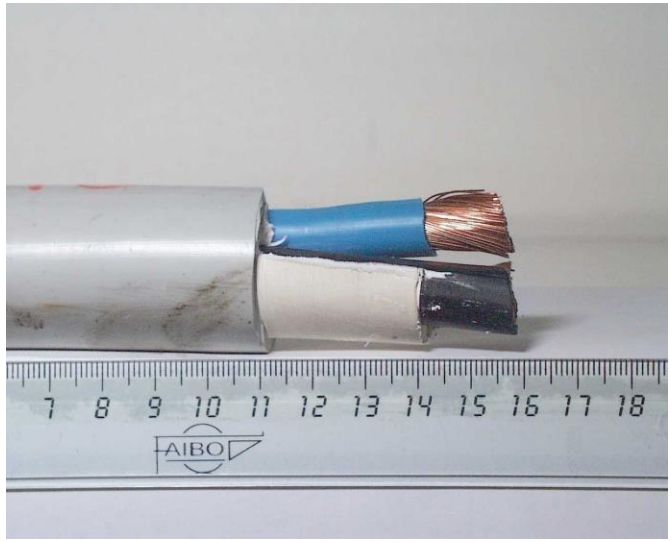
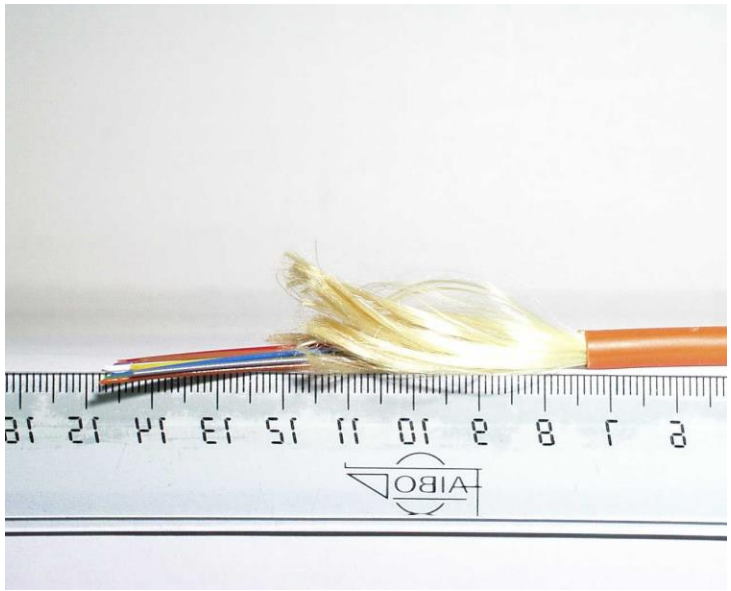
Research – Cable Fires

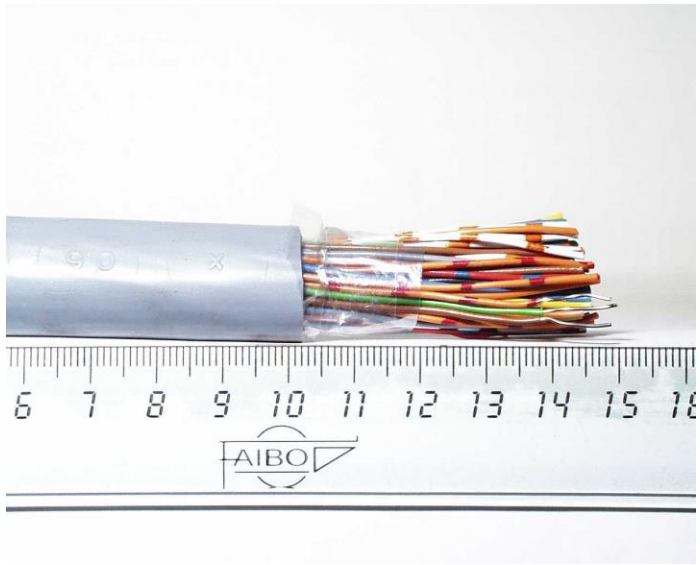
John Barton and Patrick van Hees

Content

- Diversity of Cables
- Fire spread of cables and design fires
  - Previous research – FIPEC
  - New activities for NPP
- Hypoxic air venting
- Conclusions



