

Fire Protection in Rolling Stock – Blessing or Curse?

How compensation can help solving problems!

IFAB

Different Business Units

- **Consulting**
 - Rail Safety
 - Tunnel & Underground Safety
 - Fire Protection Concepts
 - Reliability Consideration
- **Fire & Smoke Testing**
 - Large Scale Tests
 - Smoke Tests
 - Laboratory
 - Measurements & Methods
- **Training**
 - Designers
 - Consultants
 - Fire Fighters
 - Customers

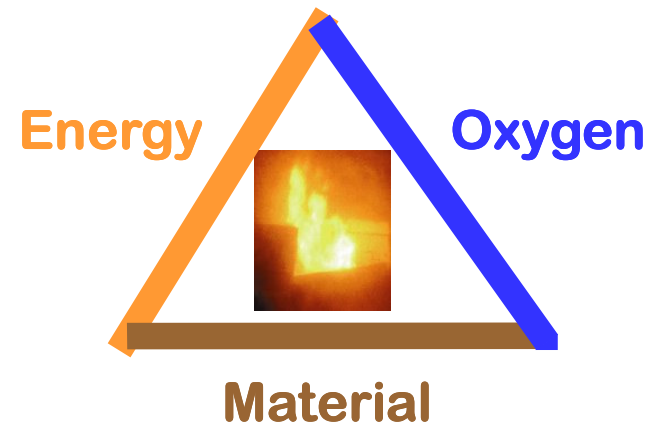


Content

- **Fire risk analysis / fire safety concepts**
- **Compensation according to standards**
- **Compensation examples using active fire protection**

Fire safety concepts for Rail Vehicles

- Description of vehicle
- Protection aim
 - Protection of persons
 - (Protection of materials for help of protection of persons)
 - (Protection of material)
- Fire Risk analysis



Fire safety concept for Rail Vehicles

- **Measures (fire safety concept)**
 - Preventive measures
 - Measures for avoidance of fire spread
 - Measures for maintenance of performance
 - Measures for fire fighting

Fire safety concept for Rail Vehicles

- **Evacuation and rescue**
- **Annexes**
 - **Material certificates**
 - **Verification of compliance with appropriate standards**
 - **Drawings**
 - **Maintenance instruction, information...**
 - **Training information regarding fire safety**
 - **Approval and mode of operation protocols**
 - **Fire risk analysis**
 - **Etc.**

Fire safety concept for Rail Vehicles

- **Basis for fire safety concepts are built by regulations, specifications (like protection aims) and risk analysis.**
- **Where requirements according to regulations can not be completely fulfilled compensation measures get more and more important.**

Compensation

Measure that ensures the same level of protection than with standard measures required by guidelines or state-of-the-art.

Example active fire protection systems:

New projects:

- Use of active fire protection measures to compensate other fire protection measures, like materials.

Existing / refurbishing projects:

- Possibility of using existing fire protection measures, but to fulfill recent state-of-the-art by implementing active fire protection measures to compensate rebuilding of vehicles / stations.

In every case a so called “evidence of equal safety” compared to standard requirements has to be provided.

Compensation measures according to TSI's

- Clear statement of compensation measures in TSI LOC&PAS → fire barriers can be compensated by appropriate measures.
- In TSI SRT and TSI HS RST no compensation measures implemented yet, but in Common Safety Methods (CSM) (EC No. 352/2009) evidence of equal safety is implemented → risk analysis.

Compensation measures

FIRE BARRIERS (according to TSI LOC&PAS)

Category B fire safety rolling stock shall comply with both of the following requirements:

“Fire spreading prevention measures (FSPM) shall ensure that fire and smoke will not extend in dangerous concentrations over a length of more than 28 m within the passenger/staff areas inside a unit, **for at least 15 minutes after the start of a fire.** The equipment to satisfy this requirement shall be installed in each vehicle and shall provide at least the same level of safety to persons on board as full cross section partitions, with integrity of 15 minutes. If full cross section partitions are used, the assessment method shall be in accordance with the requirements of EN 1363-1:1999 partition test and assuming the fire can start from either side of the partition. **If the FSPM in the unit do not include full cross section partitions within the passenger/staff areas, the safety level on board shall be demonstrated by comparative analysis between full cross section partition and the FSPM chosen.** If this demonstration is done with the help of computational fluid dynamics (CFD) simulations, these simulations shall be validated by 1:1 tests conducted on a model representing the circumstances applicable to the unit which is subject to TSI assessment. In the determination of the safety level, the reliability and availability of the FSPM, as well as the accuracy of the demonstration method, shall be taken into account.”

