

# **Bridge between BPA-SD9 and BPA-FT9**

**Fault tree generation and calculation plugin  
for BPA-SD9**

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**Version 1.0**

### *Abstract*

The *BPA FT9* is a tool dedicated to the edition and the analysis of fault trees. Calculations are performed by the *Aralia* calculation engine.

The *BPA SD9* is a tool dedicated to the edition of AltaRica models. It embeds a compiler from AltaRica to Fault Trees at Aralia format: *ABC*, see *SD9\_Appendix\_ABC\_R19D7.pdf*.

Thanks to a plugin for Safety Designer, it is now possible to benefit from the calculation engine embedded in BPA-FT9, so to conveniently generate fault trees from AltaRica models and assess these fault trees.

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# Installation and setup

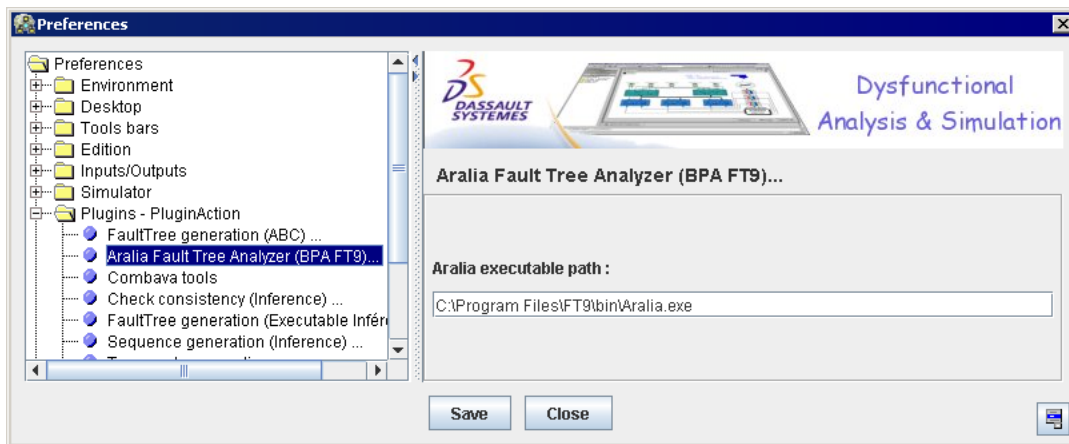
## Note

The installation and the setup of the library must be done only once.

First install the plugin, by using the plugin manager of Safety Designer (in the **System** menu, **Plugin manager** command).

1. In the **Plugins** tab, add the library `Aralia.jar` located in the plugin installation directory.
2. In the **Plugins** tab, select the **Aralia Fault Tree Analyzer (BPA FT9)** command in the `Aralia.jar` library.
3. In the **Items** tab, choose the preferred location for this command in **System** menu, then click on **Add an item**.
4. Click on the **Close** button. A new command should be accessible in the **System** menu.

Set the location of the *Aralia* calculation engine in the users' preferences pannel of BPA-SD9.



# How to perform fault tree calculations

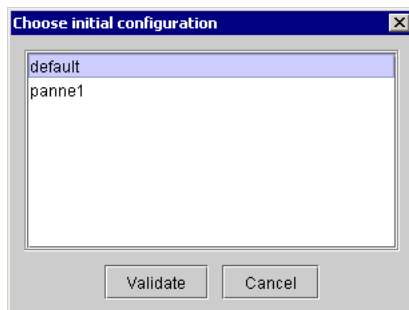
## Note

Note that a fault tree is a static, instantaneous view of a system. For this reason, dynamic AltaRica models (e.g. a model taking reconfigurations, maintenance into account) cannot be compiled into fault trees. For more information on this subject, please refer to the User's Manual Appendices of BPA-SD9: SD9\_Appendix\_ABC\_R19D7 .pdf.



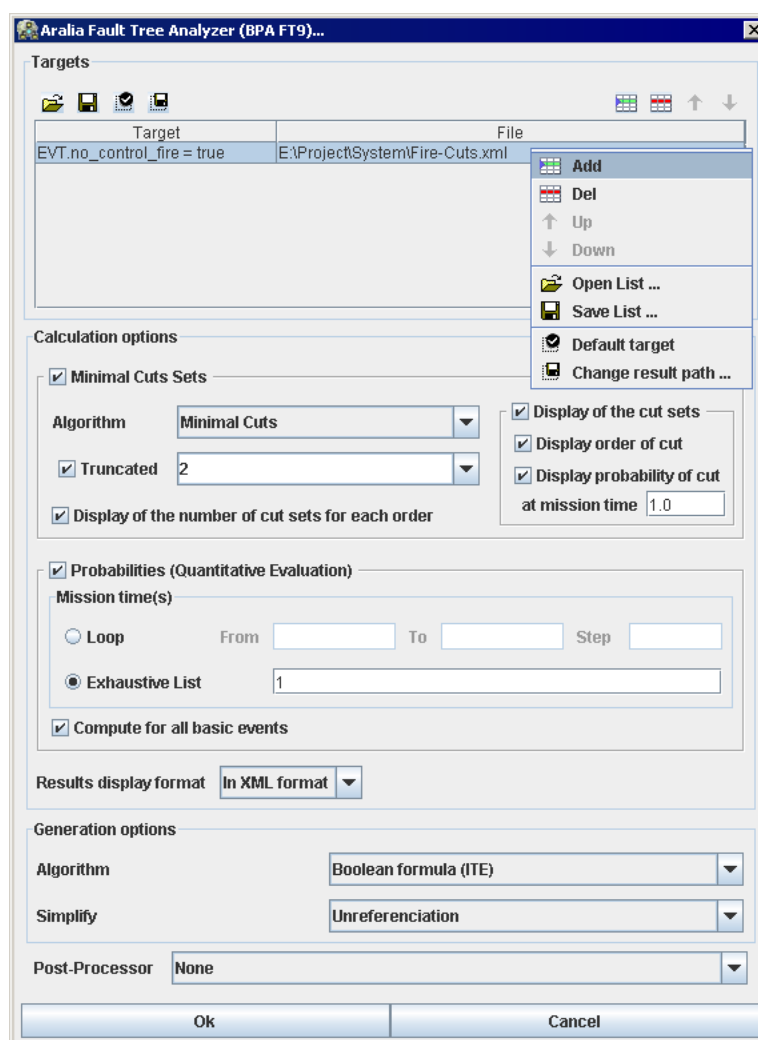
To generate a fault tree and assess it, click on the **Aralia Fault Tree Analyzer (BPA FT9)** command.

