SAFE – PRA Exchange

Vincent Renzi
Division Manager
Strategic Technology Group
vrr@epm-inc.com
508-532-7167

November 2009

Contents

Introduction

The Fire PRA model is central to the quantification of fire risk, to quantify conditional core damage probability (CCDP) and conditional large early release probability (CLERP) values for selected fire scenarios. This model is constructed based on an Internal Events PRA model that has been modified to include those initiating events that can result from a fire, to include additional equipment and/or failure modes such as spurious operations that were not addressed in an Internal Events PRA model.

Fire scenarios are used to quantify the likelihood that, given ignition of a fire, fire-induced damage to selected equipment and cables occurs. For each fire scenario the CCDP and CLERP values are calculated based on translation of the cable and equipment failures including specification of failure modes into basic events.

This paper describes how SAFE translates the cable and equipment failures to basic events in order to streamline the electronic exchange of information between SAFE and PRA software such as CAFTA[1] or WinNUPRA[2].

Map Basic Events to Components

Within SAFE, Basic Events are listed with their failure probabilities and mapped to plant cables and/or equipment. Other information such as the Top Event, Failure Code and Gate Type can also be captured.

---

[1] CAFTA is a fault tree workstation that operates in the Microsoft Windows environment. CAFTA provides the capability to calculate the basic event failure probabilities and also interfaces with other fire risk analysis codes.

[2] WinNUPRA is a software package for performing probabilistic risk/safety assessments (PRAs/PSAs). This system, which consists of five major analysis modules, is designed to generate and analyze minimal cutset solutions of various fault trees and cutset equations for accident sequences (complete branches through event trees).

Analyze Component Failures

SAFE's analysis engine evaluates fire-induced equipment failures (i.e., circuits/cables failures that have the potential to cause improper operation of a component, as a result of cable failure modes associated with fire-induced cable damage) on a compartment or scenario level.

This analysis engine uses existing database retrieval of cable routing and location (i.e., fire zone) information identified in SAFE when analyzing compartment failures. When analyzing scenario failures, the equipment and cable targets associated with a Fire Scenario will be evaluated as the component failures.

Generate PRA Exchange Reports

Using the analysis failure results, SAFE translates the cable and equipment failures to basic events. PRA Exchange Reports such as the CAFTA Flag file or WinNUPRA CSV file are generated in SAFE in the format the PRA software recognizes, allowing a direct upload of basic event failure probabilities to the Fire PRA model for each fire scenario being analyzed.

Force Basic Event Failures

At the first level of detail, the fire damaged component is assumed to have no function with a probability of 1.0. For more detailed levels of analysis, the fire damaged equipment can be specified to have a failure probability for spurious operation, etc.

SAFE provides functionality to evaluate the basic event failure probabilities based on the compartment or scenario being analyzed.

As the analyst quantifies the CCDP/ CLERP for a specific compartment or scenario, the user will have the ability to change the failure probabilities of basic events to reflect changing operational conditions using the forced basic events table.

Quantify CCDP and CLERP

For each fire scenario the final CCDP and CLERP values quantified using the Fire PRA model are recorded in SAFE. The PRA files which support these quantified values are linked in SAFE for complete traceability.

Conclusion

SAFE will identify, for a compartment or scenario, the plant equipment which is rendered inoperable due to a fire and translate these failures to basic events.

In order to streamline the exchange of information between SAFE and PRA software, PRA Exchange Reports such as the CAFTA Flag file or WinNUPRA CSV file are electronically available in the format the PRA software recognizes.

For each fire scenario, the basic event failure probabilities are directly uploaded by the PRA software and CCDP/ CLERP values quantified. The final CCDP/ CLERP values are recorded with PRA files linked in SAFE for complete traceability.