Compensation according to other regulations

TS 45545

- No explicit reference to compensation measures
- But enquiries were sent to CEN and CENELEC (from Germany)

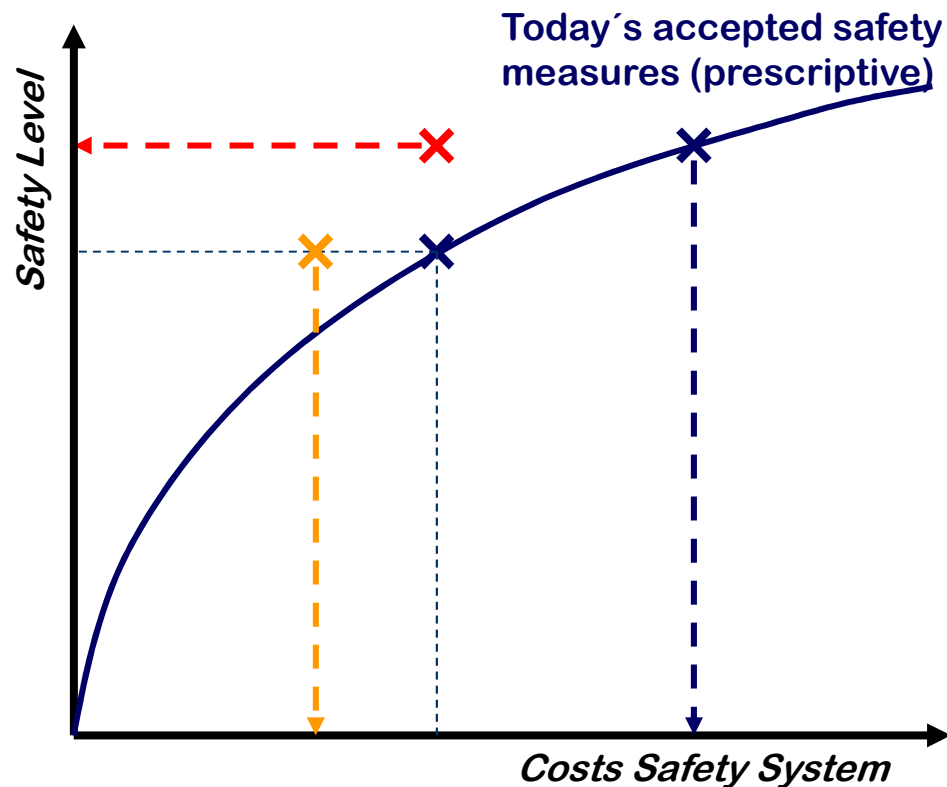
EBO

- If at least evidence of equal safety can be provided recognised codes of practice can be neglected

EBA „Leitfaden“

- If at least evidence of equal safety can be provided recognised codes of practice can be neglected

Compensation: Costs vs. Safety Level



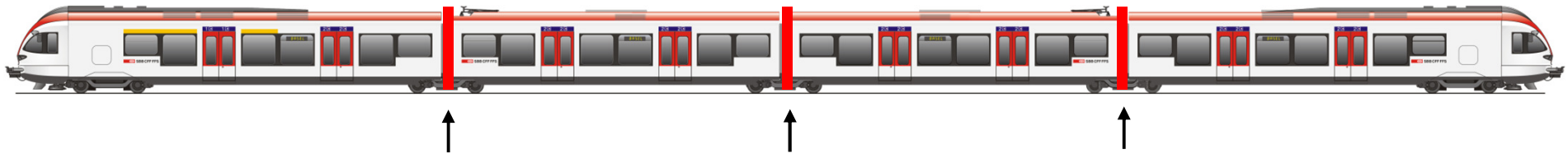
Today: prescriptive based model:

Increasing Safety Level → higher costs

Increasing Safety Level → same costs

Same Safety Level → less costs

Compensation - Example FLIRT (Stadler)

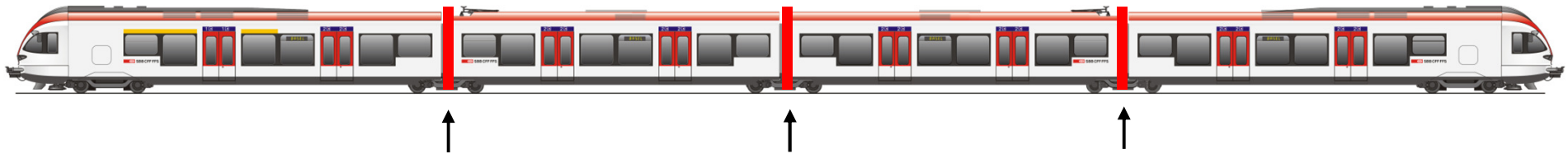


In regard to the existing guidelines, this train has to fulfill one of the Highest fire protection classes for German approval, caused by long tunnels.

