



Introduction to RISE: A Digital Framework for Maintaining a Risk-Informed Safety Case for Current and Next Generation Nuclear Power Plants

FPoliSolutions, LLC

RIPB Community of Practice
October 3, 2025 | Virtual

Acknowledgements

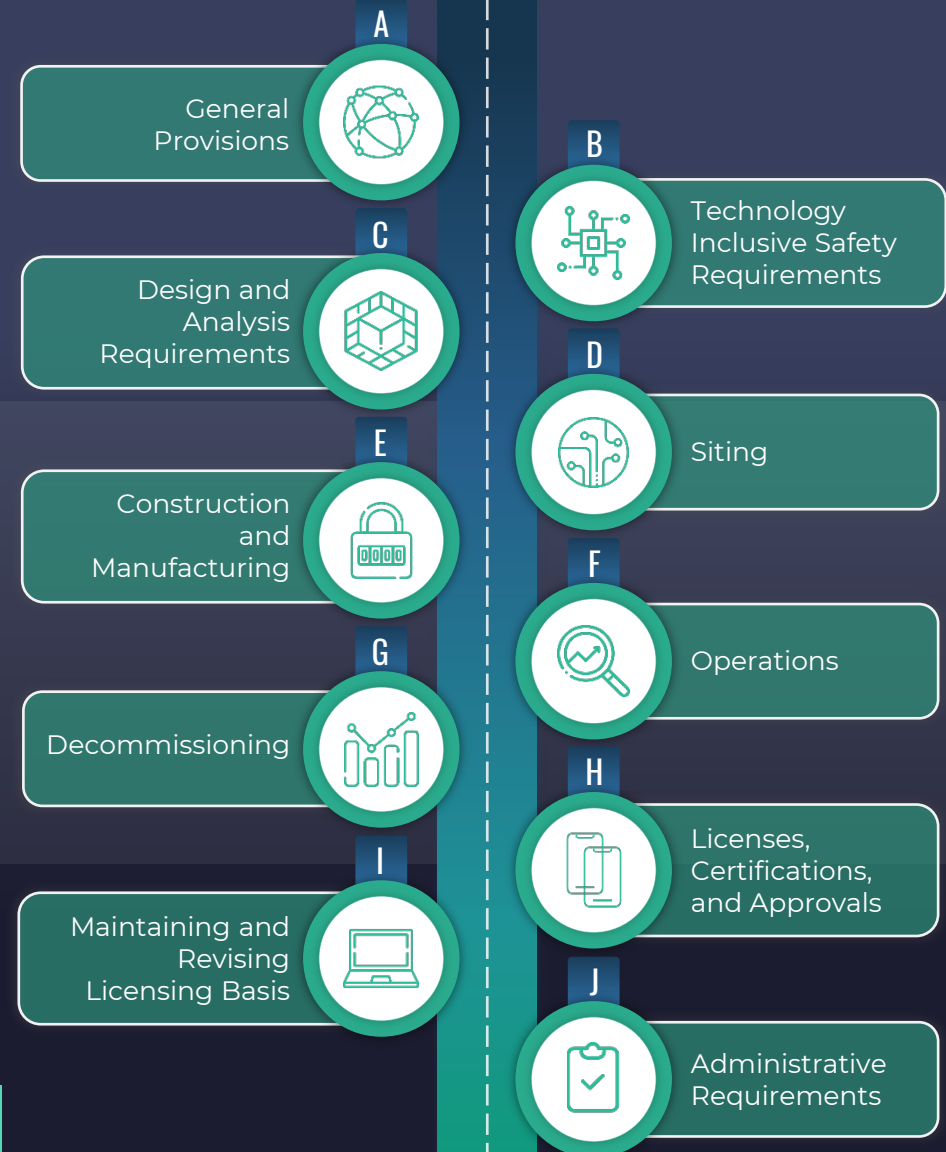
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FPoliSolutions' Vision is for RISE to become the framework of choice to enable the full benefits from a risk-informed approach for both advanced reactors and the operating fleet as envisioned by the Licensing Modernization Project (LMP) and NEI 18-04

10 CFR PART 53 ROADMAP



RISE: Risk-Informed System Engineering

RISE – Purpose



RISE

RISE

Cutting edge solution to help NPP operators and advanced reactor developers to orchestrate the complexities associated with implementing a risk-informed design process while reducing design cycle and costs like no other generic productivity tool.

This state-of-the-art software helps to:



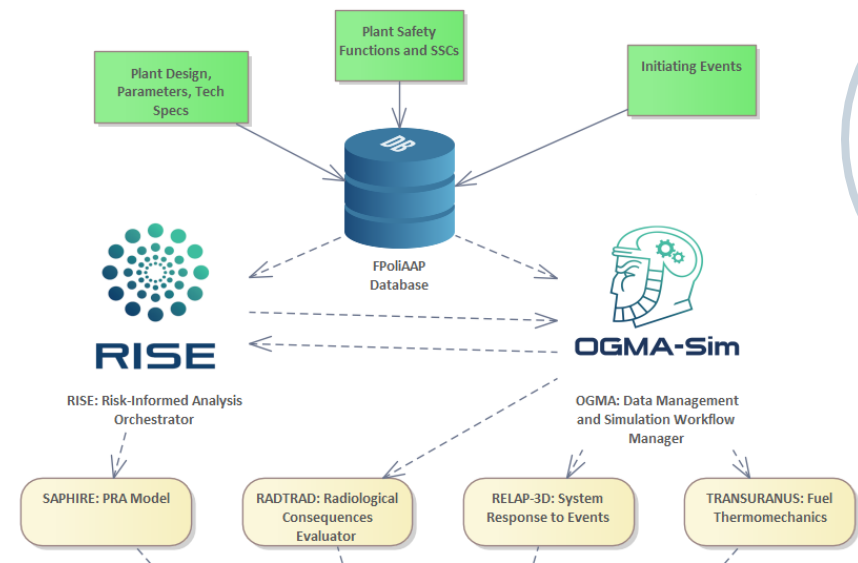
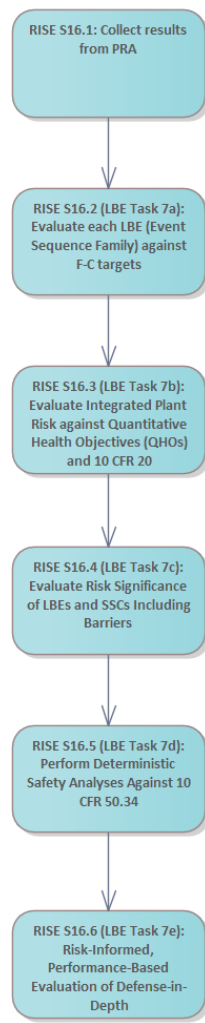
- Create a collaborative environment for engineering teams and stakeholders within their organization as they build the 'safety case' for their plant
- Digest large and complex data structures needed to characterize the engineered safety features and relationships with scenarios and events
- Optimize design to satisfy safety and economics goals.
- Guide analysts through complex workflows of simulations, data processing and qualification, analyses, and documentation.
- Maximize the value of enterprise technical data with enhanced security and process automation.
- Automate the creation of documentation and smart procedures for quality, transparency and expedited regulatory review.
- Provide a platform for maintaining the safety case throughout the life of the plant.
- Fit seamlessly within established processes of the organization.

