GRIF

Software suite
for RAMS studies
for conducting **safety**,
risk and **production**
analyses.

TotalEnergies

GRIF

GRIF (**GR**aphical **I**nterface for reliability **F**orecasting) determines the fundamental dependability indicators : **R**eliability, **A**vailability, **M**aintainability, **S**afety.

Results of more than **40 years of research and development** within **TotalEnergies**, this software suite is made up of 3 packages for a total of 12 modules to propose several modeling techniques allowing users to find the most appropriate approach for the resolution of the system under study (block diagrams, fault trees, Markov graphs, Petri nets, bowties…).

Its mature and high-performance calculation engines, combined with generic modeling dependability languages, allow to:

- Assess the **performance** and optimize **designs, costs** and **availability** of your systems;
- Ensure the **safety** of users and your employees;
- Improve the **efficiency** of your systems while limiting **CO_2 emissions**.

And that, **for any field** of activity:

> Aeronautics

> Telecoms

> Aerospace

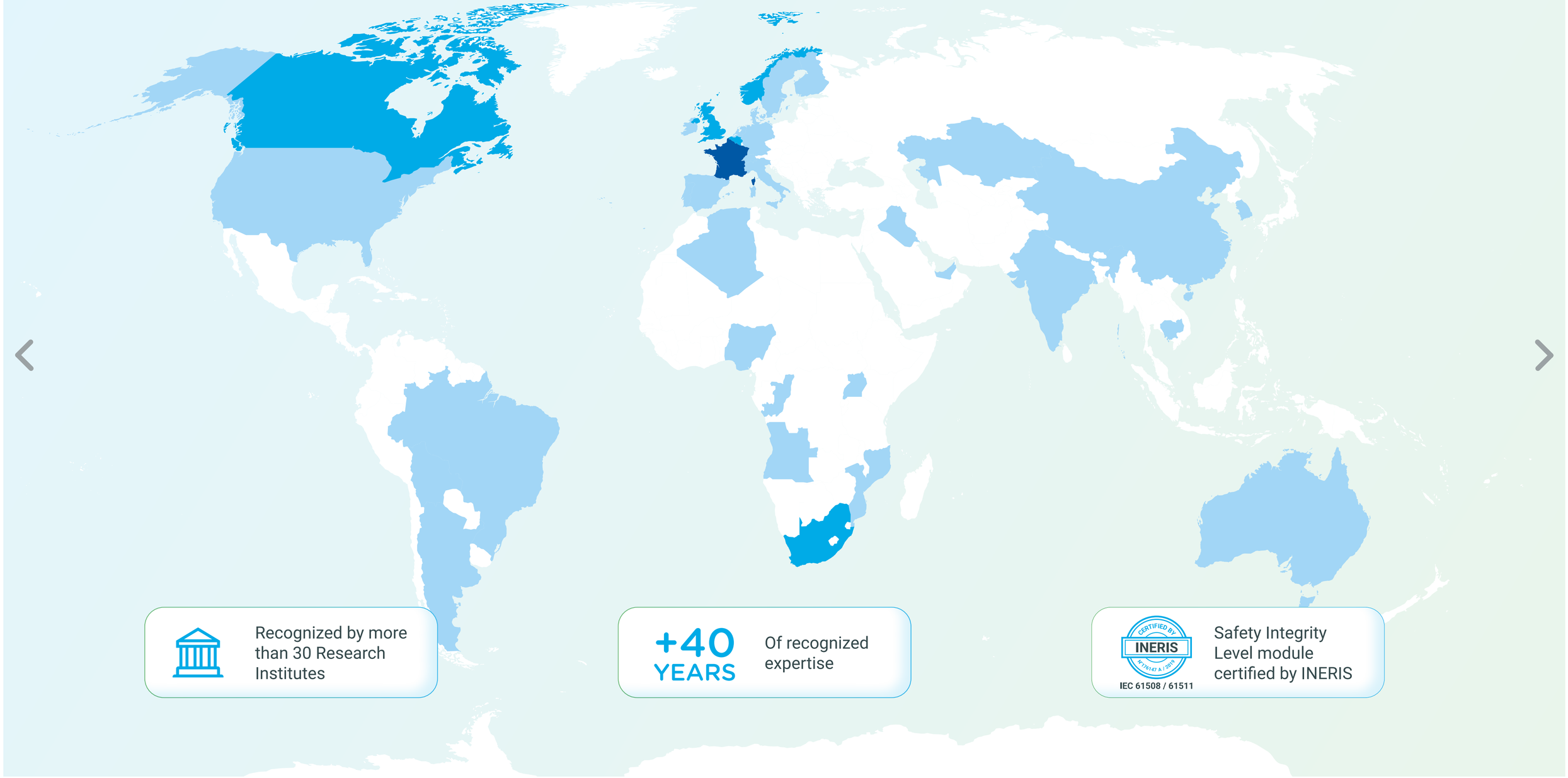
> Transportation

> Energies

> Healthcare

> Defense

> Universities and Research



Recognized by more than 30 Research Institutes

+40 YEARS

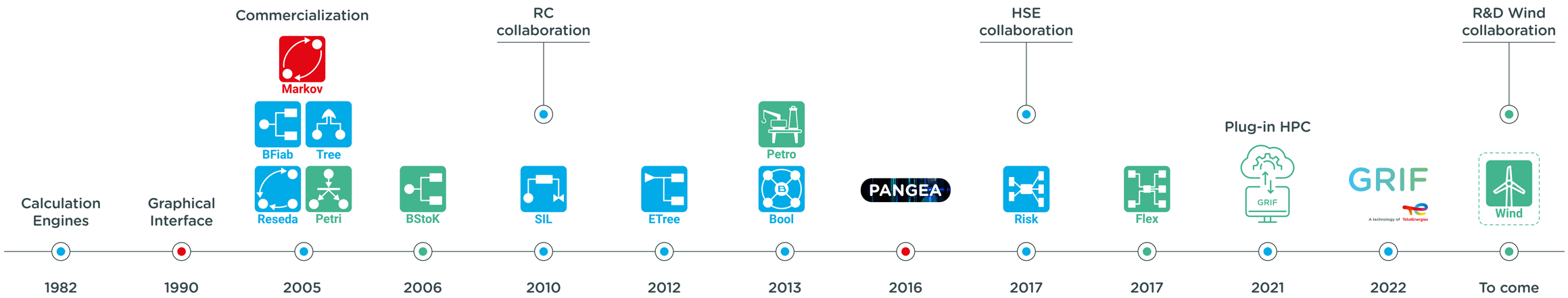
Of recognized expertise

CERTIFIED BY INERIS AM 136147 A / 2019

IEC 61508 / 61511

Safety Integrity Level module certified by INERIS

HISTORY



Like any effective tool that stands the test of time, GRIF will continue to evolve and be adapted to meet the requirements of reliability analysis professionals.

Jean-Pierre Signoret,
Founder of GRIF, Professor / Reliability expert for TotalEnergies Professeurs Associés

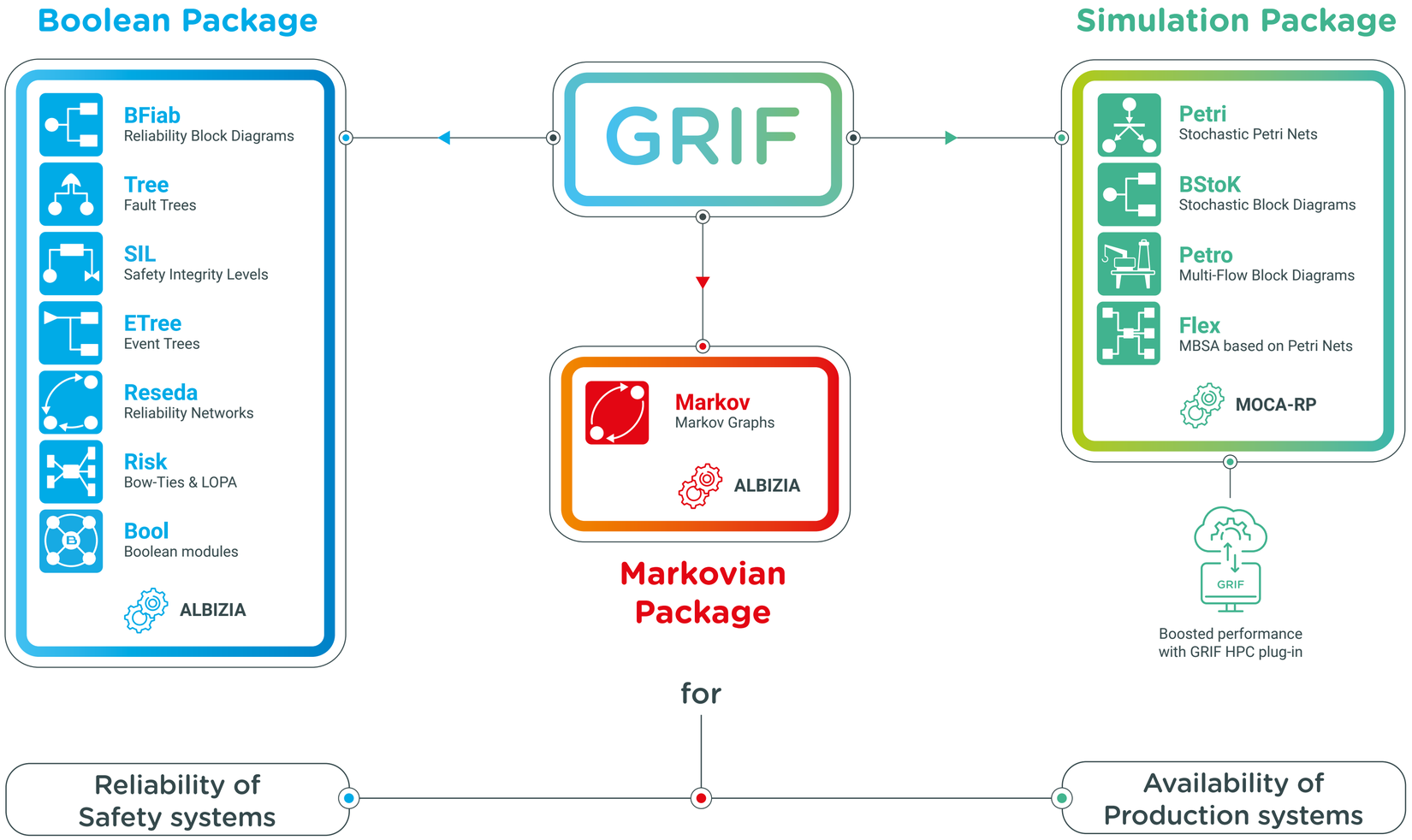
Read the full article “GRIF origins” on the website:
https://grif.totalenergies.com/en/about-grif/our-origins

Result of **more than 40 years of research and development** inside the company, GRIF was initially developed to meet internal needs and has been promoted and commercialized outside the company since the 2000s. The user community now has more than 400 users around the world.

Since 2022, GRIF has officially become a **trademark endorsed by TotalEnergies** and registered by the **European Union Intellectual Property Office**.

Its functionalities allow major industrial players to carry out **RAMS** (Reliability - Availability - Maintainability - Safety) studies **regardless of their sector of activity** and to support the company’s transition to the field of **renewable energies**.

GRIF SOFTWARE SUITE INCLUDES 3 PACKAGES AND 12 MODULES



More information on:
grif.totalenergies.com

Download GRIF Software trial version (FREE) | TotalEnergies

AN IT SOLUTION ADAPTED TO SAFETY, RISK AND PRODUCTION ANALYSIS

Initially dedicated to **reliability engineers** specialized in dependability techniques (as Fault trees, Markov graphs and Petri nets), GRIF has evolved over the decades to offer additional modules with pre-integrated architectures (e.g. Safety Integrity Levels - SIL) or a library of pre-configured equipment (e.g. Block diagrams) to be used by **safety engineers, project engineers** and **instrumentation specialists regardless of their business activities**.

Chosen by over 70% of our users, the Boolean package is suited for constructing and calculating static models (those that are non-time-dependent and lack dependencies between basic events) for safety and risk analysis.

For more information

Static model analysis | GRIF Boolean Package | TotalEnergies

Boolean Package

HPC Plug-in allows to boost performance using High Performance Computing to reduce computing time of the simulation package. Initially developed for **TotalEnergies' Pangea II HPC**, the HPC plug-in is now available on the market for all economic and industrial players looking for ultra-fast and high-performance calculation engines for their reliability studies.

For more information

HPC | Plug-in | TotalEnergies

The various modules of the Simulation package enable you to analyze the statistical outcomes of thousands of scenarios using convergence graphs, Petri nets, or stochastic block diagrams through Monte-Carlo simulation, thereby supporting your reliability analyses of production and safety systems. It allows to model complex industrial systems, evaluating their performance by estimating production availability during the project phase and throughout their operational life cycle, as well as identifying loss contributors, regardless of the business lines.

For more information

Calculation engine Monte-Carlo | GRIF Simulation I TotalEnergies

Simulation Package

Markovian Package

The Markovian methodology is based on multi-phase Markov chain to assess the performance of small dynamic system. This package employs efficient matrix computation algorithms to deliver various results, such as the probability of being in a specific state, cumulative sojourn times in each state, failure rate, Lambda Equivalent over time and system efficiency where downgraded states can be taken into account and production availability calculations performed.