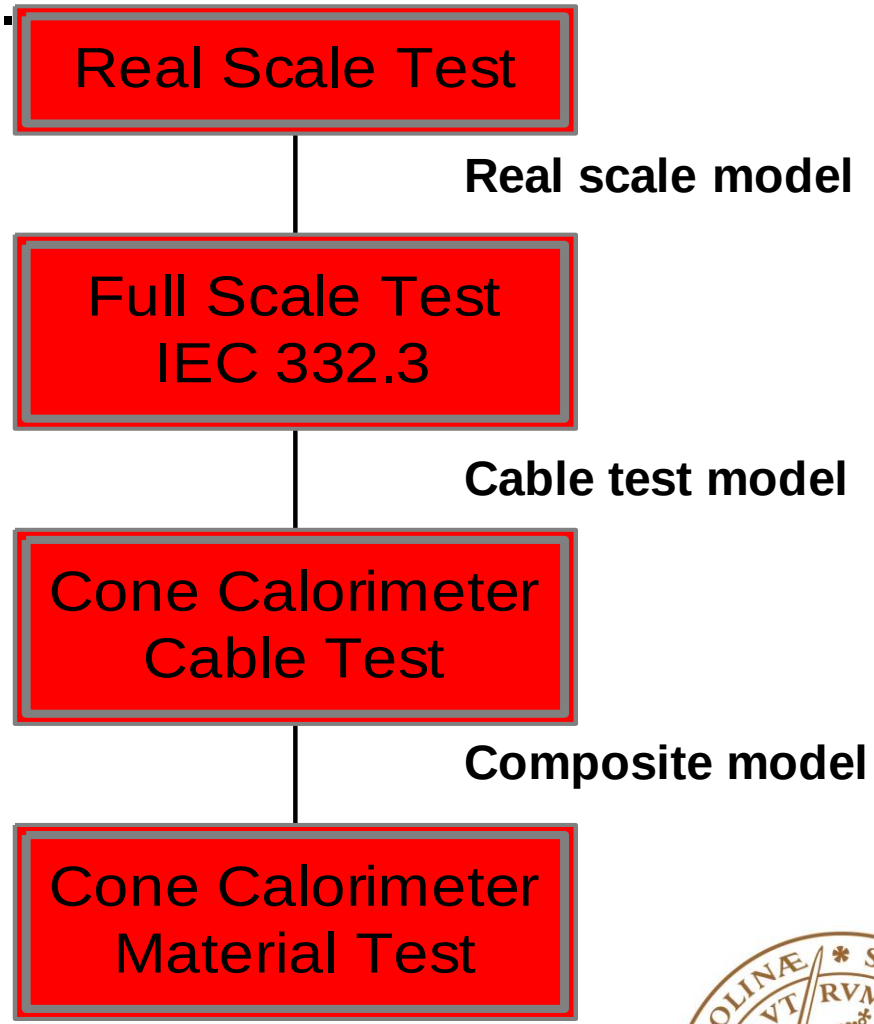




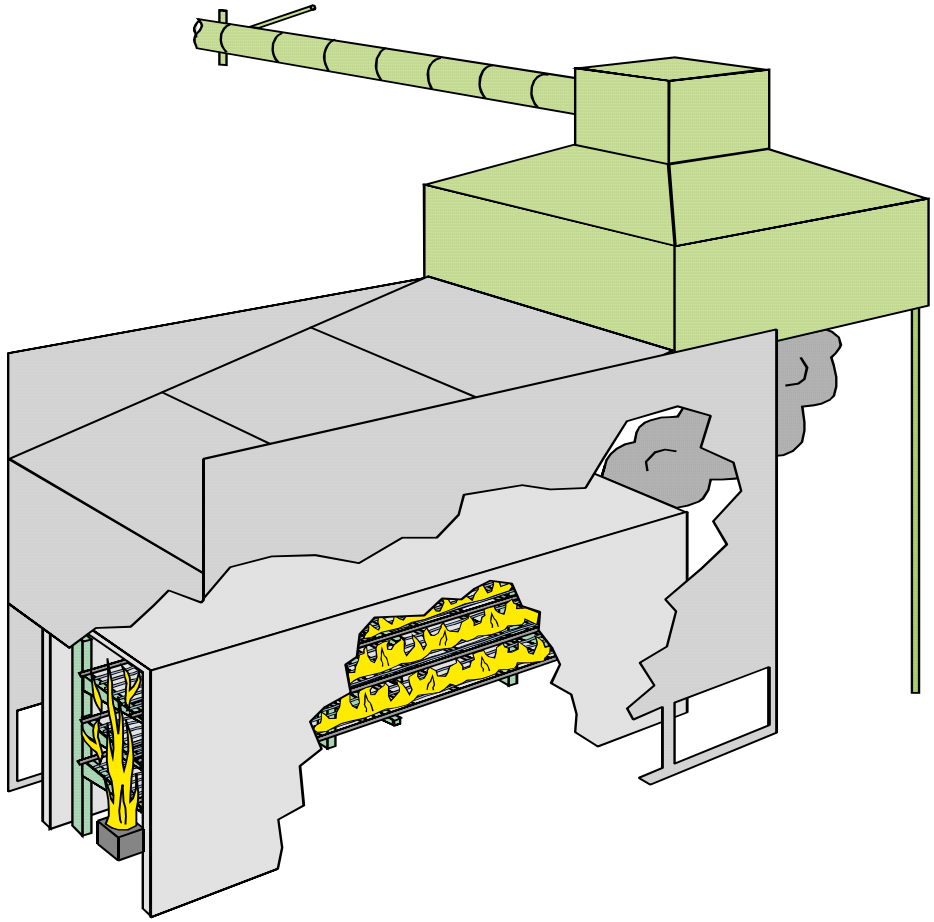
Fire spread of cables – FIPEC project

- Database with real scale cables.
- Database of small scale tests
- Conducted as EU project
- Basis for Euroclasses
- Models for material and cable prediction cables
- Published as a book
- Available www.interscience.com

- Four levels of tests
- Improvement of tests if necessary
- Modelling or correlation studies between the different levels of testing

