

SAFE-R v3

The **System Assurance and Fire Protection Engineering - Risk (SAFE-R)** module automates PRA analysis and is designed to be used in conjunction with the FRANX® software.

SAFE-R has the same user-friendly navigation, querying, and reporting features of SAFE, and expands it to provide the user with tools to support the development of Fire PRA and Internal Flood PRA models.



Automation of Fire PRA Data

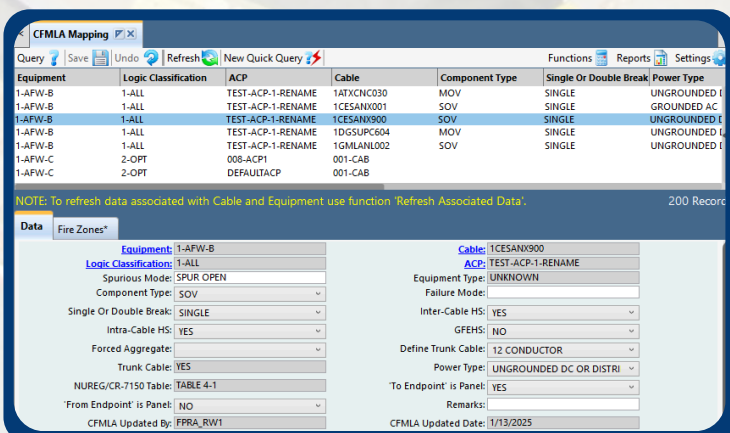
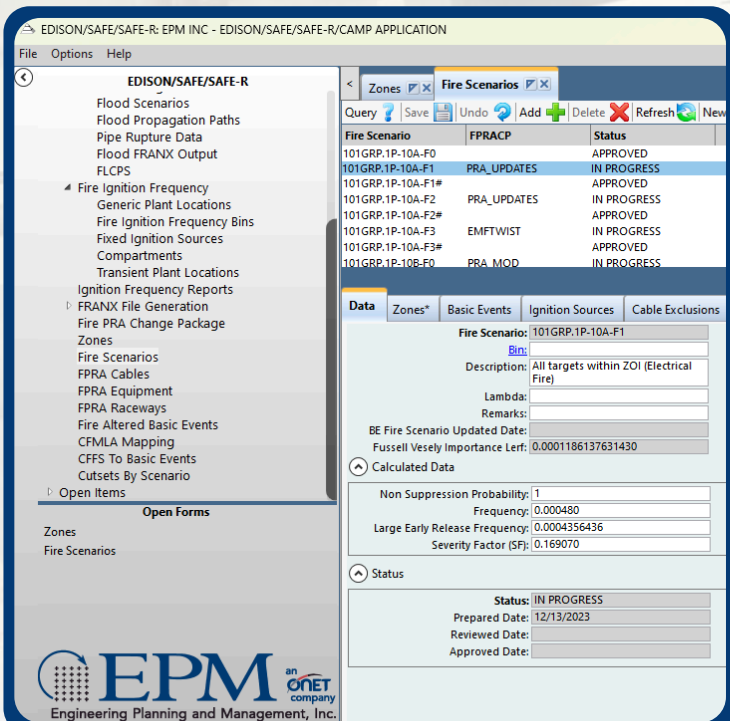
SAFE-R builds upon the functionality of SAFE to store plant information needed for the Fire PRA.

- Store cables, raceways, equipment, in a user-friendly relational database.
- Build target sets to define raceway, cable, and equipment targets for Fire Scenarios.
- Analyze at the Compartment, Fire Zone, or Fire Area level consistent with your plant's deterministic analysis.
- Maintain the mapping from Equipment Selection to Basic Events in the PRA model for integration with target sets.

A Powerful Analysis Tool

SAFE-R provides specialized tools to assist with some of the most challenging areas of Fire PRA.

