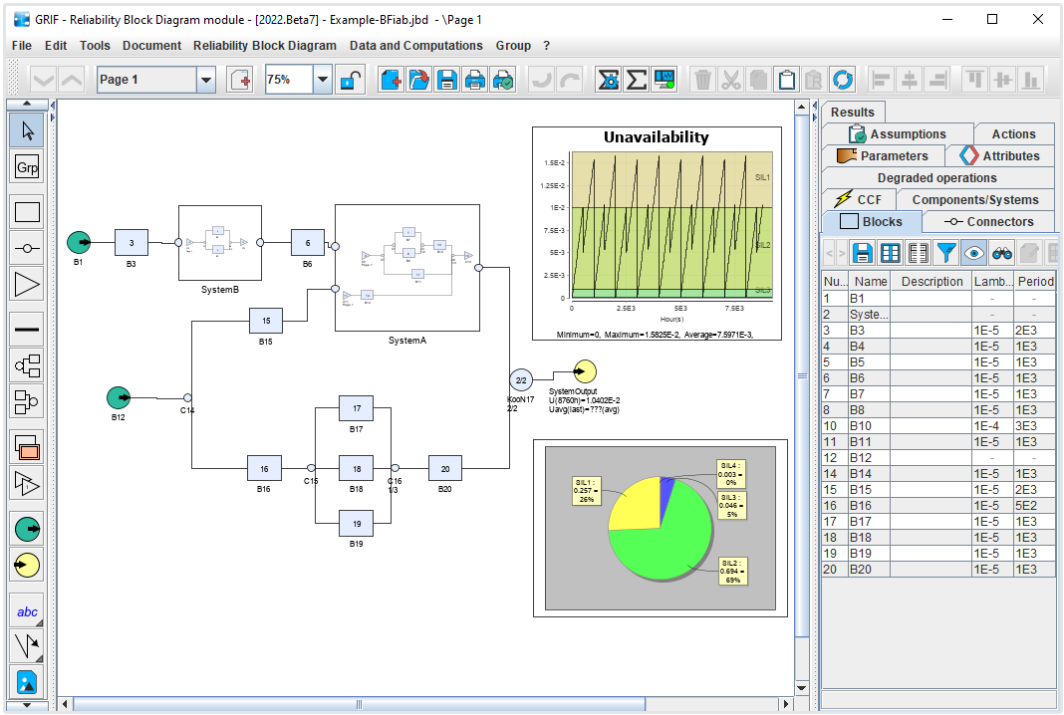
GRIF | BFiab module

Technical sheet

To evaluate system architectures using Reliability 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. BFiab module is one of the seven modules belonging to Boolean package.

BFiab is used to model a system as a Block Reliability Diagram (RBD), based on Boolean logic, for all fields of activity (aeronautics, automotive, railways, oil industry...). This module uses **ALBIZIA**, the BDD (Binary Decision Diagram) computation engine developed by TotalEnergies. ALBIZIA offers the advantage of running **accurate analytical** computations and providing extensive information on the system under study.



Modelling and computations:

You can easily create RBD via an **intuitive graphical interface**, and enter connectors (in series, in parallel, K out of N) and blocks according to the logic of the system studied and many probability laws (Exponential, Weibull, Gamma-Lambda-Mu, Periodic-Test, etc.).

If there is no distribution function, you can specify your **own probability distribution** as either a value-table or a **Markov graph.**

When the Block-Diagram is built, it is easy to define groups of components subject to Common Cause Failures using different CCF models (Beta Factor, MGL, Shock models).

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 detailed description or for traceability.

ALBIZIA, developed by TotalEnergies, provides many results for analytical computations:

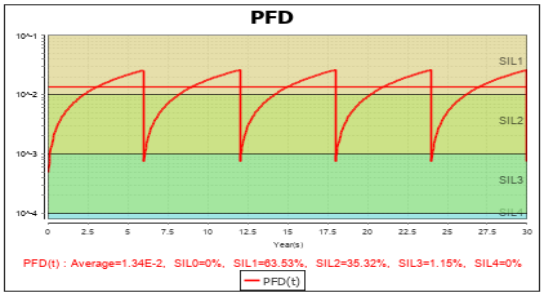
- **Unavailability**: Q(t), U(t) or PFD(t), **Availability**: A(t), **Reliability**: R(t), **Unreliability**: F(t).
- **Frequency**: W(t), UFI(t) or PFH(t); and **Failure rate**: λeq(t), λv(t) or CFI(t).
- **Usual mean values**: MTTF, MTBF, MUT, MDT, number of failures.
- **Minimal cut-sets** (probability and frequency of cut-sets).
- **Reliability allocation**.
- **Many importance factors** (Birnbaum MIF, Critical CIF, Vesely, DIF...) that will help users to find system weaknesses and improve on them.