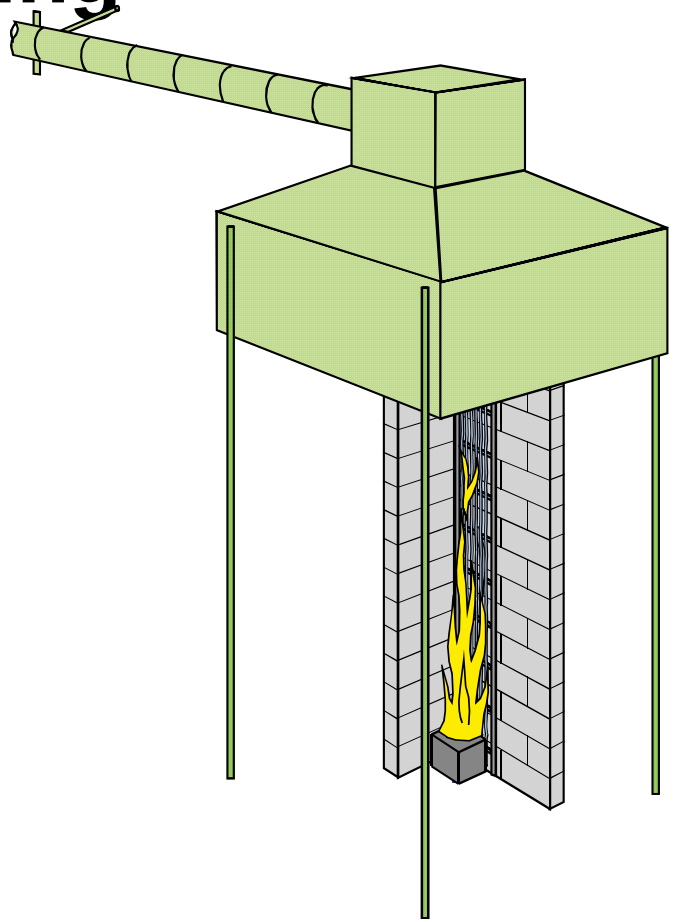


Choice of Horizontal Set-up for Data Base



- Closed configuration
- 40-100-300 kW sand box burner
- 3 trays with 4 m of cables
- Mounting with spacing

Choice of Vertical Set-up for Data base testing



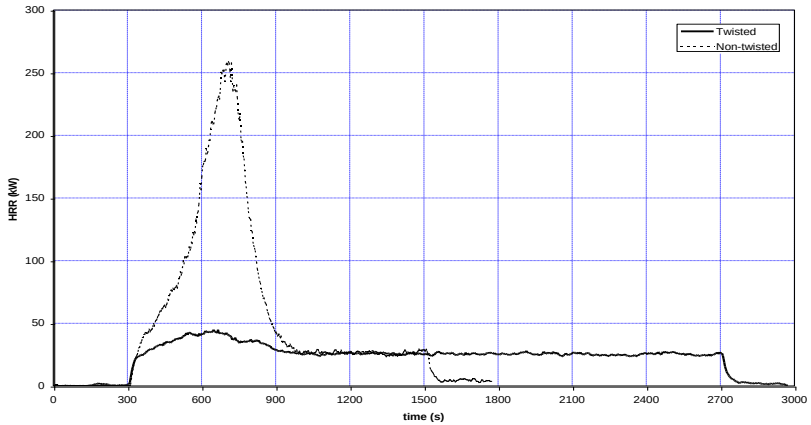
- Semi - Closed configuration (corner)
