EUROPEAN SPALLATION SOURCE

Environment, Safety & Health (ESH)
An overview

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Engineering Days – 2015-06-02--03

www.europeanspallationsource.se

5 June 2015

Overview of presentation

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- Role and task for the ESH
- Organization
- Licensing and permits
- Occupational Health Safety (OHS)
- Fire Safety

ESH Role and tasks

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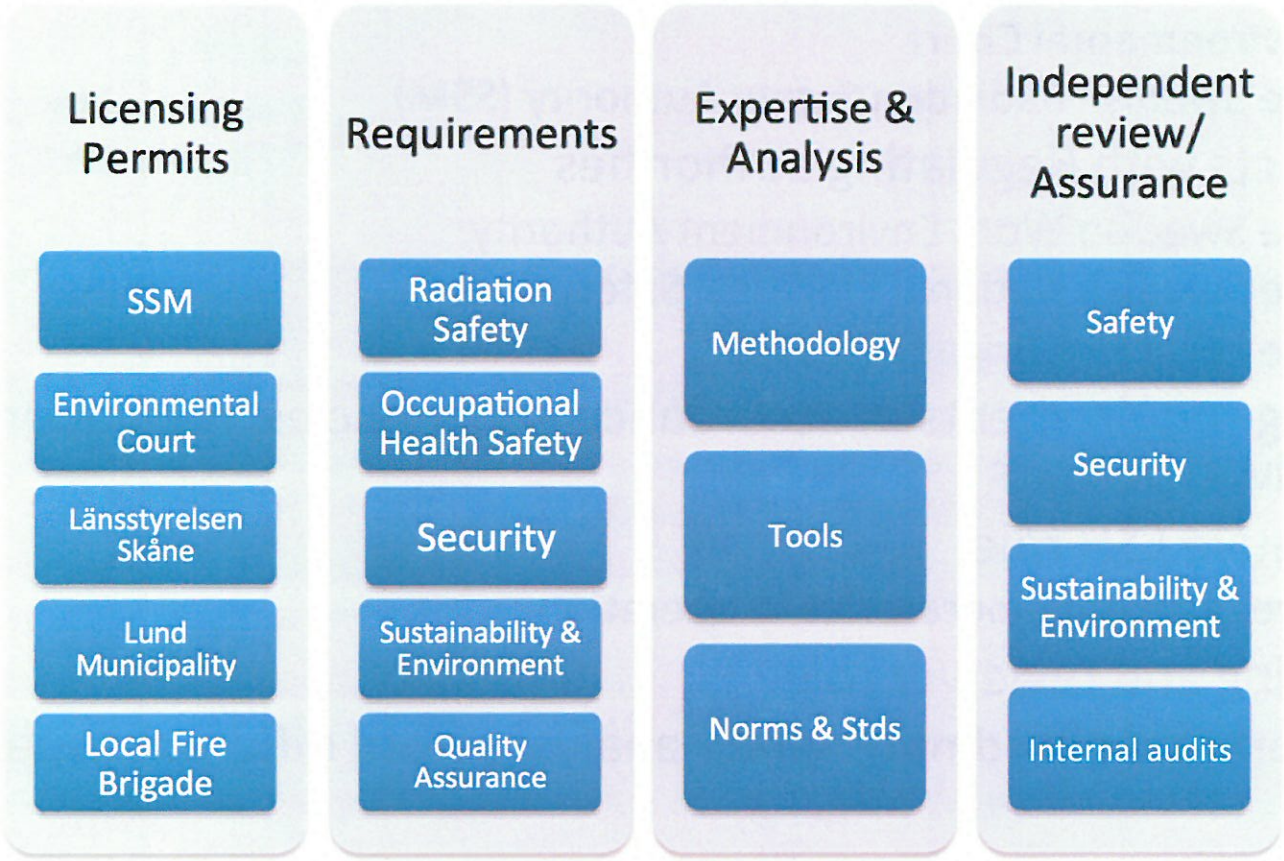
- Licensees and permits
  - Environmental Court
  - The Swedish Radiation Safety Authority (SSM)
- Contacts with Regulating authorities
  - The Swedish Work Environment Authority
  - The Swedish National Electrical Safety Board
  - The Local Fire Brigade (R Syd)
- Setting requirements in accordance with policies, regulations, laws and given permits
- Operative ESH role
  - Five different laboratories in operation
- Assuring and reviewer role
- Support and coordinate safety analyses from different aspects