RISE: A Smart Safety Case Builder for The Design and Licensing of Nuclear Reactors.



Development Status

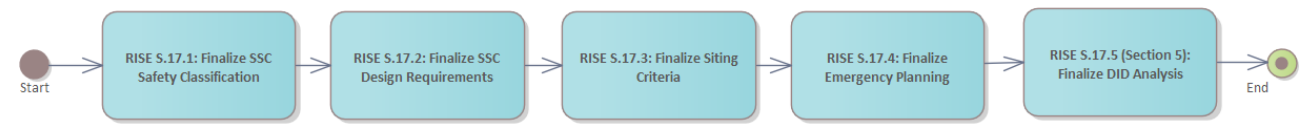
- SBIR Phase I
 - Content of this presentation
- SBIR Phase II
 - Current development
- SBIR Topic is assessment of Risk Informed Methods for application to LWRs



RISE

- RISE project was motivated by the LMP and NEI 18-04 which was directed to facilitate licensing of Advanced Reactors.
- FPoli extended the LMP methodology to the current operating LWRs fleet
- RIPB paradigm can uncover safety margin still embedded in the NPP operating fleet safety case
- A parallel can be drawn with the introduction of Best-Estimate Plus Uncertainty (BEPU) methodologies starting from the 1990's to replace the conservative Appendix-K methods:

BEPU methods made extended power uprates possible in the US NPP fleet during the 2000's for a total of 8 GW added to the grid without a single power plant built in the same time period



RISE Plant Entry

The screenshot displays the FPoliAAP web application interface. The top navigation bar includes the FPoliAAP logo, a global search bar, and links for Dashboard and Account. The left sidebar contains a menu with items such as OGMA-Calcs, OGMA User Manual, RISE, Nuclear Power Plants (selected), Plant Parameters, Safety Functions, SSCs, Initiating Events, Event Sequences, Event Sequence Families, Defense in Depth Adequacy, Fault Trees, Basic Events, Distributions, RISE Administration, and RISE User Manual.

Nuclear Power Plants

Import CSV | Export CSV | Import JSON | Export JSON | Import RISE Hierarchy

Search in Table: Show 50 entries

Plant Name	Consequence Metric	Event Classification	Plant Type	Operating Licensee	Operation Start	Rated Power
Standard Modular HTGR	30-Day Total Effective Dose Equivalent at Exclusion Area Boundary	NEI-18-04	HTGR	DOE	1986	558

HTGR | Search Consequence Metric | Search Event Classific | Search PI | Search Operating Lic | Search Operatio | Search Rat

Showing 1 to 1 of 1 entries (filtered from 15 total entries) Previous 1 Next

Refresh Table

Defining Safety Functions

FPoliAAP
By FPoliSolutions, LLC.

- OGMA-Calcs
- OGMA User Manual
- RISE
- Nuclear Power Plants
- Plant Parameters
- Safety Functions
- SSCs
- Initiating Events
- Event Sequences
- Event Sequence Families
- Defense in Depth Adequacy
- Fault Trees
- Basic Events
- Distributions
- RISE Administration
- RISE User Manual

Safety Functions Metadata
View Mode

Plant Name: Standard Modular HTGR

Plant Class: HTGR

Safety Function: Control of reactivity

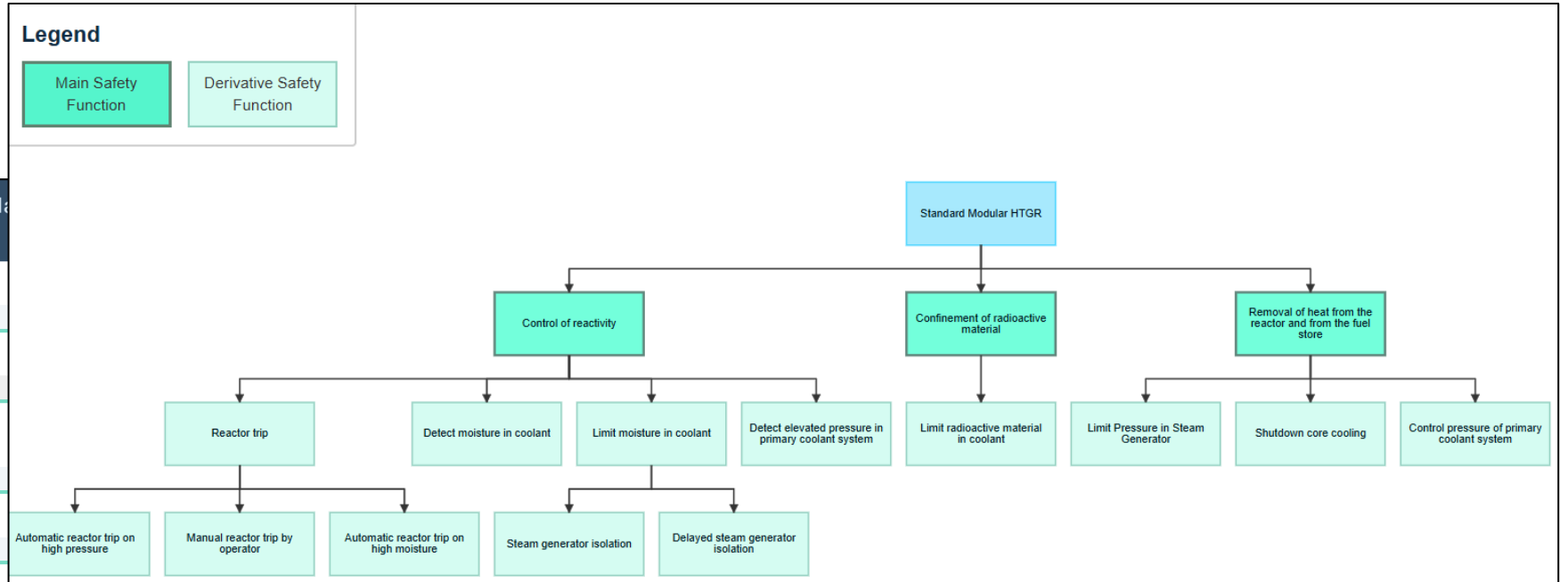
Main or Derivative?: Main

Supported Function:

Description: This is 1st main safety function according to IAEA SSG-30.

Buttons: Show Associative Events and SSCs, Expand Left Panel, Close

Plant Name	Safety Function	Main or Derivative?	Supported Function	Status	ID	Revis
Standard Modular HTGR	Reactor trip	Derivative		PRE	66	2
Standard Modular HTGR	Removal of heat from the reactor and from the fuel store	Main		PRE	62	6
Standard Modular HTGR	Shutdown core cooling	Derivative		PRE	68	7
Standard Modular HTGR	Steam generator isolation	Derivative		PRE	81	1



Plant SSC Entry and Visualization

Systems and Components Metadata View Mode

System Name: Primary Coolant System

Description: See Figure C-3 of DOE-HTGR-86-011. In the event of an earth...

