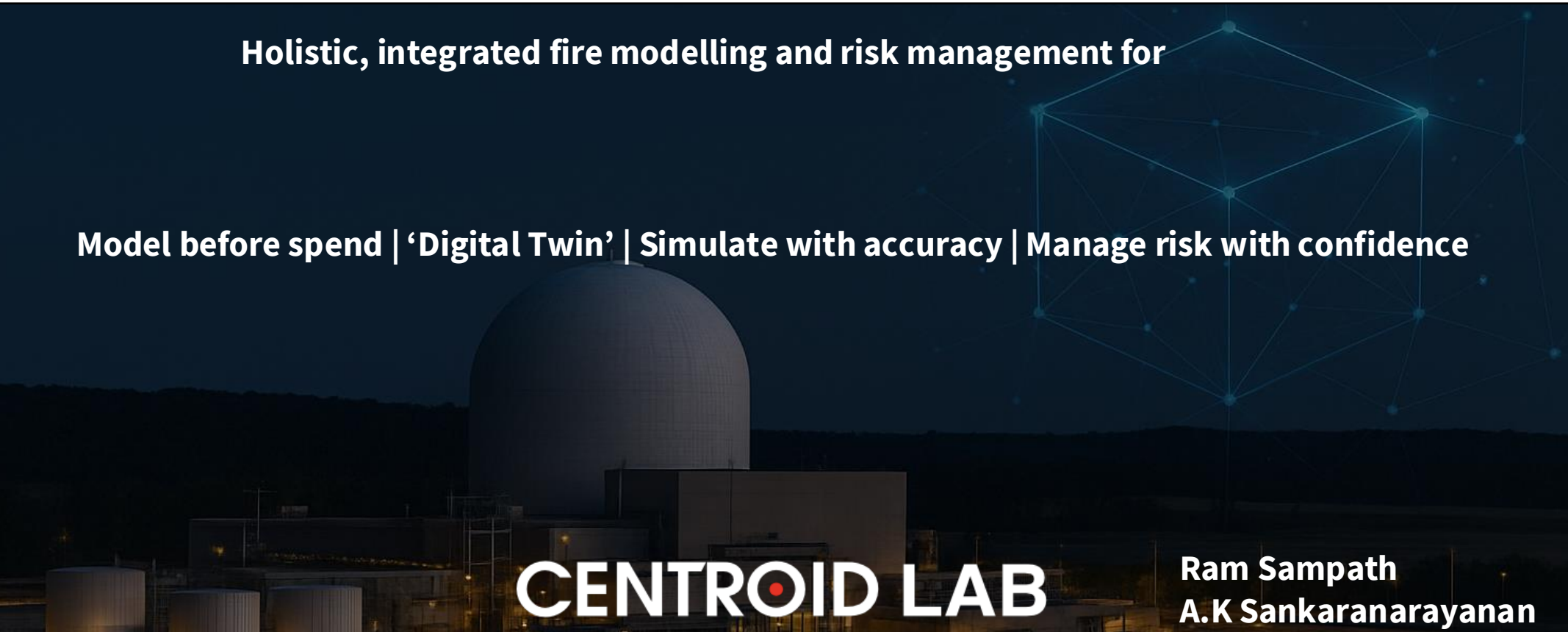
FRI3D : Fire Risk Investigation in 3D

A demonstration to RISK SPECTRUM *User Group*

3rd June 2026

Holistic, integrated fire modelling and risk management for

Model before spend | 'Digital Twin' | Simulate with accuracy | Manage risk with confidence



CENTROID LAB

Ram Sampath
A.K Sankaranarayanan

TOPICS :