For more information

Markov Graphs GRIF | TotalEnergies

GRIF SIL: Safety Integrity Level calculation

Certified by **INERIS** (National Institute for Industrial Environment and Risks), **GRIF SIL** is a module allowing to analyze, validate, and/or optimize the design and the maintenance of SIS architectures by evaluating the **Safety Integrity Level** (SIL) of **Safety Instrumented Functions** (SIF), **in line with IEC standards 61508 & 61511**.

This module, one of seven in the Boolean package, is used to evaluate the time indicators for each component of the SIFs in continuous process installations, and to calculate the **Probability of Failure on Demand** (PFD) or the **Probability of Failure per Hour** (PFH) where the undesirable event corresponds to a non-detected dangerous failure of the SIF.

GRIF SIL thus allows to verify that the **required reliability level**, as defined during the technological risk analysis in **GRIF Risk**, is reached by the implemented **Safety Instrumented System** (SIS) design, inspection maintenance and testing strategy.

	User-friendly module
ALBIZIA	Precise analytical calculations with Albizia, the Binary Decision Diagram (BDD) engine developed by TotalEnergies
CERTIFIED BY INERIS N°12147 A / 2018 IEC 61508 / 61511	Complies with IEC 61508 & IEC 61511

Download GRIF SIL product sheet

Did you know?

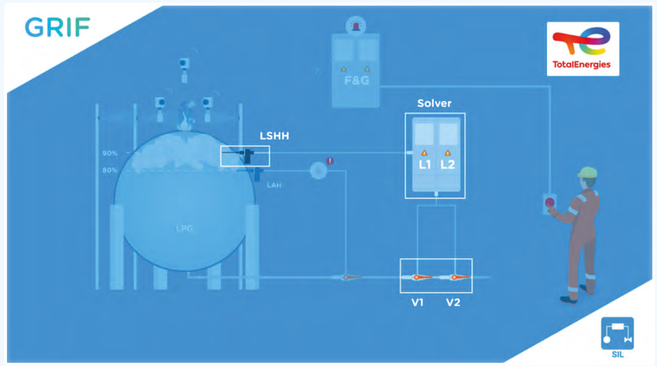
The SIL module was created in 2010 within TotalEnergies in collaboration with the Refinery Chemicals branch, which is now the main user of the software to ensure the safety and reliability of their safety systems.

> *The GRIF SIL user-friendly interface offers the flexibility to be used by non-specialists in reliability analysis, helping them to analyze, validate, and/or optimize the design and maintenance strategy. This is achieved through indisputable calculations certified by the National Institute for the Industrial Environment and Risks (INERIS) as compliant with the IEC functional safety standards 61508 & 61511.*
>
> *GRIF SIL skill leader at TotalEnergies*

Tutorial example:

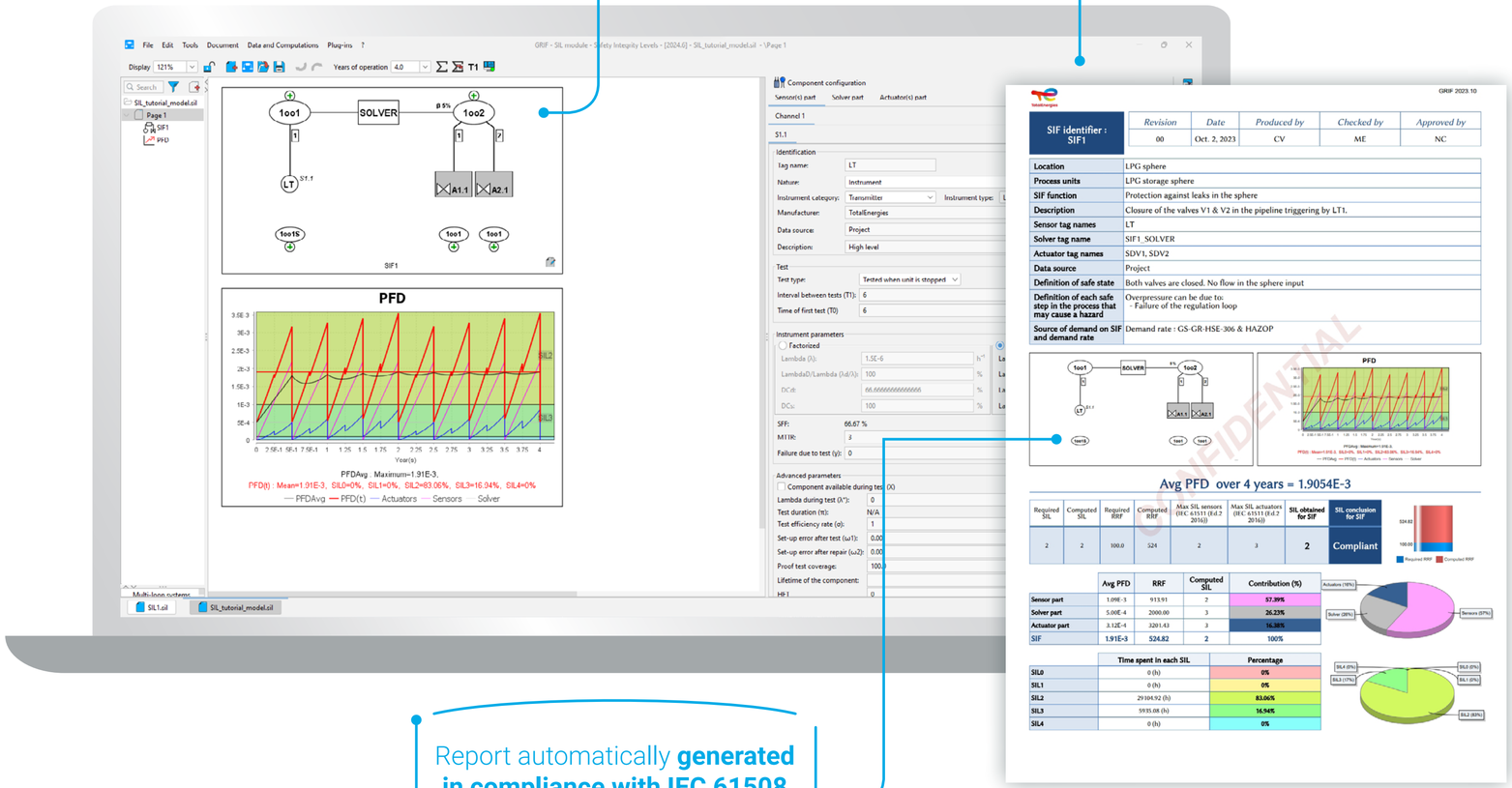
SIL assessment of protection against high high level in a LPG sphere

- **Sensor:** One level transmitter installed at 90% of the sphere's maximum to detect high high levels of hydro-carbon.
- **Solver:** Programmed to stop the input flow in the sphere in case of high high level detected.
- **Actuators:** 2 shutdown valves. If one valve is closed the plant is protected and the system is in a safe mode.
- **Maintenance:** Perform test procedures every 6 months and partial stroking test for valves.
- **Common Cause Failure (CCF):** Beta Factor for valves.



Pre-configurated architecture to facilitate modeling phase.

Components parametrization of the sensor, solver and actuators of the SIF based on the SIS implementation.



Report automatically **generated in compliance with IEC 61508 & 61511** requirements.

GRIF Tree: Fault trees analysis

Certified by INERIS (National Institute for Industrial Environment and Risks), the GRIF Tree module facilitates reliability and safety analysis of system architectures, adhering to **IEC standards 61508 and 61511**.

As part of the Boolean package, this module models systems as fault trees using Boolean logic. It enables users to calculate system **unavailability**, determine probability and frequency of **minimal cut sets**, identify various **importance factors** (such as Birnbaum, Fussel-Vesely, RAW, RRW...), and evaluate the impact of maintenance strategies on system unavailability, including the time spent in each **Safety Integrity Level** (SIL) zone.

- Easy to use, with customable information
- ALBIZIA — Precise analytical calculations with Albizia, the Binary Decision Diagram (BDD) engine developed by TotalEnergies
- CERTIFIED BY INERIS N°176147 A | 2019 — IEC 61508 / 61511 — Complies with IEC 61508 & IEC 61511

Did you know?

GRIF Tree is one of the very first modules in the GRIF software suite (2005)!

GRIF Tree meets the requirements of my business. It is flexible and can adapt to other sectors, allowing us to respond quickly to our needs.

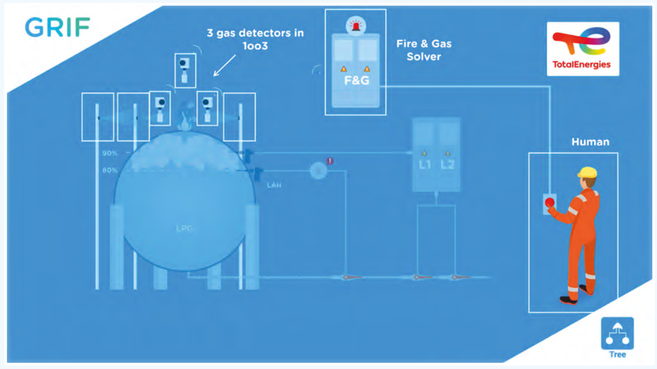
Tree user in Aerospatiale domain

Download GRIF Tree product sheet

Tutorial example:

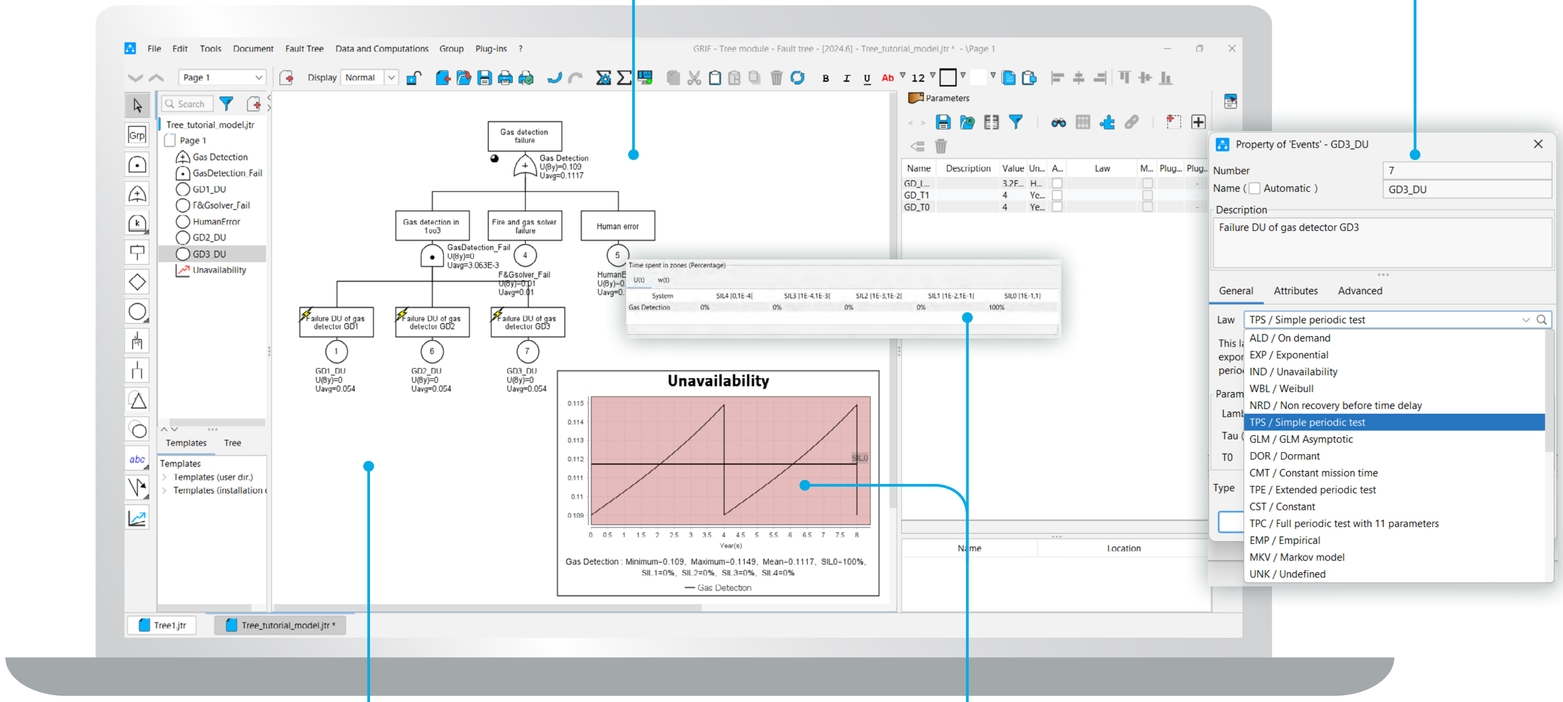
Unavailability assessment of a deluge system in case of leaks in a LPG sphere

- **Gas detectors:** 3 gas detectors in 1oo3 redundancy to detect gas or fire.
- **Fire & Gas solver:** Programmed to trigger the alarm in the event of gas or fire detection.
- **Human:** The deluge system is activated by the operator when the alarm is triggered.
- **Maintenance:** Perform test procedures every 4 years for gas detectors.
- **Common Cause Failure (CCF):** Beta Factor for gas detectors.



Components parametrization of the sensor, solver and actuators of the SIF based on the SIS implementation.

Configuration of events using wide choice of probability distribution laws (exponential, periodic tests…) or using a Markov graph.



