



RMC-TotalRisk

Quantitative Risk Analysis Software

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Background & Motivation

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The screenshot displays the RMC-TotalRisk 1.0 software interface. The Project Explorer on the left lists the project structure, including Hazards, Discharge-Frequency, Seismic, Transforms, System Responses, Spillway, Consequences, and Risk Analyses. The main diagram area shows a flowchart for the Foster Dam system, starting with a Hazard (Stage-Frequency) and branching into three parallel paths: Non-Fail, Spillway Chute Slab, and Spillway Stilling Basin. Each path includes a Transform, Response, and Consequence block. The Message Window at the bottom indicates 0 Errors, 0 of 17 Warnings, 0 of 41 Messages, and 0 of 1 Events.

Excel Hell

Created On: 11/18/2022 3:02:15 AM
Last Modified: 9/22/2024 12:15:12 PM
Consequence: Life Loss
Consequence Unit: Lives

SIMULATION
☒ Simulate Mean Risk Only
☐ Simulate Risk with Full Uncertainty

Estimate

Risk Analysis Properties
A risk analysis computes the risk associated with a collection of potential failure modes for each component in the system. Each failure mode consists of a hazard, the system response to that hazard, and the consequences resulting from that response.

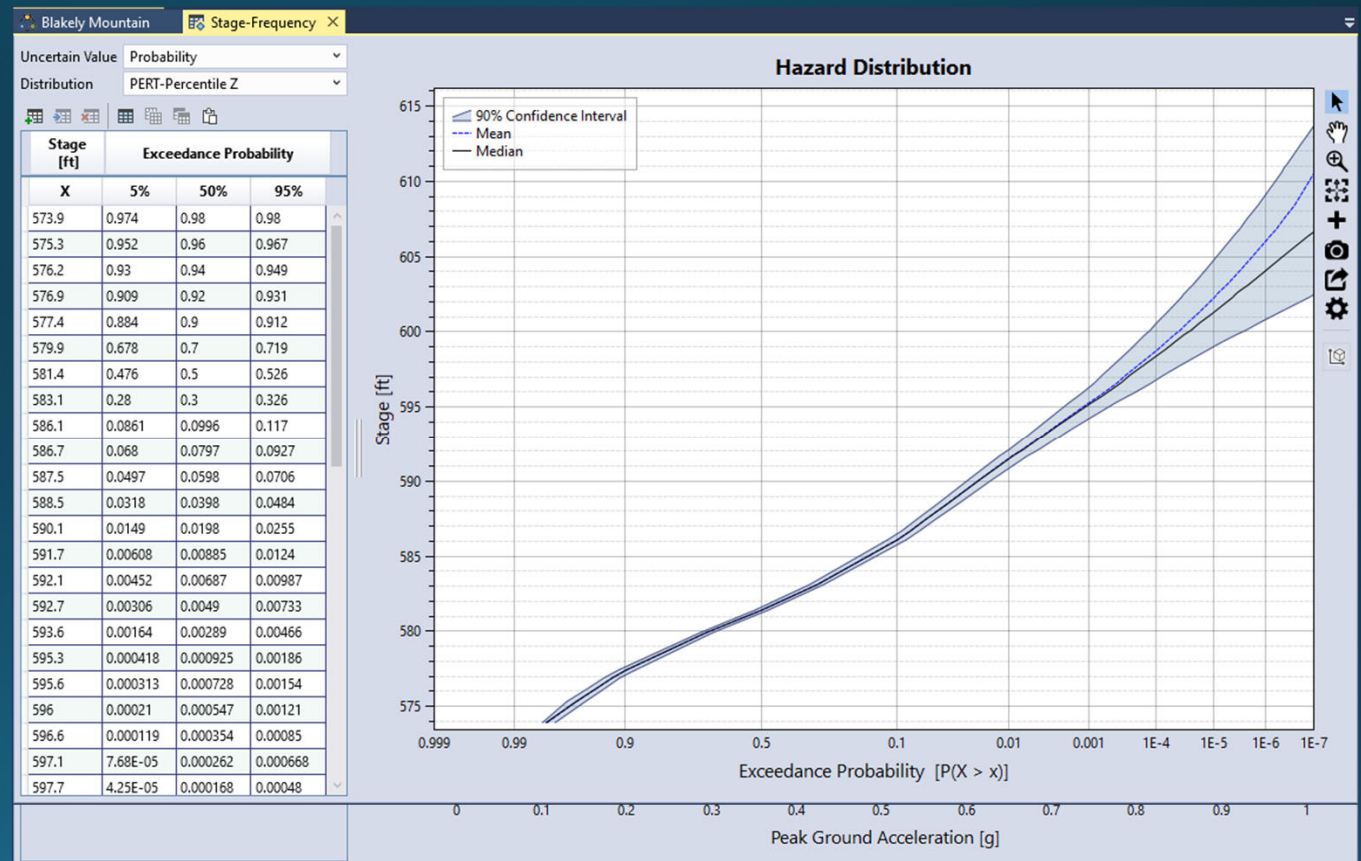
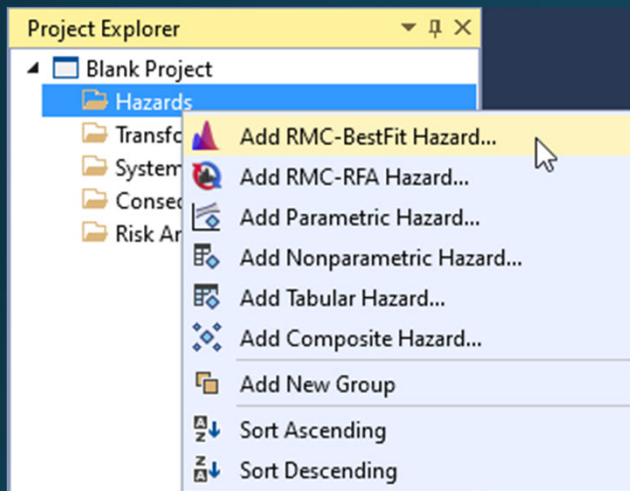
Goals of RMC-TotalRisk