1. SETTING THE CONTEXT:
   The opportunity

2. FRI3D :
   The digital future. What is it?
   How does it work? Op & Pre-Op

5 mins

3. FRI3D DEMO:
   An overview of the unified workflow

20 mins

4. THE BUSINESS CASE:
   The “Why” : measure, quantify, justify

5. In summary, C.I and Q&A
   And next steps

15 mins

RISK SPECTRUM

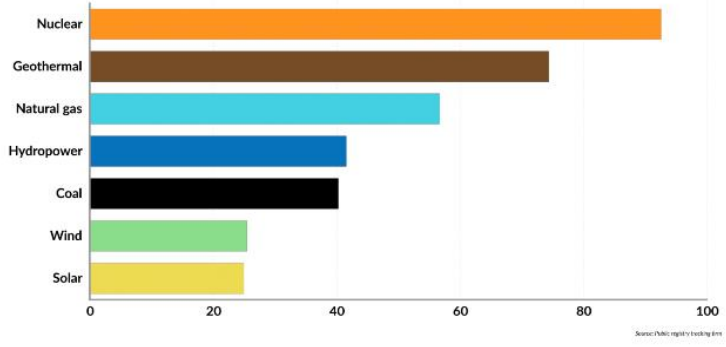
User Group

fri3d.centroidlab.com

NUCLEAR INDUSTRY: The Context

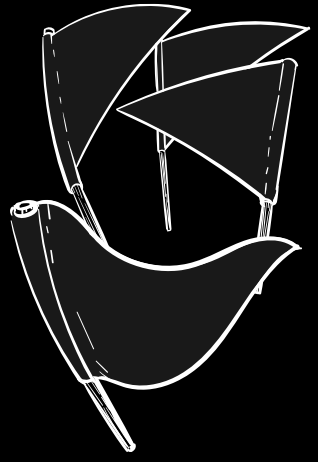
- Energy demand to increase at **50% CAGR in next 15 years**. (E.g. Britain's consumption to increase by **30% in 10 years to 370-408 Terawatt-hours**. And **600 TWH by 2050)**
- **Clean energy** (renewables, nuclear) and **Grid infrastructure** are expected to be key strategies to meet increased demand
- **40%** of plans to fulfil this demand is already at risk. **Dichotomy** between rate of increase in demand and rate of increase in corresponding sourcing tech/ methods.

Capacity factor of energy sources



Capacity factor is the ratio of electrical power produced over a period of time to the maximum possible energy output for the same period. For example, a 1 megawatt generator that produces 1 megawatt-hour of electricity every hour has a capacity factor of 100 percent. © GIS by macpixxel

- Speed, cost & safety for increased demand
- Getting it right first time is critical
- SMR design and build success
- Extending lifetimes and efficacy of aging plants



NUCLEAR INDUSTRY: The opportunity and imperatives

Future Proofing Safety Against Fire & Flooding for increased scale

- In the design and build phases – PreOp
- In the Run stages (for existing and new) – Op

Nuclear industry could meet the non linear increase in demand with advanced tech and methods

Assured accuracy | Reduced timelines | Reduced costs | Ease of use, approvals | Increased Realism

Copyright 2026 Centroid Lab Inc

WHAT IS FRI3D?

fri3d.centroidlab.com

A single integrated simulation and modelling platform for all your fire safety needs

Combines the multiple components and tasks of hazard and risk modeling into a **holistic, seamless, unified workflow** to automate manual processes and aid critical design decisions.

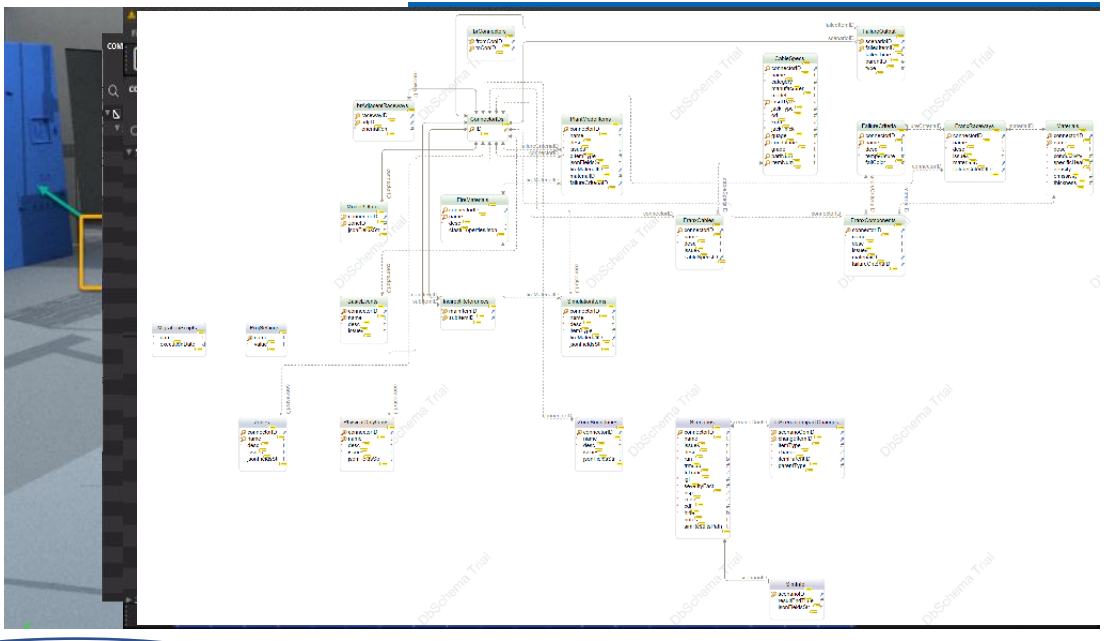
..... And creates a 'digital twin' as a digital asset for rapid re-use/ multi-use