System Acronym: PCS

Tag ID: SCC-1239

Sub-Systems:

- Reactor Vessel (SR)
- Reactor Core (SR)
- Neutron Control Sub-system (?)
- Control rods (?)
- Reserve shutdown control equipment (SR)
- Primary Coolant System (SR)
- Primary Circuit Relief Valve (?)
- Plant Protection Instrumentation System (?)
- Moisture Monitor (?)
- Primary Coolant Pressure Transducer (?)
- Helium Purification System (?)
- Steam Generator (?)
- Steam Generator Tubes (?)
- Steam Generator Isolation Equipment (?)
- Steam Generator Feedwater Valves (?)
- Steam Generator Steam Valves (?)
- Steam Generator Dump Tank (?)
- Steam Generator Relief Valve (SR)
- Vessel Heat Removal Systems (?)
- Shutdown cooling system (?)
- Heat transport system (?)
- Reactor Cavity cooling system (SR)

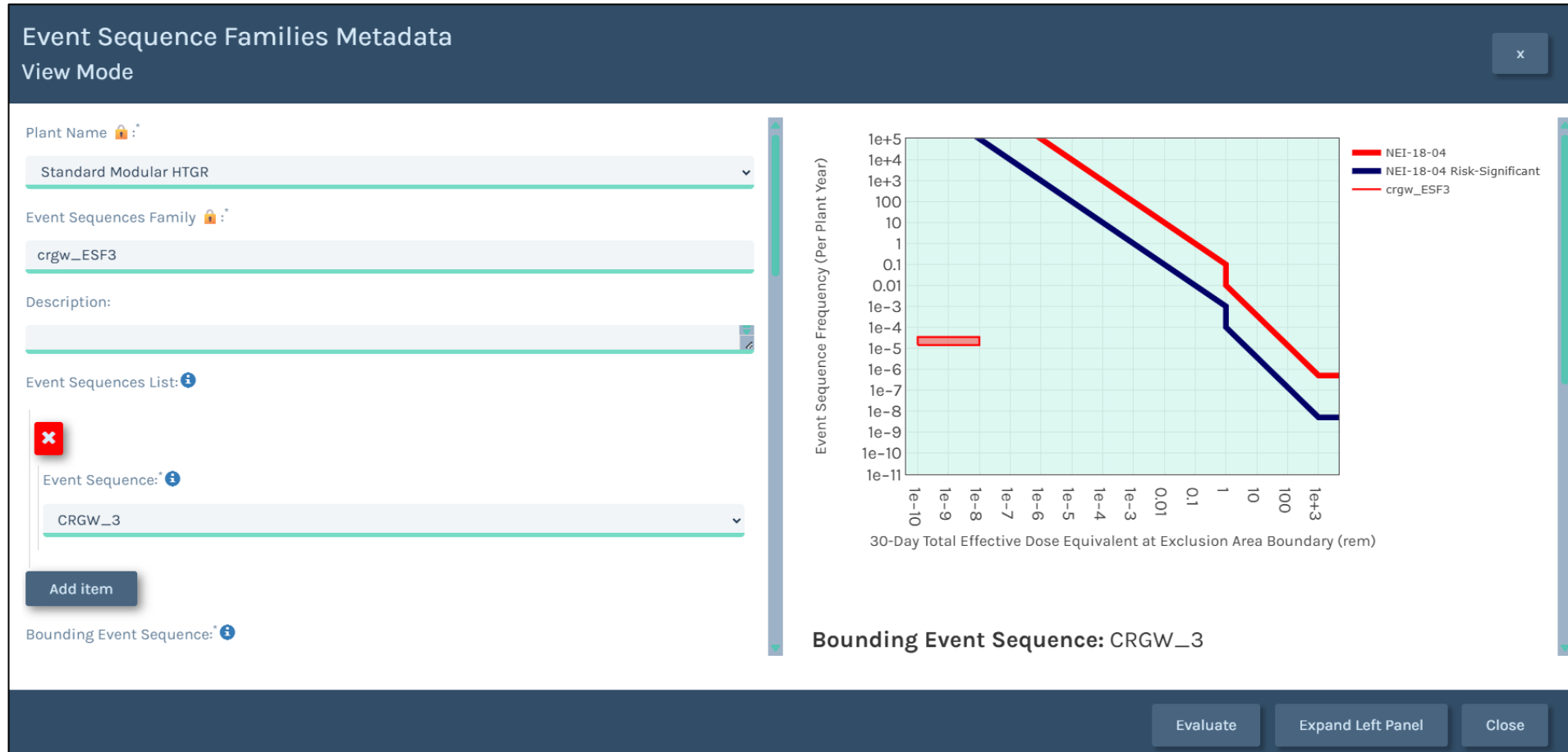
Shutdown cooling system	SCC-1235	Undetermined	Shutdown core cooling			
Steam Generator	SSC-1241	Undetermined	Removal of heat from the reactor and from the fuel st...			
Steam Generator Dump Tank	SSC-1245	Undetermined	Limit moisture in coolant			
Steam Generator Feedwater Valves	SSC-1243	Undetermined	Limit moisture in coolant			
Steam Generator Isolation Equipment	SSC-1244	Undetermined	Removal of heat from the reactor and from the fuel st...			

Initiating Events, Event Sequences, and Event Sequence Families


The screenshot displays the FPoliAAP web application interface. The main content area shows a table titled "Event Sequence Families for Standard Modular HTGR". The table has columns for Plant, Event Sequences Family, Bounding Event Sequence, Status, DBID, and DBRV. Below the table, there are search filters for Plant and Initiating Event, and a pagination control showing "Showing 1 to 11 of 11 entries".

Plant	Event Sequences Family	Bounding Event Sequence	Status	DBID	DBRV
Standard Modular HTGR	atws_ESF1	ATWS_01	PRE	103	188
Standard Modular HTGR	atws_ESF2	ATWS_02	PRE	104	186
Standard Modular HTGR	atws_ESF3	ATWS_03	PRE	105	189
Standard Modular HTGR	atws_ESF4	ATWS_08	PRE	106	186
Standard Modular HTGR	atws_ESF5	ATWS_09	PRE	107	191
Standard Modular HTGR	atws_ESF6	ATWS_10	PRE	108	186
Standard Modular HTGR	atws_ESF7	ATWS_05	PRE	171	164
Standard Modular HTGR	atws_ESFRR	ATWS_13	PRE	109	187
Standard Modular HTGR	atws_ESFRR_no_heatup	ATWS_04	PRE	172	163
Standard Modular HTGR	crgw_ESF1	CRGW_1	PRE	110	186
Standard Modular HTGR	crgw_ESF2	CRGW_2	PRE	111	191
Standard Modular HTGR	crgw_ESF3	CRGW_3	PRE	112	186
Standard Modular HTGR	crgw_ESF4	CRGW_5	PRE	113	188
Standard Modular HTGR	Anticipated Transient Without Scram	ATWS_09	PRE	218	12
Standard Modular HTGR	Anticipated Transient Without Scram	ATWS_10	PRE	219	12
Standard Modular HTGR	Anticipated Transient Without Scram	ATWS_11	PRE	220	12
Standard Modular HTGR	Anticipated Transient Without Scram	ATWS_12	PRE	221	12
Standard Modular HTGR	Anticipated Transient Without Scram	ATWS_13	PRE	222	13
Standard Modular HTGR	Control Rod Group Withdrawal	CRGW_1	PRE	202	11
Standard Modular HTGR	Control Rod Group Withdrawal	CRGW_2	PRE	203	12
Standard Modular HTGR	Control Rod Group Withdrawal	CRGW_3	PRE	204	10
Standard Modular HTGR	Small Primary Coolant Leak		PRE	35	3
Standard Modular HTGR	Small Steam Generator Leak		PRE	36	3