That means higher requirements on materials (non flammable), for the evacuation concept, the running capability and implementation of fire barriers.

These requirements are coming from DIN, NFF, UNI, TS, EN and the new european law TS1.

Compensation - Example FLIRT (Stadler)



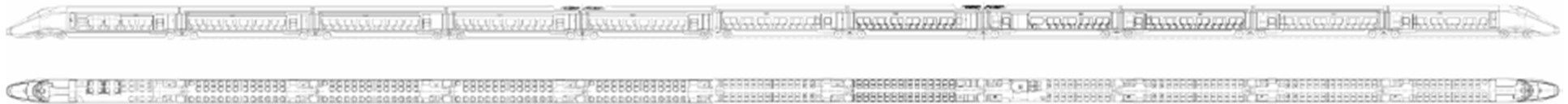
Result:

- More weight by fire barrier doors, appr. 300 kg each fire barrier
- More costs for higher performance of the materials and more costs for material testing
- Wish to have an open train with wide gangways from beginning to the end could not be fulfilled
- No standard to improve running capability

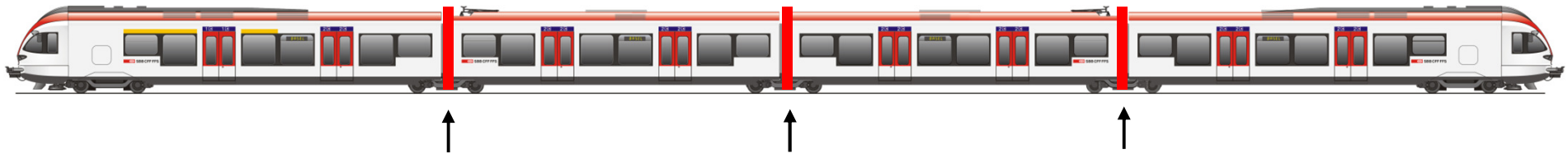
And now think about



- 4 cars
- 5 cars
- 6 cars
or
- 11 cars



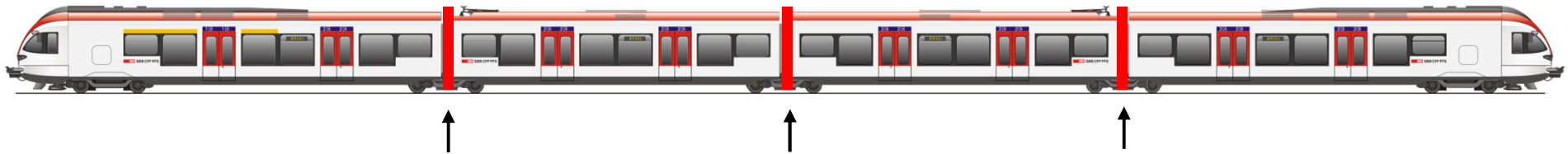
Compensation - Example FLIRT (Stadler)



Implement a fully validated fire protection system (FOGTEC system), that

- 1) Detect a fire fast enough for safety reasons without the risk of losses in availability
- 2) Suppress the fire to ensure a safe atmosphere for the people around to realise the transport to the next evacuation place

Compensation - Example FLIRT (Stadler)



Result:

- The fire barriers could be avoided (- 900 kg), so positive effect to weight management
- Additional space available for people and also better evacuation times
- The manufacturer could reduce requirements on materials
- The manufacturer could simplify the evacuation concept
- Positive effect to costs
- More possibilities regarding design purposes

Compensation - Example EVAG

Problem:

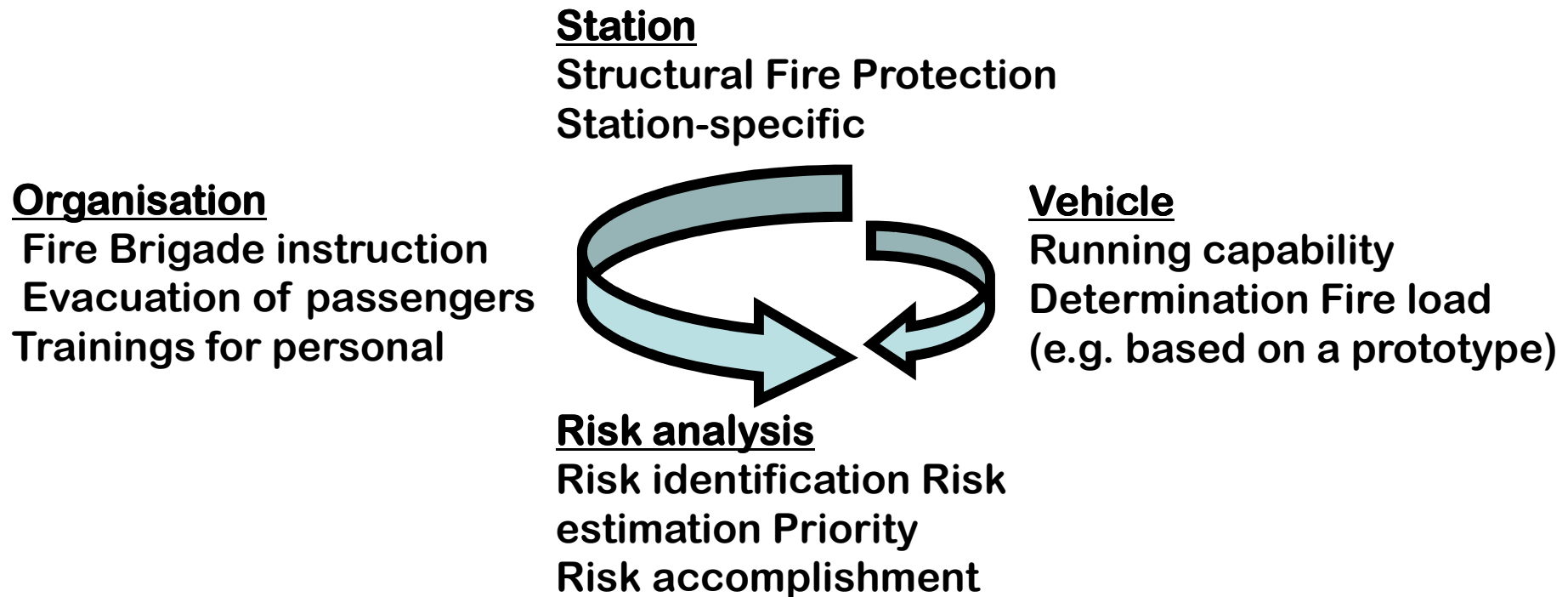
- Stations are 30 to 40 years old and the to be realised measures are related to extreme efforts and costs.

Compensation idea:

- Reduce the given scenario by active measurements on board, in this case with a fire detection and fire suppression system.

Compensation - Example EVAG

Underground traffic facilities require a coordinated concept of fire-safety measurements



Compensation - Example EVAG

EVAG in numbers

- 35 underground stations
- 29 km underground railway lines
- > 130 tramlines or light rail vehicles



M-Vehicles

Type of wagon 1500 (low-floor vehicles)