HOW DOES FRI3D WORK?

www.fri3d.com

Combines the multiple components and tasks of hazard and risk modeling (fire, flood, sodium) with integrated CAD/BIM modeling into a **holistic, seamless, unified workflow** to automate manual processes and aid critical design decisions.

- Existing Plant Data
- Spatial Information
- Fire Simulation
- Visualization
- Fire Scenarios
- PRA Calculation
- Results & Reports*



Ops & Pre-Ops

Optimal automation at each stage

UNIFIED WORKFLOW | SINGLE VERSION OF TRUTH | RE-USABLE DIGITAL ASSET | SAVE TIME, EFFORT, COST| LESS ERRORS

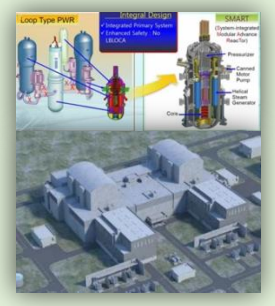
FRI3D in action : Design and build of plants

Highlights of leveraging FRI3D

- Model *before* spend
- Multiple scenarios modelled
- Design mods, eqpt placements
- Verify safety contemporaneous to design
- Streamline PLM, first time right
- Life Cycle use of asset

Design teams

Design Artefacts



Input to FRI3D

Feedback to Design teams

'Digital Twin' that helps visualize Risk accurately (prior to build)

Phase 2: Fire modelling, visualization, simulation, baseline scenarios

CENTROID LAB services on

Fd

Phase 1: Model developed with design spatial data and drawings

Phase 3: Scenario expansion, sensitivity analyses & Risk informed evaluations

Part of **Hazard, Risk and Safety Teams** (providing design support, inputs)

Reports, Design feedback for critical input to design/ build teams

Pre-Ops [Streamlined PLM: design, build with assurance, speed]

A 'Digital Twin' that helps visualize Risk accurately (even prior to build)

ASSURED ACCURACY | REDUCED TIMELINES | REDUCED COSTS | EASE OF USE, APPROVALS | INCREASED REALISM

Fd

FRI3D DEMO

A Unified Workflow

fri3d.centroidlab.com

- Overview walk through of FRI3D menus
- Ease of importing CAD, 2D drawings to create 3D models. Or create from scratch
- Ease of importing plant data, spatial data
- Exhaustive database of Fire related heat properties of materials.
- Multiple scenarios modelled, stored, re-used. Enabling critical design decisions.
- Seamlessly integrates with RiskSpectrum or CAFTA, CFAST or FDS.
- Reports and analyses

..... And creates a 'digital twin' as a digital asset for rapid re-use/ multi-use