Assessment of the impact of CCF on system reliability (Beta Factor, MGL, Shock models…).

Determining the system's unavailability and the time spent in each SIL zone and identify weaknesses.

GRIF BFiab: Reliability Block Diagrams analysis

GRIF BFiab, as part of the Boolean package, is used to model system architectures as **Reliability Block Diagrams** (RBD) using Boolean logic for reliability and safety analysis in **all sectors of activities** (aeronautic, automobile, rail, energies…). It enables users to calculate system **unavailability**, determine probability and frequency of **minimal cut sets**, identify various **importance factors** (such as Birnbaum, Fussel-Vesely, RAW, RRW…) that will help users to find system weaknesses, critical components and improve on them, or evaluate the impact of maintenance strategies on system unavailability by running multiple batches with different parameters.

Equipped with ALBIZIA, the **Binary Decision Diagram** (BDD) calculation engine developed by TotalEnergies, GRIF BFiab offers precise analytical computations and detailed insights into the system, including the time spent in each **Safety Integrity Level** (SIL) zone.

- User-friendly module
- Precise analytical calculations with Albizia
- Compatible with the other Boolean package modules

Did you know?

GRIF BFiab is one of the 4 modules used by WG4 to draft the application cases of ISO/TR 12489 defining Reliability modelling and calculation of safety systems.

Find out more >>>

ISO/TR 12489:2013 - Petroleum, petrochemical and natural gas industries — Reliability modelling and calculation of safety systems

Download GRIF BFiab product sheet

Tutorial example:

Unavailability assessment of a deluge system in case of leaks in a LPG sphere

- **Gas detectors:** 3 gas detectors in 1oo3 redundancy to detect gas or fire.
- **Fire & Gas solver:** Programmed to trigger the alarm in the event of gas or fire detection.
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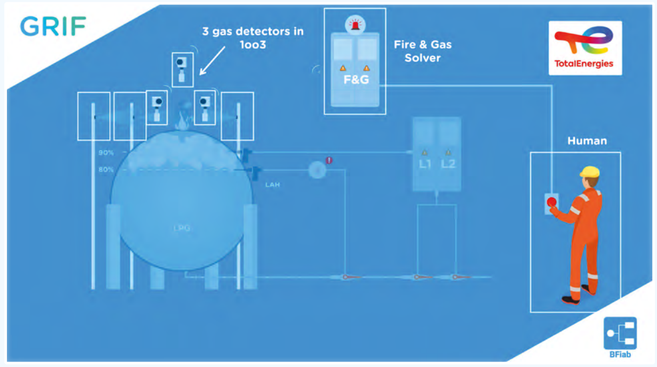
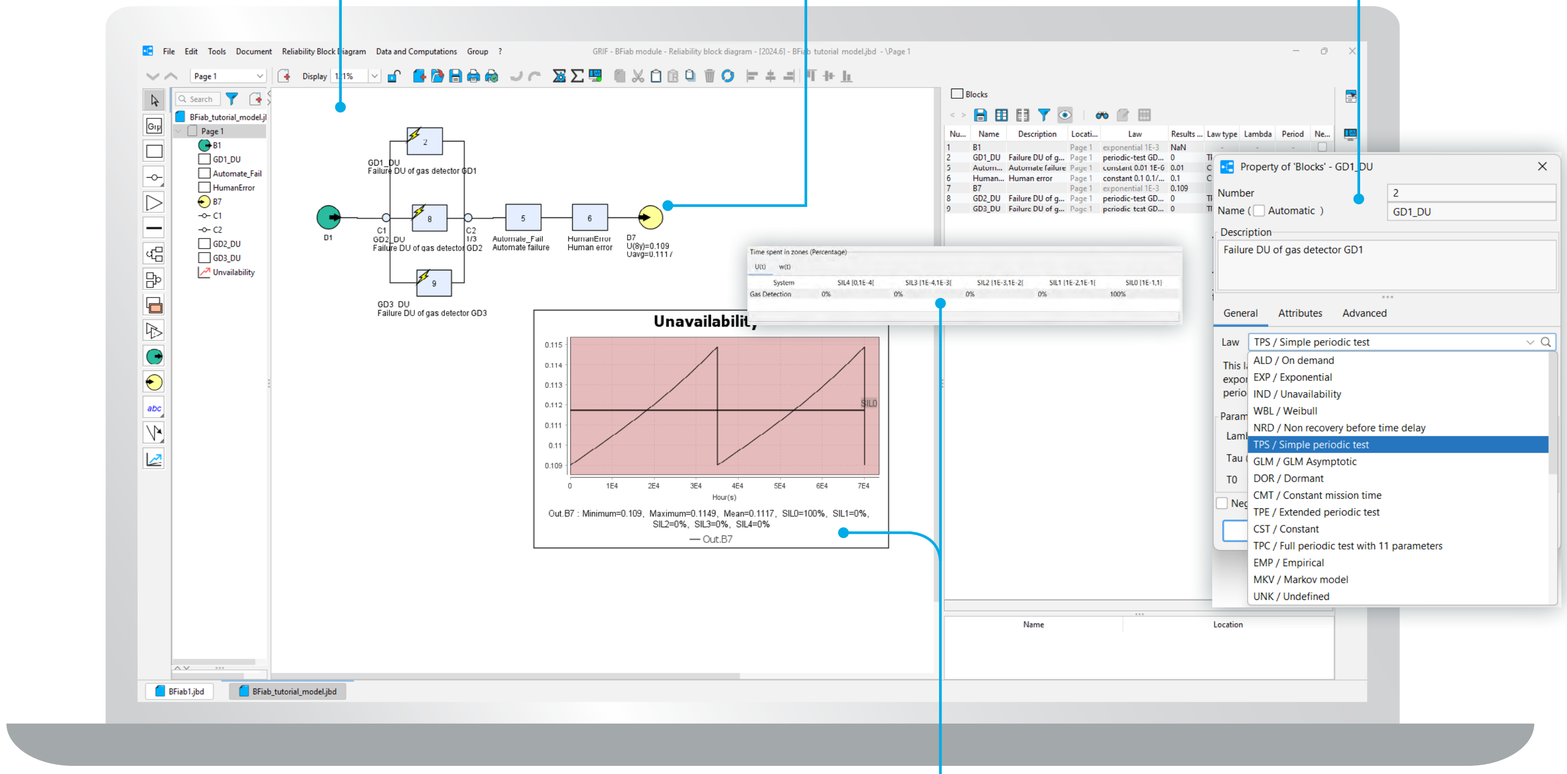


Assessment of the impact of CCF on system reliability (Beta Factor, MGL, Shock models...).

Intuitive visual representation of the components and their interconnections.

Configuration of events using wide choice of probability distribution laws (exponential, periodic tests....) or using a Markov graph.

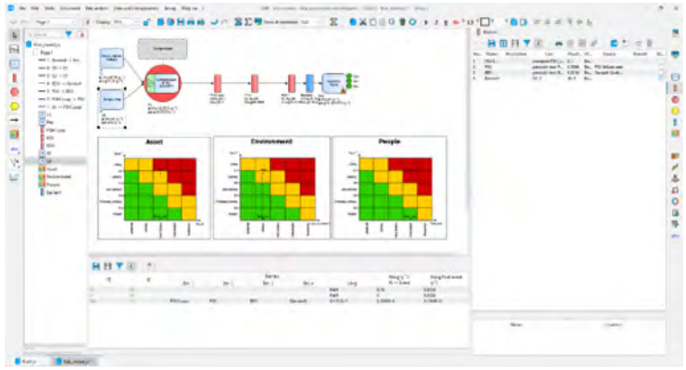


Determining the system's unavailability, the time spent in each SIL zone and identify weaknesses.

GRIF Risk: Risk analysis using Bowtie method and LOPA tables

GRIF Risk is a module allowing to evaluate the risk level of technological risk scenario by modeling **layers of protection** or **Safety Instrumented Systems** using either the **bowtie method** or a **Layers Of Protection Analysis** (LOPA) table. Its use can be particularly powerful studying complex safety barrier models, for e.g. with **GRIF SIL** or **GRIF Tree**.

As part of the Boolean package, it is equipped with **ALBIZIA**, the Binary Decision Diagram (BDD) calculation engines developed by TotalEnergies. ALBIZIA offers the advantage of running **accurate probabilistic calculations** and providing a range of information required for risk assessment.



Compatible with PHA-Pro and BowTie XP

ALBIZIA

Precise analytical calculations with Albizia

Compatible with the other Boolean package modules

Download GRIF Risk product sheet

Did you know?

The Risk module was created in 2017 within TotalEnergies in collaboration with the OneHSE branch. This initiative has now evolved to R&D activities on visualizing the SECB in the operational phase using Bowtie models.

Find out more >>> *GRIF à l'affiche du congrès EPSC ! | GRIF (totalenergies.com)*

GRIF Risk offers clear advantages for which it's the unique software available on the market:

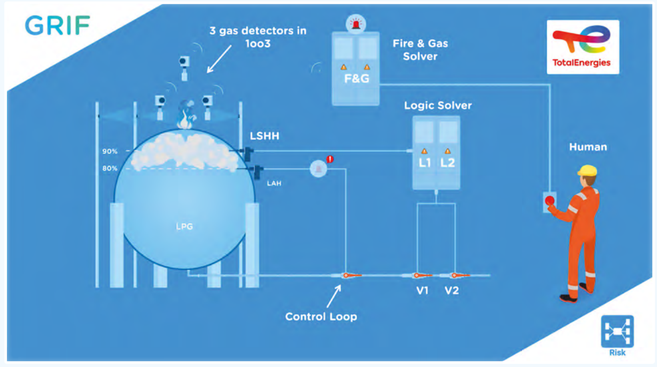
- *Possibility to integrate complex safety barrier architectures, barrier dependence or common cause factors;*
- *During the different steps of a project, it's possible to use the same bowtie model for SIL assignment, Safety Instrumented Function definition on HSE safety engineering side, up to SIS design and verification by E&I project engineering;*
- *Import functionality of HAZOP scenarios.*

GRIF Risk skill leader at TotalEnergies

Tutorial example:

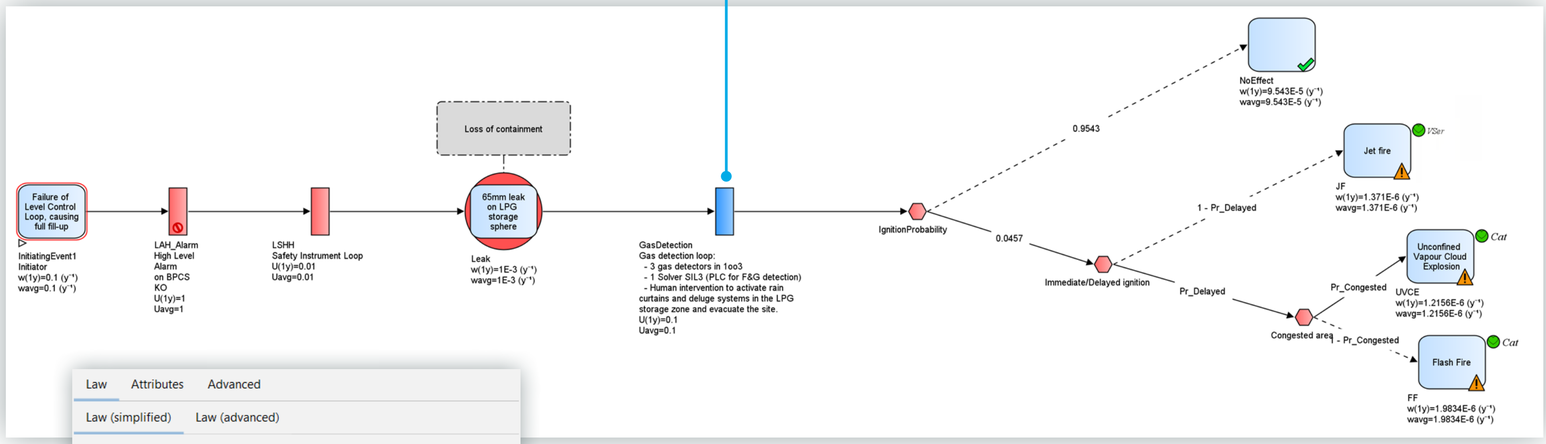
Risk assessment of overfilling a storage LPG sphere

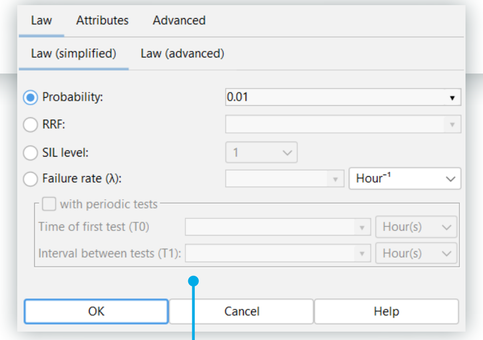
- **Existing barriers:** A Level Control loop with a high level sensor, a high level alarm (LAH) and a valve, and a Safety Instrumented loop with one high high level sensor (LSHH), one logic solver, and two shutdown valves (V1, V2).
- **Barrier to be studied:** A deluge system with 3 gas detectors in redundancy 1oo3, Fire and Gas solver and human.
- **Conditional modifiers:** Ignition probability, Immediate / Delayed ignition probability and Congested area probability.
- **Consequences:** Jet Fire, Unconfined Vapour Cloud Explosion or Flash Fire.