B-Vehicles

Type of wagon 5000 - 5100



Dockland-Vehicles

Type of wagon P86 und P89



M-Vehicles

Type of wagon 1000 – 1100 - 1400



Source EVAG

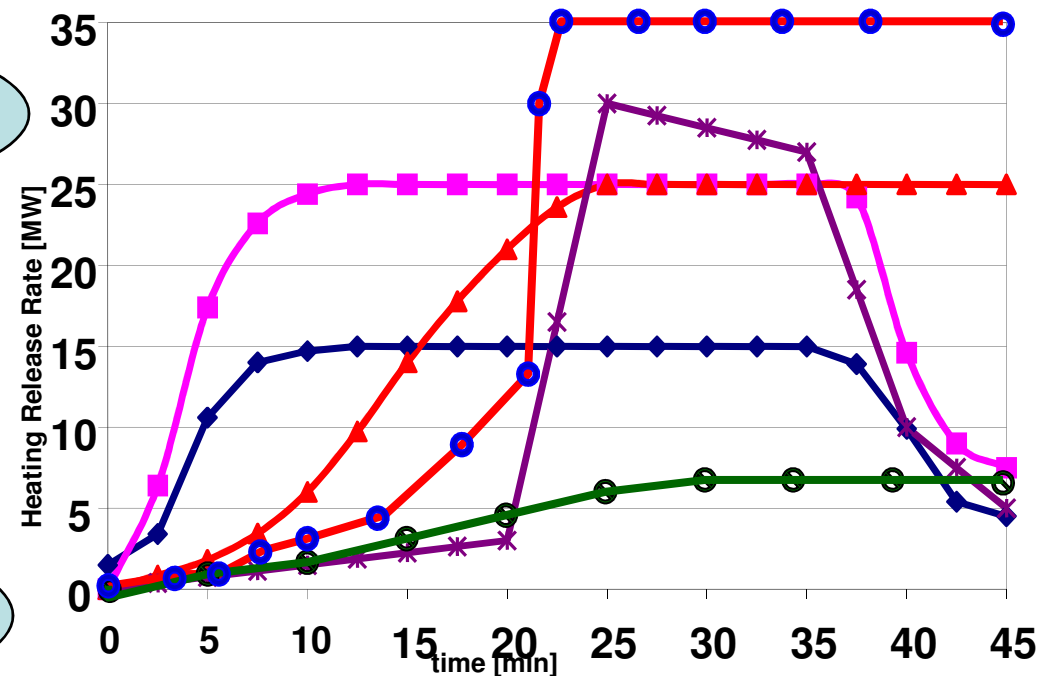
Compensation - Example EVAG

Basis for the extent of the Fire Protection measurements in underground stations of the EVAG are the Fire tests conducted by EVAG

Keeping the Fire into control during a vehicle fire in an underground / tunnel

Avoid Flash Over during the self-rescue time (15 min.) and the rescue time of the Fire Brigade (30 min.)

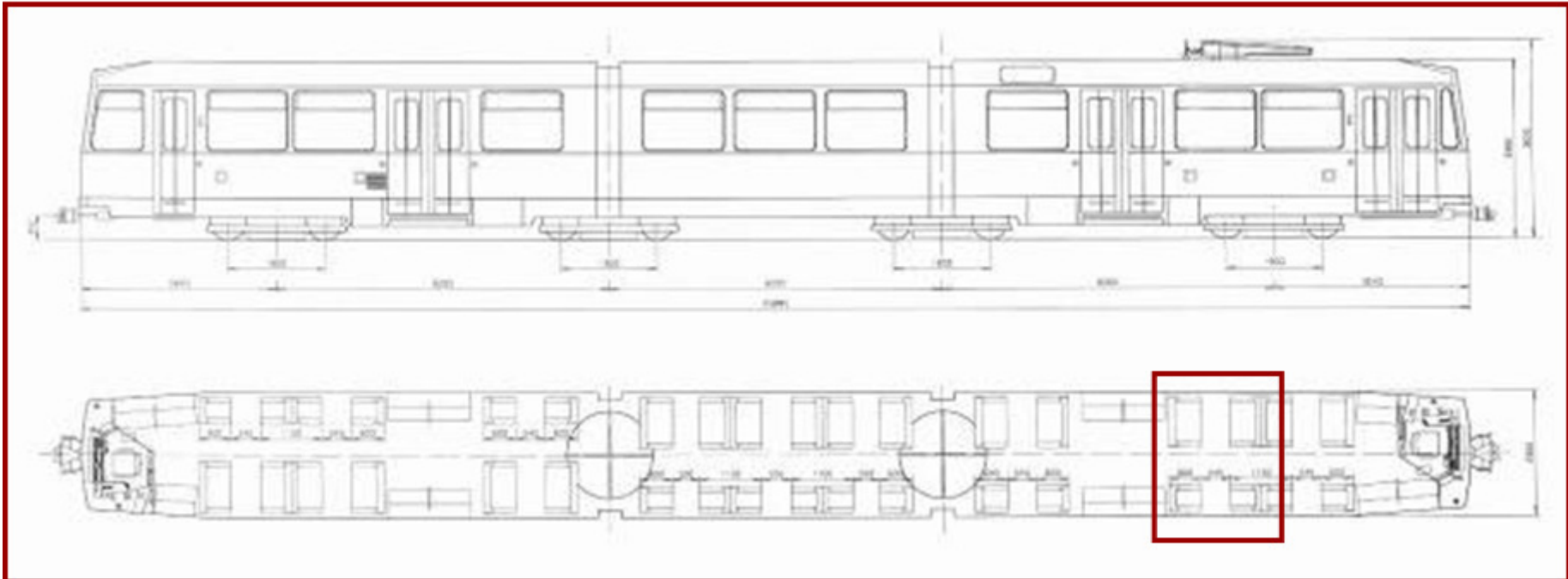
a vehicle fully burning reaches the maximal temperature release after 25min