Event Sequence Families



Event and Fault Trees



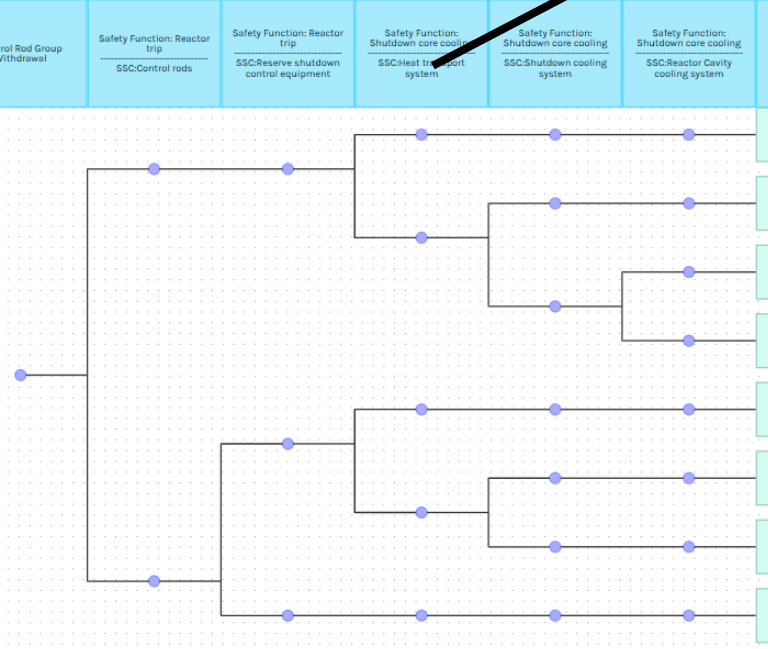
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Global Sea

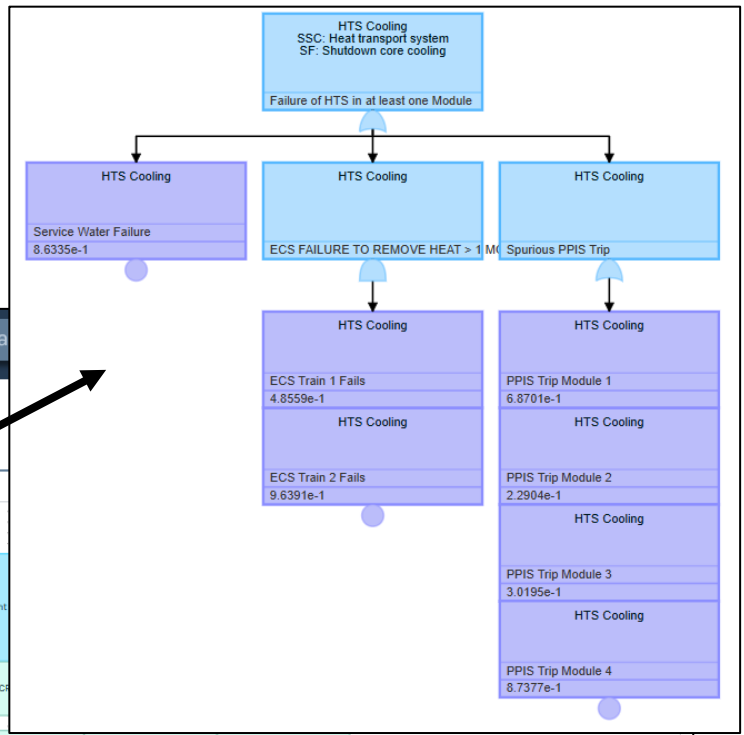
RISE Visualizations: Event Tree Diagram

Plant & Initiating Event: Standard Modular HTGR; Control Rod Group Withdrawal

Control Rod Group Withdrawal	Safety Function: Reactor trip SSC:Control rods	Safety Function: Reactor trip SSC:Reserve shutdown control equipment	Safety Function: Shutdown core cooling SSC:Heat transport system	Safety Function: Shutdown core cooling SSC:Shutdown cooling system	Safety Function: Shutdown core cooling SSC:Reactor Cavity cooling system	Event
------------------------------	---	---	---	---	---	-------



CRGW_2	None	crgw_ESF2
CRGW_3	None	crgw_ESF3
CRGW_4	None	crgw_ESFRR
CRGW_5	None	crgw_ESF4
CRGW_6	None	crgw_ESFRR_no_heatup
CRGW_7	None	crgw_ESFRR
CRGW_8	None	crgw_ESF5



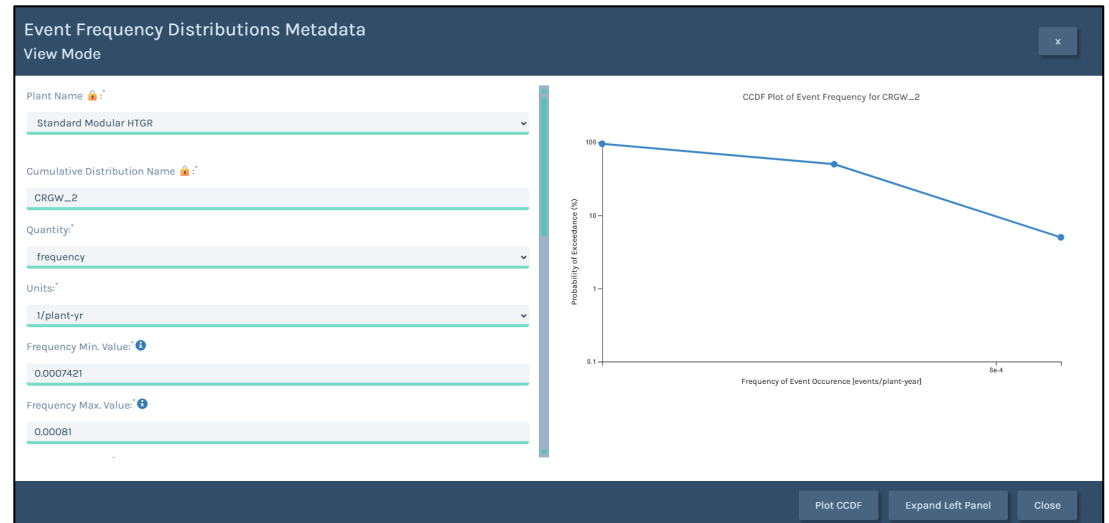
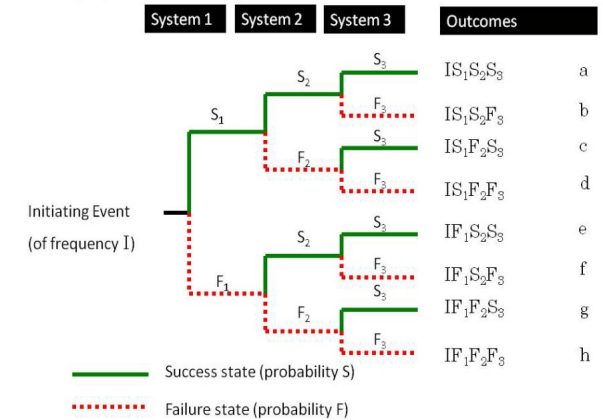
Frequency Distributions

