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Using probabilistic fire response models to benchmark fire service interventions and fire protection strategies - Case study: the FRPAM model for CERN Future Circular Collider

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When designing a complex facility, project decision makers must cope with the problem of choosing among multiple fire protection packages and emergency response service models to guarantee the compliance to the safety goals and objectives. Passive and active fire protection measures can be costly thus requiring a thorough and solid justification.
Deterministic assessments, although widely used for these purposes, are limited due to the uncertainties tied to the cross-related parameters playing a role in the fire safety outcome. Fire Response Probabilistic Analysis Model (FRPAM) concerns a combination of probabilistic models spanning from the fire detection to the fire extinguishment encompassing sub-models for alarm notification, travel time, access configuration, compartmentalisation scheme, automatic fire suppression approach, fire ventilation strategy and the firefighting extinguishing time.
With the FRPAM model, different trial designs proposing alternative fire protection measures and emergency response deployments can be analysed looking at the time needed to extinguish the fire, the probable property loss or the total energy release. Probabilistic fire response models provide the cumulative distribution functions for these variables making it possible to draw sound conclusions on the suitability of different designs based on their performance. To illustrate the overall system, a case study based on the CERN Future Circular Collider is presented.

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