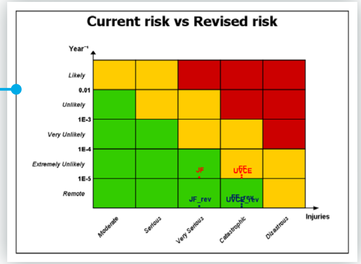


Adding of existing barriers (current risk), but also study new barriers (revised risk) to see if they allow to achieve an acceptable risk zone.

Average frequencies calculations for all scenarios and assessment of the revised risk to reach the green acceptable zone!







Elements parametrization with constant (average) PFD or integration of more complex laws (exponential, periodic test...).

Average frequencies calculations for all scenarios and assessment of the revised risk to reach the green acceptable zone!

GRIF ETree: Risk analysis using Event Trees

ETree is a module allowing to build **event trees** for the risk assessment of safety barriers and is an easy way to obtain and combine **several risk matrices**. The module is one of the seven modules belonging to Boolean package.

It's equipped with **ALBIZIA**, the Binary Decision Diagram (BDD) calculation engines developed by TotalEnergies. ALBIZIA offers the advantage of running **accurate analytical computations and providing rapidly extensive information** on the system under study like the frequency of each consequence over time.

Calculations can be performed in **the same document using any model in the Bool module**: Fault Tree (Tree), Block-Diagram (BFiab), SIS (SIL)..., etc. For example, initiating events and barriers can be defined using a Fault Tree created with the Tree module, or a SIF via the SIL module.

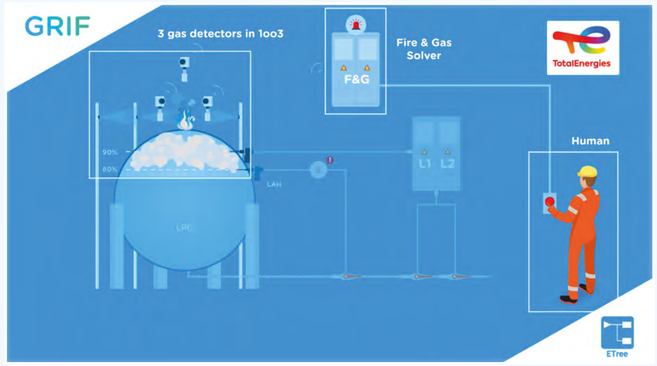
- User-friendly module
- Precise analytical calculations with Albizia
- Compatible with the other Boolean package modules

Download GRIF ETree product sheet

Tutorial example:

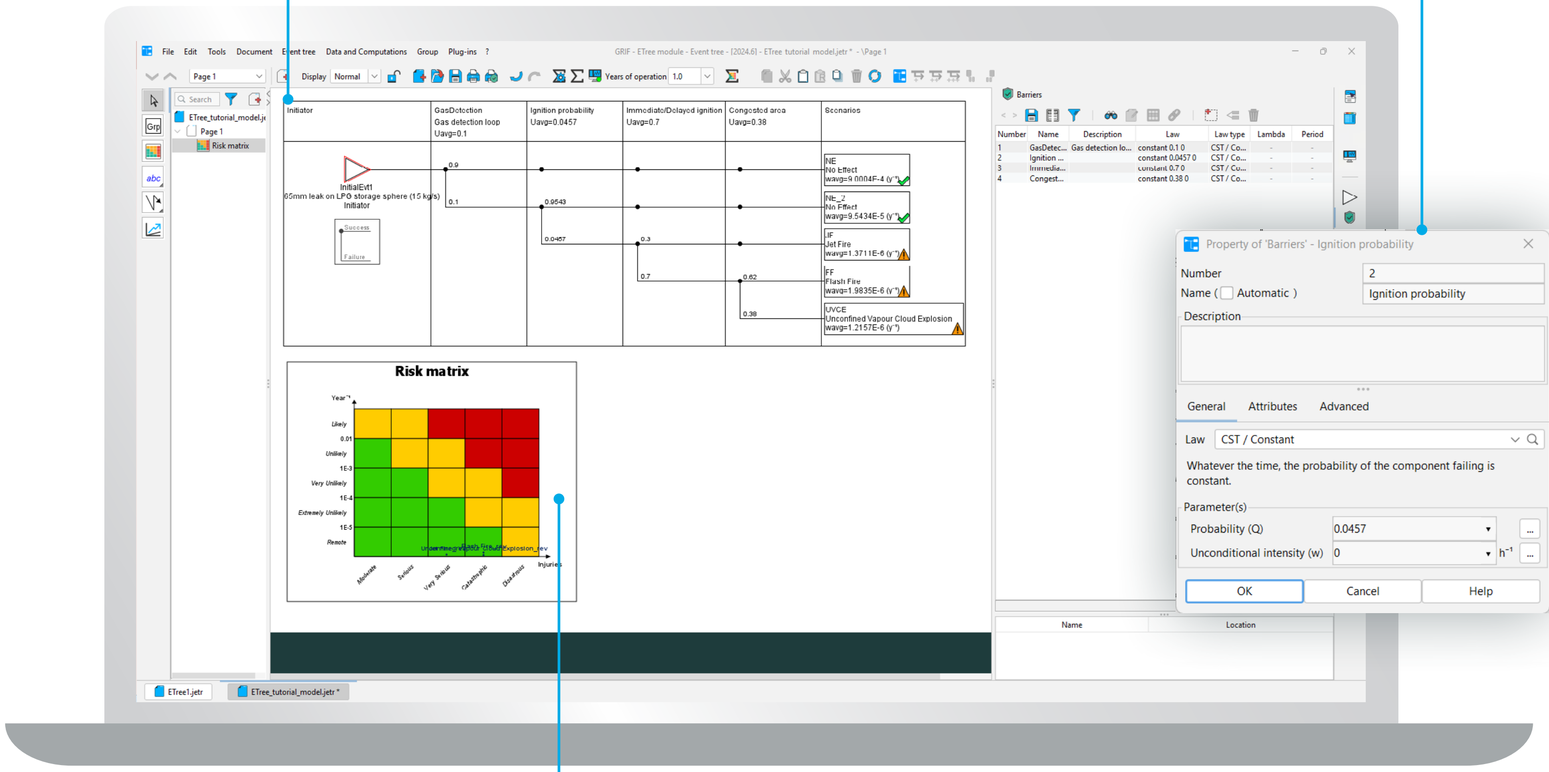
Risk assessment of overfilling a storage LPG sphere

- **Deluge system:** 3 gas detectors in redundancy 1oo3, Fire and Gas solver and human.
- **Conditional modifiers:** Ignition probability, Immediate / Delayed ignition probability and Congested area probability.
- **Consequences:** Jet Fire, Unconfined Vapour Cloud Explosion or Flash Fire.



Intuitive graphical interface where each scenario is defined by a succession of barrier failures and successes.

Setting of elements with wide choice of probability distribution laws (Exponential, Weibull, periodic tests...).

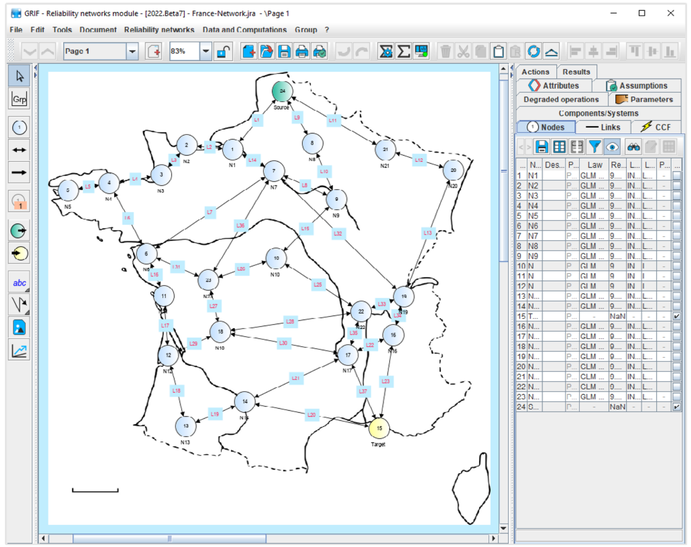


Checking compliance with acceptable risk levels.

GRIF Reseda: Reliability/Availability analysis of networks

Reseda is a module allowing to model systems based on **reliability networks** that are made up of nodes and links. It proposes more than **20 probability laws** and is suited to **any kind of network**: electrical, radio, fluid, IT, etc. The aim is to evaluate **network failure**, assuming failure is the loss of all paths between the input and the output.

The module is one of the seven modules belonging to Boolean package. It's equipped with **ALBIZIA**, the Binary Decision Diagram (BDD) computation engine developed by TotalEnergies. ALBIZIA offers the advantage of running accurate **analytical computations and providing extensive information** on the system under study and available results: Unavailability (PFD), Availability, Reliability, Unreliability, Frequency (PFH) and equivalent failure rate. The importance factors are used to identify the network's weak points and select the nodes/links that need to be improved.



Download GRIF Reseda product sheet

Did you know?

Reseda is one of the five pioneering modules in the GRIF software suite, dedicated to telecommunications, distribution, and computer networks.

Find out more >>>

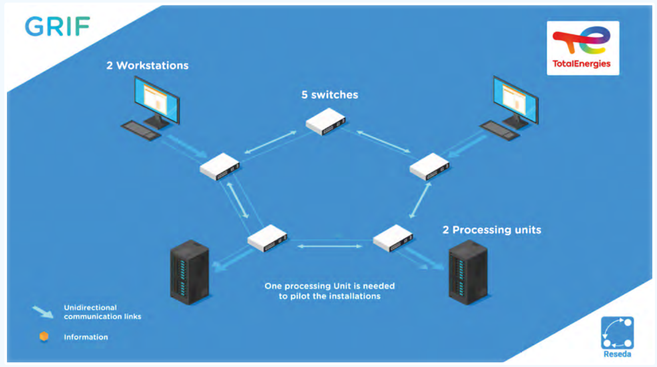
Computing Network Reliability with Réséda and Aralia (researchgate.net)

✓	User-friendly module
ALBIZIA	Precise analytical calculations with Albizia
+20	+ 20 probability distribution laws

Tutorial example:

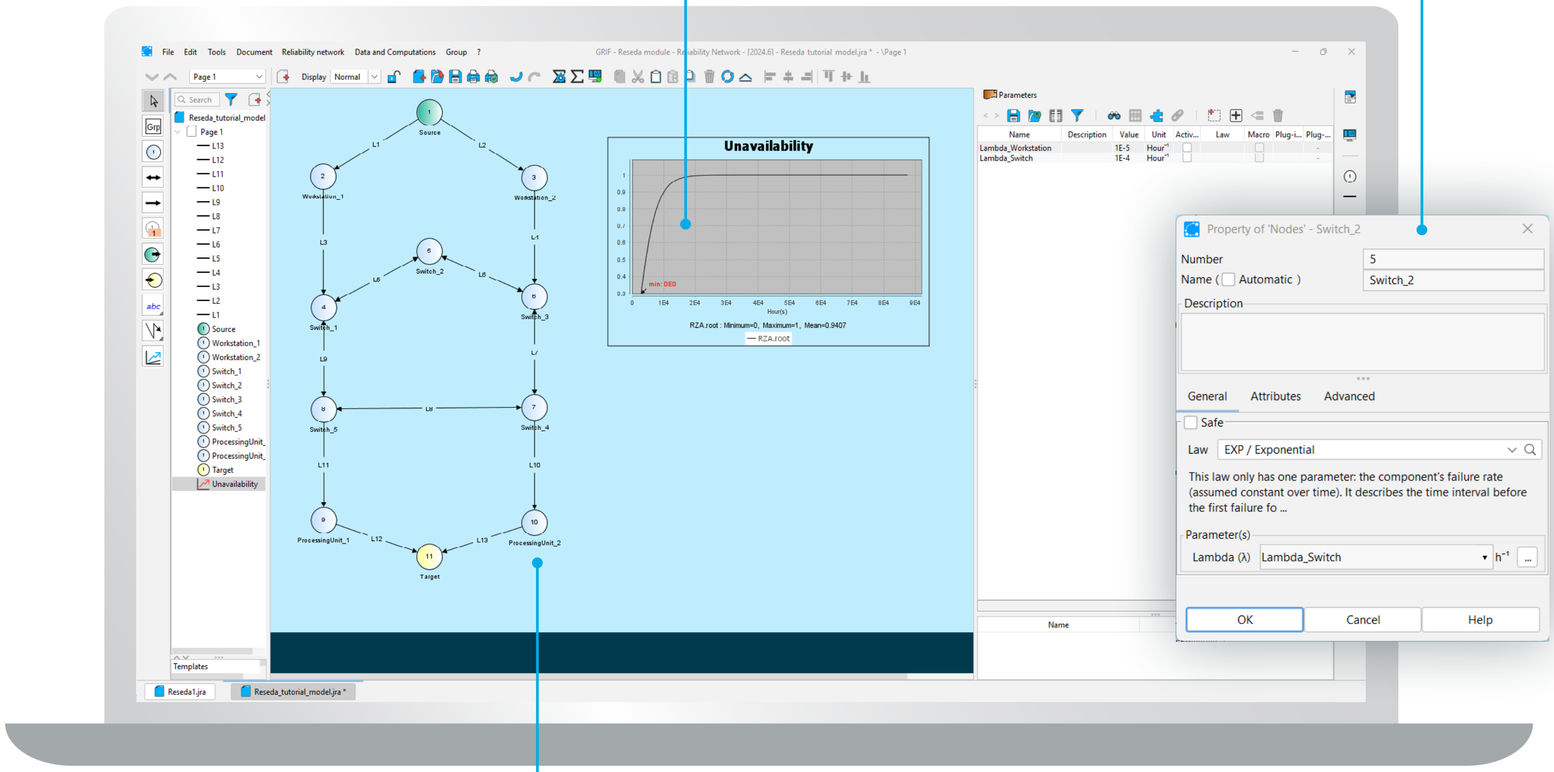
Reliability analysis of an IT communications network

- **Sources:** 2 workstations.
- **Relay:** 5 switches allowing information to flow.
- **Targets:** 2 processing units.
- **Links:** Information cannot flow up to the workstations or from the processing units to the switches (Undirectional links). However, it can circulate in both directions between the switches (Bidirectional links).