- 40-100-300 kW sand box burner
- 1 ladder with 4 m of cables
- Mounting with spacing

Full scale testing

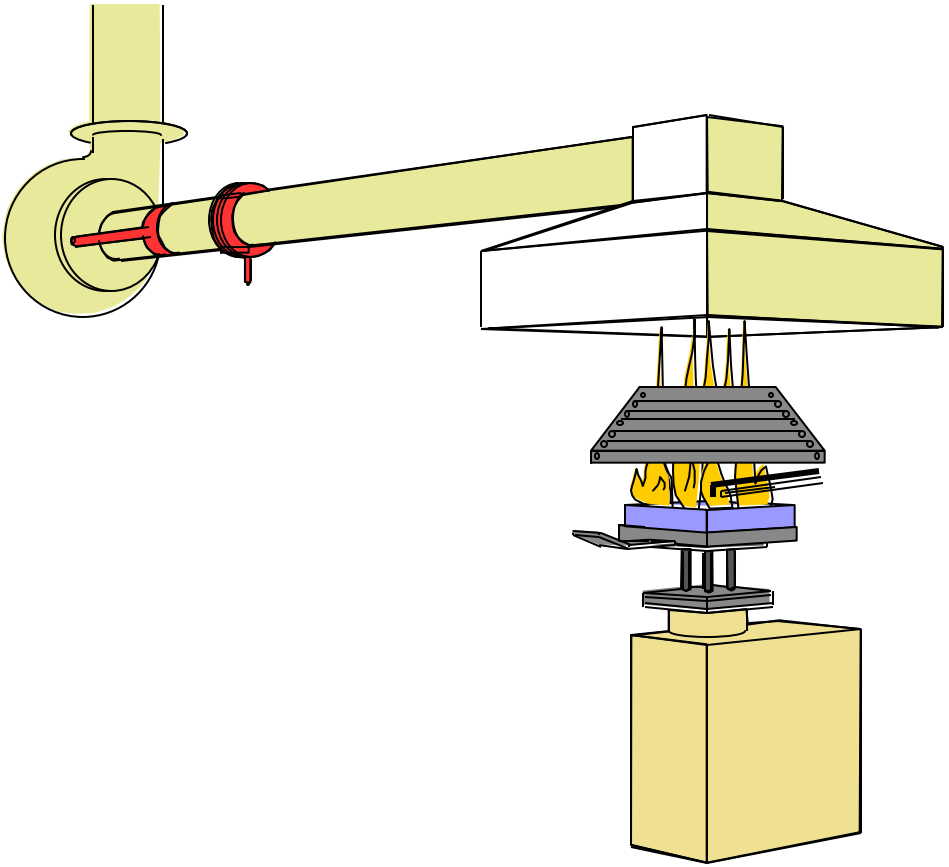
- based on IEC 332.3 (60332.3) test
- HRR and Smoke measurements included
- sensitivity study to improve IEC 332.3 test
- database tests on selected cables
- Test used for Euroclasses