- Key Principles:
 - Handle both simple systems and complex systems with multiple components and failure modes.
 - Support deterministic and probabilistic methods.
 - Be efficient to make modeling fast, intuitive, and repeatable.
 - Produce clear outputs that help communicate risk and uncertainty to decision makers and stakeholders.

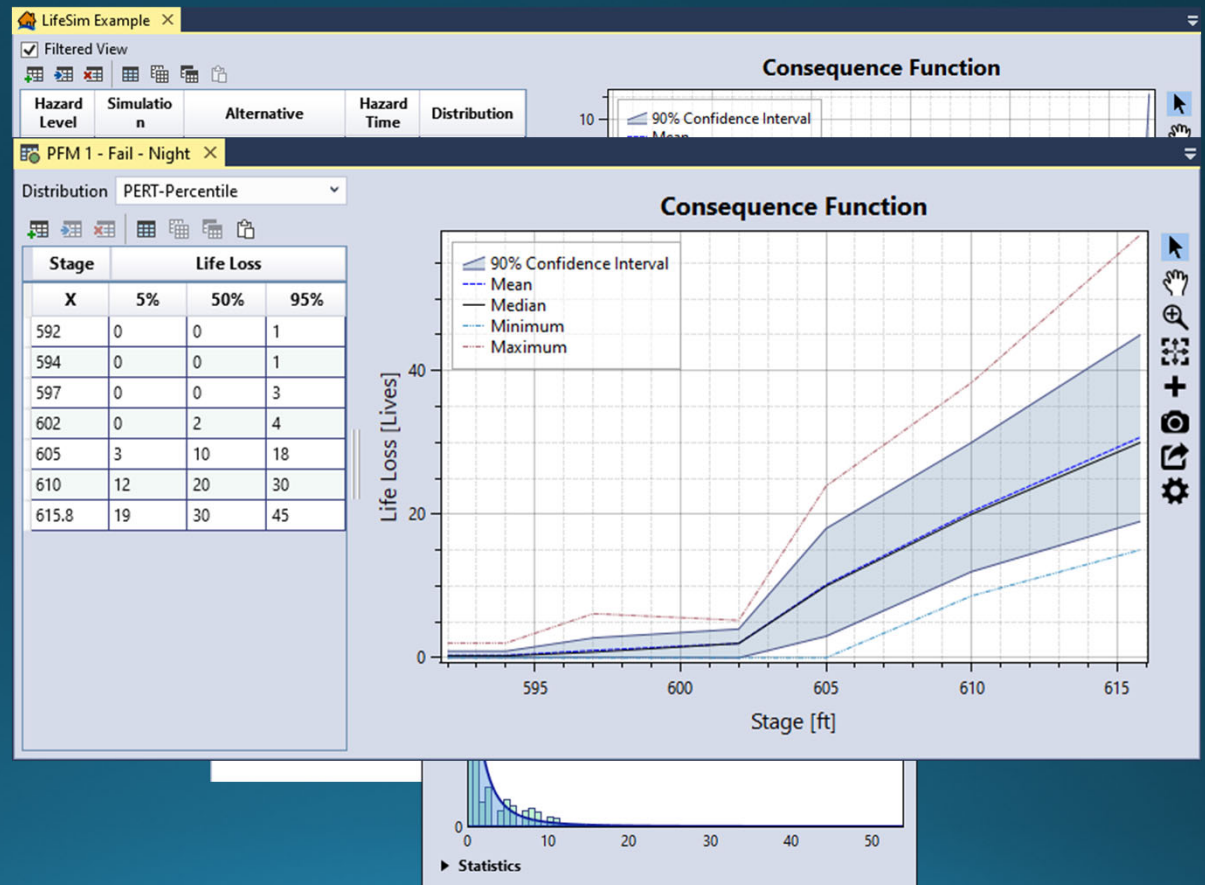
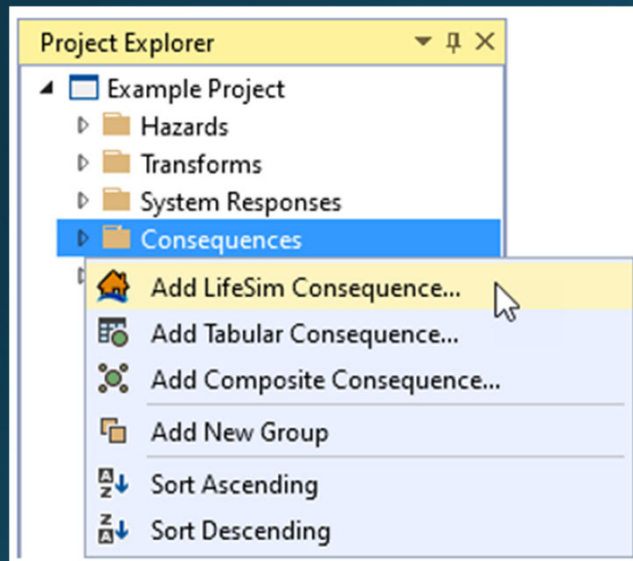