- Manual Input of PRA Artifacts
- Automated Importation of PRA data
 - API for import

PRA Model: Event Trees and Event Frequencies




CAFTA



Consequence Distributions

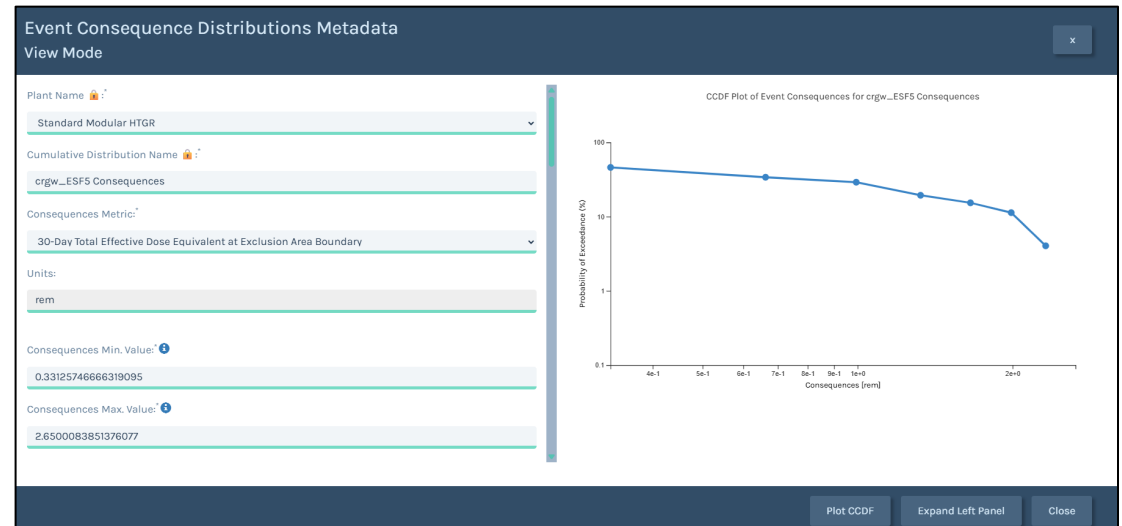
- Manual Input of Dose Values
- Calculation of Dose Values through OGMA Simulation Manager RAVEN
 - External Couplings
 - Uncertainty Propagation

Severe Accident Progression and Radiological Consequence Dose Assessment

RELAP5-3D +  RADTRAD

 + 
Accident Consequence Model

Custom Python Scripts for Dose Assessment

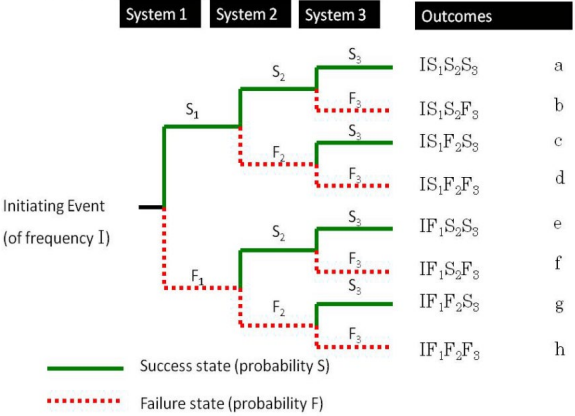


Risk Informed Decision Making

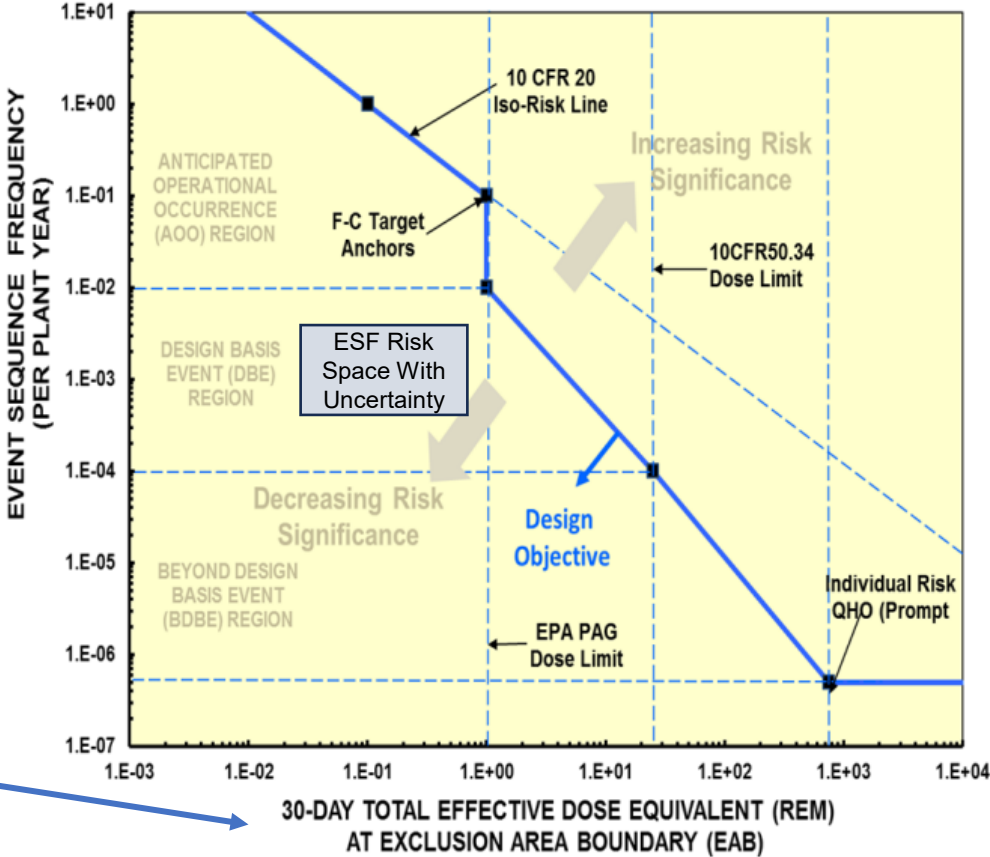
PRA Model: Event Trees and Event Frequencies



CAFTA



Frequency – Consequence (FC) Chart



Severe Accident Progression and Radiological Consequence Dose Assessment



Custom Python Scripts for Dose Assessment

RISE Analysis Dashboard

The screenshot displays the RISE Analysis Dashboard. At the top left, the logo for FPoliAAP is shown, with the text "By FPoliSolutions, LLC." below it. To the right of the logo is a "Global Search" input field with a magnifying glass icon. Further right are navigation links for "Dashboard" (with a home icon) and "Account" (with a user icon). A dark sidebar on the left contains a list of menu items: OGMA-Projects, OGMA-Docs, OGMA-Tests, OGMA-Sim, OGMA-Calcs, OGMA User Manual, RISE, Administration, Glossary of Terms, Report an Issue, HDF5 Viewer, and a "Hide Sidebar" button. The main content area is titled "RISE Dashboard" and "Standard Modular HTGR". On the right side of the main area is the RISE logo, which consists of a circular pattern of dots. Below the title, there is a section titled "RISE Analysis Configuration" with the instruction: "Select components of the RISE Analysis to execute, and click Run Selected RISE Analyses to begin processing." Underneath this is a section titled "RISE Analysis Components" with a list of items, each preceded by a checked checkbox: LBEs Analysis, Integrated Risk Analysis, Risk Margin Analysis, PRA Safety Functions Analysis Setup, Preventative and Mitigating Safety Functions Analysis, Safety Function Studies, SSCs Performing RSF Analysis, SSC Classification Analysis, and Select All.