- **Automatically export Fire PRA data to a FRANX® file.**
- Circuit Failure Mode Likelihood Analysis (CFMLA): using the methodology from NUREG/CR-7150, build your plant's CFMLA and create the output that goes directly into the FRANX® model.
- Ignition Frequency: store fixed and transient ignition sources and calculate per-source ignition frequency.
- Calculate Fussell-Vesely importances for cables, raceways, and equipment.



FRANX® File Generation

SAFE-R contains all the data needed to populate a FRANX® database. This includes the “FireImpact” table (for exclusions and additions) and “FireAlteredBE” (for CFMLA conditional probabilities). Update SAFE-R and then generate a ready-to-quantify FRANX® file with the press of a button.

Circuit Failure Mode Likelihood Analysis

Following the guidance in NUREG/CR-7150, conditional failure probabilities can be calculated on a per-cable basis for any equipment in the FPRA. All required parameters can be modeled for any configuration. Then, generate Fire-Altered Basic Events based on this analysis for export to the FRANX® database.

Fire Ignition Frequency Tool

All fixed and transient ignition sources are stored in SAFE-R. Easily create and update ignition frequency bins based on industry guidance. Calculate per-source ignition frequency for every ignition source and per-Compartment or per-Fire Zone frequencies.

Importance Measures

After quantification, cutset results can be loaded into SAFE-R. Basic Events are tied to their corresponding equipment, cables, and raceways, allowing for the calculation of Fussell-Vesely importances at the FPRA target level.

CFMLA Mapping

Equipment	Logic Classification	ACP	Cable	Component Type	Single Or Double Break	Power Type
1-AFW-B	1-ALL	TEST-ACP-1-RENAME	1ATXCN030	MOV	SINGLE	UNGROUND
1-AFW-B	1-ALL	TEST-ACP-1-RENAME	1CESANX001	SOV	SINGLE	GROUND
1-AFW-B	1-ALL	TEST-ACP-1-RENAME	1CESANX900	SOV	SINGLE	UNGROUND
1-AFW-B	1-ALL	TEST-ACP-1-RENAME	1DGSUPC604	MOV	SINGLE	UNGROUND
1-AFW-B	1-ALL	TEST-ACP-1-RENAME	1GMLANL002	SOV	SINGLE	UNGROUND
1-AFW-C	2-OPT	008-ACP1	001-CAB			
1-AFW-C	2-OPT	DEFAULTACP	001-CAB			

NOTE: To refresh data associated with Cable and Equipment use function 'Refresh Associated Data'. 200 Records

Data **Fire Zones***

Equipment: 1-AFW-B	Cable: 1CESANX900
Logic Classification: 1-ALL	ACP: TEST-ACP-1-RENAME
Spurious Mode: SPUR OPEN	Equipment Type: UNKNOWN
Component Type: SOV	Failure Mode:
Single Or Double Break: SINGLE	Inter-Cable HS: YES
Intra-Cable HS: YES	GFEHS: NO
Forced Aggregate:	Define Trunk Cable: 12 CONDUCTOR
Trunk Cable: YES	Power Type: UNGROUNDED DC OR DISTRI
NUREG/CR-7150 Table: TABLE 4-1	'To Endpoint' is Panel: YES
'From Endpoint' is Panel: NO	Remarks:
CFMLA Updated By: FPRA_RW1	CFMLA Updated Date: 1/13/2025

Conditional Probability

Fire Zone: 1-CR-4	Conditional Probability: 0.55
Override Conditional Prob: NO	Conditional Probability Orde:

Cable Logic Path Fields

SS Function: CONTROL	Fire Damage Results: SPURIOUS
Reason Code:	Remarks:

Cable End Points

Configuration Control

SAFE-R will track and manage the revision of Fire Scenarios using the FPRA Change Process (FPRACP).

Automated status updates will be provided based on electronic signatures for the preparer, reviewer, and approver. Electronic history files are automatically created and viewable from within SAFE-R.

