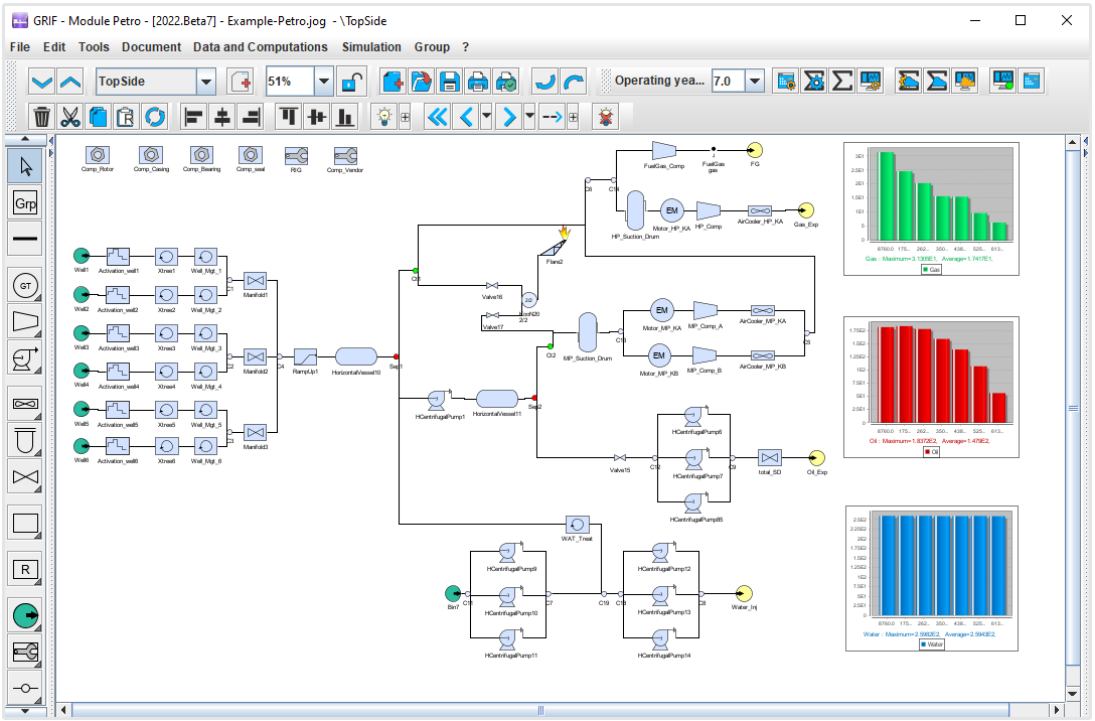
GRIF | Petro module

Technical sheet

To evaluate the performance of dynamic multi-flow systems using Stochastic Block Diagrams

GRIF (GRaphical Interface for reliability Forecasting), a technology of TotalEnergies since the 80s, includes 3 packages and 12 modules allowing the user to choose the most appropriate modelling technique for the resolution of the studied system. Petro module is one of the four modules belonging to Simulation package.

Petro is used to model and simulate multi-flow process systems in a number of industrial sectors (oil & gas, distribution, etc.) in order to calculate production availability. This decision-making tool helps to optimise the design of a given installation by comparing the production availabilities of different possible architectures, to identify the weak points and check that the targets defined for the system are met. This module is based on **MOCA-RP** (for MOnte-CArlo - Petri nets), **owned by TotalEnergies**: **an ultra-fast calculation engine based on Monte-Carlo simulation** and which pushes the limits of modeling, as its name indicates.



Modelling and computations using the MOCA-RP engine:

- **Users can easily create block diagrams** via **an intuitive graphical interface** and have access to a large choice of equipment (pumps, compressors, filters, separators, tanks, wells, flares, etc.). The equipment behavior is **highly configurable**, and users can modify a number of parameters including failure rate, repair time, start-up time, capacity, start-up conditions, downgraded events, teething problems and common cause failures.

- **When the system has been modelled, the MOCA-RP engine delivers a large number of results:**
  - Temporal, mean or periodic production for each flow and each of the system outlets.
  - The contribution of each piece of equipment to the system production losses.
  - Mean or per period availability of the installation for each flow.
  - Maintenance teams: mobilization time from zone A to B, conditional mobilization, schedule, etc.
  - Spare part management: initial size, resupplying policy (threshold or periodical), multi-level resupplying.
  - Sequences or cut sets that lead to a specific event.
  - Cost management (OPEX / CAPEX).
  - Shutdown duration analysis.