The role of ESH and QA



Competence & Personal

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- Radiation & Nuclear Safety
  - Peter Jacobsson
  - Thomas Hansson
  - Leif Spanier
  - Daniela Ene
- Shielding Calculations
  - Günter Myhrer (TD)
  - Riccardo Bevilacqua (TD)
  - Lali Tchelidze (AD)
  - Luisella Lari (AD)
  - Phil Bentley (NSS)
- Risk Analysis
  - Jan-Espen Presteng (c)
- Rad Waste
  - Per Persson
  - Tommy Hansson (c)
- Security
  - Ulrika Agnvik
- Occupational Health Safety
  - Bertil Winér
  - Ernst Christensson (CF)
- Fire Safety
  - Fredrik Jörud
- Electrical Safety
  - Jörgen Mattsson (CF)
- ODH
  - Duy Phan (AD)
- Sustainability & Environment
  - Malin Åberg (CF)
  - Erika Lindström (CF)

ESH & QA – Organization

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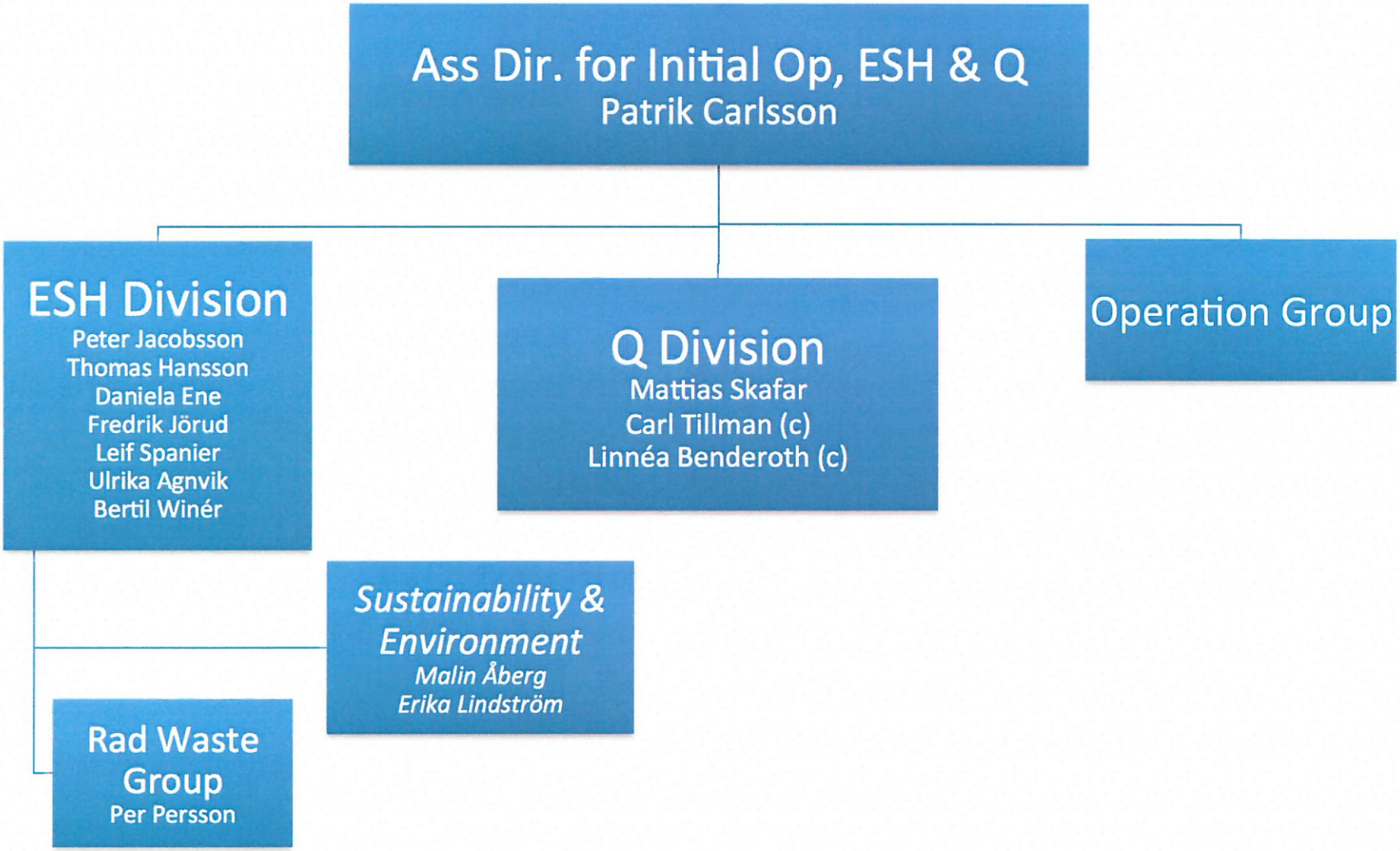