Summary Sensitivity Mounting

- Spacing is more severe than non spacing for larger diameters
- Spaced bundles are more severe for smaller cables
- Increasing loading by more layers does NOT make the test more severe by definition
- Mounting is a DOMINATING factor in the flame spread of cables



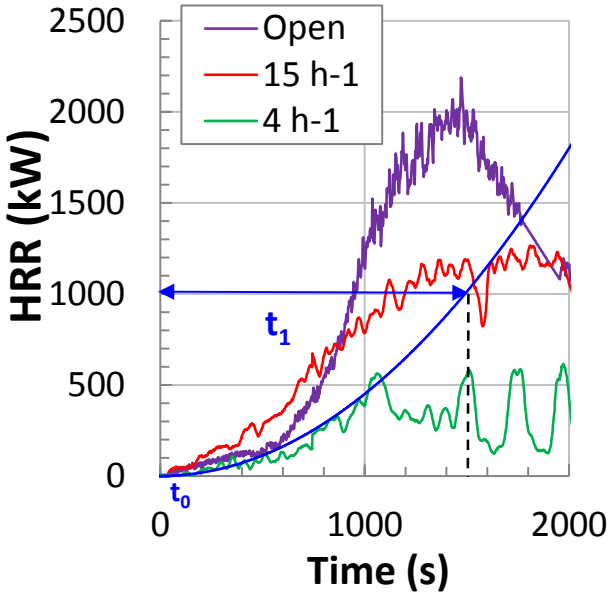
Cone calorimeter testing



- development of a test procedure for cables and cable materials
- cable materials were tested as composites and as single materials
- data base tests on selected cables

New activities – Design fires for NPP

- Develop database and method to define the design fire for cables.
- Integration of other project such as:
  - NIST/NRC project: Christchurch project – room tests
  - PRISME2 project – Ventilated rooms



Important factors for flame spread

- Geometry
- Mounting
- Type of cable trays
- Amount of cables
- Ventilation
- Properties of cables.
- …