Select the initial configuration to consider.









A target event corresponds to a given state reached by the model, more precisely it corresponds to a selected variable reaching a specified value. Calculation parameters (e.g. the result file name) are generally associated with a calculation target.



Target events can be specified in the following window; a result file will be generated for each target.



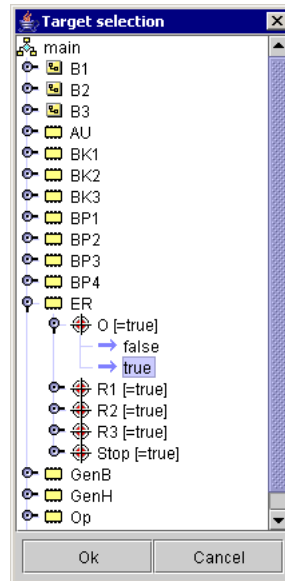
This is the target event manager. When it is closed (by clicking the **OK** button), target events' descriptions are checked (variable existence in current model, result file path accessibility, etc.). If a result file already exists, a window would pop up, for confirming its overwriting.

The following list modifiers are available.

	Add a new target event to the list (duplicating the default description).
	Remove selected target event.
	Move selected target up in the list.
	Move selected target down in the list.
	Use selected target description as the default one.
	Save the list into an XML file for interoperability.

	Load a list of targets.
	Define a result filename pattern, for automatic result-based filename generation. The filename is obtained by replacing the following tags by their calculated values: %num% => order number in the list, %var% => variable name, %val% => value to use.

Double-clicking on a target event in the list opens the following target event editor.



This editor shows all the model variables in a tree view. Select the appropriated variable and value to describe a target event.

The filename field opens a standard file explorer.

## Calculation options

To calculate minimal cut sets, tick the **Minimal Cut Sets** check box. Parameters are the following:

- Preferred algorithm (the algorithm **Minimal Cut Sets** covers the majority of use cases).
- (Optional) Cutoff, to limit the calculation to the most significant cut sets.
- (Optional) **Display of the number of cut sets for each order**
- (Optional) **Display of the cut sets**, to list the cut sets, their order and their probabilities at the given mission time.

To calculate probabilities, tick the **Probabilities (Quantitative Evaluation)** check box.

- Specify mission time(s), using a **Loop** and/or an **Exhaustive List**.
- Indicate whether probabilities of basic events must be calculated, by ticking the **Calculation for all basic events** check box.

Select the **Result display format** among:

- **In Text format**, i.e. *Aralia's* standard output format.
- **In XML format**, for enhanced interoperability with post-processors.

## Fault tree generation options

Select the **Compilation Algorithm**:

1. **Boolean Formula (SOP)**: compile the AltaRica model into a Sum Of Products.
2. **Boolean Formula (ITE)**: compile the AltaRica model into an If/Then/Else tree structure (recommended for large systems).

Three **Simplification Levels** are available:

- **None**
- **Constant propagation**: boolean connectors having true or false arguments are simplified.
- **Dereferencing**: simplifies the tree by deleting useless intermediate variables.

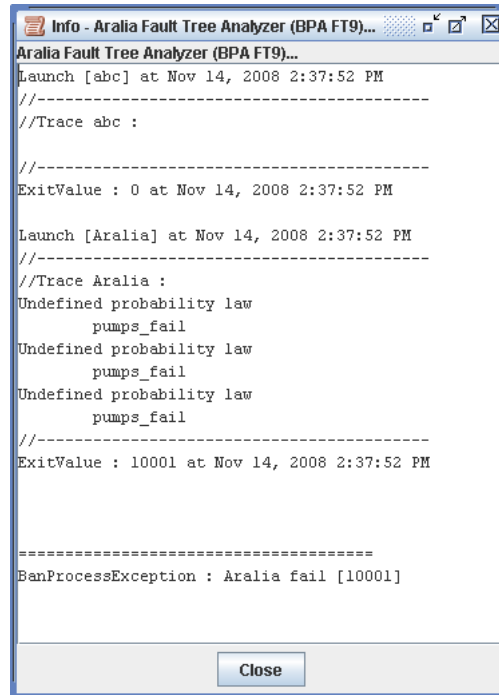
Once these forms are correctly filled, a new task named **Aralia** is created in the task manager of BPA SD9.



# Result of fault tree calculations

When calculations end, a window displays the execution logs of *ABC* and *Aralia* engines.

If the system could not be treated by *ABC* or *Aralia* (e.g. the system had loops, probability distributions are missing, etc.), corresponding error messages will show up in the window.



Otherwise, the log is empty.