How is TotalRisk Unique?

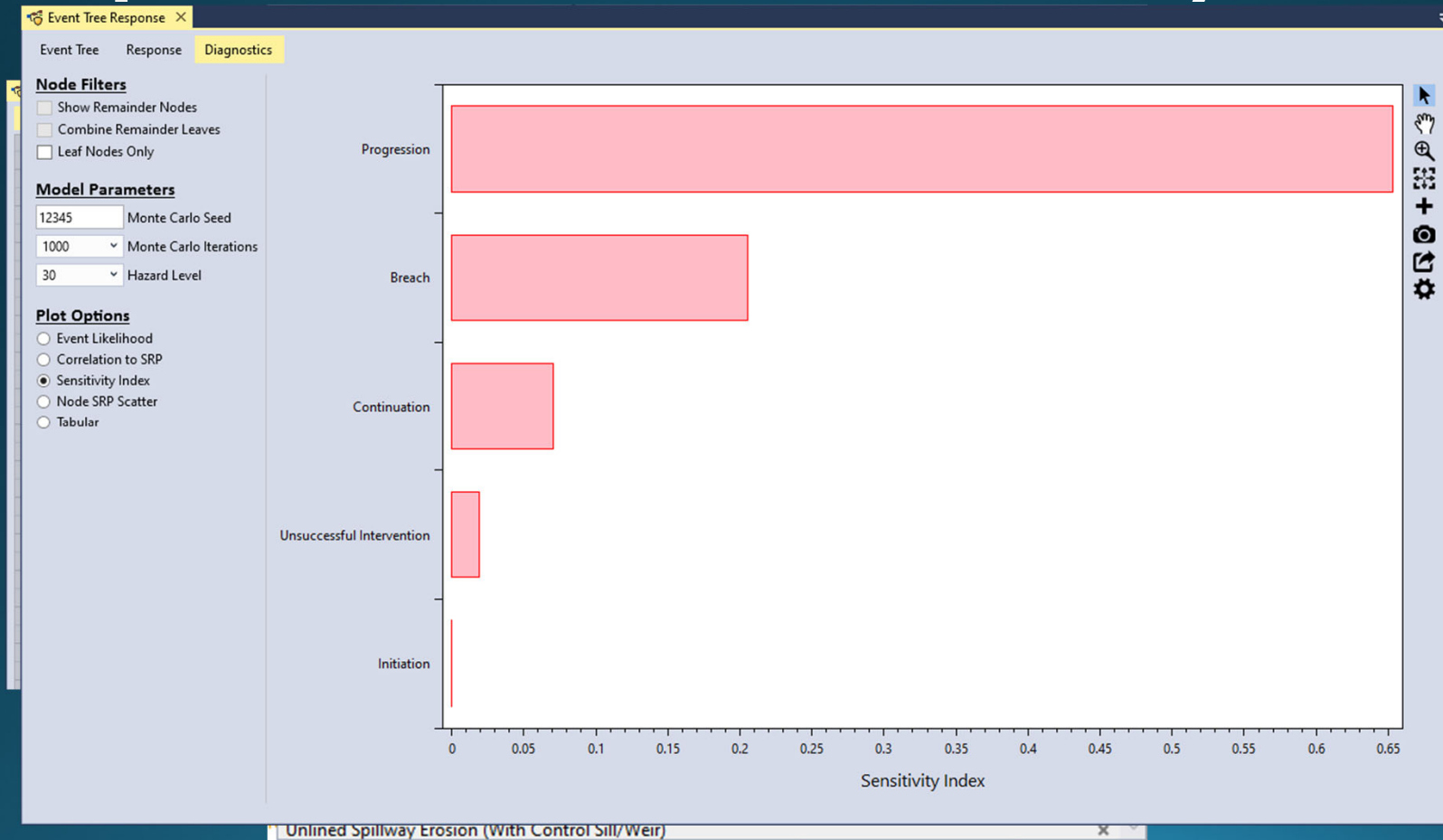
Hazards



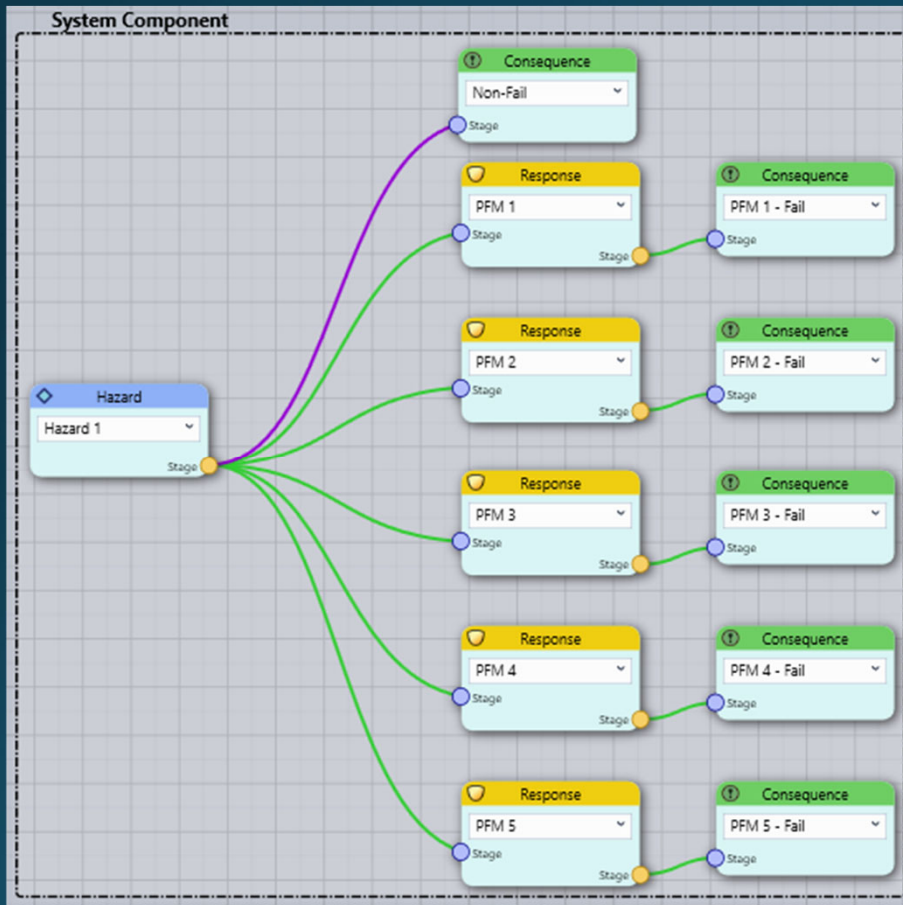
Consequences



Response - Event Tree Analysis



Response - Multiple Failure Modes



SYSTEM COMPONENT

System Component

Name

Failure Mode Method

Joint Consequences

Failure Dependency

Correlation Matrix

Hazard & Response Dependency

SYSTEM COMPONENT

System Component: System Component

Name: System Component

Failure Mode Method: Joint Failures

Joint Consequences: Maximum

Failure Dependency: Independent

Profile Hazard: Hazard 1 - Stage [ft]

