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WP6 - Thought for Eurocodes Upgrade

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Proposal for EN1991-1-2

Possible Annex on the selection of design fire scenarios

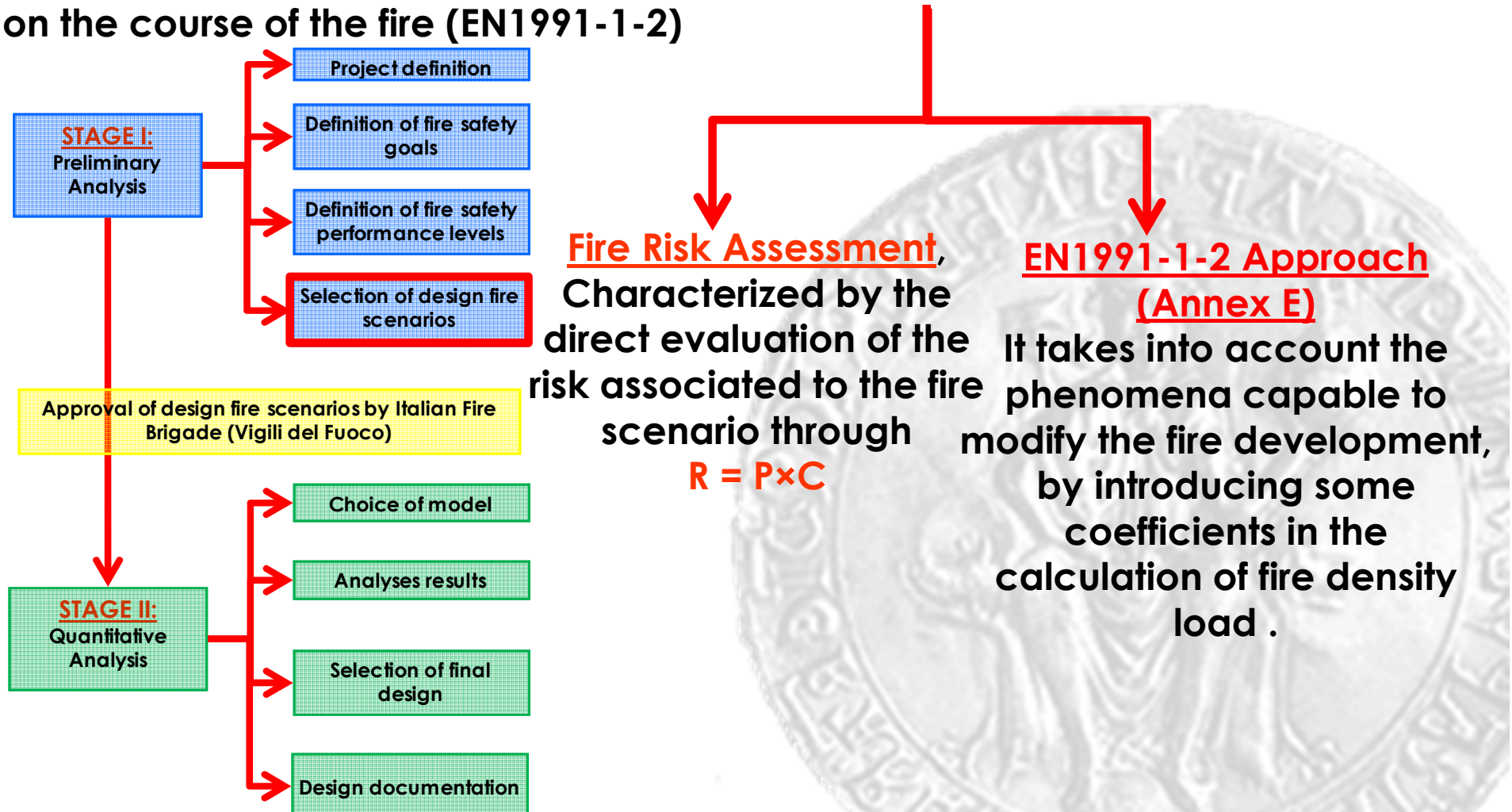
by Fire Risk Assessment (FRA) in FSE Approach