Unavailability calculations of the system.

Setting of elements with wide choice of probability distribution laws (Exponential, Periodic tests...).

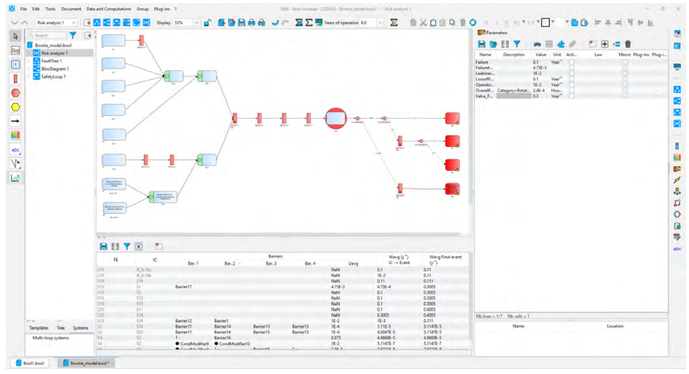


Configuration of the network with links and nodes.

GRIF Bool: Analysis of system architecture using Boolean approach

GRIF Bool is a module allowing to analyze the reliability, availability and safety of system architectures using Boolean approach, **in line with Uncertainty factors (UF) and IEC standard 61511**. The module is one of the seven modules in the Boolean package.

It's equipped with **ALBIZIA**, the Binary Decision Diagram (BDD) calculation engines developed by TotalEnergies. ALBIZIA offers the advantage of running **accurate analytical computations and providing extensive information** on the system under study.

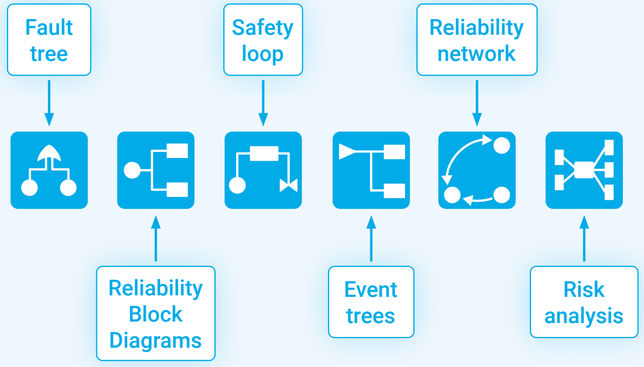


- User-friendly module
- Precise analytical calculations with Albizia
- Uncertainty Factors (UF), IEC 61511 standards

Download GRIF Bool product sheet

Did you know?

The special feature of the BOOL module is that it can combine all the modules in the Boolean package in the same model, enabling collaborative work between different professions during the Engineering phase.



Tutorial example:

Risk assessment of overfilling of a storage LPG sphere

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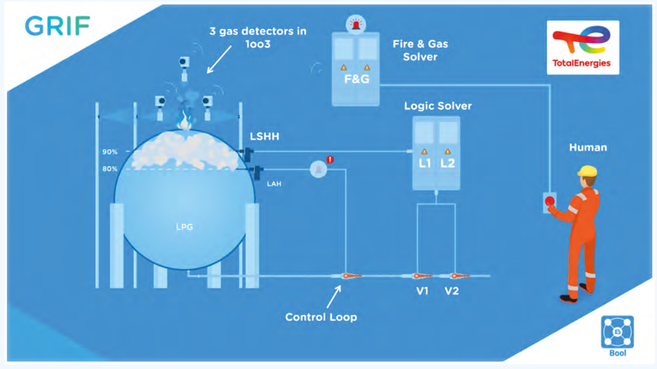
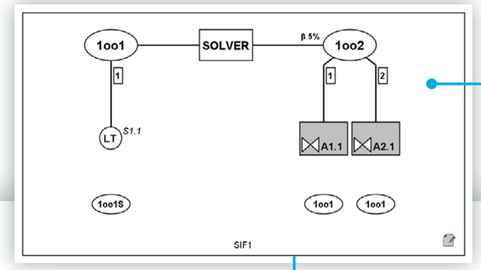
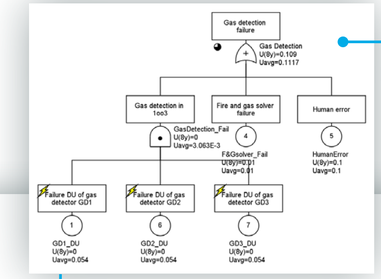
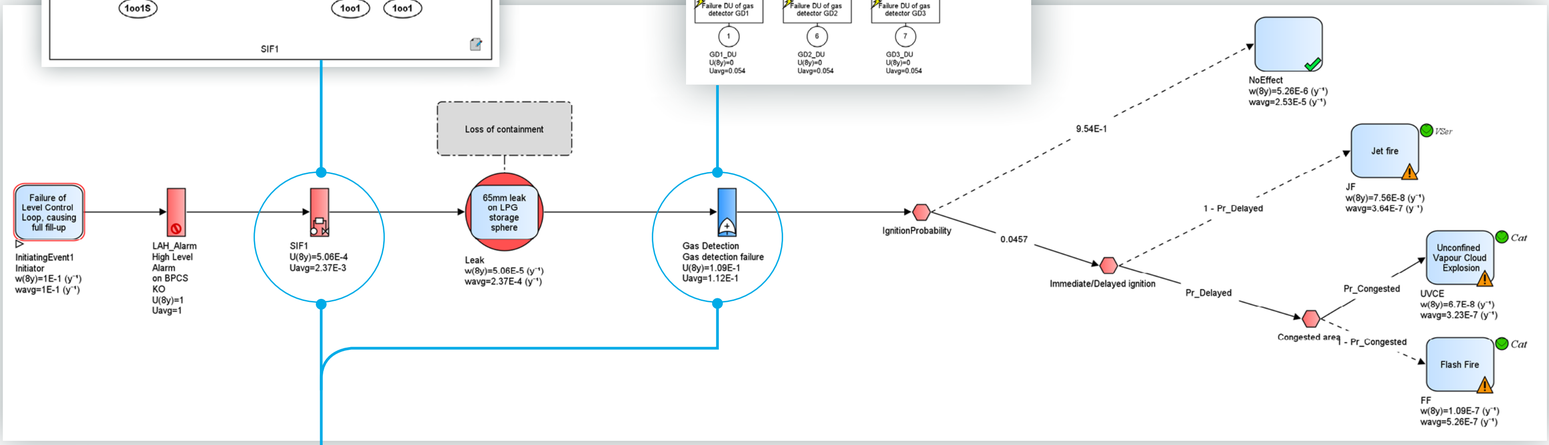


Modeling of the Level Control loop with GRIF SIL.

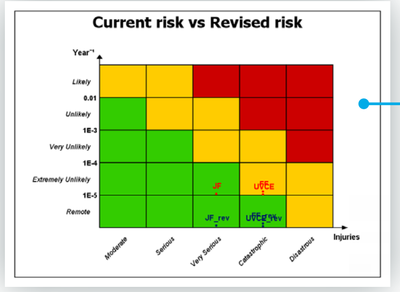


Modeling of the Deluge system with GRIF Tree.





Combination of the SIL and Tree models in a bowtie with GRIF Risk.



Bowtie risk assessments using complex **safety barriers** or any other model that requires a combination of different representations.

GRIF Markov: Multi-phase Markov chains

GRIF Markov is a module allowing to create **Markov chains** to assess the reliability, availability and safety of system architectures. As part of the Markovian package, it's equipped with **ALBIZIA**, the Binary Decision Diagram (BDD) calculation engines developed by TotalEnergies that offers the advantage of running **accurate analytical computations and providing extensive information** on the system under study including the availability and Lambda Equivalent of a system over time, the probability of being in each state or the cumulative sojourn times.

Moreover, the different phases of a component's lifetime can be modeled in the Markov module by creating **multi-phase Markov chains**, which can be used to display the availability of a system that is periodically tested, considering many parameters: test duration and efficiency, reconfiguration errors, etc.

- User-friendly module
- Precise analytical calculations with Albizia
- Multi-phase Markov chains
- Can be used with all the GRIF Boolean module to describe a component failure

Did you know?

The concept of multi-phase has been developed specifically for this module in order to take into account the effects of PMI on system availability.

Find out more >>>

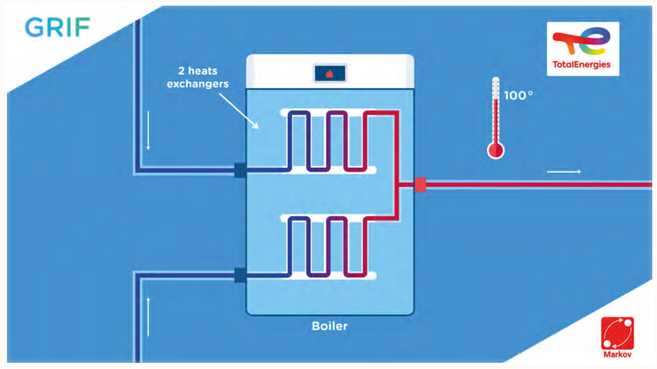
Reliability Assessment of Safety and Production Systems: Analysis, Modeling, Calculations and Case Studies | SpringerLink

Download GRIF Markov product sheet

Tutorial example:

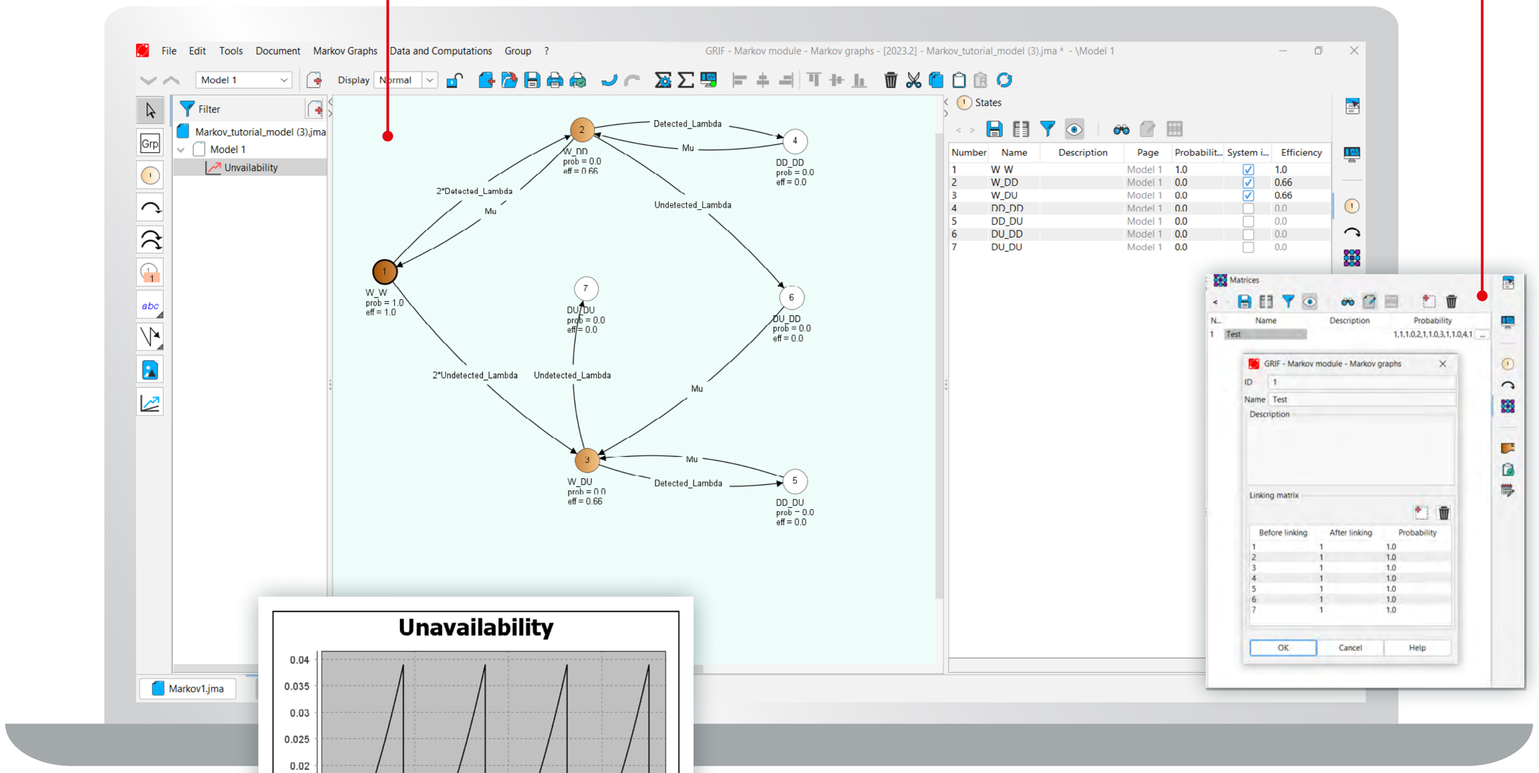
Evaluation of the Unavailability of a system made up of 2 components

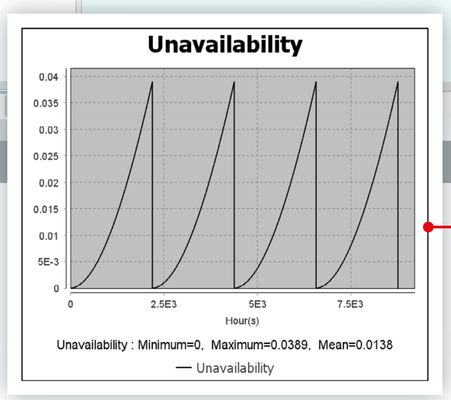
- **Sources:** 2 workstations.
- **System:** Boiler water heating system with 2 reparable and identical heat exchangers in 2x66% redundancy.
- **States:** Each component has 3 states: Work (W), Dangerous Detected failure (DD) and Dangerous Undetected failure (DU).
- **Maintenance:** 1 technician for corrective maintenance, and preventive maintenance managed via multi-phase every 3 months. Undetected failure will be detected only during preventive maintenance. Each test is perfect, and all failures are detected and repaired (DD & DU).