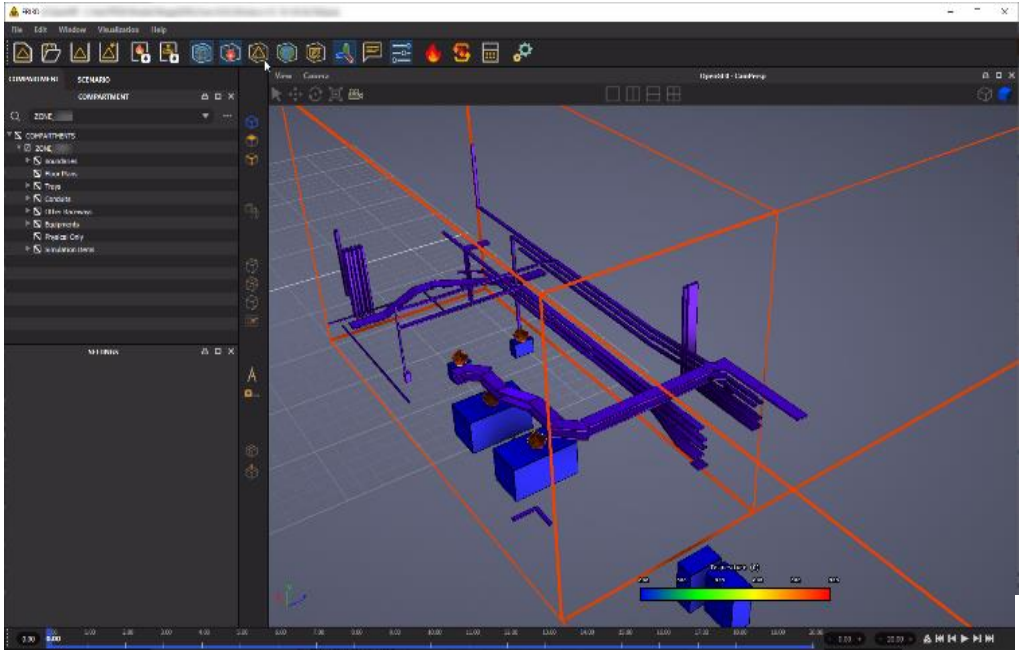
FRI3D in Action : Quantifying benefits

Steps executed in use case

Easy adoption & use

1. Layered in drawings & schematics
2. Modeled compartment boundaries
3. Added 4 components
4. Modeled 100 raceways (16 hours)
5. Placed 8 ignition sources (4 hours) [added source library to reduce this]
6. Generated scenarios and ran CFAST PRA (seconds)

Modeling was done by ***first time users*** of FRI3D who attended a workshop and 3 hours of training.



Quantifying : A case for the use of FRI3D (versus without FRI3D)