Hazard Threshold: 0

SYSTEM

System Risk Method: Joint Risk

Joint Consequences: Additive

Hazard Dependency: Independent

RISK MEASURES

Consequence Threshold: Independent

Alpha: 0.001

Correlation Matrix

	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5
Dam 1	1.00	0.03	0.29	-0.04	0.85
Dam 2	0.03	1.00	-0.08	0.32	0.05
Dam 3	0.29	-0.08	1.00	0.59	-0.18
Dam 4	-0.04	0.32	0.59	1.00	-0.17
Dam 5	0.85	0.05	-0.18	-0.17	1.00

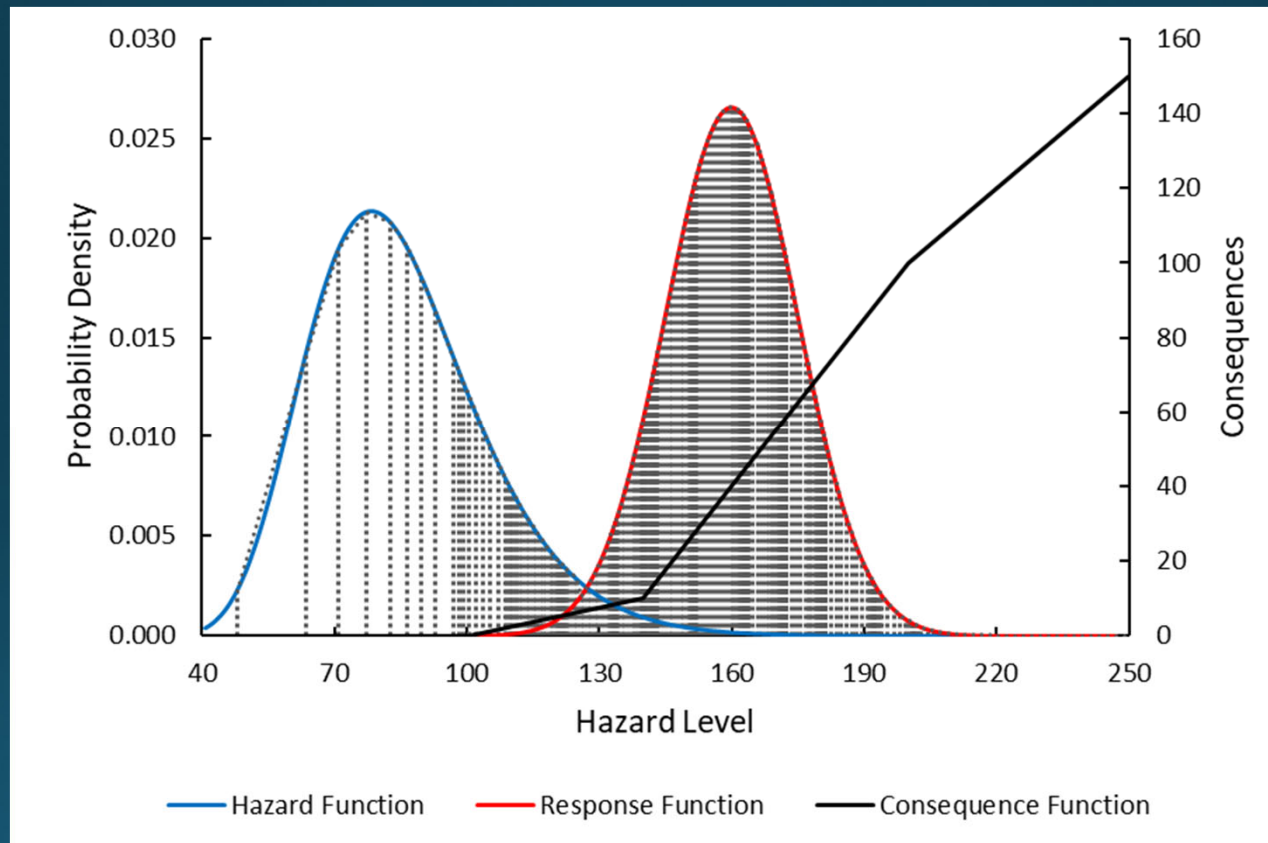
Apply Cancel

Correlation Matrix

	PFM 1	PFM 2	PFM 3	PFM 4	PFM 5
PFM 1	1.00	0.03	0.29	-0.04	0.85
PFM 2	0.03	1.00	-0.08	0.32	0.05
PFM 3	0.29	-0.08	1.00	0.59	-0.18
PFM 4	-0.04	0.32	0.59	1.00	-0.17
PFM 5	0.85	0.05	-0.18	-0.17	1.00