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Global Search

Dashboard Account

RISE Dashboard
Standard Modular HTGR

RISE

RISE Analysis Configuration

Select components of the RISE Analysis to execute, and click Run Selected RISE Analyses to begin processing.

RISE Analysis Components

- LBEs Analysis
- Integrated Risk Analysis
- Risk Margin Analysis
- PRA Safety Functions Analysis Setup
- Preventative and Mitigating Safety Functions Analysis
- Safety Function Studies
- SSCs Performing RSF Analysis
- SSC Classification Analysis
- Select All

RISE Dashboard – LBE Classification

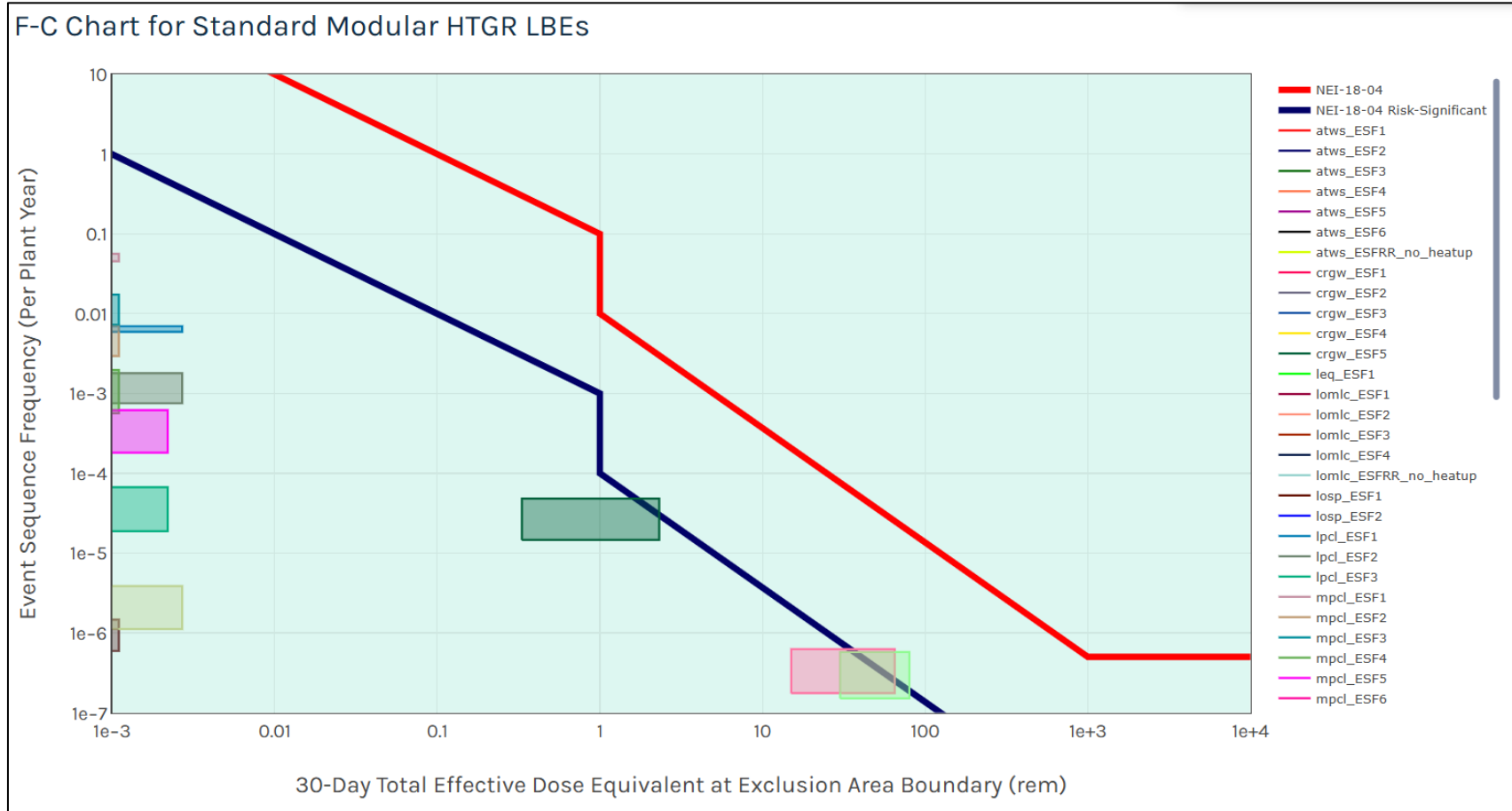
157 Event Sequences > 82 ESFs > 60 LBEs

LBEs Classification for Standard Modular HTGR

Search in Table: Show **50** entries

Event Sequences Family	Simulations	AOO	DBE	BDBE	Status	DBID	DBRV
atws_ESF1		true	false	false	PRE	93	184
atws_ESF2		true	false	false	PRE	95	184
atws_ESF3		true	false	false	PRE	96	184
atws_ESF4		false	true	false	PRE	98	184
atws_ESF5		false	true	true	PRE	100	184
atws_ESF6		false	false	true	PRE	101	184
atws_ESFRR_no_heatup		false	false	true	PRE	151	162
crgw_ESF1		true	false	false	PRE	105	184
crgw_ESF2		false	true	false	PRE	107	184
crgw_ESF3		false	false	true	PRE	109	184
crgw_ESF4		false	false	true	PRE	111	184
crgw_ESF5		false	false	true	PRE	155	134
leq_ESF1		false	false	true	PRE	165	112
lomlc_ESF1		true	false	false	PRE	116	184
lomlc_ESF2		true	false	false	PRE	118	184
lomlc_ESF3		false	false	true	PRE	120	183
lomlc_ESF4		false	false	true	PRE	122	184
lomlc_ESFRR_no_heatup		false	false	true	PRE	152	163
losp_ESF1		false	true	false	PRE	126	184
losp_ESF2		false	false	true	PRE	128	184
lpci_ESF1		false	true	false	PRE	131	184
lpci_ESF2		false	true	false	PRE	133	184