Creation of the multi-phase Markov chains with failure rates and repair times.

Test procedures configuration.





Unavailability calculation over time of the system which is periodically tested.

GRIF Petri: Stochastic Petri nets with predicates and assertions

GRIF Petri is a module used to build accurate, exhaustive and efficient models for reliability, safety and production availability analyses. It's used to model the behavior of complex dynamic systems using **stochastic Petri nets** with **Predicates, Assertions** and **Monte-Carlo simulation**.

The module is one of the four modules in the Simulation package. It's equipped with **MOCA-RP** (MOnte-CArlo – Petri Nets), **TotalEnergies high-speed computation engine**, itself based, as its name suggests, on the **Monte-Carlo simulation** which pushes back the boundaries of modelling. Thanks to the **powerful modeling language** and a **high-speed computation engine**, Petri offers the opportunity to assess the **performance of High Integrity protection System** (HIPS) when their design and/or maintenance strategy is too complex to be handled by the conventional Boolean package module, such as **GRIF SIL**.

	Performance analysis of complex systems with dependencies
MOCA-RP	High performance calculation engine MOCA-RP
HPC Plug-in	Compatible with the HPC Plug-in

Download GRIF Petri product sheet

Did you know?

Petri nets are becoming increasingly widespread in industry. Our users know them best: A dependability engineer at CNES is tackling the challenges of analyzing the availability of a constellation using Petri nets, according to different deployment and renewal scenarios.

Find out more >>>

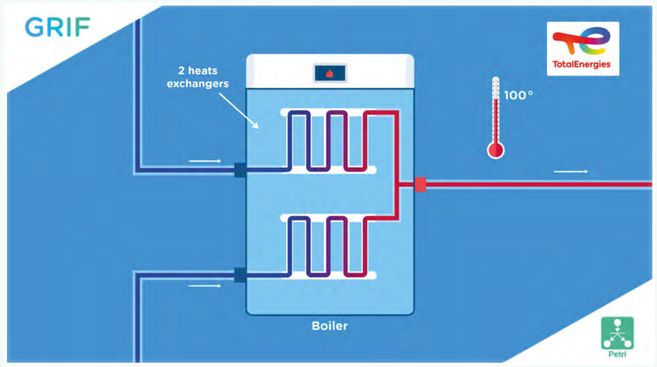
GRIF at the European Space Agency (ESA)
RAMS Conference in the Netherlands | GRIF (totalenergies.com)*

> *Petri module proposes a dynamic approach associated with a powerful simulation engine which was the only solution to model and assess properly this system and its O&M strategy performance.*
>
> *RAM Manager at TotalEnergies*

Tutorial example:

Evaluation of the unavailability of a system made up of 2 components

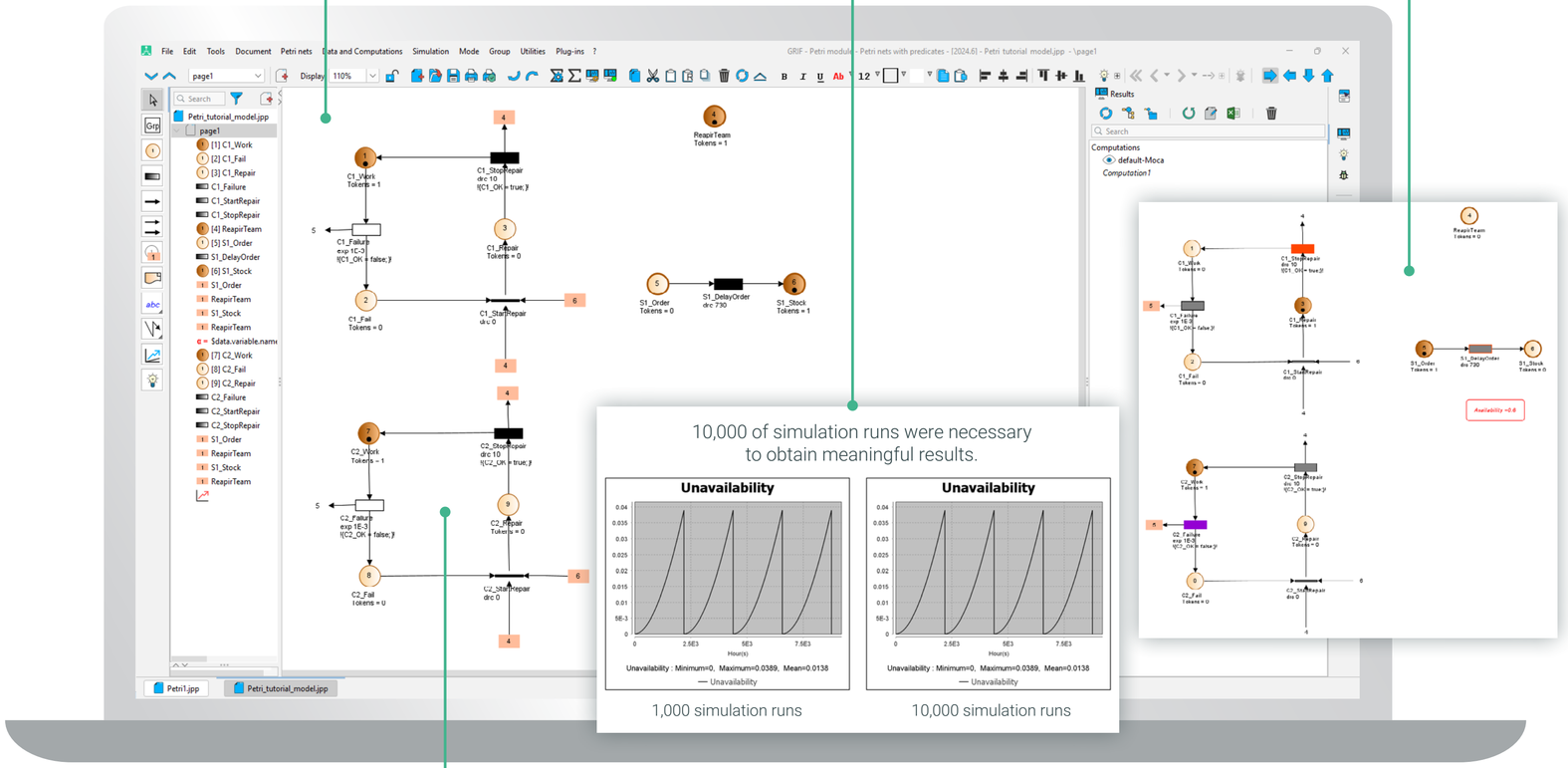
- **System:** Boiler water heating system with 2 reparable and identical heat exchangers in redundancy. The system operates at 60% if one of the two heat exchangers fails.
- **Maintenance:** One repair team and one spare part with a procurement duration of 1 month



Configuration of Petri nets with dependencies between components, conditional repair interventions and spare parts management.

Unavailability calculation of the system.

Simulation step-by-step to assure the model.



Configuration of the transitions with a wide choice of probability laws (Exponential, Dirac, Weibull...) and variables which can be modified when firing transitions (Assertions).

GRIF Petro: Production availability of multi-flow process systems

GRIF Petro is a module allowing to model and simulate **multi-flow process systems** using **stochastic block diagrams** in several industrial sectors (oil & gas, distribution, etc.) to calculate production availability in line with **ISO/TR 20815**.

As part of the Simulation package, it's equipped with **MOCA-RP** (MOnte-CArlo – Petri Nets), **TotalEnergies high-speed computation engine**, itself based, as its name suggests, on the **Monte-Carlo simulation** which pushes back the boundaries of modelling.

The methodology delivered permits to:

- **ASSESS:** The **performance level** of a project or an existing asset by analyzing its ability to deliver an expected production profile.
- **IDENTIFY:** The **weak points** of the design and the **main contributors** to production losses.
- **PROVIDE: Recommendations** (design, spare parts, operating philosophy, maintenance philosophy…) and **decision aid support**.

ISO	Production availability in line with ISO/TR 20815 standards
MOCA-RP	High performance calculation engine MOCA-RP
HPC Plug-in	Compatible with the HPC Plug-in

Did you know?

GRIF PETRO optimizes the balance between production availability, capital expenditure and project operating costs, while managing environmental aspects.

Find out more >>>

Energy: GRIF optimizes your plant production

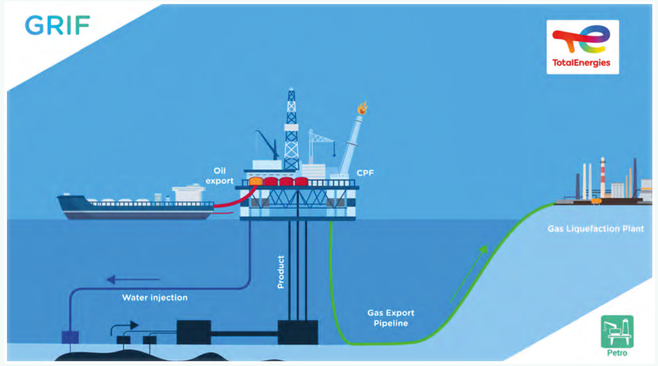
> *GRIF Tree is a very robust tool, offering user-friendly functionality that scores better than Arbre Analyst. Similarly, Petro is solid and competitive in the market compared to MAROS.*
>
> *Petro/Tree user in Consulting services*

Download GRIF Petro product sheet

Tutorial example:

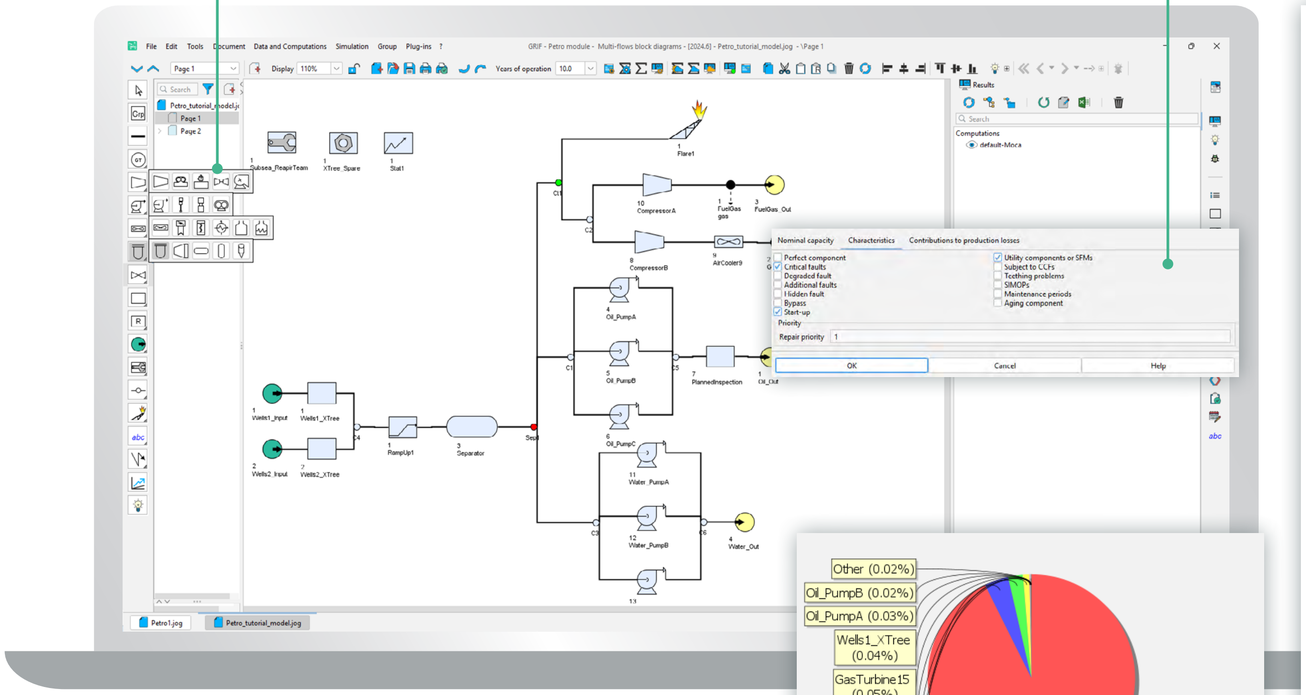
Evaluation of the production availability of a multi-flow system in oil industry

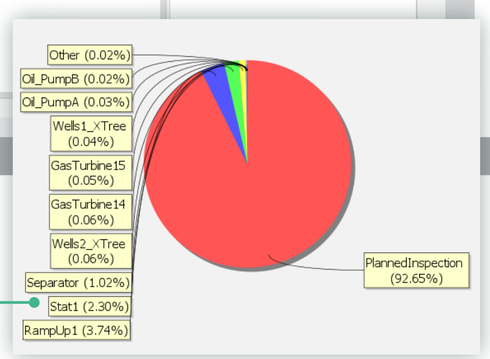
- **Process:** Crude oil extracted from two production wells, then sent to a CPF to separate oil, gas and water. The gas is sent to an onshore liquefaction plant and water is then returned to the wells to maintain pressure.
- **Utility:** Power Generation which supplies all equipment and needs fuel gas to start.
- **Maintenance:** 2 Subsea teams with mobilization time and specific working hours. Spare part management for subsea units.



