



Quasi-Dynamic Simulation – New Visualisation Options



- Energy Plots are available for:
 - Complete Generation
 - Plant Categories
 - Renewable vs Fossil Generation
- Energy plots can be displayed in absolute values or relative in percent
- Annual duration curves



Sensitivity Analysis – New distribution factory



- New Quantities:
 - PTDF (Power Transfer Distribution Factor)
 - LODF (Line Outage Distribution Factor)
 - OTDF (Outage Transfer Distribution Factor)
 - PSDF (Phase Shift Distribution Factor) or TCDF (Tap Change Distribution Factor)
- Calculation for multiple elements:
 - Multi-selection of analysed elements saving time in processing the individual quantities
 - Sensitivities with different contingencies
- Reporting:
 - Tabular report with user-defined filter and thresholds

LODF Report

Study Case: 01 Load Flow
Result File: Distribution Factors Results (SYM)_LODF

Display results for: bus1
Threshold (abs. value): 30 [%]
Monitored element(s): 17 of 17 selected

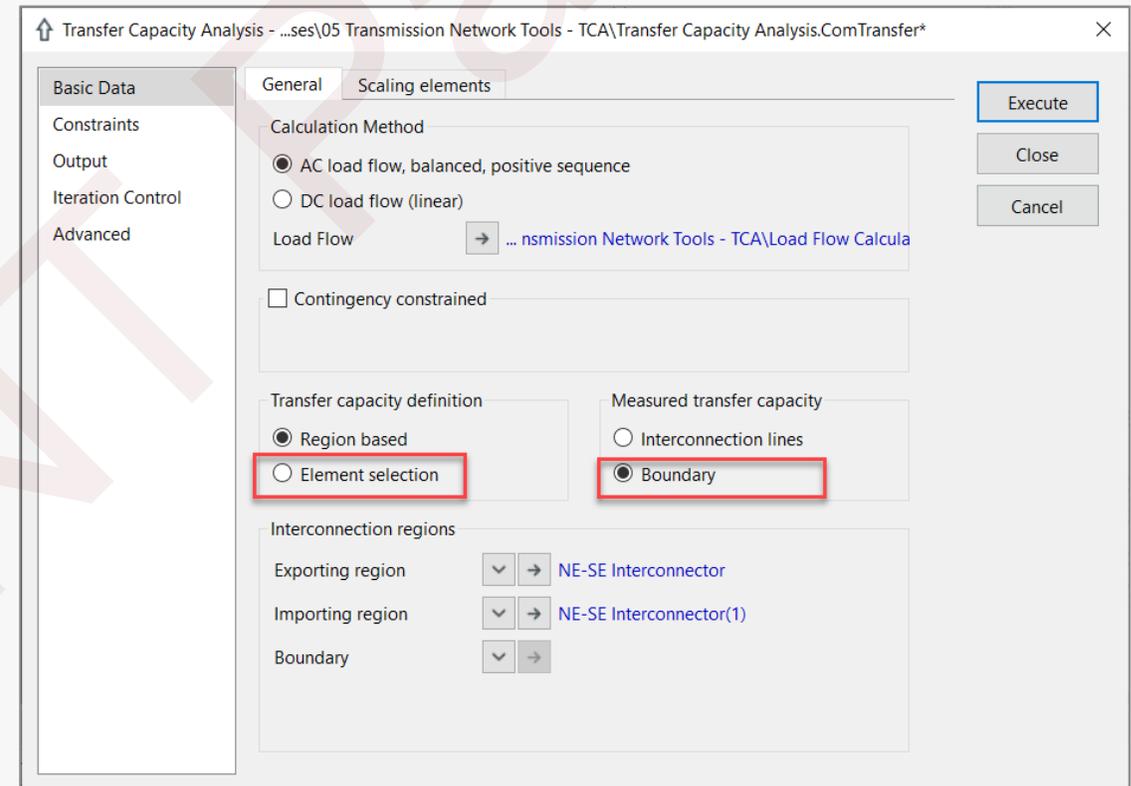
Outage Case	NE-SW_L1 [%]	NE_L1 [%]	NE_L2 [%]	NE_L3 [%]
1 NE_01_BB1 [NE_01]		-47,63533	-47,63533	
2 NE_01_BB2 [NE_01]		-47,45118	-47,45118	-53,52336
3 NE_02_BB1 [NE_02]	-32,24036	210,6289	-100,0000	-99,99977
4 NE_02_BB2 [NE_02]		-100,0000	76,03406	95,70103
5 NE_03_BB1 [NE_03]	-100,00000	-99,99093	41,36140	
6 NE_03_BB2 [NE_03]	-34,36120	-82,28583	-99,99080	

Ln 1 | 6 Line(s) of 6 | 1 Line(s) selected

Transfer Capacity – New Options



- Importing and exporting regions:
 - User definable importing and exporting regions using boundaries
 - Allowing full flexibility in the analysis
- Definition of scaled elements:
 - User definable definition of scaled elements
 - Including generators and loads



Unit Commitment and Dispatch Optimisation – Storage Models



- The storage model can be used as:
 - Hydro Units
 - Batteries
 - General storages
- Consumption and generation mode
- Linked to the generator via efficiency curves
- Several generators can be linked to one storage via a Virtual Power Plant

Storage - 5 NORTH CENTRAL\Hydrodam Lewisville.ElmStorage*

Basic Data
 Quasi-Dynamic Simulation
Unit Commitment
 Description

Operational energy limits

Min. 0. MWh 0. p.u.
 Max. 10000. MWh 1. p.u.
 Soft constraint

Energy constraint at study period end

Off
 Hard constraint
 Soft constraint

Min. energy 7000. MWh 0.7 p.u.
 Energy at study period start 7000. MWh 0.7 p.u.
 Water spillage 0.2 MW 0.00002 p.u./h
 Inflow 400. MW 0.04 p.u./h

Unit Commitment Storage Report

Study Case: Study Case
 Result Files: Unit Commitment (after optimisation) DC
 Unit Commitment (summary) DC
 Time Range: 24.10.2020 00:00 - 25.10.2020 00:00