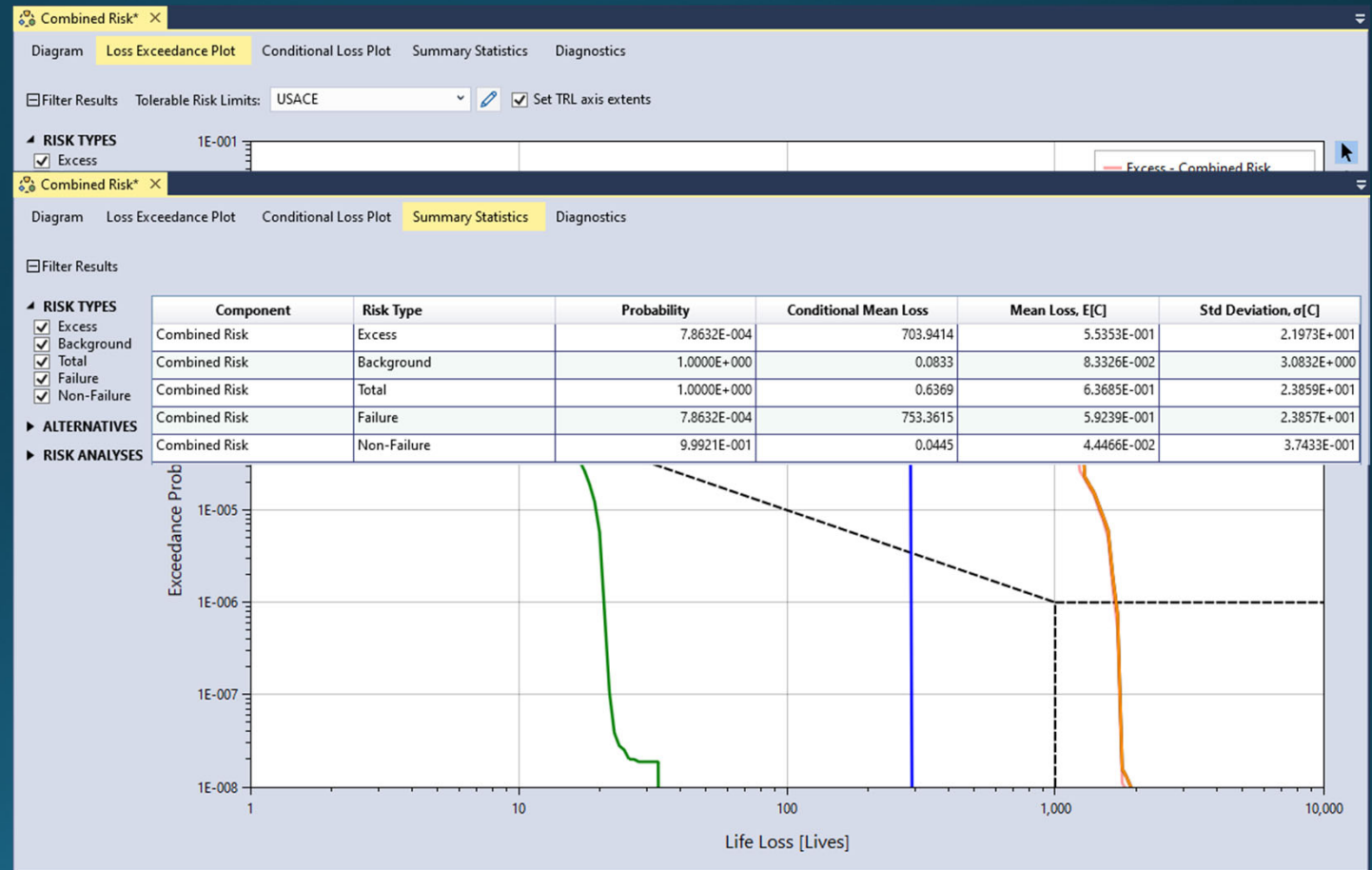
Apply Cancel

Adaptive Integration