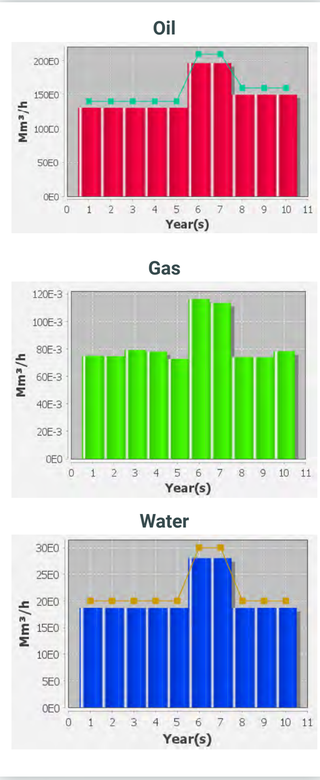
Implementation of a system integrating a wide range of equipment (pumps, compressors, filters, etc.) modeling by Petri nets representing the behaviors specified by the user.

Configuration of the items with production profiles, failure rate, repair time, maintenance period, logistic delays, start-up, redundancies, utility connection...





Running of a step-by-step simulation before starting the calculation to obtain production availability and identify the mains contributors to production losses.



GRIF BStoK: Production availability of single flow process systems

GRIF BStoK is a module used to model **single flow** systems. In contrast to reliability block diagrams, **BStoK considers the dynamic behaviour of systems** using **stochastic block diagrams** to calculate production availability in line with **ISO/TR 20815**.

This module is one of the four modules in the Simulation package. It's equipped with **MOCA-RP** (MOnte-CArlo – Petri Nets), **TotalEnergies high-speed computation engine**, itself based, as its name suggests, on the **Monte-Carlo simulation** which pushes back the boundaries of modelling. It helps to **optimize the design** of a given installation by comparing the production availabilities of **different possible architectures**, identifying the **weak points** and ensuring that the targets defined for the system are met.

ISO	Production availability in line with ISO/TR 20815 standards
MOCA-RP	High performance calculation engine MOCA-RP
HPC Plug-in	Compatible with the HPC Plug-in
✓	Compatible with GRIF Petro

Download GRIF BStoK product sheet

Did you know?

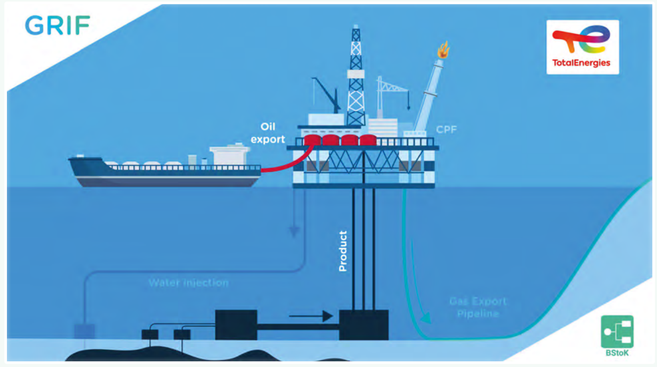
BStoK is the ancestor of the Petro module and was developed in 2006.

Its special feature is its ability to handle single-flow systems!

Tutorial example:

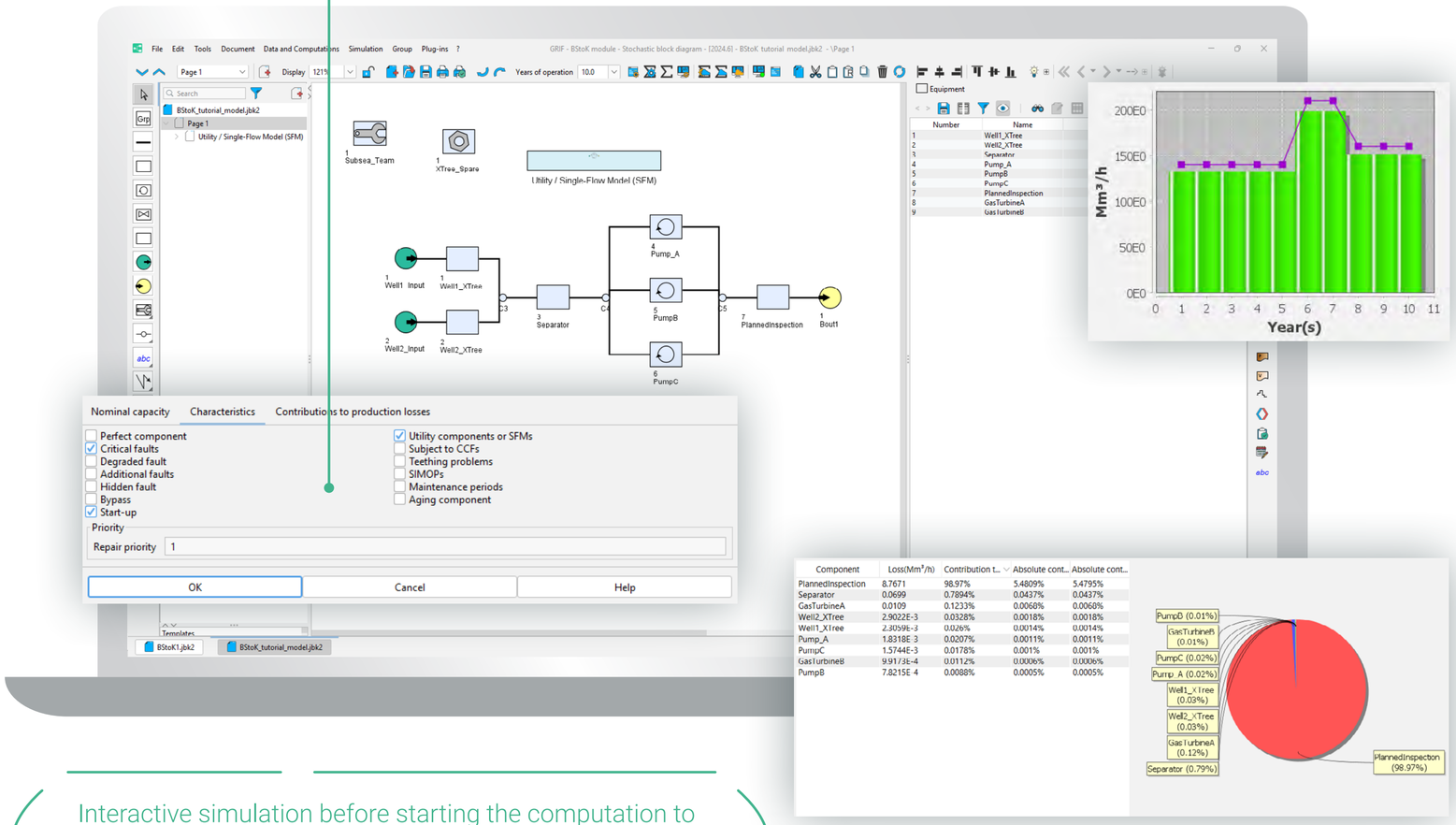
Evaluation of the production availability of a single flow system in oil industry

- **Process:** Crude oil extracted from two production wells, then sent to a CPF to separate oil, gas and water. Only the oil flow is modeled.
- **Utility:** Power Generation which supplies all equipment.
- **Maintenance:** 2 Subsea teams with mobilization time and specific working hours. Spare part management for subsea units.



Configuration of the items with production profiles, failure rate, repair time, maintenance period, logistic delays, statistical data, redundancies, utility connection...

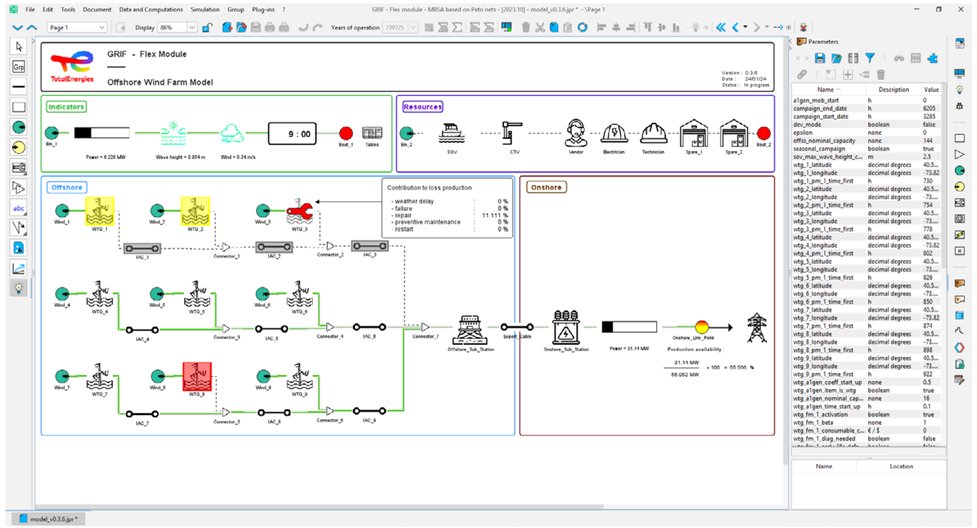
Intuitive graphical representation requiring no prior knowledge of Petri nets.



Interactive simulation before starting the computation to obtain production availability over the year, incidents, main contributors, use of spare part and maintenance crew...

GRIF Flex: MBSA based on Petri nets

GRIF Flex is a module allowing to construct multi-stream block diagrams that facilitate the creation of your own **Petri net** prototypes, for more accurate and exhaustive overview of your operations at every stage of production. GRIF Flex is used to model systems and their **logistics support** and to calculate their **production availability**. No matter if you're modelling an assembly line, an electrical grid, a production system, or any other type of system, this module can be used across all industrial sectors.



The module is one of the four modules belonging to the Simulation package. It is equipped with **MOCA-RP**, an ultra-fast calculation engine developed by TotalEnergies. MOCA-RP is based on **Monte-Carlo simulation**, which pushes the limits of modelling, as its name indicates.

This **decision-making** tool can be used to optimize the design of a given unit by comparing the production availability of various architecture, in order to identify **weak points** and check that the **targets** defined for the system are being met. Users can create additional variables to evaluate and obtain comprehensive results for every aspect of their system. As a result, Flex can also be used for safety considerations, performance assessments, and SIL optimization.

Download GRIF Flex product sheet

Did you know?

The Flex module enables MBSA (Model Based Safatey Analysed). This is the latest addition to the software suite, which underwent major upgrades in 2024 to enable it to be used on an industrial scale in a wide range of industrial sectors!.