Study time: Summary
 Energy Representation: absolute

Storage	Storage type	Storage Energy at Start [MWh]	Storage Energy at End [MWh]	Storage Energy Total Difference [MWh]	Sum of Inflow [MWh]	Sum of Self-discharge Water spillage [MWh]	Power plant	Sum of generated Energy [MWh]	Sum of consumed Energy [MWh]	Efficiency Factor Energy generation	Efficiency Factor Energy consumption	Dispatch Costs Energy generation [USD]
1 Storage river	Hydropower	80000.00	79351.79	-648.21	1920.00	120.00	Run of River Power Plant	2369.27	0.00	0.97	1.00	236926.89
2 Pump Storage	Hydropower	100.00	300.00	200.00	0.00	0.00	Pump Storage Plant	465.55	665.55	0.97	0.95	47067.05
3							Pump Storage Gen 1	232.77	332.77	0.93	0.90	23510.25
4							Pump Storage Gen 2	232.77	332.77	1.00	1.00	23556.80
5 Battery Storage	Battery	100.00	100.00	-0.00	0.00	48.00	Battery	150.71	207.52	0.97	0.98	1300.00

Ln 1 | 5 Line(s) of 5 | 0 Line(s) selected

Unit Commitment and Dispatch Optimisation – Virtual Power Plant



- Combination of several generation units for the optimisation
- Use cases:
 - Several generators can be represented as one power plant in market simulations.
 - Aggregate single wind turbines to a wind park.
 - Linking several machines to one storage.

Virtual Power Plant - HydroStorage Lewisville.ElmBmu

Basic Data | Description | Automatic Dispatch | Quasi-Dynamic Simulation | **Unit Commitment**

Controls | Operating Costs | Redispatch Costs | Start-Up/Shut-Down Costs | Constraints

Power plant usage: **Coupled with storage model**

Storage model: **Coupled with storage model**

Controls:
 Active power
 Reactive power
 Must run

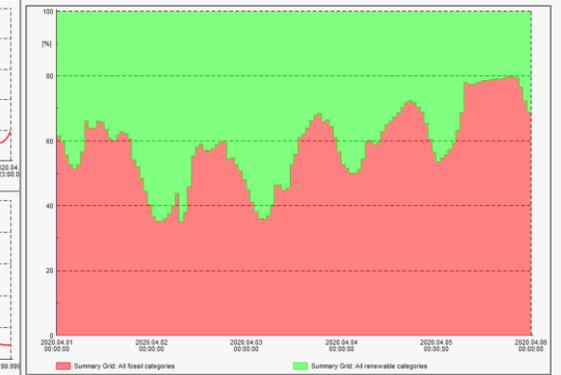
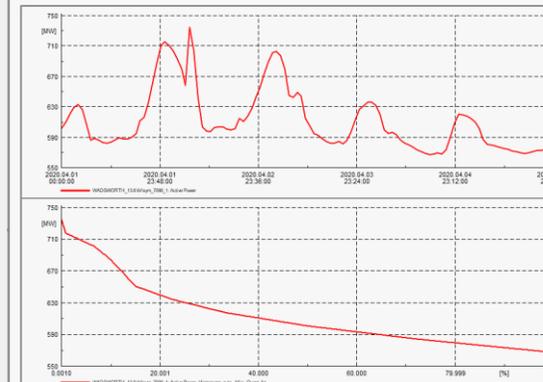
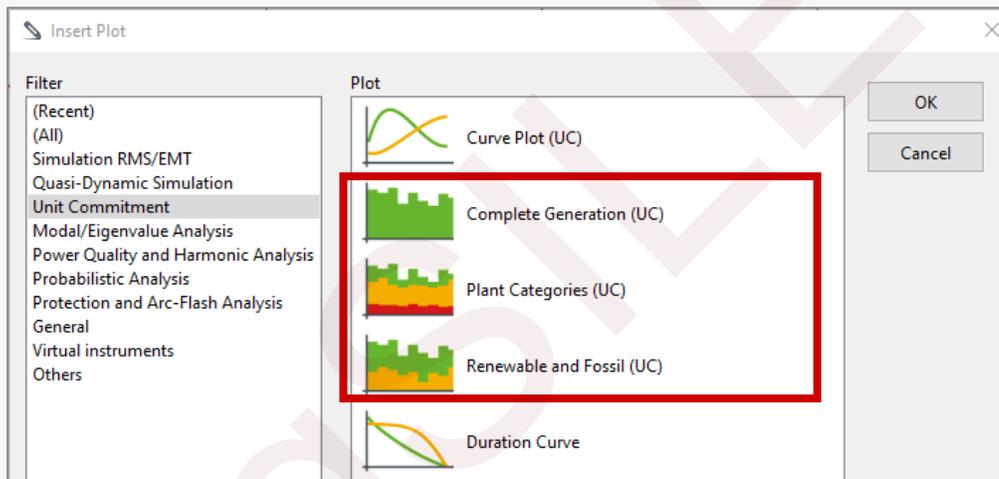
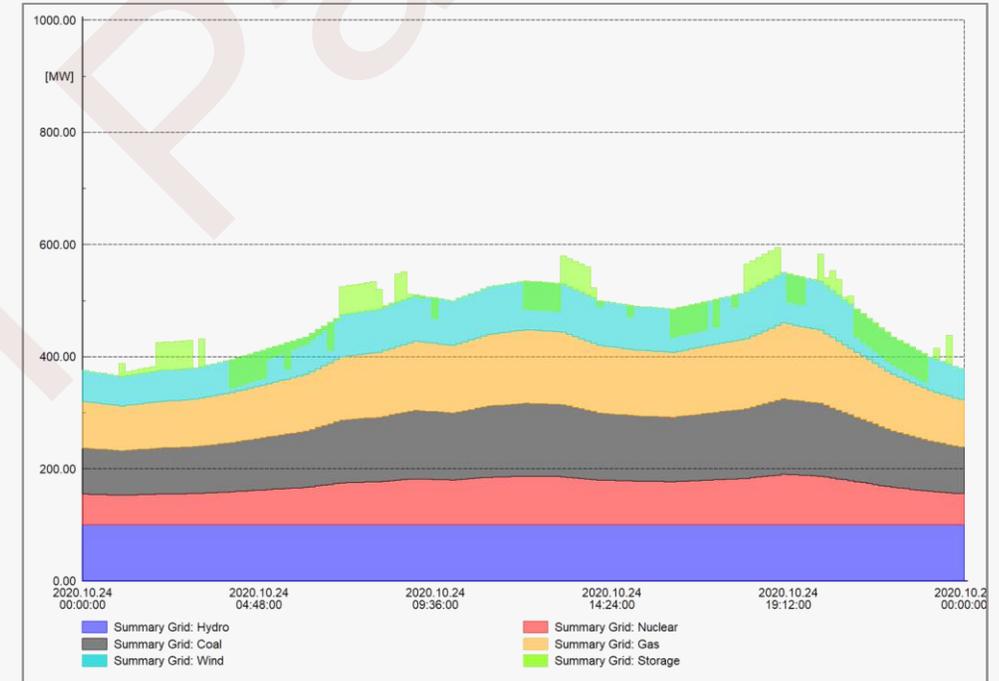
Power distribution:
 According to nominal power
 According to dispatched power
 According to generation shift keys
 Respect individual operational machine limits

