

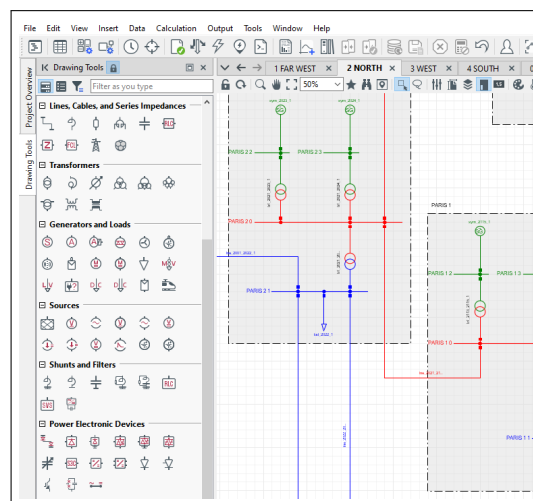


Network Planning

The long-term planning of a transmission or distribution network is an area of work whose importance cannot be overstated, and the complexity of which should never be underestimated. Network owners and operators must decide how to upgrade, change, develop and expand their networks in order to meet future demand requirements and facilitate future generation connections. All this has to be done years ahead of the event, to allow for construction lead times, meaning that every process has to also include forecasts of everything from demand growth to market drivers and changes in grid code requirements.

But it isn't sufficient to just to have first-rate analysis and reporting capabilities. The planner needs a whole package that will facilitate the end-to-end processes of network modelling and visualisation, network development and change management, multi-scenario assessment and coordinating the required analysis over many time-scales. In this paper, we explore the features in *PowerFactory* that fulfil this need.