Find out more >>>

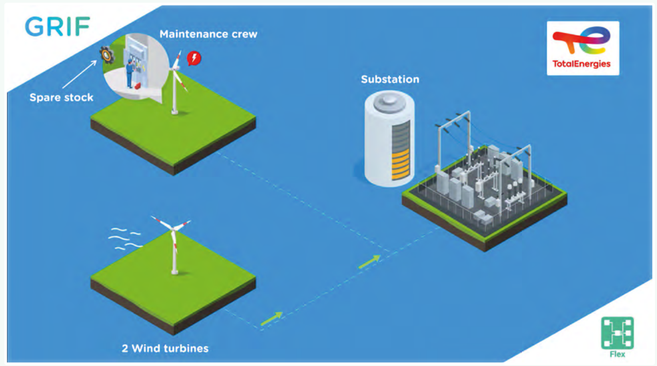
ABSTRACT. MBSA model to evaluate and analyze the production availability of an offshore wind farm | GRIF (totalenergies.com)

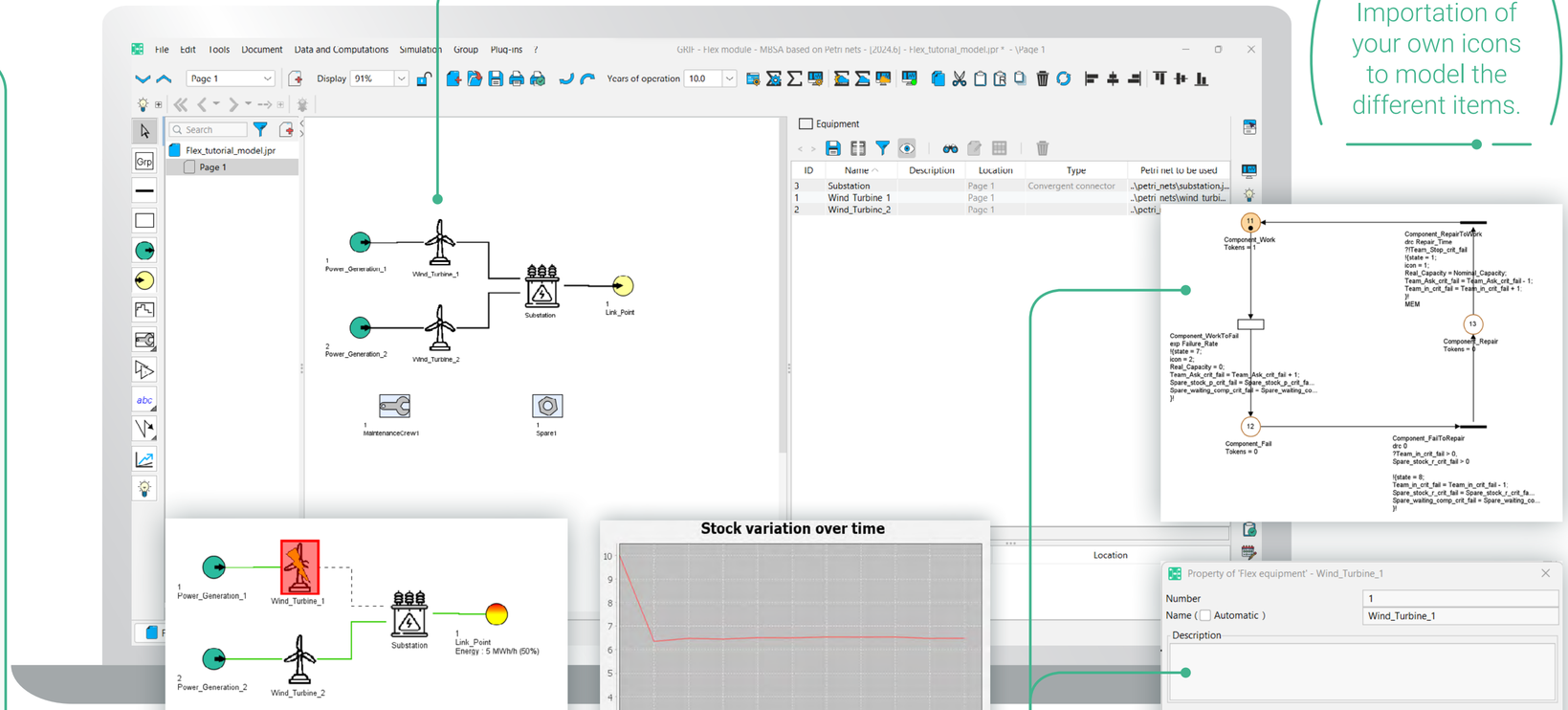
- Complete system modeling
- High performance calculation engine MOCA-RP
- Data shared with each stakeholder

Tutorial example:

Evaluation of the production availability of an onshore wind farm

- **System:** Two wind turbines connected in parallel and then in series to a substation.
- **Maintenance:** One maintenance crew with mobilization time and specific working hours. Spare part management for wind turbines and substation is considered perfect.





Importation of your own icons to model the different items.

Running a step-by-step simulation before starting the calculation to assure the model.

Production availability or use of spare part and maintenance crew calculations.

Configuration of the components with your own library of Petri nets.

GRIF AT TOTALENERGIES

Did you know? GRIF was initially developed more than **20 years ago exclusively** by and for TotalEnergies to meet the company's needs in **safety** and **production availability** studies before officially entering the software **market in 2005**. It officially became a **trademark of TotalEnergies** in 2022 and took over the company's product market. Over the past year, the community has multiplied by 3.

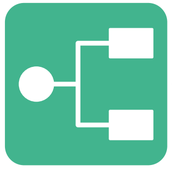
TotalEnergies employees remain the primary users of the software suite to this day and influence its daily evolutions, which are managed within an entity named RAM.
It is developed **in line with ISO 20815** and **IEC 61508 / 61511** where TotalEnergies has representatives. Here are some key milestones:

Originally developed in 2017 in partnership with the OneHSE branch, this tool has been continuously updated to align with the company's risk analysis needs according to **IEC 61508 standards**. The latest enhancement involves integrating with BowtieXP software, enabling our affiliates to transfer hundreds of existing models to the GRIF platform for quantitative risk analysis.

Learn more

GRIF on the line-up at the EPSC conference! (totalenergies.com)

Risk



Petro

Developed in 2013 to facilitate the execution of production availability studies previously conducted with the Petri module, it is used daily by the RAM teams to predict the performance of the company's projects.
It allows **meeting the production availability/reliability and safety targets at the right cost:** +$200M of CAPEX/OPEX savings tested and validated through Production Availability Studies over 2022/2023 (+$800M since 2010 and +$60M for OBOs).

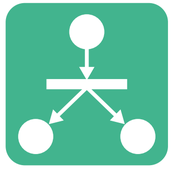
Learn more

Optimize your installations with GRIF! | GRIF (totalenergies.com)

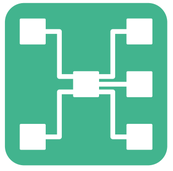
As the flagship of the software suite, it is the solution **for modeling complex systems** whose behaviors are not covered by the Petro or BStock modules. It enables the management of innovative projects such as those related to **CO_2 storage or safety studies with complex maintenance philosophy**.

Learn more

GRIF, from the CSTJF, to catalyse the energy transition | ETABLISSEMENT PAU LACQ (totalenergies.fr)



Petri

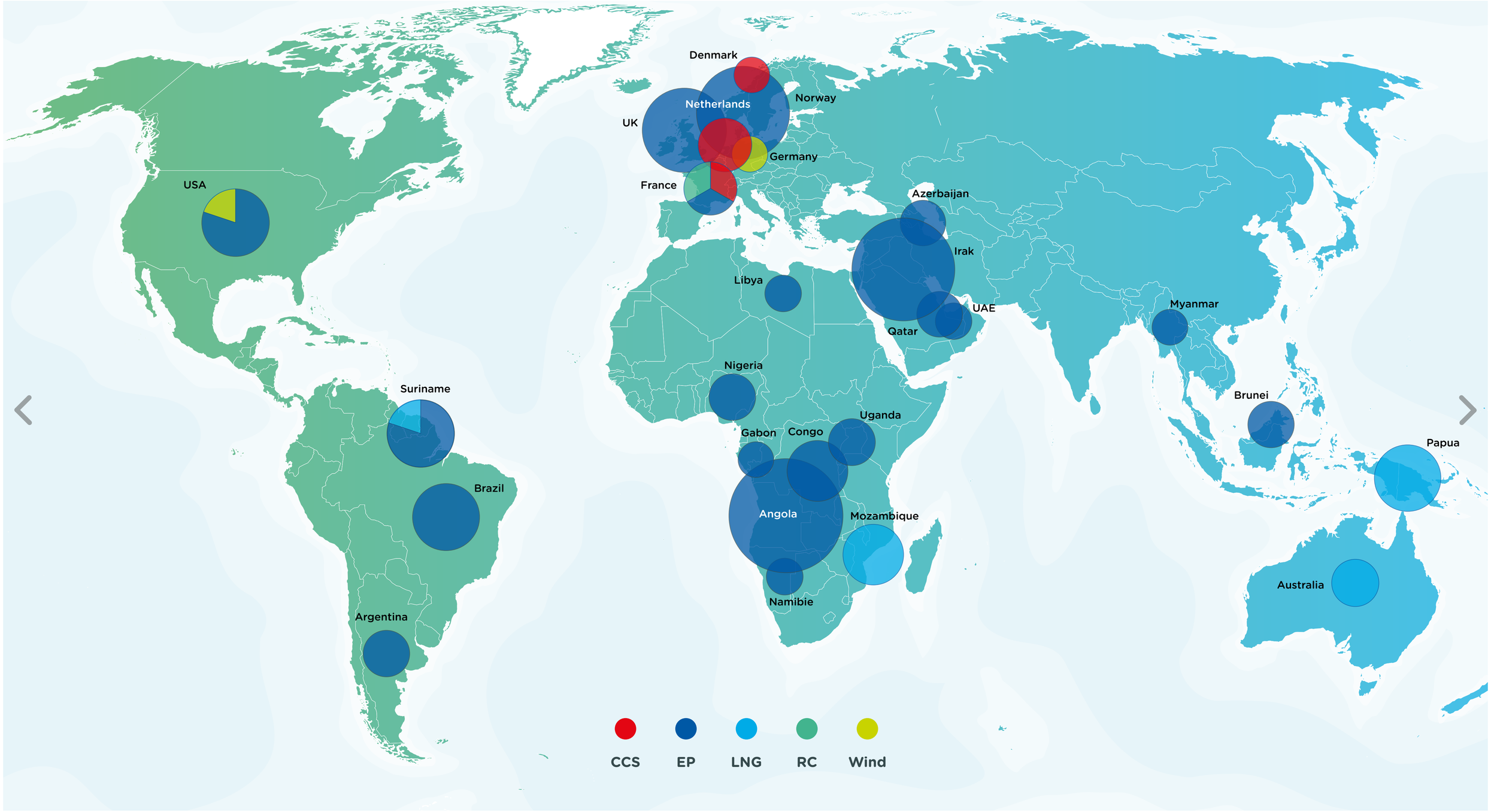


Flex

Initially developed to meet the needs of third-party clients, it was selected in 2022 to build the functional prototype of a future module dedicated to the **evaluation of offshore wind farms**. Our O&M Wind System Integration colleague, speaks about it best: "In almost 18 months, from the moment we asked ourselves the question to the moment we applied our developments in an industrial context, we succeeded in bringing out a new solution in GRIF. This demonstrates the **agility of this tool**, which has been evolving for 40 years and is able to keep pace with rapid industrial change, such as the shift taken by TotalEnergies to address offshore wind energy.
It's a fine **demonstration of the relevance of our traditional skills in addressing new energies.**

Learn more

LambdaMu 2024 presentation


Denmark
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Uganda
Gabon
Congo
Papua
Brazil
Angola
Mozambique
Australia
Namibie
Argentina
CCS
EP
LNG
RC
Wind

GRIF FOR ACADEMIC PURPOSES

The GRIF software suite is an excellent tool for teaching dependability. It is very comprehensive, including reliability diagrams, fault trees, Markov models and stochastic Petri nets, and enables rapid modeling of systems for operational safety assessment. Its wide range of safety indicators is particularly appreciated and its intuitive graphical interface enables students to quickly familiarize themselves with GRIF. Once they've mastered one module, they can easily move on to the others. Students find GRIF a pleasure to use.

Learn more

UPPA and GRIF, technology from TotalEnergies:
A rewarding collaboration to train tomorrow's engineers | GRIF

GRIF software suite is for academic purposes*

Who can request an academic GRIF license?

An academic GRIF license can be requested by professors and teachers at universities or engineering schools for academic purposes.

How to request?

Fill in the contact form on the GRIF website:
grif.totalenergies.com

Is it difficult to start working with the GRIF software suite?

To help you get started with GRIF, we offer a free demonstration session (1 hour) with the GRIF expert, and detailed manuals for each module.

To go further, you can invite a TotalEnergies Associate Professors to conduct a training course based on his or her area of expertise:
https://prof.totalenergies.com/

** Academic purposes refer to RAMS activities related to education and scientific research in universities and engineering schools. This includes activities such as teaching for professors, and paper-writing for PhD students.*

GRIF SERVICES TOTALENERGIES YOUTUBE

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GRIF SOCIAL LIFE

ESA RAMS:
It would be interesting to continue to exchange ideas and **open the doors of the conference to a software that is quite unique on the market**.

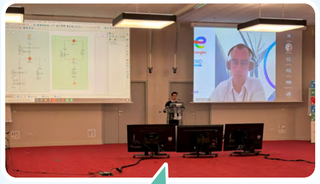
GRIF at the European Space Agency (ESA) RAMS Conference in the Netherlands!

GRIF at the third European Conference on Plant & Process Safety (EPSC) in the Netherlands !

UPPA and GRIF, technology from TotalEnergies: A rewarding collaboration to train tomorrow's engineers.

ABSTRACT.
Optimizing The Balance Between Production Availability, Capex And Opex Of Projects While Managing Environmental Aspects With A Simulation Tool.

The GRIF Club 2025 edition will take place on April 3rd, 2025, at TotalEnergies headquarters in Paris.



ADIPEC 2024 sets new records, featuring TotalEnergies' GRIF software suite

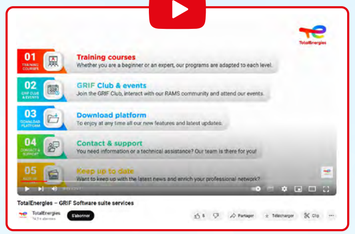
TUTORIAL VIDEOS ON YOUTUBE

GRIF's innovative tools showcased at EPSC 2024

GRIF at the **Offshore Technology Conference 2024 in Texas!**

ABSTRACT.
MBSA model to evaluate and analyze the production availability of an offshore wind farm.

GRIF Club: 57 participants from all **over the world** and from a **wide range of industrial sectors** (aeronautics, aerospace, defense, nuclear, energy, etc.)



We felt the need to look into this further and TotalEnergies offered us the opportunity to bring in professionals to train our students.

NOTES

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