Controllable machines:

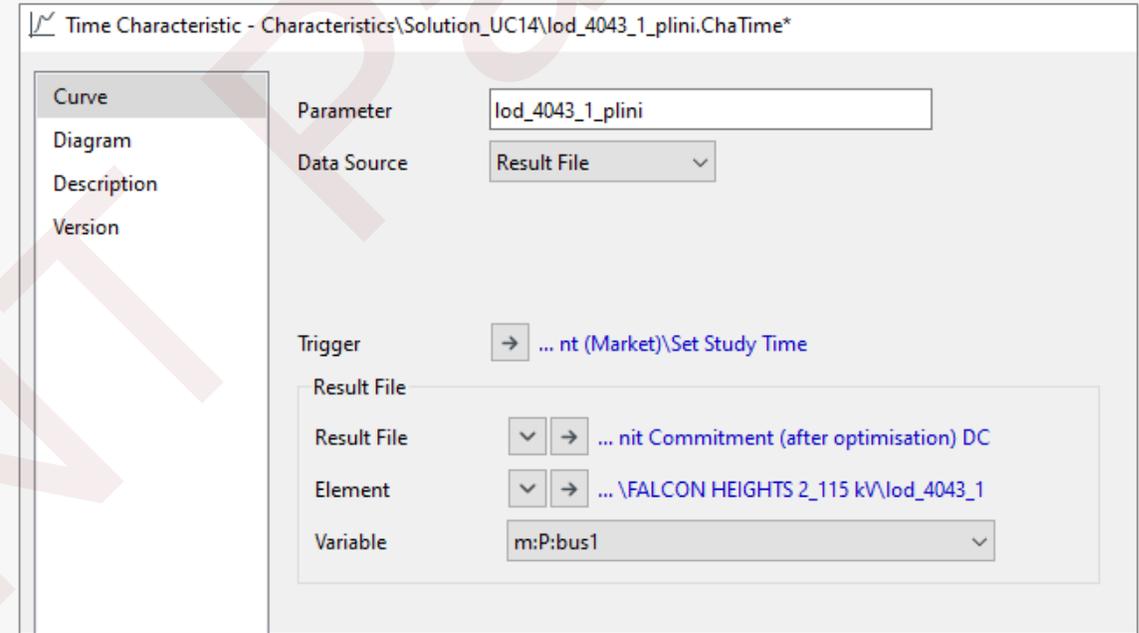
	Machine	Generator usage	Active power control
1	✓ sym_5343_1	Part of Vi...	<input checked="" type="checkbox"/>
2	✓ sym_5342_1	Part of Vi...	<input checked="" type="checkbox"/>

Unit Commitment and Dispatch Optimisation – New Plots

- Energy Plots are available for:
 - Complete Generation
 - Plant Categories
 - Renewable vs Fossil Generation
- Energy plots can be displayed in absolute values or relative in percent
- Annual duration curves



- Loading a single point in time from the result file to the network model.
 - Allows as detailed investigation in the network model for certain areas
- Load the complete results from the optimisation to characteristics.
 - Allows the execution of other calculation on the optimised network.
 - Enables to execute a market simulation without constraints first and then executing a re-dispatch calculation based on the market results.