Proposals for improvement of Eurocodes based on local/European projects	
Eurocode: EN 1991-1-2	
Country	Italy
Proposers	E. Nigro, G. Cefarelli, I. Del Prete, A. Ferraro, D. Sannino
Subject	Selection of design fire scenarios through the Fire Risk Assessment (FRA) in FSE Approach
Clause No.	Update of Annex E or possible new Annex
Reasons for improvement	Traditional Eurocode approach, proposed in Annex E, concerns the mechanical resistance and stability of structures, with reference to a single fire event, in which the effective value of fire load is modified in a semi-probabilistic way by means of partial safety factors, in order to take into account the events that can affect fire development. In some cases studied the approach proposed in Annex E is not cautelative.
Proposed Changes	The identification of design fire scenarios can be carried out by means of Fire Risk Assessment, applying the event tree approach and the risk ranking evaluation according to ISO-16732 Guidelines. Different design fire scenarios may be related to different fire performance levels (e.g. resistance of structures for highest risk fire scenario and limited damage for the most probable fire scenario).
Status of the proposal (Finished/in progress)	In progress.
Is the proposal being considered on the Evolution Group of this part of the Eurocode? (Yes/No)	No
Was the proposal studied in the framework of a project? (If yes, reference, title, and Local/European project)	No
References (background information)	1) E. NIGRO, G. CEFARELLI, A. FERRARO, I. DEL PRETE, D. SANNINO, G. MANFREDI. <i>Application of Structural Fire Engineering to an Italian Tall Office Building</i> . 7th International Conference on Structures in Fire (SIF'2012), Zurich, Switzerland, June 6-8, 2012, p. 13-22. Editors: M Fontana, A. Frangi, M. Knobloch. Printed and bound by ETH Zurich. DOI: 10.3929/eth-a-0070501097. 2) DEL PRETE I., CEFARELLI G., FERRARO A., NIGRO E., SANNINO D., <i>Selection Criteria of Fire Scenarios for Buildings</i> , XXIV Italian Conference on Steel Constructions, Turin (ITALY), 30 Sept-02 Oct. 2013.

Selection of Design Fire Scenarios through Fire Risk Assessment

Fire Scenario

qualitative description of the development of a fire with time identifying key events that characterise the fire and differentiate it from other possible fires. It typically defines the ignition and fire growth process, the fully developed stage, decay stage together with the building environment and systems that will impact on the course of the fire (EN1991-1-2)



Selection of Design Fire Scenarios through Fire Risk Assessment

Fire Risk Assessment procedure

1. identification of a comprehensive set of possible fire scenarios;
2. estimation of **probability of occurrence** of each fire scenario;
3. estimation of the **consequence** of each fire scenario;
4. estimation of the **risk** of each fire scenario (combination of the probability of a fire and a quantified measure of its consequence);
5. **ranking of the fire scenarios** according to their risk.