GRIF
GRaphical Interface for reliability Forecasting
August 2022

TotalEnergies SE
CSTJF
64018 Pau Cedex - FRANCE
Phone : +33 (5) 59 83 40 00
grif.totalenergies.com

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.

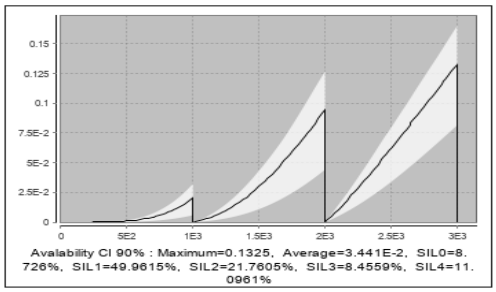
Specificities and strengths:



– **Computing the time spent in the SIL zones**: in addition to its computations capacities previously highlighted, **ALBIZIA is the only engine able to compute how long the PFD(t), PFH(t) or EqLambda(t) of a system spends in a given interval during its mission period.**

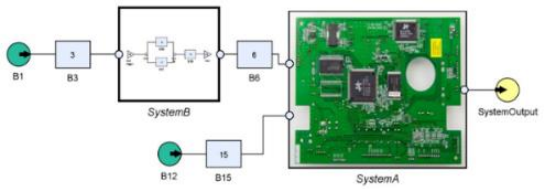
  The following figure shows a mean availability of 8.44E-3, which corresponds to a SIL2. However, it also indicates the percentage of time the system spent in each SIL over its 30-year mission. In this case, 39.77% of its time was spent in SIL1.

– **User-friendliness**: With the automatic layout function, users can efficiently organize their RBD simply by pressing F7. Blocks can be duplicated rapidly using the copy/paste function. A specific image can be allocated to each block to improve diagram readability. Moreover, you can add comments and line graphs to build your report directly from the PDF printing.



– **Factoring in uncertainties:** To reflect real conditions as much as possible (and ensure compliance with certain standards), parameter-related uncertainties can be factored in. For example, a failure ra te can be qualified as following a Uniform, Normal or Log-normal law. **A Monte-Carlo simulation** is performed in addition to the BDD computation in order to obtain mean values. Finally, a quantile computation is run to provide a dispersion interval on each result. It can be a 60, 70, 80, 85, 90, 95 or 99% interval (centred or not).
  N.B. it is a requirement of the IEC standard 61511.

– **Groups and sub-systems**: In addition to the pages that let you organize your diagram and make it easier to print, this module enables creation of sub-systems. This notion of hierarchy means that the model can be divided up according to the actual deconstruction of the system whatever the number of inputs/outputs. A preview can appear on the block so that its composition can be always seen.



BFiab is suitable with all modules of GRIF Boolean package:

All RBD performed can be used in the Bool module which combines the features of all modules of the package.

– In the same document, calculations can be made by using Event Trees (ETree), Fault Trees (Tree), Reliability Block Diagrams (BFiab), Safety Instrumented Systems (SIL), Reliability Network (Reseda), or Bow-Tie / LOPA tables (Risk).
– Models can be linked together, and a link enables the definition of any object (Event, Block, Barrier, Network node, etc.) by any models: Fault-Tree, Block-Diagram, SIS, Event-Tree; etc.
– Users in different departments of a company can work with the models they are used to, then link their models. For example, a system engineer will define a 30-equipment system with a block diagram, and reliability engineers will create a fault tree for each item of equipment. Each fault-tree is then linked to its block and the system engineer can compute the system availability or reliability without seeing fault-tree.

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 small files that can be sent by email even for documents with several hundred pages.
– Interaction with the operating system: possibility of copying/pasting to or from word processing software, spreadsheets, or presentation tools.
– Model export into Fault-Tree.
– Model export into BStoK module to take into account Integrated Logistics Support.
– External files (PDF certificates, system pictures, etc.) can be included in the document and be part of the full report.

TotalEnergies

Trial version available on
grif.totalenergies.com