Source EVAG

Compensation - Example EVAG

Transfer from reality to 1:1 full scale test

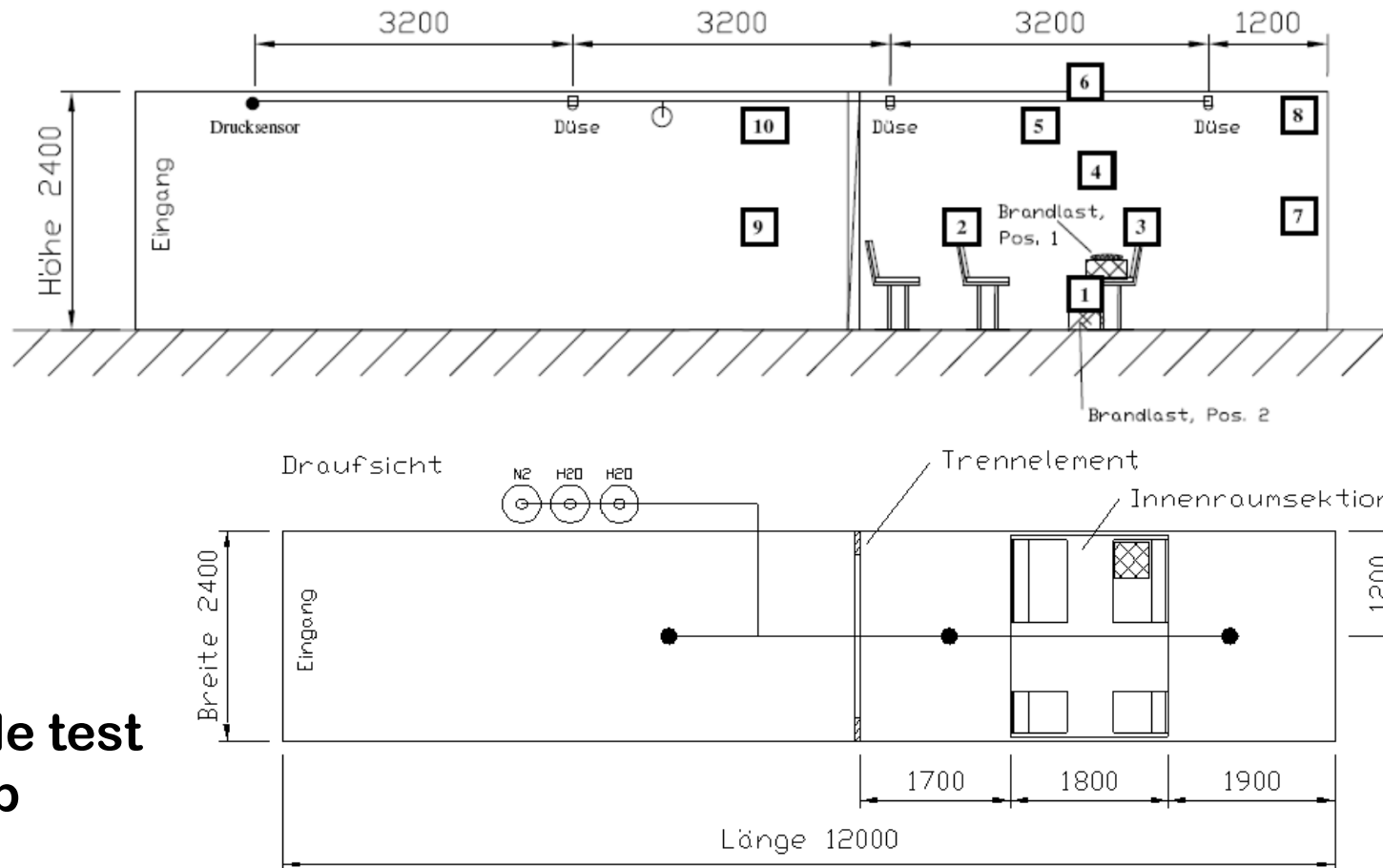


Compensation - Example EVAG



Construction of a 1:1 mock-up

Compensation - Example EVAG



**Full scale test
Mock-Up**

Compensation - Example EVAG

Bag ignited by UIC cushion on a seat with activation of HPWM



- Reduced impact on the bag
- Low impact on seats
- No impact on surrounding equipments



Source: FOGTEC

Compensation - Example EVAG

Bag under the seat with activation of HPWM



- Low impact on surrounding equipments
- No Fire expansion



Compensation - Example EVAG

Bag ignited by UIC cushion on the seat without activation of HPWM



- Fire expansion to surrounding equipments in a really short time
- Big smoke generation
- After 6 min: Fire expansion to the vehicle structure