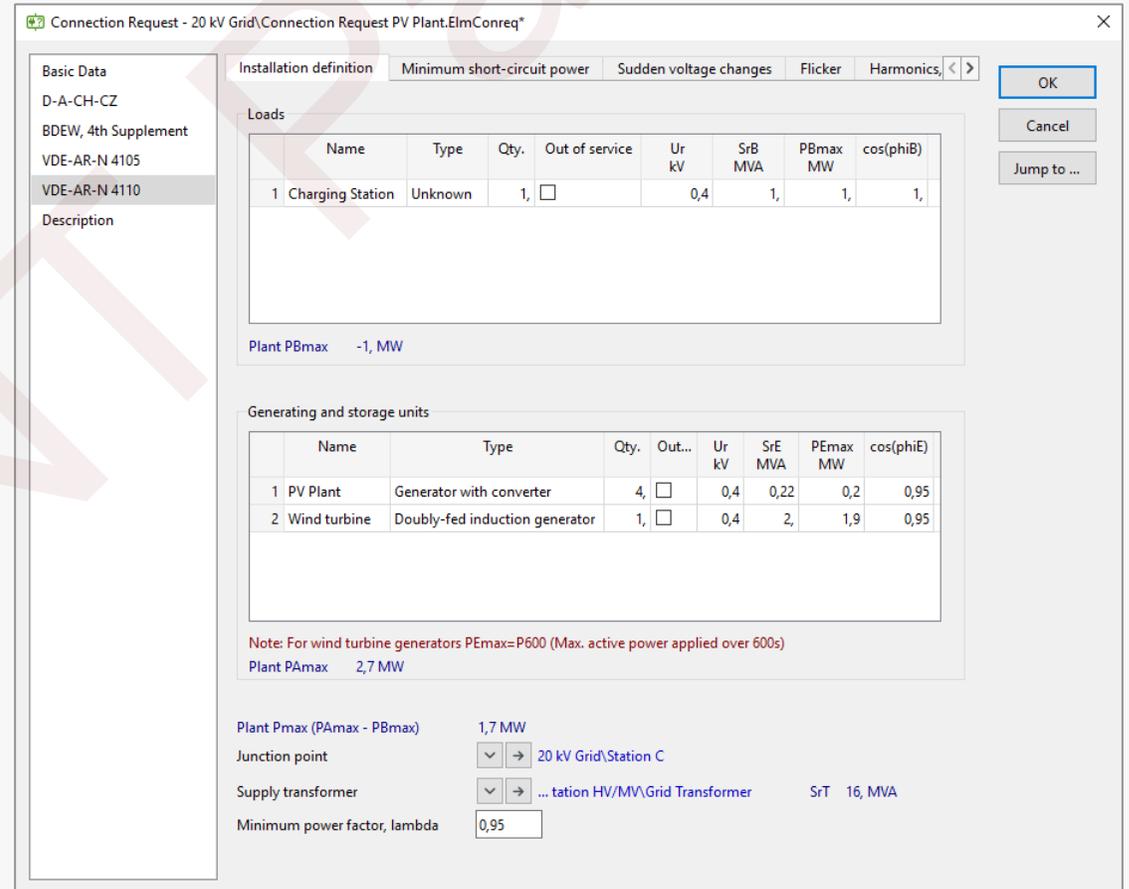


- **VDE-AR-N 4105:2018**

- For low voltage networks
- Update from version 2011 to 2018
- Applicable for generators

- **VDE-AR-N 4110:2018**

- For medium voltage networks
- New guideline replacing the BDEW
- Applicable for customer plants (generator, loads, storage units, mixing plants and charging equipment for electric vehicles)



Connection Request - 20 kV Grid\Connection Request PV Plant.ElmConreq*

Installation definition Minimum short-circuit power Sudden voltage changes Flicker Harmonics, < >

Basic Data
D-A-CH-CZ
BDEW, 4th Supplement
VDE-AR-N 4105
VDE-AR-N 4110
Description

Loads

Name	Type	Qty.	Out of service	Ur kV	SrB MVA	PBmax MW	cos(phiB)
1 Charging Station	Unknown	1,	<input type="checkbox"/>	0,4	1,	1,	1,

Plant PBmax -1, MW

Generating and storage units

Name	Type	Qty.	Out...	Ur kV	SrE MVA	PEmax MW	cos(phiE)
1 PV Plant	Generator with converter	4,	<input type="checkbox"/>	0,4	0,22	0,2	0,95
2 Wind turbine	Doubly-fed induction generator	1,	<input type="checkbox"/>	0,4	2,	1,9	0,95

Note: For wind turbine generators PEmax=P600 (Max. active power applied over 600s)
Plant PAmx 2,7 MW

Plant Pmax (PAmax - PBmax) 1,7 MW
Junction point 20 kV Grid\Station C
Supply transformer ... tation HV/MV\Grid Transformer SrT 16, MVA
Minimum power factor, lambda 0,95

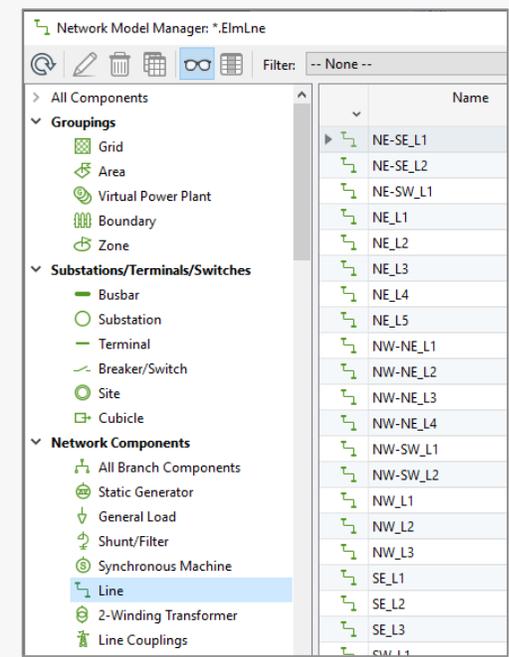
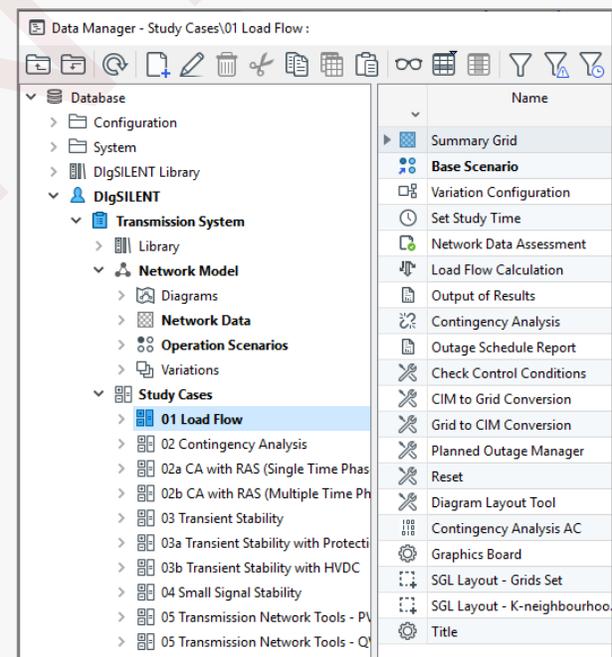
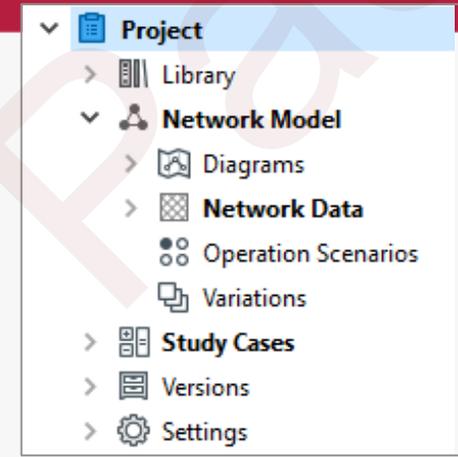
OK Cancel Jump to ...