Methods for design fires

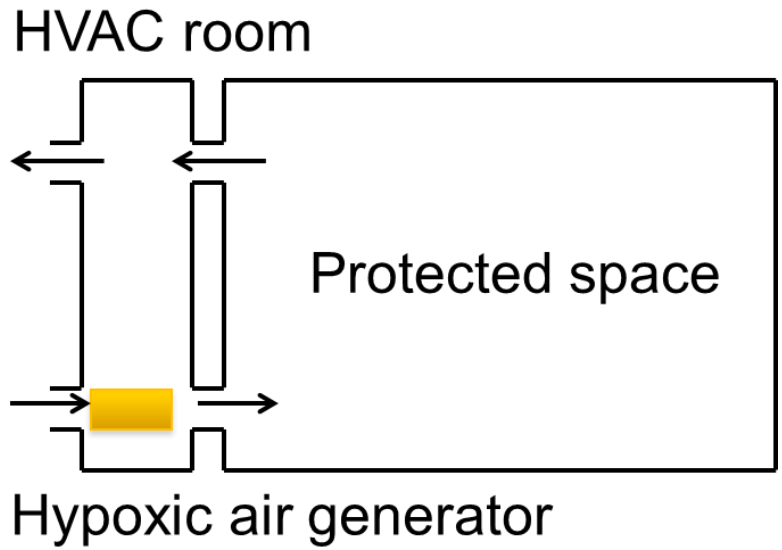
- Simulations tools
- Virtual experiments – PhD and Lic. Thesis Nils Johansson
- Probabilistic methods in order to define average growth factors and their distribution:
  - Nilsson, Martin; Johansson, Nils; Van Hees, Patrick; A New Method for Quantifying Fire Growth Rates Using Statistical and Empirical Data Applied to Determine the Effect of Arson, 11th International Symposium on Fire Safety Science, 2014, International Association of Fire Safety Science.

Hypoxic air venting

- Pre-study performed for SSM (Swedish nuclear regulators)
- Resulted in a lic. thesis of Martin Nilsson and publication in Fire and Materials.
  - Nilsson, Martin; Hees, Patrick; Advantages and challenges with using hypoxic air venting as fire protection,Fire and Materials,38,5,559-575,2014,
- New project will look into material behaviour at lower oxygen levels

Hypoxic air venting operation

- Nitrogen added to protected space
- Oxygen concentration lowered to 15% by volume
- Personal protective equipment not needed



Hypoxic air effects

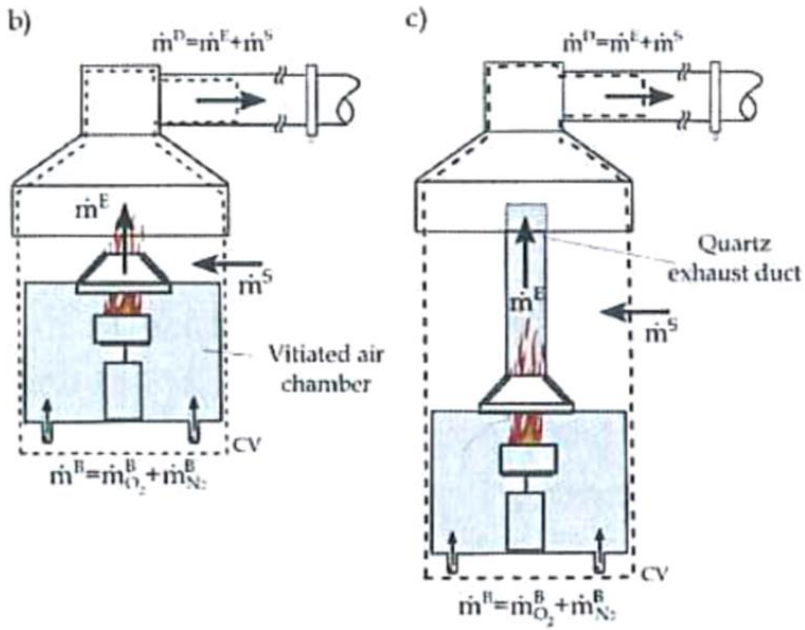
- Reduces flame temperature and soot volume fraction of flame
- Fire size and flame spread rate reduced
- Ignition time can be increased
- CO yield increases
- Effect on smoke yield varies

Hypoxic air venting standards

- PAS 95:2011
- VdS 3527
- Particleboard passed test in normal atmospheric air

Future hypoxic air venting research

- Open controlled atmosphere cone calorimeter
- Investigating behavior of different materials
- Composite materials



Conclusions

- Mounting is important for flame spread and makes it difficult to develop design fires
- Hypoxic air venting is a promising technique but is only a replacement for extinguishment if low levels are used.

LUND UNIVERSITY

http://www.brand.lth.se