Compensation - Example EVAG

Fire test without the activation of the system

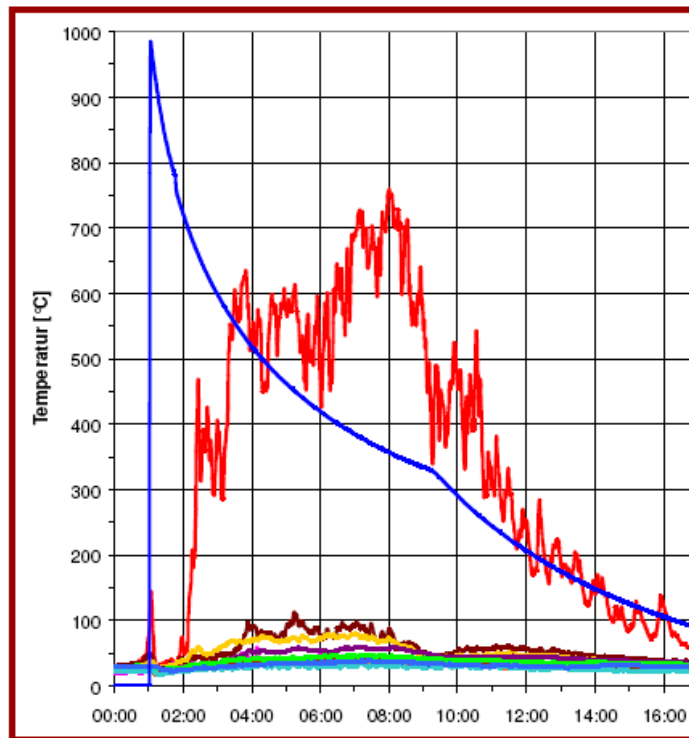


**Test abruption
after 11 minutes!**

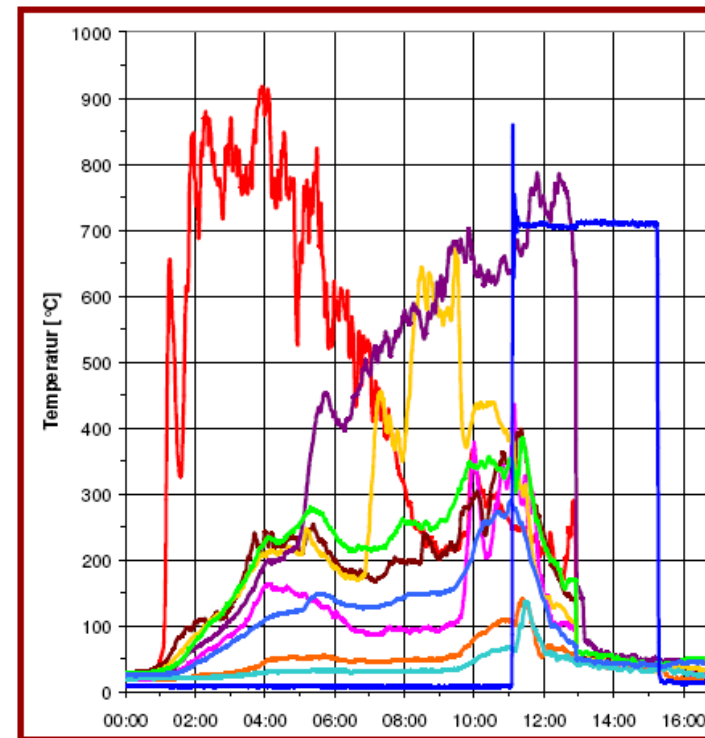
**Strong destruction of the
Mock-up**

Compensation - Example EVAG

Fire expansion with and without High Pressure Water Mist System (bag on the seat)