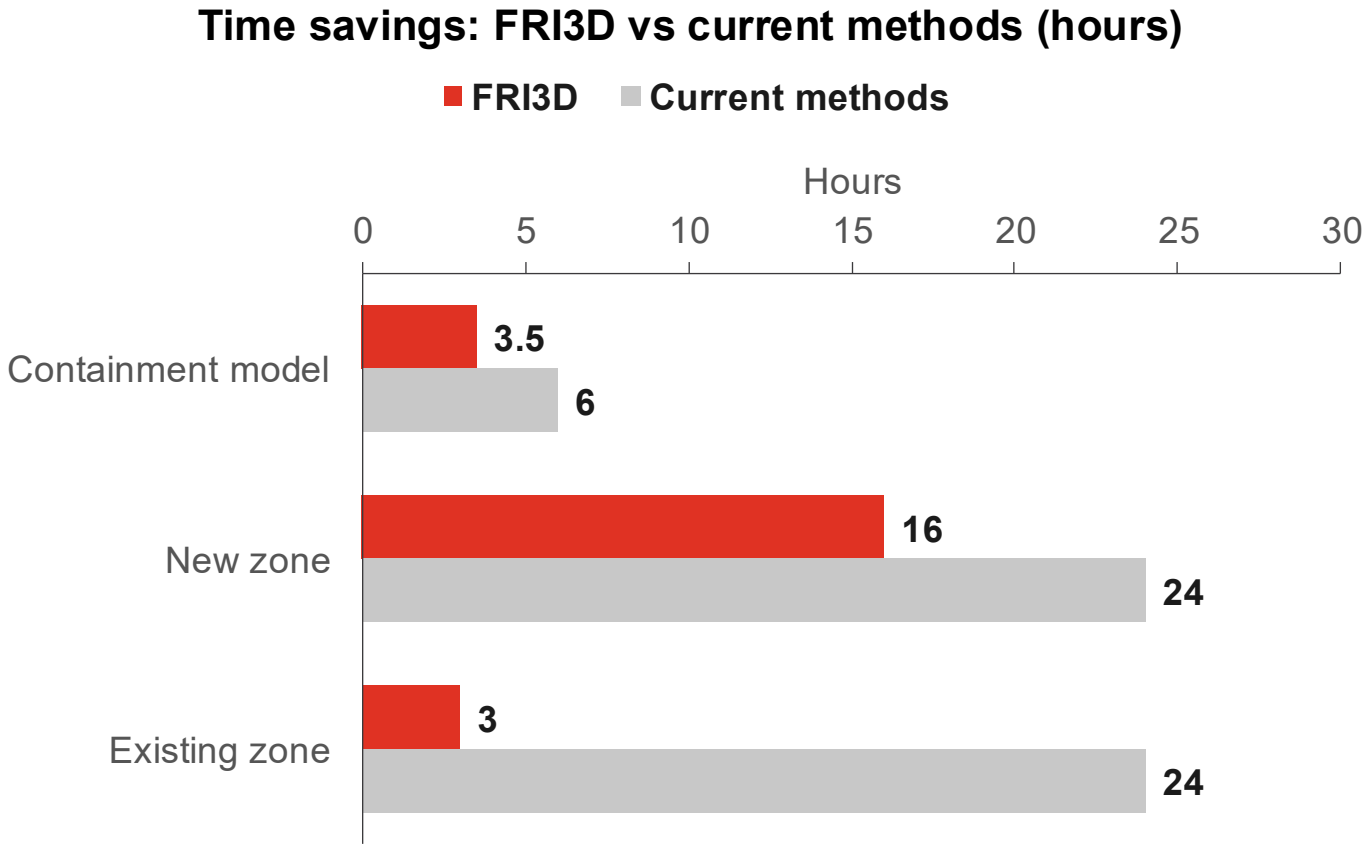
BENEFIT REALISATION FROM DAY 1

~50% savings

CONTAINMENT MODEL
3-4 HOURS FRI3D
Vs
4-8 HRS

NEW ZONE
12-20 HOURS
FRI3D
Vs
16-32 HRS

EXISTING ZONE
1-5 HOURS FRI3D
Vs
16-32 HRS



After Initial 3D Modeling time taken for further analysis for new scenarios is insignificant.

FRI3D fitment/ applicability: Organisation type and Use cases

5

ORGANISATION ↓ / USE CASE →	PLANT OPERATIONS	MODIFICATIONS (H/M/L)	NEW DESIGN	R&D SUPPORT	REGULATORY USES
Plant Licensees Existing fleet operators	Y	Y	Y	M	Y
Regulatory Bodies Approvals, audit, oversight	Y	Y	Y	Y	Y
Engineering Companies EPCs, design houses	M	Y	Y	Y	M
Research Organisations Labs, universities	Y	Y	Y	Y	M
New LW Reactors (large) Greenfield large-scale	LIFECYCLE	LIFECYCLE	Y	M	Y
New Advanced Reactors SMRs, sodium	LIFECYCLE	LIFECYCLE	Y	M	Y

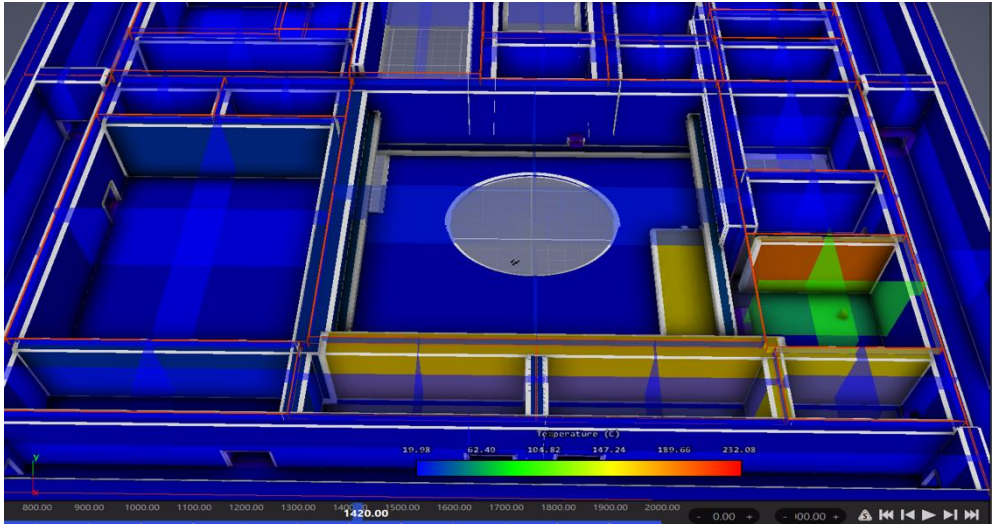
Aligns every stakeholder across the full plant life cycle.