Handling and Data Management

Improved Project Structure

- Default **Project structure** has been tidied-up:
 - **Operation Scenarios** are now located in Network Model folder
 - **Variations** are now located within the Network Model folder
 - Variation recording logic remains unchanged (i.e. recording of Network Data changes)

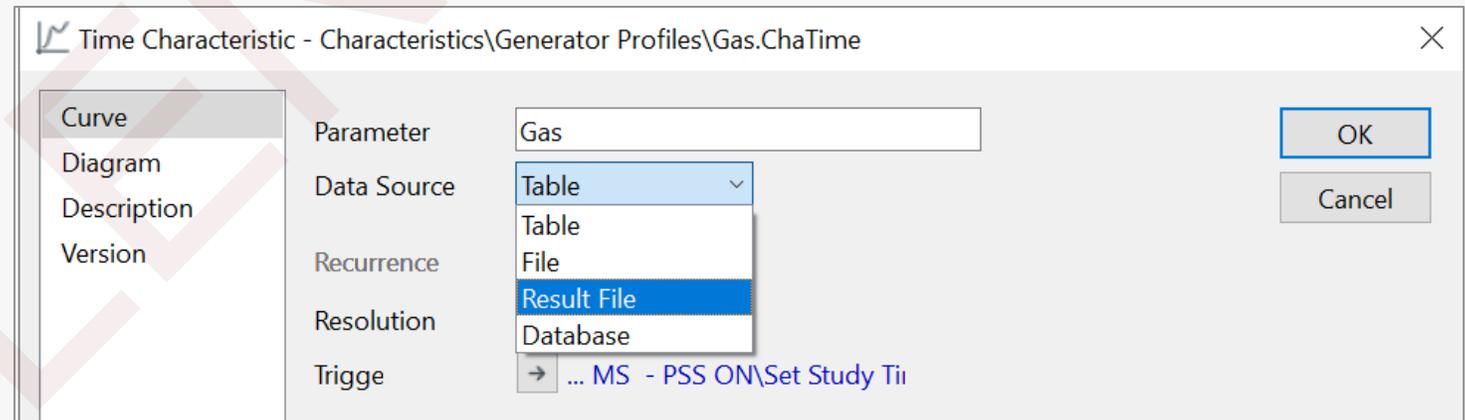
- **Data Manager & Network Model Manager:**
 - Redesign of all icons
 - Alignment with icons of main toolbars



Characteristics – Support of new data sources



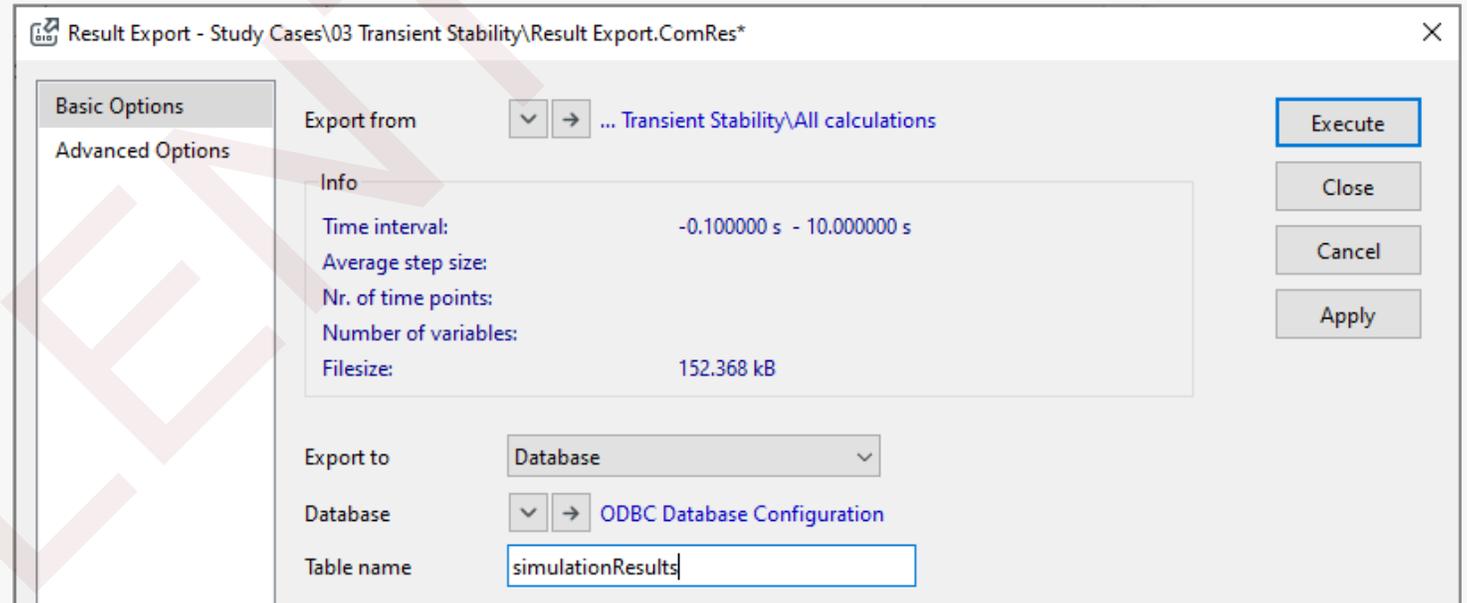
- Support of new sources for characteristics
 - From database: direct access to common databases (Oracle, PostgreSQL, MS SQL Server) to take time series data
 - From result files: using old results e.g. from the Unit Commitment and reuse these data as input



