

Systems Reliability and Safety Analysis Using Fault Trees. A FTA Software Packages Comparison

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Abstract

In the first part of the paper a critical study concerning the Fault Tree Analysis (FTA) method is made. The Fault Tree Analysis translates the physical system into a logical diagram due to which it is one of the most favored method involved in reliability and safety analysis of high functional importance systems. It was originated from aerospace industry and then adapted by nuclear power plant industry to qualify and quantify the hazards and risks involve in nuclear power generation. The Fault Tree Analysis is a top down deductive approach, in which the causes of an event are deduced. This method gives a visual model of how equipment failure, human error and external factors a.o. contribute to an accident or critical event for the analyzed system. Several symbols and logical gates are used in this analysis. This method was introduced in the Romanian technical literature in reliability field by Ioan Bacivarov in 1977 in a conference given at the 1st National Research Symposium in Electronic Technology [1] and structured in [2].

In the second part of the paper, a procedure for fault trees construction and evaluation based on [5] was developed;

- Define the system of interest: the boundaries of interest are defined in this step on which analysis is to be made along with the conditions of the system.
- Define top event of the system: Specify the problem on which the analysis will be made like shutdown, pipe rupture etc.
- Define tree top Structure: Define the events and the conditions that lead to the top event.
- Explore each branch in successive level of details: Determine the events and conditions that lead to the intermediate event and keep repeating this process at different successive levels unless the fault tree is completed.
- Solve the fault tree for the combination of events contributing to the top event: Examine all the event and conditions that are necessary for the top event to occur and develop a minimal cut set.
- Identify important dependent failure potentials and adjust the model appropriately: Study the event and find the dependencies among the event that can cause a single or multiple events and conditions to occur simultaneously.
- Perform quantitative analysis: Use the past statistical data to evaluate or predict the future performance of the system.
- Use the results in decision making: Find the conditions in which the system is at most potential hazard and place appropriate measure and recommendations to counter with such risk.

The advantages and the disadvantages of the FTA method are discussed in the third part of this paper. The conclusion is that the Fault Tree Analysis is a very effective reliability & safety assessment tool for reasonably complex systems ; but for very large systems, which includes a large number of equipments and process variables, the fault tree becomes enormous and its quantitative evaluation is complicated and time consuming. Consequently, it is therefore necessary to develop appropriate methods and the use of appropriate software packages, making it possible to build and quantitative assessment of fault trees for very complex systems. Some example concerning the fault tree

construction and evaluation for electronic systems are presented. Several software packages were used into this aim.

In the last paragraph of the paper, the different software packages used for the construction and analysis of fault trees were discussed and compared, namely: SMARTDRAW, FTA SOFTWARE and EDRAW MAX.

- SMARTDRAW allows to make a clear, easy-to-read fault tree diagram in minutes on any device. SmartDraw is easy to use because it does much of the drawing. Just open a fault tree analysis template, choose from the extensive library of symbols, and type in your information. All the logical gates and different event are available. But this software is not able to make a fault tree analysis.

- With FTA SOFTWARE, it is possible to build fault tree with different logical gates. All the current events are available. FTA SOFTWARE enable to do fault tree analyse and particularly the quantitative analysis. With this software you can calculate your fault tree probability for mission time or for Steady-state mode. It includes events and intermediary gate probabilities and you can define the mission duration. Well, it enable to generate and download reports for your fault tree with list of Minimal Cut Sets, list of fault tree events and gates. When you finish building your fault tree, download it to your own PC. When you need to work with this fault tree, you can upload it back to our Fault Tree Analysis tool.

- EDRAW MAX is a vector-based diagramming software with rich examples and templates. It is easy to create fault tree diagrams. With this software you can build your fault tree with up-to-date, intuitive and advanced diagram interface with facilitates full control over the diagram. You have many of elements layout, themes, to facilitate the work. You can all the current logical gates and events and this is easy to use the library. Finally you can do both qualitative and quantitative analysis of data.

References:

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