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GRaphical Interface for reliability Forecasting
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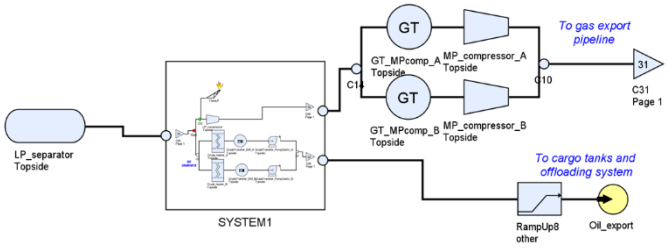
Hardware requirement: Intel Core i3 or faster, 4 GB of free RAM, 1 GB of free space, no internet connection needed. **Software requirements**: Windows 10 or Linux or MacOS X with Java 11. **Licenses**: standalone with USB dongle or Floating licenses with Sentinel server. Installable, laptop.

Specificities and strengths:

- **Modelling power**: for each piece of equipment, the Petro module generates Petri nets that correspond to the behaviors specified by the user. The great strength of stochastic Petri nets lies both in their modelling power and in their capacity to describe the dysfunctional (component failures) and functional (architecture and support functions such as maintenance or reconfiguration procedures) parts of an installation. Users can very easily precisely describe the conditions required to start or stop equipment, define the ageing process, or set a timer to delay execution.

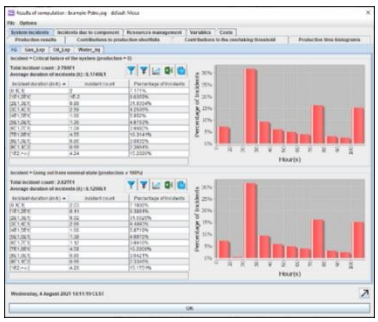
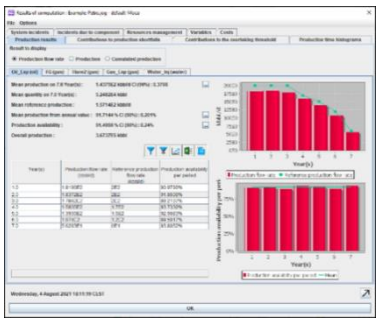
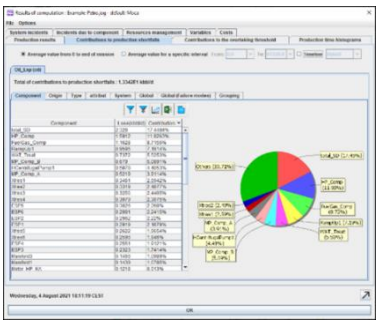
- **Management of sharing resources**: In addition to system modelling, the Petro module helps manage the associated logistics and operating environment. A Gantt diagram can be used to define preventive maintenance operations. For each instance of equipment failure, the repair team and the stock of spare parts to be used can be specified. Users can configure the time required to mobilize the repair team and the time slots for each team. They can also indicate the number of spare parts and explain how the replenishment process works: either periodically or on request when a certain threshold is reached, and either directly from the provider or from another stock. The mobilization time of a maintenance team may vary according to the component location since some systems are operated over large areas

- **Hierarchical systems:** it is possible to work in a hierarchical way by creating subsystems in order to improve the readability and to facilitate the duplication of parts of the model.



- **Interactive simulation:** users can validate the model operation using step-by-step simulation, as in the Petri and BFiab modules.

- **User-friendliness:** Petro runs interactive simulations to enable observation of equipment behavior and validate models step by step. A detailed analysis of contribution to losses is also available: for all components, by failure type, by component type or by groups of components defined beforehand. All key results are summarized in a separate window.

Using data and results:

- Possibility of automating calculations (batch runs) and drawing variations for sensitivity analysis.
- Results are stored in the document and can be exported in a variety of formats (csv, XML, Excel, etc.).
- Results can be viewed as line graphs pie charts or histograms.
- Vectorial printing in PDF format generates high-quality pictures but the files are small enough to be sent by e-mail, even if they contain hundreds of pages.
- Interaction with the operating system: possibility of copying/pasting to or from word processing software, spreadsheets, or presentation tools.
- The “Attribute” feature (a custom property system) can be used to add any required information to each object in the document, either for a more precise description, for traceability or for result grouping.
- Interaction with the operating system: possibility of copying/pasting to or from word processing software, spreadsheets, or presentation tools.
- It has a **High-Performance Computing (HPC) plugin** for using the most powerful supercomputers.

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Trial version available on
grif.totalenergies.com