RISE Dashboard – FC Chart



RISE Dashboard – Integrated Risk Metrics

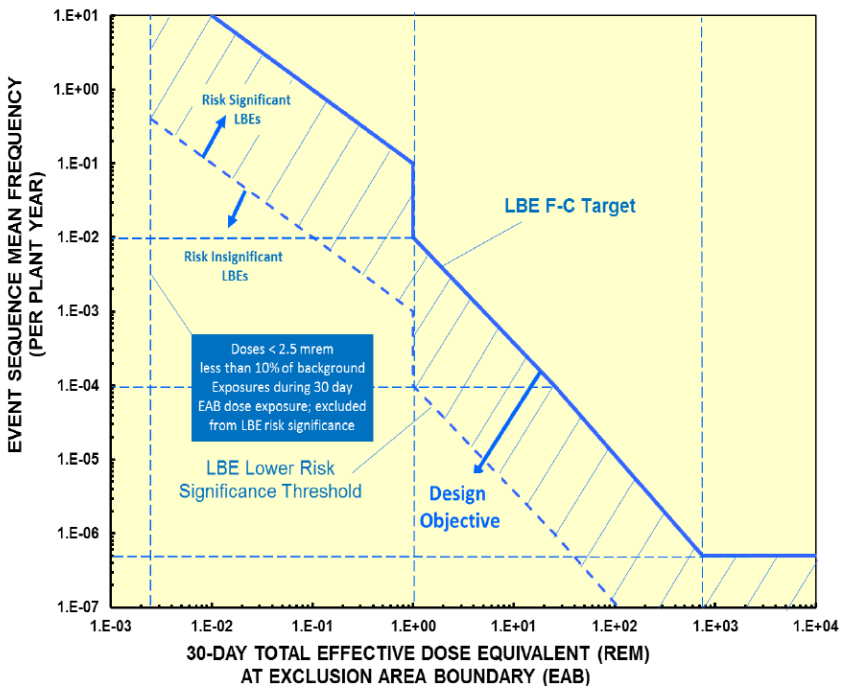
Integrated Risk Against Cumulative Metrics for Standard Modular HTGR

Search in Table: Show **50** entries

Target	Metric Definition	Units	Regulatory Guidance	RISE Estimated Value	Acceptable?	Compliance
Cumulative Dose Exceedance Frequency	Total frequency of exceeding site boundary dose of 10...	1/plant-year	1.0	0.00004927855376619	Yes	
Cumulative Early Fatality Risk	Average individual risk of early fatality within 1 miles ...	1/plant-year	5.0E-7	0.000000600000000000000004	No	
Cumulative Latent Fatality Risk	Average individual risk of latent cancer fatalities with...	1/plant-year	2.0E-6	0.000000610000000000000004	Yes	

Showing 1 to 3 of 3 entries

RISE Dashboard – Risk Margin Quantification



Risk Margin Quantification

[Import CSV](#)
[Export CSV](#)
[Import JSON](#)
[Export JSON](#)

Search in Table:

LBE	Mean Frequency Margin [-]	Mean Consequence Margin [-]	95th Percentile Frequency Margin [-]	95th Percentile Consequence Margin [-]	Risk Significant?
atws_ESF1	2.43e-07	2.43e-07	2.54e-06	2.54e-06	No
atws_ESF2	2.58e-08	2.58e-08	3.64e-07	3.63e-07	No
atws_ESF3	1.34e-09	1.34e-09	2.19e-08	2.19e-08	No
atws_ESF4	7.29e-12	1.60e-10	7.74e-11	1.67e-09	No
atws_ESF5	7.66e-13	3.32e-11	1.08e-11	4.23e-10	No
atws_ESF6	4.09e-14	4.32e-12	6.66e-13	6.07e-11	No
atws_ESFRR_no_heatup	4.36e-15	0.00e+00	7.24e-14	1.29e-11	No
crgw_ESF1	9.92e-10	1.00e-09	9.92e-09	1.00e-08	No
crgw_ESF2	7.76e-12	1.67e-10	8.10e-11	1.73e-09	No
crgw_ESF3	2.40e-13	1.48e-11	3.39e-12	1.89e-10	No
crgw_ESF4	9.90e-15	1.61e-12	1.41e-13	2.06e-11	No
crgw_ESF5	9.86e-05	5.70e-03	1.60e-02	5.57e-02	Yes
leq_ESF1	1.18e-13	9.01e-12	1.19e-12	9.07e-11	No
lomlc_ESF1	2.47e-08	2.47e-08	2.52e-07	2.52e-07	No
lomlc_ESF2	1.31e-09	1.31e-09	1.84e-08	1.84e-08	No
lomlc_ESF3	4.94e-13	2.45e-11	5.17e-12	2.53e-10	No
lomlc_ESF4	2.59e-14	3.14e-12	3.65e-13	3.99e-11	No