Result Files – Support of External Databases



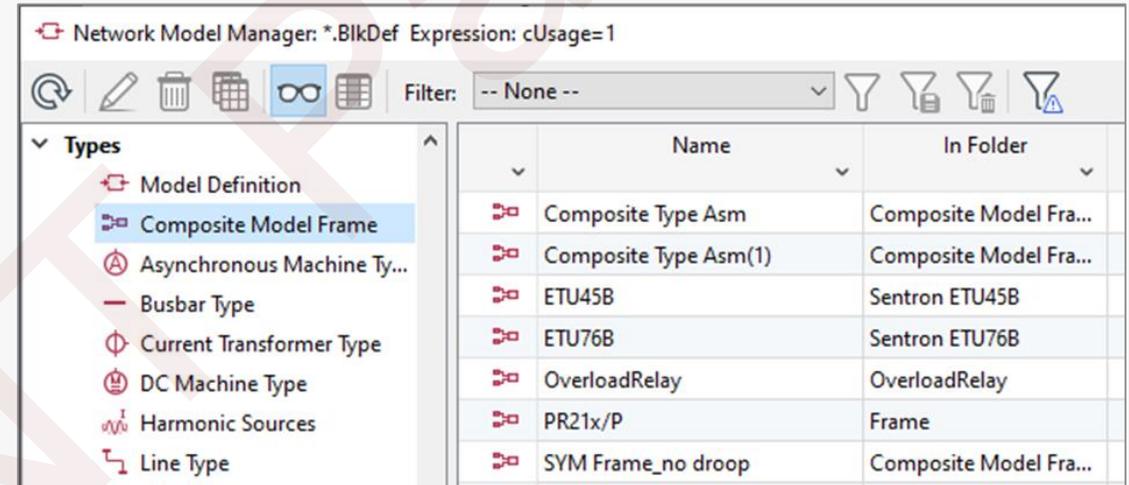
- Exporting result files to databases
 - Support of the direct database export
 - Supported databases via ODBC:
 - Oracle
 - PostgreSQL
 - MS SQL Server



Dynamic Models – New Filter options

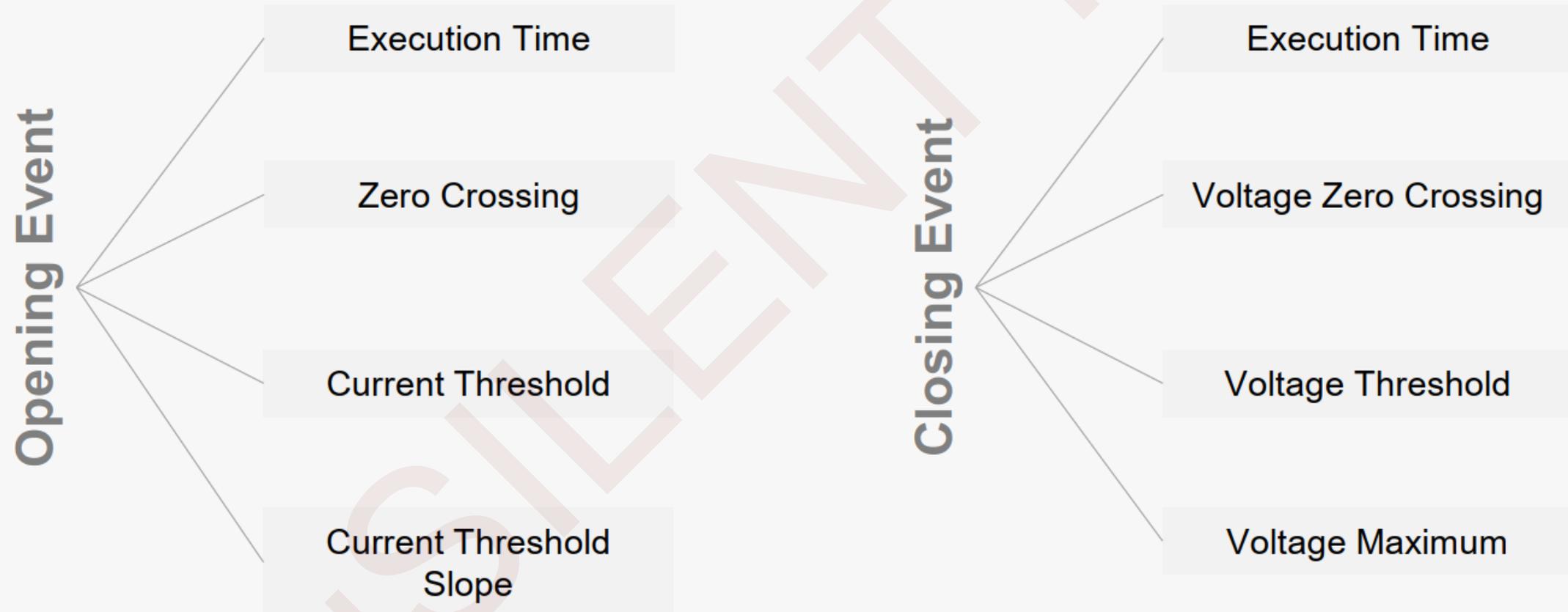


- Filtering between different kinds of models
 - Allowing to separate models such as
 - Model Definition
 - Composite Model (Frames)
 - Split within the network model manager by default
 - Giving a quick overview what the BlkDef is doing

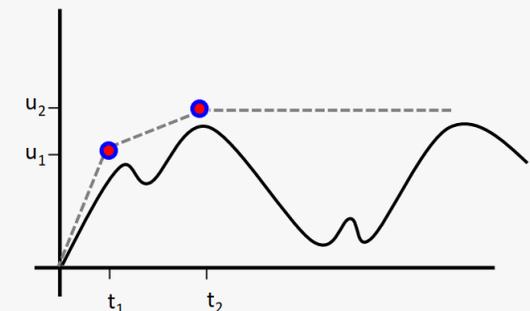
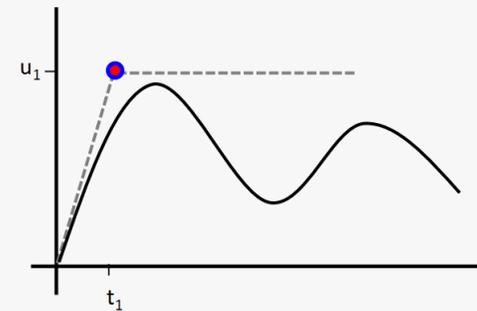
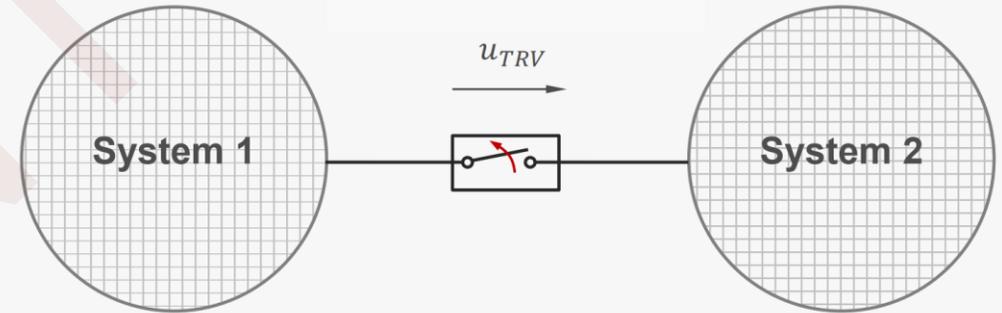
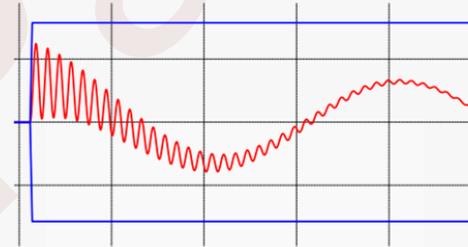