Y STRONG FIT ACROSS LIFE CYCLE M CONDITIONAL

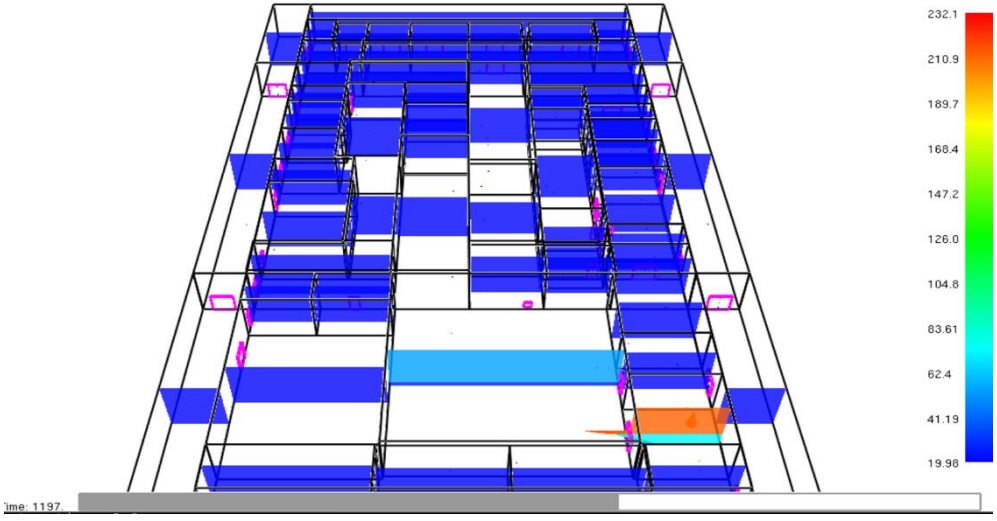
Multi-Compartment Fires.

Coupled CFD across rooms — full plant thermal and smoke propagation in a single FRI3D run.

3D PERSPECTIVE · t = 1420 s



PLAN VIEW · t = 1197 s



CAD BASED COMPARTMENT SEPARATION
Solve every compartment in one coupled run.

VENTS ACROSS COMPARTMENTS
Heat and smoke flow across room boundaries.

MULTIROOM SIMULATIONS + REPORTS
Equipment Failures + PRA Coupling

SAME DIGITAL ASSET, EVERY STAKEHOLDER

Why FRI3D ? : Benefits stakeholders reap

FRI3D	Other Tools + Current Methods
1. Most processes are automated	A lot of manual entries are needed
2. Intuitive user friendly UI	UI may or may not be present
3. Relational database to store models and info	Manual or non-relational database
4. Integrated CAD model capabilities	CAD modeling has to be done externally
5. Integrated FLASH-CAT, heat soak, THIEF methods for cable failures	Need manual post processing runs to determine cable failures
6. Integrated 3D visualization – helps understand the model	No integrated visualizations
7. Easy setup, get results accurately and quickly	Long process to setup the model
8. Visual troubleshooting	Manual troubleshooting
9. Requires minimal training for fire modeling	Requires exhaustive training
10. Automated processes for reducing user errors	Many manual steps may be involved
11. Integrated CFAST/ FDS and requires no model change for other fire codes	Each fire simulation code require a separate workflow
12. Integrated scenario visualization of fire scenarios with failures	Requires other codes and visualization tools
13. Automated reporting and dashboard tools	No dashboard and manual report

Almost as a by-product, the asset of a digital twin of the facility is created, for subsequent multi-purpose use.

We thank our partner ecosystem

INDUSTRY PARTNERS

RISK SPECTRUM

EPM an ONET company
Engineering Planning and Management, Inc.

newcleo
Futurable Energy

EXLEET EDGE

US GOVT PARTNERS

NREL

INL Idaho National Laboratory

U.S. DEPARTMENT OF ENERGY

U.S.NRC

RESEARCH PARTNERS

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

NC STATE UNIVERSITY

www.fri3d.com