Modelling your current network



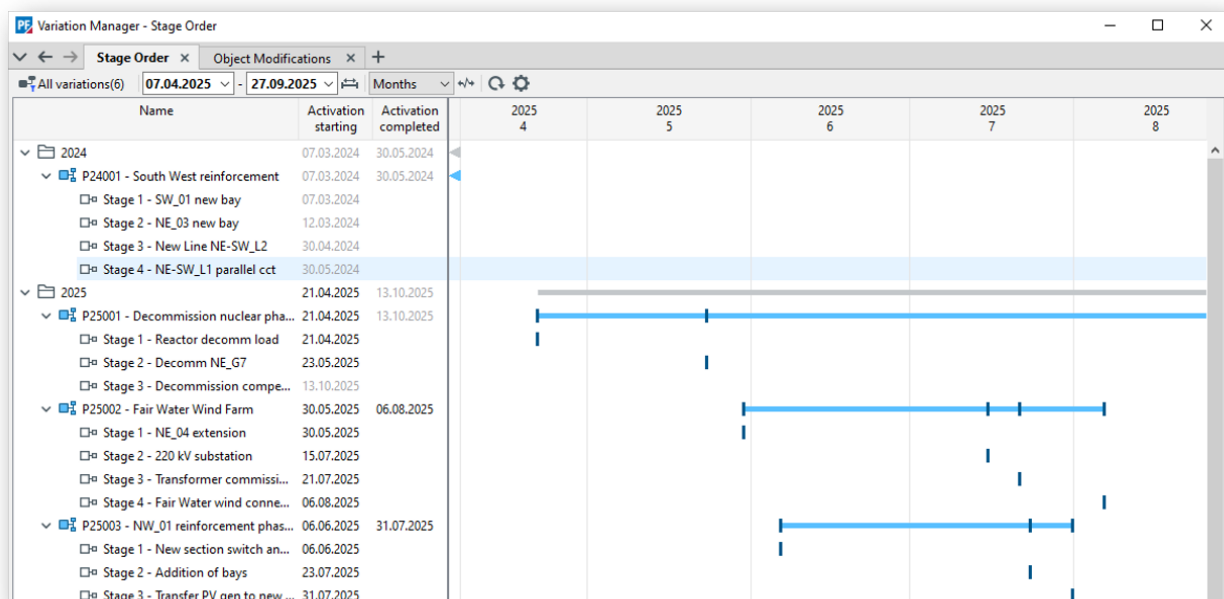
Working in a team

Even in the initial building of a network model, it is likely that a team of people will be involved. And this will continue to be the case as the planning process gets underway. *PowerFactory* offers different options for sharing data and managing the need for multiple people to update a network model whilst at the same time providing a stable, single definitive model for the purpose of analysis. Many planning teams opt for *PowerFactory* Team Edition, which allows for the use of a shared database. In addition to facilitating the copy of projects (studies) between users, it also provides the ideal platform for employing *PowerFactory*'s Base and Derived Project concept.

This concept allows users to have a central and definitive base project, in which versions are defined at chosen points in time. Other users then create derived projects from these versions; this allows them to work independently, but a link is maintained with the base, which means that whenever they wish they can refresh their projects with necessary updates from the base. For a large user population this becomes an essential mechanism for maintaining a good quality basis for the planning process.

Modelling planned network developments

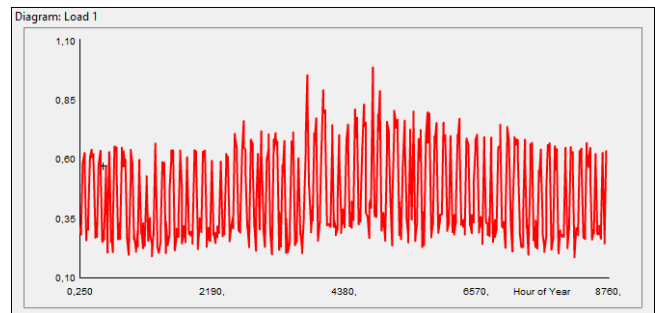
In *PowerFactory* the study case concept is key. A study case, which is part of a network “project”, is a mechanism for pulling together everything you need to represent the system at a particular point in time. It also stores calculation settings and results. Network developments over time are represented in the project by so-called Network Variations, which contain timed stages that introduce new elements, modify existing elements, or remove elements from the model. Multiple variations, some of which may be mutually exclusive options, can be created. Once these are in place, the user can see the network at any point in time by simply changing the study case time and date. With many different developments being planned, the user can get an overview in Gantt-chart format, using the Variation Manager, which also provides links to the underlying data.



Planners must consider a wide range of possible operating conditions

In conjunction with the network model, planners have to carry out analysis for a range of operating conditions. The Operation Scenarios in *PowerFactory* are used to store operational data such as demand forecasts, predicted generation, and substation switching information. Features such as load scaling can be used to vary the presented conditions. Any study case can be used in conjunction with any Operation Scenario. In addition to this basic functionality, other tools are available to allow the planner to easily assess different operational situations:

- Parameter Characteristics can be applied to operational and other data, for example to vary a load hourly over the year.
- The Quasi-Dynamic Simulation function can be used to execute load flow calculations at required intervals over a period of time. This will take into account both changes in operational data modelled via Parameter Characteristics and also any network model changes resulting from the timed stages of the Network Variations.
- The Probabilistic Analysis function offers a more sophisticated approach to planning for a wide number of scenarios; using input data based on distributions, it employs Monte-Carlo or Quasi Monte-Carlo methods to generate statistical representations of expected outcomes.