RISE Dashboard – Safety Function Classification

LBES Associations and Safety Functions for Standard Modular HTGR

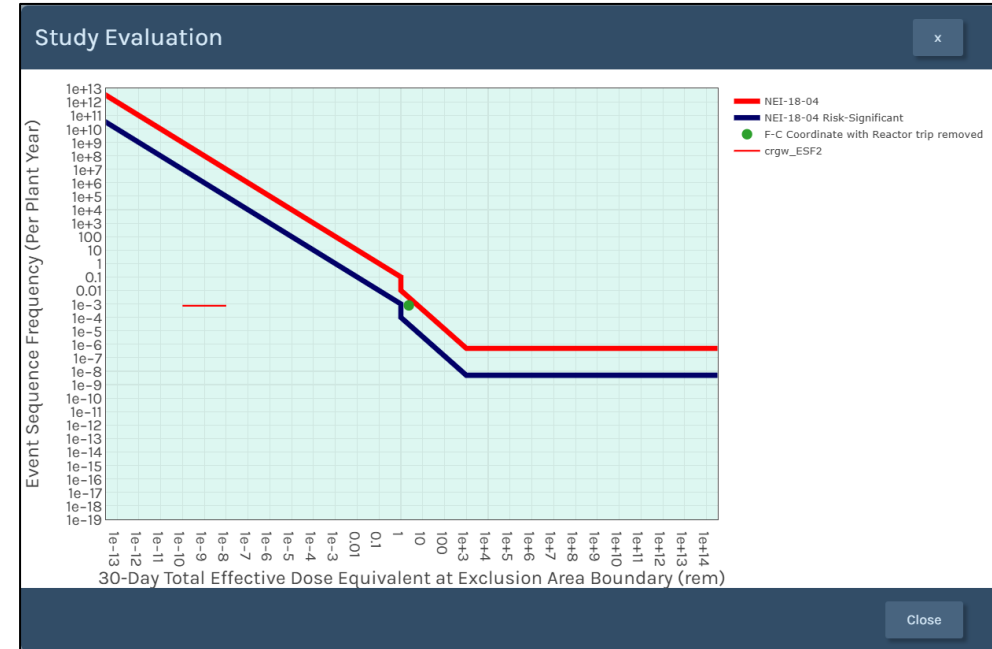
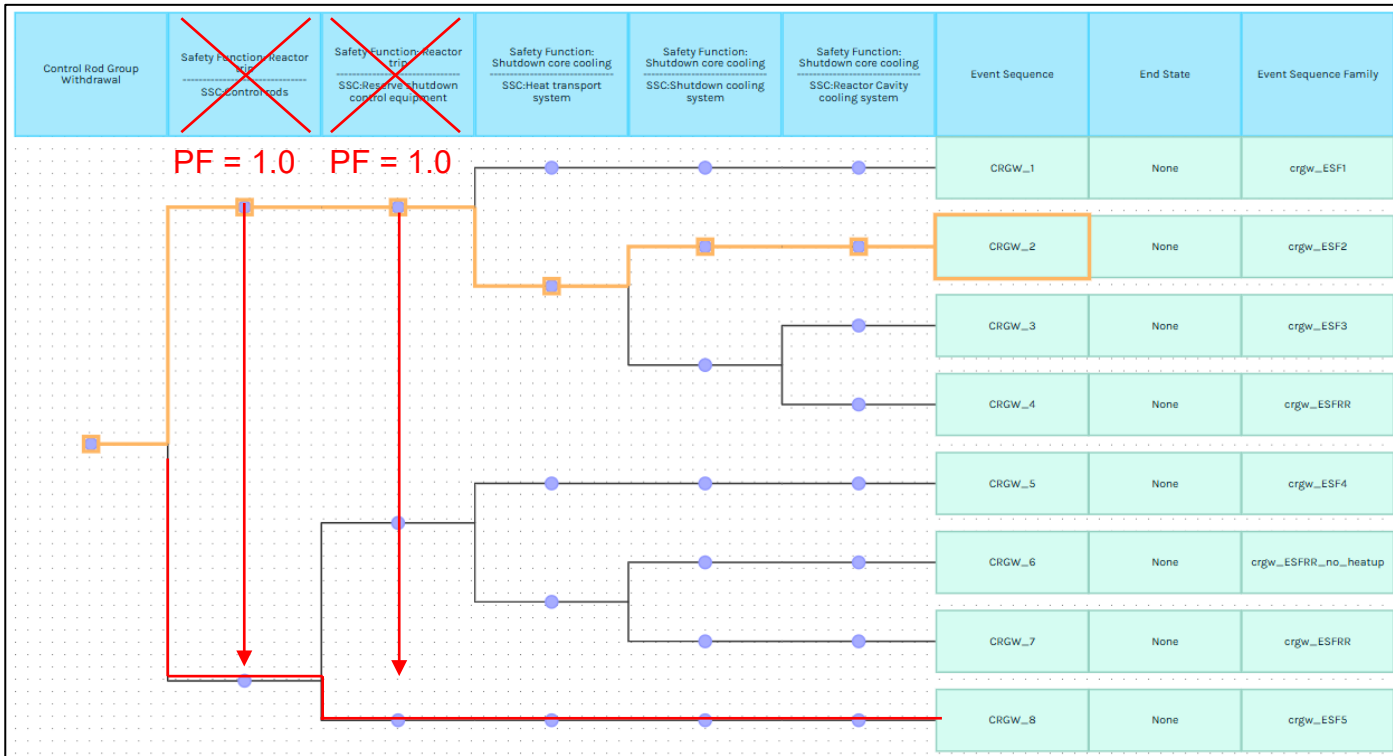
[PRA Safety Functions](#)
[Preventative Safety Functions](#)
[Mitigating Safety Functions](#)
[Safety Function Studies](#)
[Required Safety Functions](#)

[Import CSV](#)
[Export CSV](#)
[Import JSON](#)
[Export JSON](#)

Search in Table: Show **50** entries

DBE	Safety Function Challenged	Are FC Targets Met?	Status	DBID	DBRV
atws_ESF4	Control pressure of primary coolant system	Yes	PRE	17	37
atws_ESF4	Manual reactor trip by operator	Yes	PRE	15	37
atws_ESF4	Reactor trip	No	PRE	14	37
atws_ESF4	Shutdown core cooling	Yes	PRE	16	37
atws_ESF5	Control pressure of primary coolant system	Yes	PRE	13	37
atws_ESF5	Manual reactor trip by operator	Yes	PRE	11	37
atws_ESF5	Reactor trip	No	PRE	10	37
atws_ESF5	Shutdown core cooling	Yes	PRE	12	37
crgw_ESF2	Reactor trip	Yes	PRE	40	37
crgw_ESF2	Shutdown core cooling	Yes	PRE	41	37
losp_ESF1	Reactor trip	Yes	PRE	83	37
losp_ESF1	Shutdown core cooling	Yes	PRE	84	37
lpci_ESF1	Control pressure of primary coolant system	Yes	PRE	66	37

RISE Dashboard – Safety Functions Studies



RISE Dashboard – SSC Classification

SSCs Classifications

SSC Classification SSC Performing Safety Function Risk-Significant SSC Studies SR SSCs NSRST SSCs NST SSCs

SSC Table Instructions Show Full-Screen Table View

Event Data						Required Safety Functions					
LBE	Initiating Event	Is DBE?	Is BDBE?	FC Target Met?	ES	Reactor trip			Shutdown core cooling		
						Control rods	Reserve shutdown control equipment <i>Safety Related</i>	FC Met for SF Study?	Reactor Cavity cooling system <i>Safety Related</i>	Shutdown cooling system	Heat transfer system
atws_ESF4	Anticipated Transient Without Scram	true	false	Yes	ATWS_08	Failure (0.00003 prob.)	Success (0.99996 prob.)	No	Pass Through	Pass Through	Success (prob.)
atws_ESF5	Anticipated Transient Without Scram	true	true	Yes	ATWS_09	Failure (0.00003 prob.)	Success (0.99996 prob.)	No	Pass Through	Success (0.95 prob.)	Failure (0.03 prob.)
spcl_ESFRR	Small Primary Coolant Leak	false	true	Yes	SPCL_15	Failure (2.0E-5 prob.)	Failure (4.0E-5 prob.)	No	Pass Through	Pass Through	Pass Through
					SPCL_14	Failure (2.0E-5 prob.)	Success (0.99996 prob.)		Failure (1.0E-6 prob.)	Failure (0.03 prob.)	Failure (0.03 prob.)
					SPCL_13	Failure (2.0E-5 prob.)	Success (0.99996 prob.)		Success (0.999999 prob.)	Failure (0.03 prob.)	Failure (0.03 prob.)

RISE OPPORTUNITIES



ADVANCED REACTOR LICENSING

Generate the **RIPB safety case**
Provide **transparency, scrutability, and collaboration**
Provide risk insights for design changes
Maintain safety case through plant lifetime
Guide analysts through complex workflows
Automate documentation

OPERATIONAL MARGINS AND FLEXIBILITY for LWRs

Challenge/remove artificial surrogate safety limits while maintaining safety-in-depth
Improve fuel utilization
Facilitate **management of operational incidents/issues/non-compliance**
Commoditize fuel supply (reduce fuel product transition costs)
Streamline safety analysis methods and enhanced transparency for safety determinations
Risk insights (F-C) for SSC safety classification
Expand benefits from **10 CFR 50.69 programs**

PROMOTE INNOVATION AND PUBLIC ACCEPTANCE

Enable deployment of **Highly Enriched-High burnup and/or Accident Tolerant Fuel** products
Siting and Emergency Planning Zone (EPZ) Management activities
Facilitate disposition Generic Safety Issues (GSI)

Questions

Risk-Informed
Systems
Engineering (RISE)



Mike Mankosa, Cesare Frepoli
FPoliSolutions, LLC.
Pittsburgh, PA
info@fpolisolutions.com