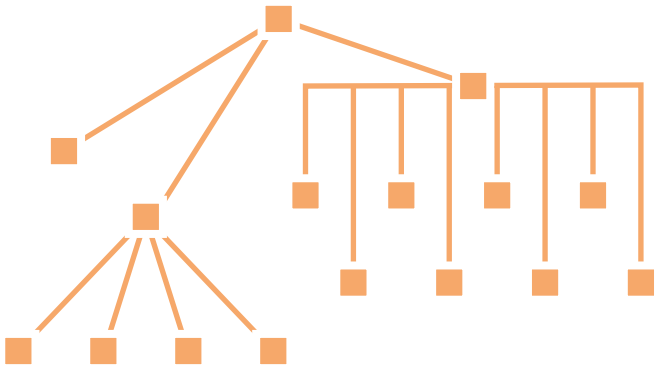
Improve your Availability and Reliability Assessment

RiskSpectrum ModelBuilder is a platform for model-based dependability (reliability, availability) analysis. As an analyst you can use RiskSpectrum ModelBuilder's built-in library to define component type behaviour and interactions. The libraries are called knowledge bases. A knowledge base guides the analyst in generating system-level models for further processing. It also determines which types of analyses shall be possible and which features shall be included in the analysis of the models.

No Fault Trees Required

There are numerous situations where a standard fault tree has challenges to sufficiently represent the reliability or availability of systems. Looking at, for example, an electrical system from a PSA (Probabilistic Safety Assessment) perspective it is already complex enough to be able to represent properly. There are, for example dependencies between high power and low power systems; different time intervals that needs to be considered; situations where only batteries can be considered and situation where only diesels can be considered in long term loss of offsite power scenarios.

From a risk assessment perspective, it is normally acceptable to make some rough assumptions that would not be appropriate from an availability assessment perspective. To properly understand the true availability for example an electrical busbar you probably need to consider the switching between sources in a more refined way.



One approach to better represent the system behaviour would be a Markov process. With ModelBuilder you can use different types of approaches also for Markovian assessments. Ranging from mathematical approaches (low-level) like Boolean Driven Markov Processes (BDMPs) to a set up of the system that resembles the actual system design (single line diagram presentation) with complex priority-based reconfiguration strategies. The availability analysis of this system by the means of Monte Carlo simulations explores behaviours where the system responds to various failures by reconfigurations and attempts to repair failed components.

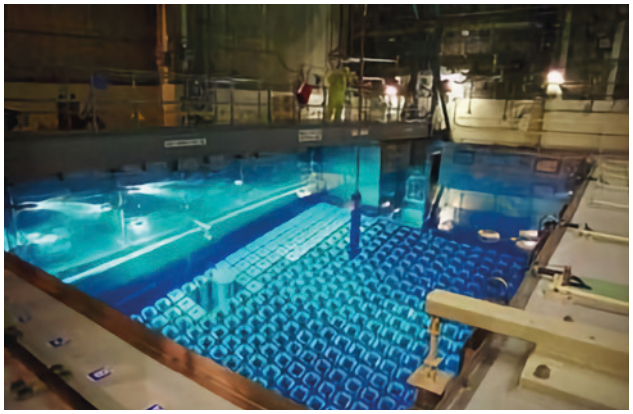
Consider Multi-State Components using Petri Nets

The electrical system and the BDMP is only one example that illustrates the type of calculation that requires more capabilities. Another example could be state triggered situations, where there can be waiting times involved. Consider a repair dependent on states, where there are multiple states considered. The reliability and the repair time of the individual component depends on its state (as good as new, some degradation, significant degradation, failed/ repaired). In this case it may be relevant to consider the use of a Petri Net. These types of approaches are fully feasible in a model-based approach software like RiskSpectrum ModelBuilder.

Below are three examples where RiskSpectrum ModeBuilder have been used for reliability and availability assessments

Wind farm

RiskSpectrum ModelBuilder can be used to assess the availability and output that a wind farm can deliver. The challenge is to consider the failures in the system, and the reconfigurations needed to continue operation and the repair time until full production can be restored. A specific challenge is the delay in repair that will be caused, for example a repair ship will need to be sent for a sea-based windfarm. Especially, optimized strategies for when the repair ship shall be sent under the constraint of costs can be developed.



Spent Fuel Pool

Spent Fuel Pool (SFP) analysis differs from a regular nuclear PSA in several aspects.

- The plant has limited redundant backups.
- The SFP Cooling System is constantly running, and its potential failures can be tolerated for a relatively long period of time.

A single knowledge base defined in RiskSpectrum ModelBuilder can include behaviours required in the analysis. A fault tree model for systems in this plant, such as the SFP Cooling System, is automatically generated in RiskSpectrum ModelBuilder and availability assessment, unconditional failure intensity and the mean time to repair of the system can be analysed and calculated.

Hybrid production plant

Hybrid energy generating power plants have complex control logic prioritizing between different power sources and possibilities to store the excess energy. The types of equipment are typically:

- a set of renewables, i.e., wind turbines and solar power plants producing power depending on weather
- a set of backup gas turbines
- batteries or other storage capabilities for storing excess electricity
- a power station controlling the production and connecting all power production systems

The complexity in the plant; the control logic, how it collects necessary information, takes decisions and propagates them through the plant can with ease be defined in the high-level code in the knowledge base in RiskSpectrum ModelBuilder.

An availability analysis for this type of model can use the built-in Monte Carlo simulation tool in ModelBuilder to quantify the plants availability. You can, apart from the time where the plant fulfills the demand, also calculate costs and additional parameters such as secondary production or over-production which is essential in the design stage. All plant properties that can be expressed in the tool modelling language about the plant can be measured by the Monte Carlo simulator.

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Get in touch!

Please visit www.riskspectrum.com
for more information
Or email sales@riskspectrum.com

RiskSpectrum AB
Elektrogatan 10
171 54 SOLNA
Sweden