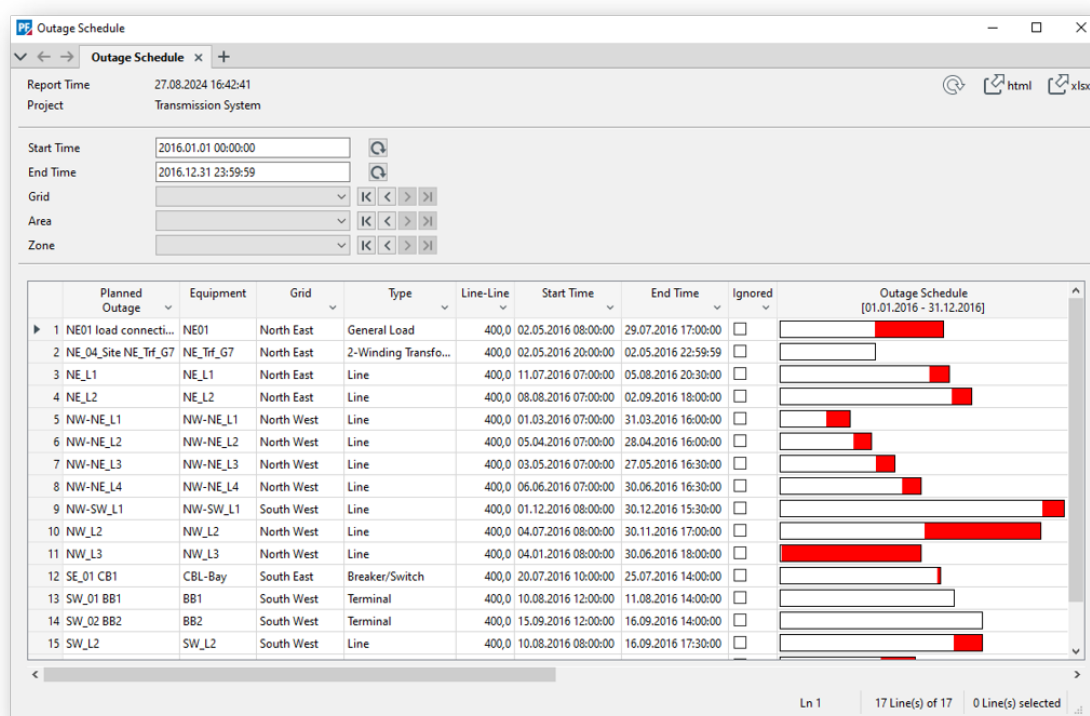
Potential network changes must be assessed and compared

For any particular system conditions, there may be multiple options for expanding or modifying the network to meet the requirements. *PowerFactory* provides the necessary tools to carry out this comparative work:

- Multiple options for system changes can be modelled as separate Network Variations, which can be activated and deactivated as required.
- Results of calculations such as load flow analysis can be compared and the differences presented graphically.
- The Economic Analysis Tools module includes a Techno-Economic Analysis function, which can be used to assess the development cost and economic benefit of any network development, and incorporates a comparison feature that enables different options to be assessed against each other.

Feasibility of the development plan

It is not sufficient to determine how the network should look five years, or ten years, from now. An essential part of network planning is to answer the question, “how do we get from here to there?”. In other words, it is necessary to plan all the network outages that will be required for each development project. All these outages have to be coordinated in such a way that the security of the network and its operation in accordance with grid code requirements is assured at all time. *PowerFactory*’s Outage Management module gives the user the tools to model all planned outages for each year of the plan, and carry out all the necessary network analysis against this background.



Reporting

Reporting results from calculations are of course an essential part of any sort of analysis, and network planners will make full use of plots, network model manager flexible data pages and analysis-specific reports. But it isn't sufficient for the engineer to assess this output; it is important that the outcomes can be easily presented in report formats that will form part of the general planning process. In *PowerFactory*, reports can be generated in PDF format, or other formats as required, and the software incorporates a complete Report Designer tool; this allows users if they wish to customise the report layout, or even create complete new report designs.

Network Planning using *PowerFactory* - all you need in one place

PowerFactory gives you everything that you need for the planning process:

- Network Variations, which allow the user to model networks over many years, in one project
- The Study Case, whose time and date determines the state of the network and stores the inputs and outputs of calculations
- Operation Scenarios, which can be used to model a range of operating conditions in conjunction with any given network topology
- Flexible options for the diagrammatic representation of the network model
- Wide range of analysis tools, together with tabular and PDF reporting options
- *PowerFactory* Team Edition, for collaborative work within a shared database and the central management of critical data

All functions described in this white paper are available in the *Base Package*. For collaborative work, the *Team Edition* is required.



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