Bins

Bin ID	Bin Ignition Source	Bin Type	Bin Features	Bin Frequency (sn)
12	CABLE RUN (SELF-IGNITED CABLE FIRES)	CABLE		0.00E+00
13	DRYERS	FIXED		
14	ELECTRIC MOTORS	FIXED	ELECTRIC MOTOR	
15	ELECTRICAL CABINETS	FIXED	ELECTRICAL CABINET	3.0E-02
16.1	HEAF FOR SEGMENTED BUS DUCTS	FIXED	HEAF	2.3E-03
16.2	HEAF FOR ISO-PHASE BUS DUCTS	FIXED	HEAF	
16.A	HEAF FOR LOW-VOLTAGE ELECTRICAL CABINETS (480-1000 FIXED V)	FIXED	HEAF	

74 Records

Data **Documents** **Notes**

Bin ID: 15

Bin Ignition Source: ELECTRICAL CABINETS

Bin Power Mode: ALL PLANTS AT POWER

Bin IGN Reference:

Bin Features: ELECTRICAL CABINET

Location Weighting Factor: 6

Adjusted Plant Frequency (sn): 1.8E-01

Remarks: NUREG-2169

Bin Plant Location: PLANT WIDE COMPONENTS

Bin Type: FIXED

Bin Frequency (sn): 3.0E-02

Bin Notes:

Bin Total Count: 0

Plant Availability Factor: 1

Per Source Frequency (sn):

Internal Floods PRA

SAFE-R also builds an Internal Floods PRA model.

Generate the data you need for the analysis:

- Like the FPRA module, store flood sources, flood areas for analysis, and flood elements like doors, dampers, and penetrations.
- Equipment targets are stored with failure heights and the option to apply spray shields or other protective features.
- Self-consistency checks make sure doors and other penetrations are applied to the correct adjacent flood areas.
- Data from EPRI (or other industry guidance if needed) for computing initiating event frequencies.
- A Flood Change Process, similar to the FPRACP, ensures configuration control for modifications to the analysis.

The screenshot displays the SAFE-R software interface with several data entry and analysis screens. The top section shows 'Flood Areas' and 'Flood Penetrations' tables. The 'Flood Areas' table lists areas like AB-19670-R1109, AB-19670-R1110, etc., with columns for Building, Plan Elev, and Room Height. The 'Flood Penetrations' table lists penetrations like 41012, 41013, etc., with columns for Penetration Type, Penetration Elevation, and Flow Area Size. Below these are 'Flood Sources' and 'Flood Mitigations' sections. The 'Flood Sources' section shows a list of sources like KC-0.75 PIPING-0.75-4301*TB-20000-R4301. The 'Flood Mitigations' section shows details for a specific flood source, including System, Train, Source Elevation, Source Temperature, Pipe Length, Pipe Weld Number, Pipe Degrade Susceptibility, Ultimate Source Volume, and Screened status.

Calculate Initiating Event Frequencies

Use industry data to compute initiating event frequencies for pipe rupture scenarios using either a simplified model or Equivalent Break Size (EBS).

Determine Flood Propagation Paths

With flood initiators and flood area characteristics such as penetrations defined, use SAFE-R to automatically generate flood propagation pathways. Define target sets for flood scenarios based on equipment failed by the propagated flood.

FRANX® Output

With flood scenarios and target sets defined, SAFE-R generates an output that can be immediately used to quantify the FRANX® file .

SAFE-R Deployment:

Server Requirements:

- Oracle® 18c or greater; or SQL Server 2017 or greater
- Operating System: Microsoft® Windows Server 2016 (or greater); or server capable of running Unix (for Oracle® database)
- Disk Space 8 GB (minimum)
- Memory 16 GB (minimum)

Client Workstation Requirements:

- Windows 10 or 11
- Microsoft® .NET Framework 4.8
- Microsoft® Office 2013 (or greater)
- Adobe® Acrobat
- 8 GB memory (minimum)
- 8 GB disk space (minimum)

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