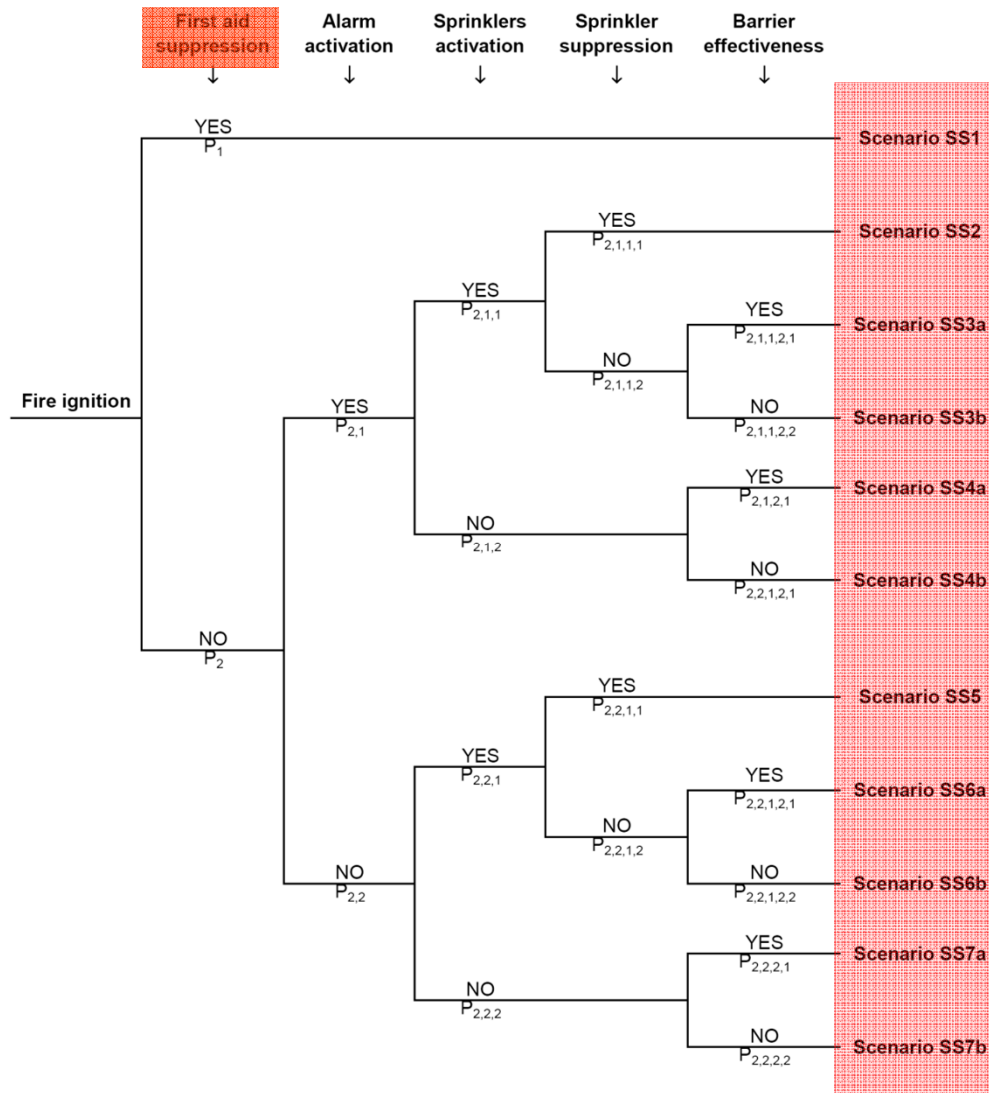
➔ **Event tree** time-sequence path from the initial condition through a succession of intervening events to an end-event.

Technical references

- ISO/TS 16732: “Fire safety engineering – Guidance on fire risk assessment”. Draft 2010.
- ISO/DS 16733: “Fire safety engineering - Selection of design fire scenarios and design fires”. 2005.

Selection of Design Fire Scenarios

Main events:



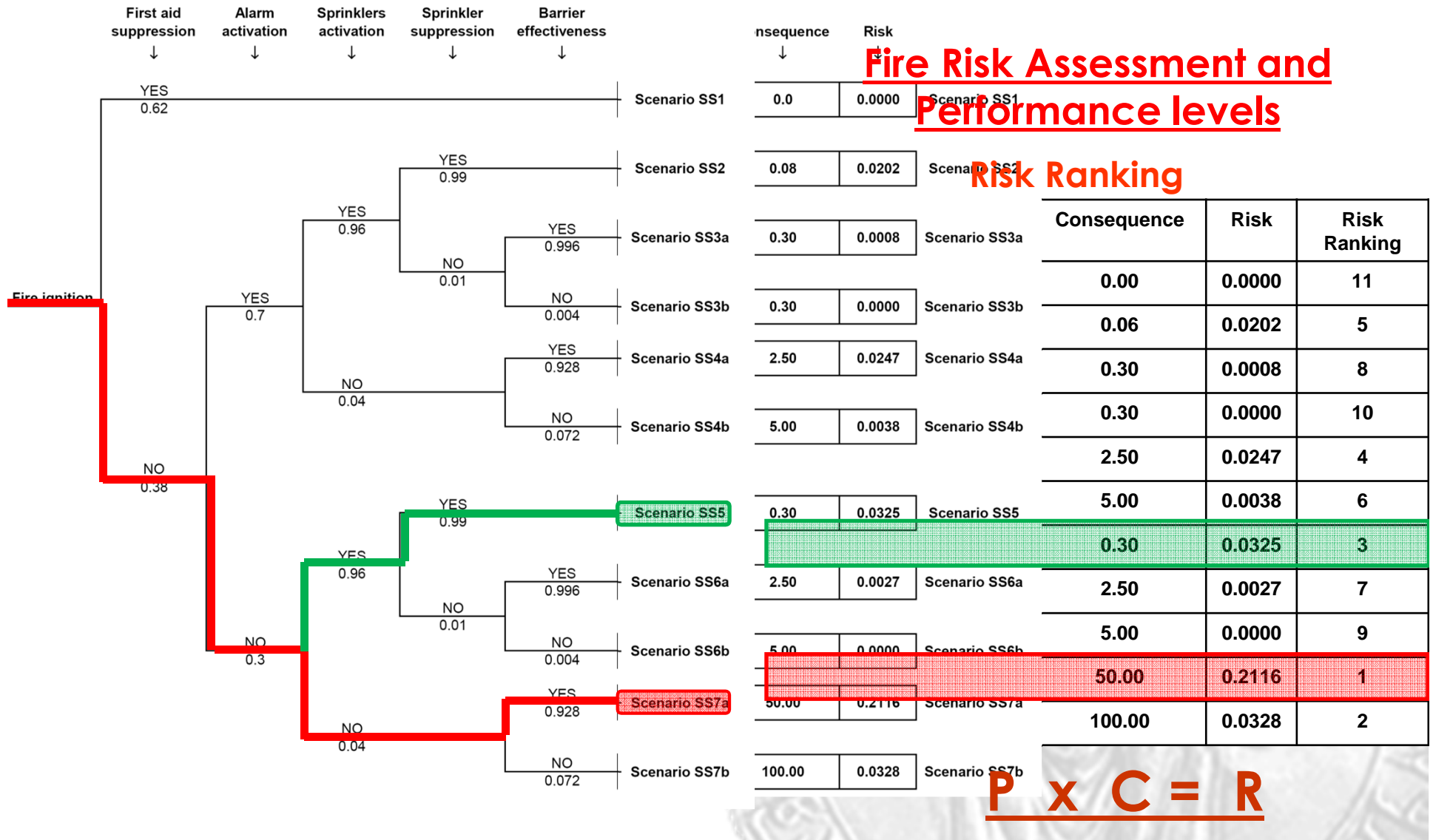
Secondary events:

- ✓ doors state (open or closed)
- ✓ windows state (open or closed)

may be taken into account by the fire model

Probability of occurrence of each event and consequence value of each fire scenario are obtained both by direct estimation from available data and engineering judgment.