Power Equipment Models

- Additional options for opening and closing events in time domain simulations



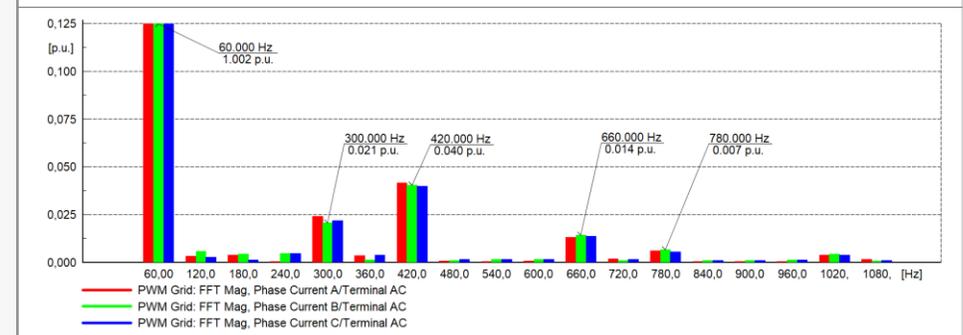
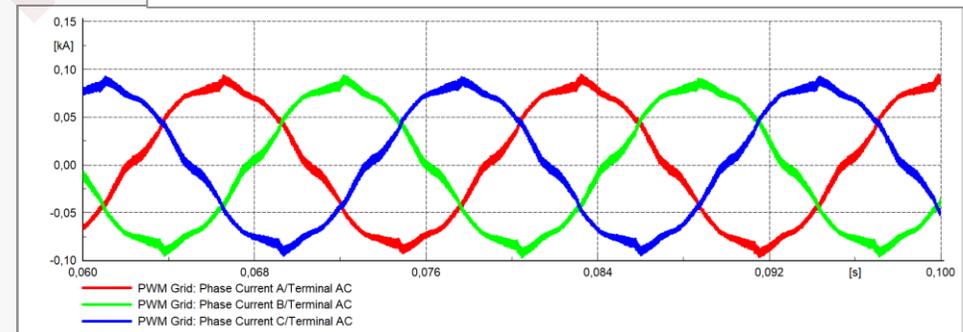
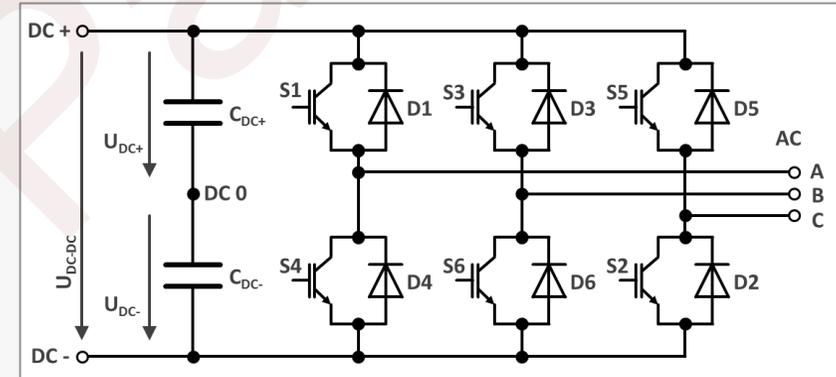
- Circuit Breaker Envelope Curve
 - Circuit Breaker envelope curve representing the dielectric strength during transient recovery voltage (TRV)
 - Envelope curve can now be defined in the circuit breaker type
- IEC 62271-100
 - Both 2-parameter and 4-parameter curve for the dielectric strength of the circuit breaker available



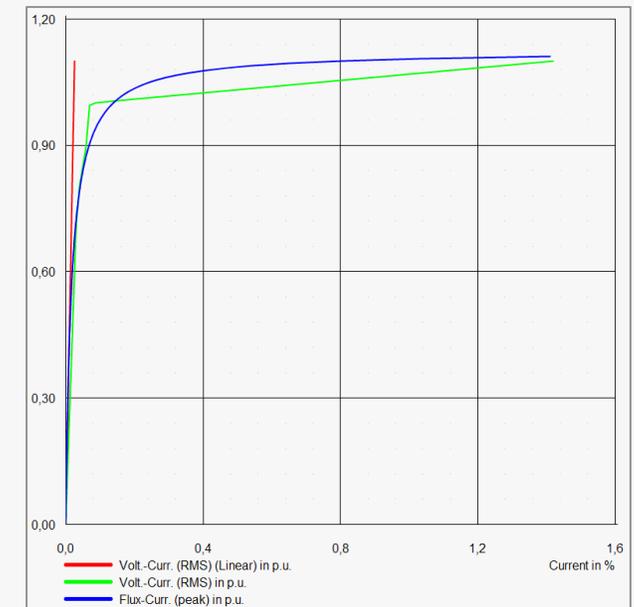
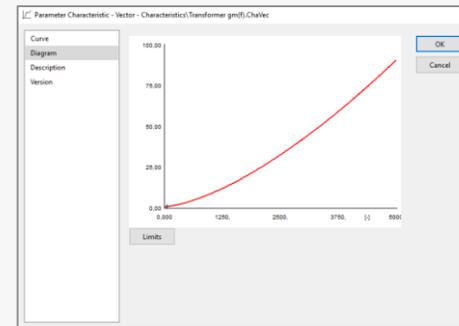
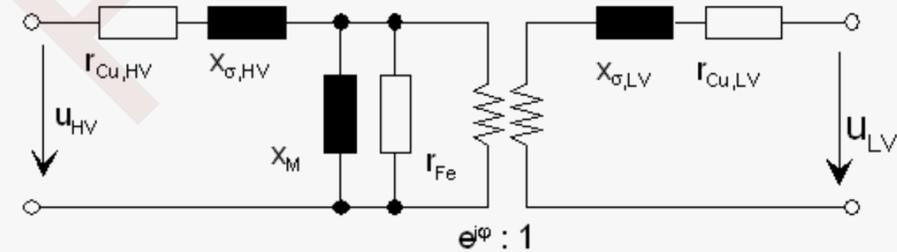
Power Equipment Models – Two-Level PWM Converters