bag with active HPWM



bag without activation of HPWM

Compensation - Example EVAG

Evaluation after Fire Tests



Considerable limitation of the temperature in passenger area

Fire progression at the end of the activation time marginal

Fire limited by the Fire Protection System

Significant differences with / without Fire Protection System

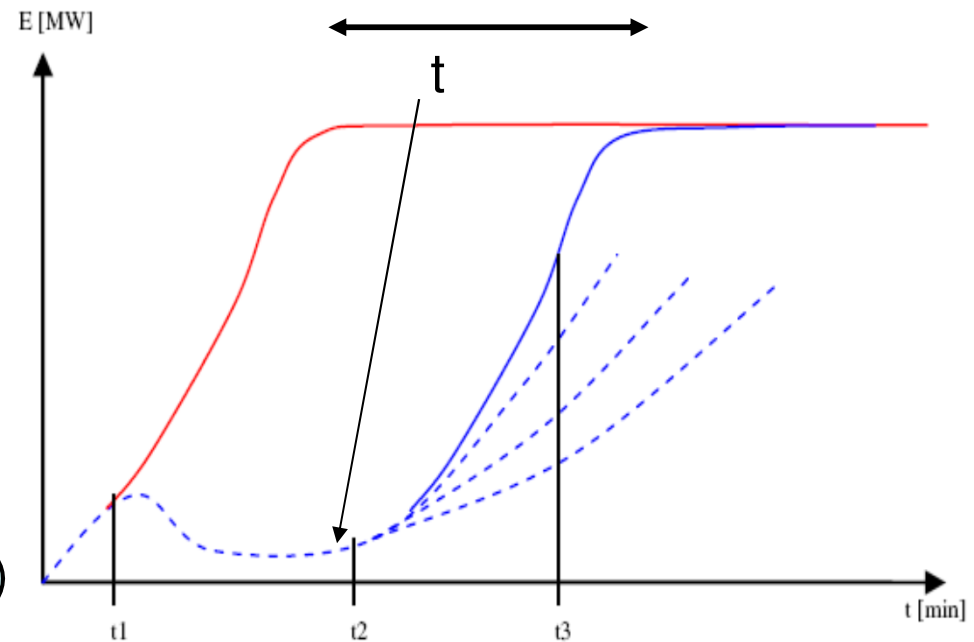
Compensation - Example EVAG

Evaluation of the Fire scenario on EVAG-Infrastructure side with active Fire Protection System on vehicle

Passenger area protected with a Fire Fighting System

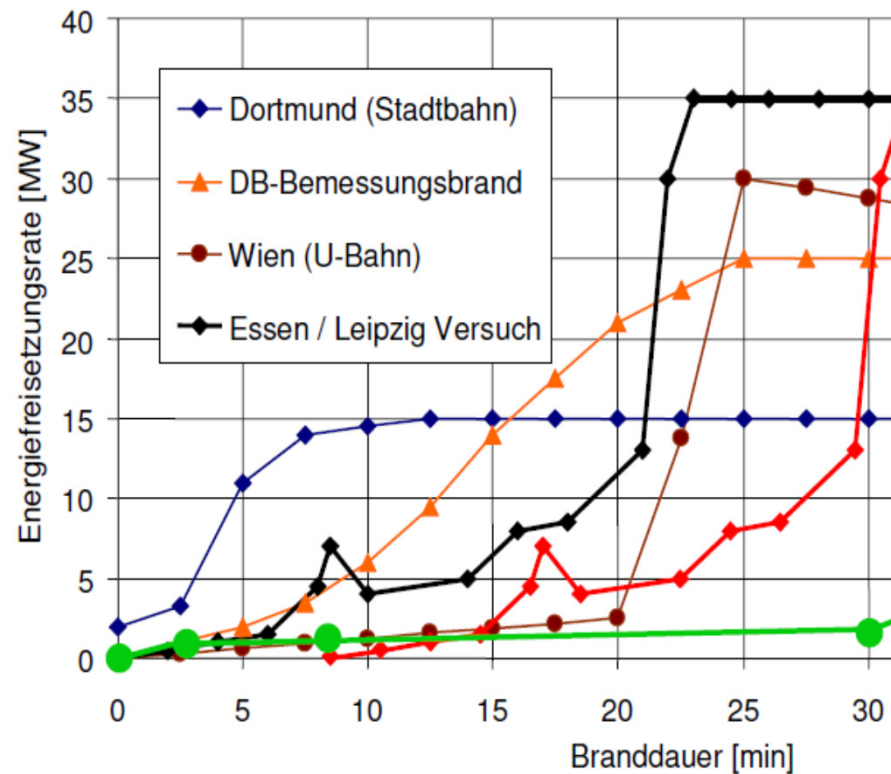
Assessment of efficiency of the Fire Fighting System based on ARGE Directives (Fire Fighting)

The Fire Fighting System is directly triggered by the Fire Detection System according to ARGE Directive (Fire Detection)



Compensation - Example EVAG

Reduction of HRR from 35MW to 3MW!



Summary

- It is necessary to implement compensation measures into standards, regulations etc. to built the basis for specifications.
- Onboard systems give the possibilty of new design aspects, like open gangways.
- Onboard systems give the possibility to save weight by compensating e. g. fire barrier doors.
- Protection objectives and economical efficiency to be adapted based on the considered system (e.g. vehicles, tunnel, underground).
- High Pressure Water Mist systems on underground trains realise a significant limitation on Fire expansion.
- Adjacent to improvements of the infrastructure on underground stations (housing of staircases), onboard Fire Protection can be used as compensation measures!
- Vehicles with onboard Fire Protection systems ensures a global personal and material safety in tunnels and at stations and make modernisation (or new constructions) economically possible.

Thank you for your attention!

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