Case Study: Design Fire Scenarios definition



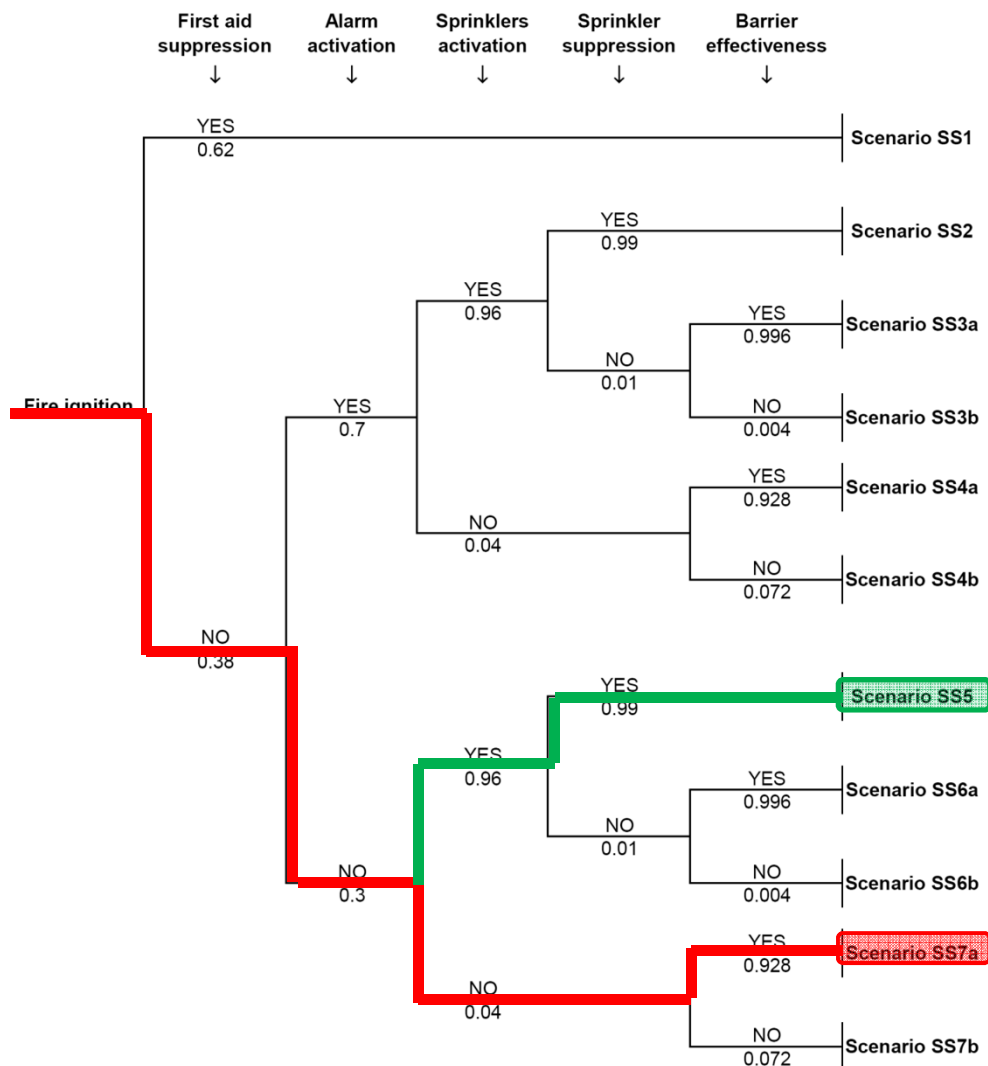
Performance Level IV : limited damage

Performance Level III : resistance for all fire exposure time

Fire Safety Performance Levels

Fire Safety Goals

The main objective of fire safety checks concerns the mechanical resistance



Performance levels

Highest risk scenario

High probability scenario

Performance Level III

maintaining the **fire resistance** requirements, which ensure the lack of partial and/or complete structural collapse, for a **sufficient time in terms of emergency management or for the entire duration of the fire**

Performance Level IV

limited damage of the structures after fire exposure

Conclusions and proposal

➤ Fire Safety Engineering, according to european codes, allows to define the safety goals and different performance levels associated to different fire scenarios

➤ The choice of the design fire scenarios may be carried out through two possible procedures:

- the Fire Risk Assessment
- EN1991-1-2 (Annex E) Approach

➤ **the Fire Risk Assessment should be the reference approach for the most accurate selection of the design fire scenarios, also because it has enable to associate different performance levels to different group of fire scenarios .**

Thanks for your attention