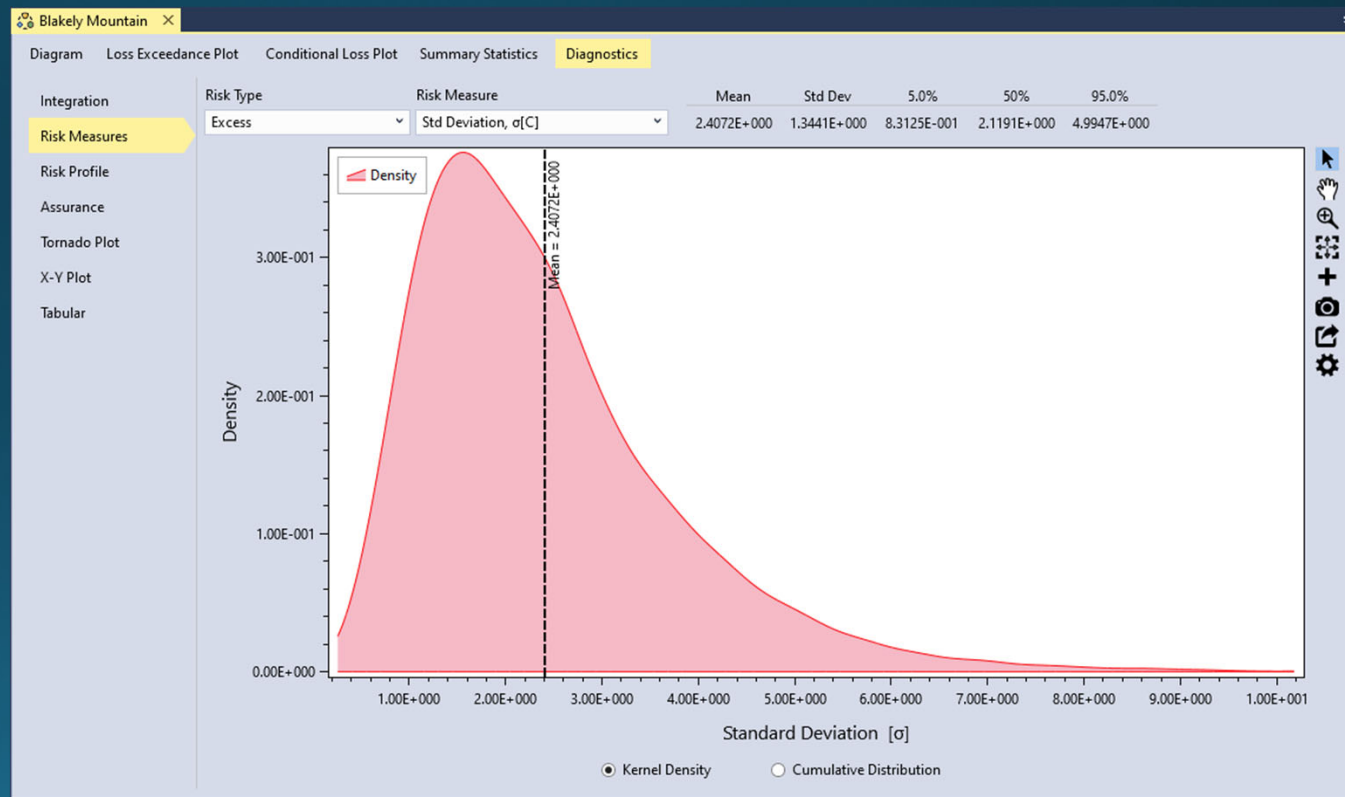
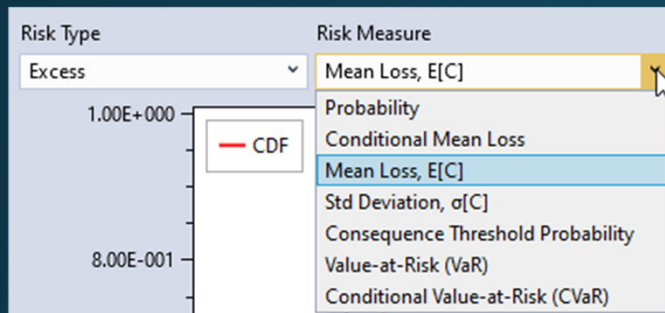