- **Support of dead-time:** switching in/out of same leg transistors occurs with an OFF state delay (both transistors of same leg are OFF)
- For **EMT simulation only, detailed model** only
- Dead-time generates considerable **low level harmonics** (5th, 7th, 11th, 13th, ..)
- Two configuration options:
 - Dead-time parameter in build-in model, or
 - Individual transistor gate signals (6 signals)



- Single phase three winding transformer
 - Railway systems but also for special transformers in three phase system
- Frequency-dependent magnetising impedance
 - $L(f)$ and $G(f)$ for harmonic load flow calculation and frequency sweep
- Frolich equations for saturation models
 - Improved modelling of magnetising curve for EMT simulations such as transformer energisation and resonance studies

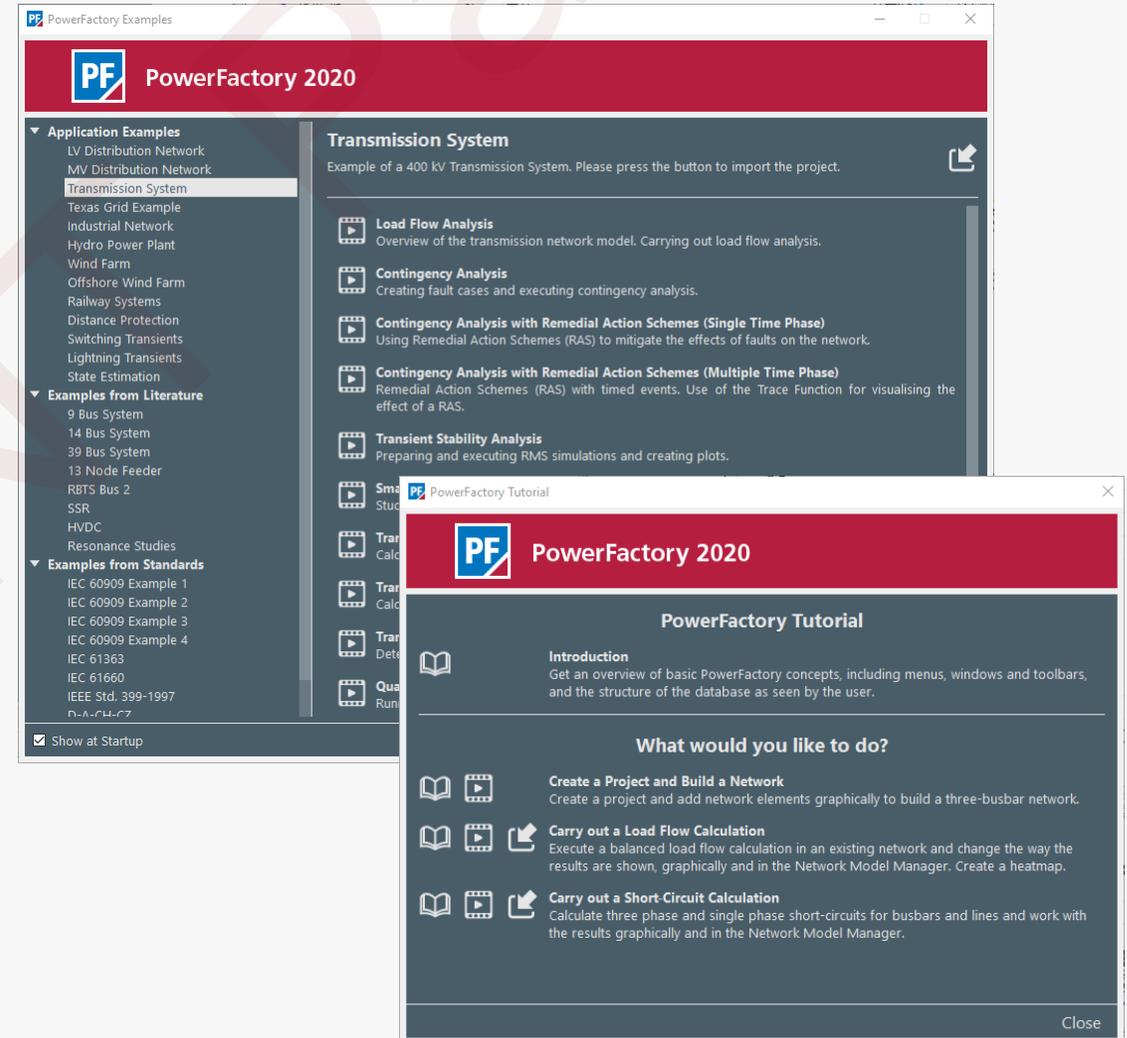


- Synchronous Machines
 - Single phase synchronous machines model (e.g. for railway systems)
 - Support of negative sequence torque for the “*Standard*” synchronous machine model

- Shunts
 - Support of continuously controlled shunts
 - Used for theoretic results
 - Modelling PE-controlled shunts

Documentation material

- Documentation
 - Updated User Manual
 - Updated Technical References
 - Updated Scripting References
 - New „Welcome to PF“ intro
- Application Examples
 - Redesign of Application Examples dialogue
 - Revision of Application Examples
 - Lightning Transients
 - Switching Transients
 - New Application Examples:
 - Texas Grid
 - Resonance Studies
- Tutorial
 - Revision of introductory tutorial



Interfaces, Converters & Compatibility

- Python Interface
 - Support of Python 3.8
- PSS/E Converter
 - Support of PSS/E version 34 for import
 - Support of PSS/E version 33 for export
- Compatibility
 - Support of Windows Server 2019
 - Support of Oracle database clients 18c and 19c



Thank you!

And enjoy PowerFactory 2020