Risk Types

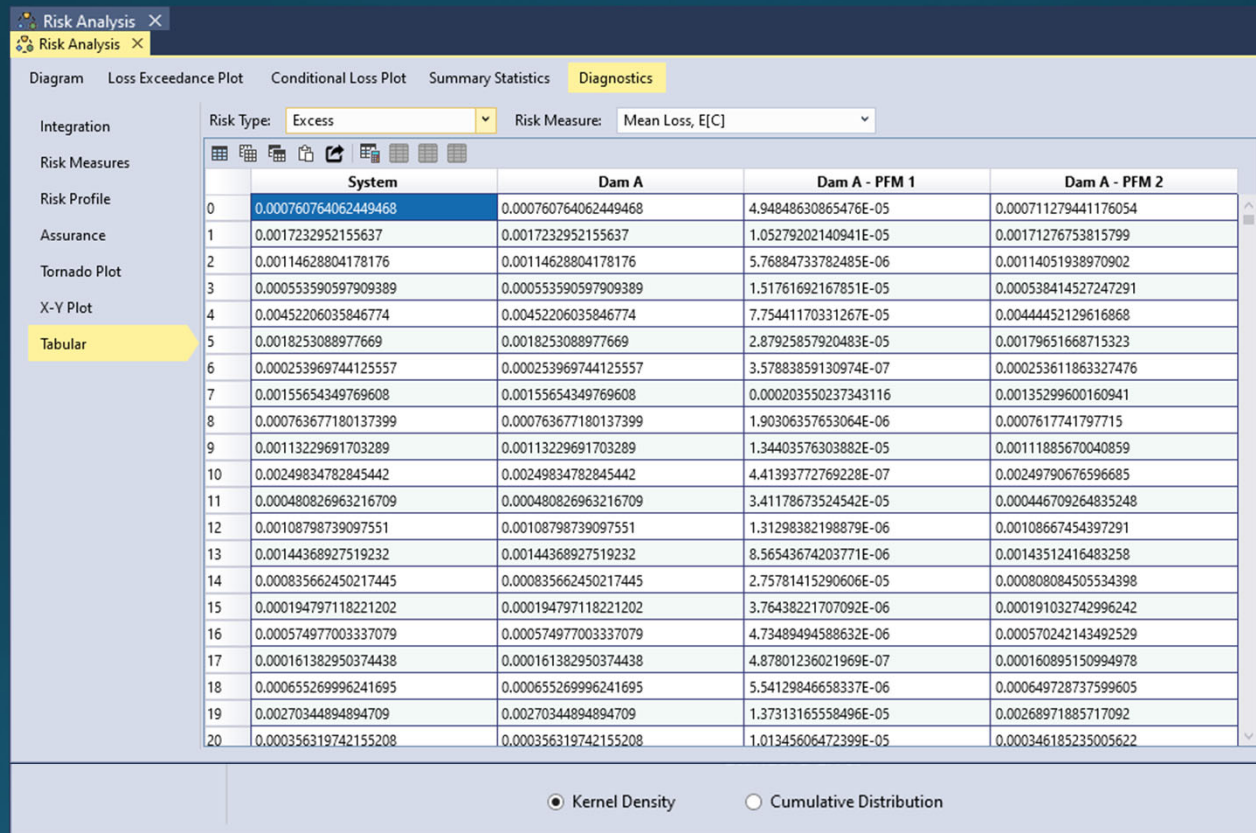
- Excess
- Background
- Total
- Failure
- Non-Failure



Risk Measures and Outputs



Diagnostics



Inter-Software Compatibility

- DAMRAE
- QRACalcs
- LST
- HEC-FDA

	Ex. Probability, α	Conditional Mean, η	Mean, $\mathbb{E}[N]$
DAMRAE [®]	3.150E-07	1010	3.180E-04
RMC-TotalRisk	3.146E-07	1010	3.177E-04
% Difference	0.1%	0.0%	0.1%

Risk Type	LST, $\mathbb{E}[N]$	RMC-TotalRisk, $\mathbb{E}[N]$	% Difference
Excess	9.426E-02	9.345E-02	0.9%
Background	3.042E-02	3.026E-02	0.5%
Total	1.247E-01	1.237E-01	0.8%

Study	HEC-FDA 1.4.3	RMC-TotalRisk	% Difference
Muncie	\$ 3,886.49	\$ 3,699.06	4.8%
North DeSoto	\$ 3,715.31	\$ 3,707.50	0.2%
Glendive	\$ 900.27	\$ 900.42	0.0%
River Des Peres	\$ 6,857.77	\$ 6,945.00	1.3%
Tarfuna	\$ 10,479.56	\$ 9,970.00	4.9%
London Orleans	\$ 43,389.16	\$ 42,074.40	3.0%
Beargrass Creek	\$ 952.48	\$ 934.45	1.9%

Future Plans

- Download at: <https://github.com/USACE-RMC/RMC-TotalRisk>
- Finalizing publications and online documentation
 - Journal paper(s) on computational framework
 - Verification Report
 - Technical Reference Manual
 - Online Tutorials
- AWS Web Training
 - Day 1 – Overview of Quantitative Risk Analysis
 - Day 2 – Multiple Failure Modes, Event Trees, LifeSim
 - Day 3 – System Risk, Multiple Hazards, Uncertainty Analysis





Demonstration