Graded approach SSM - Schedule

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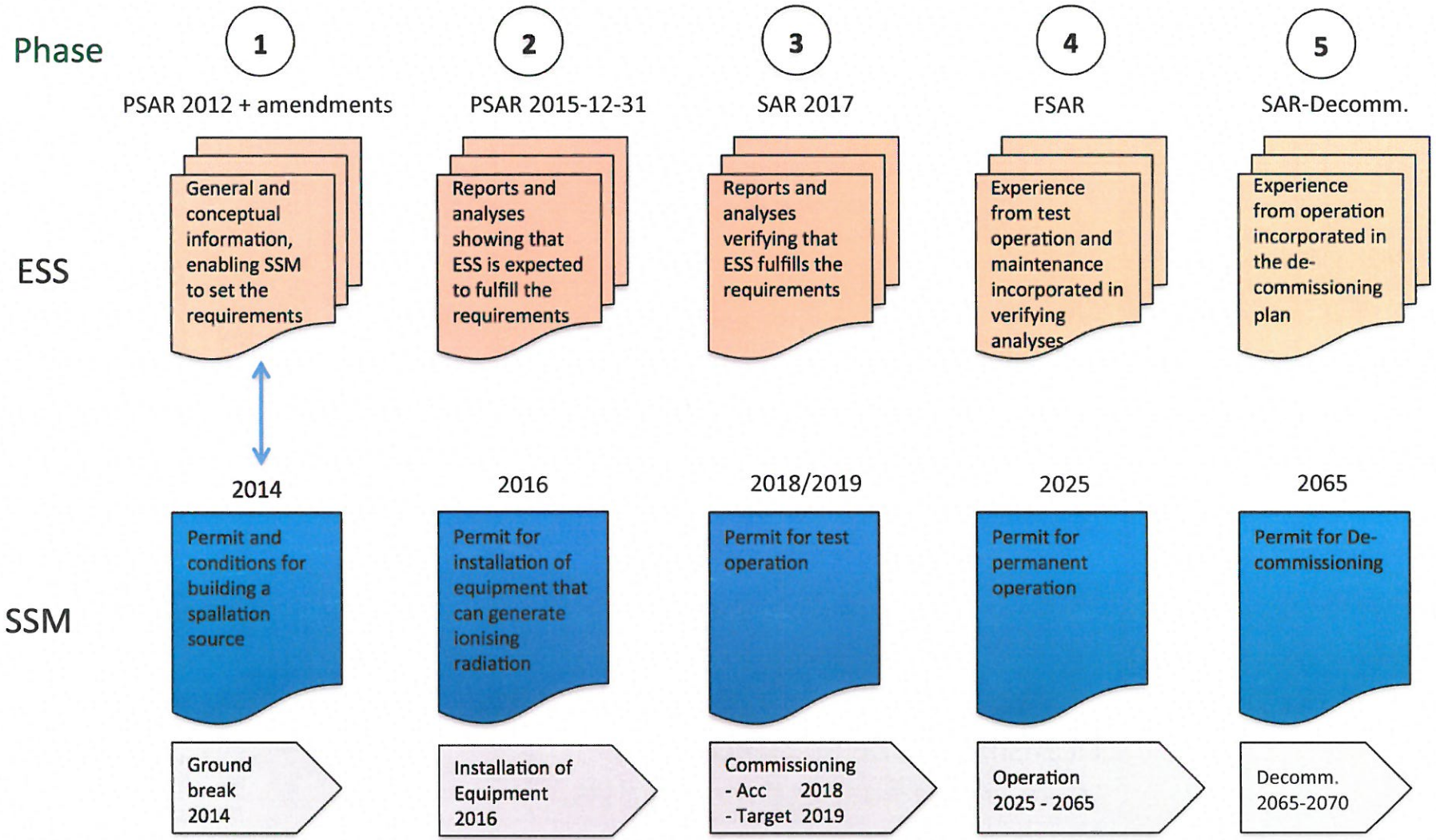

ESS Schedule – Licensing

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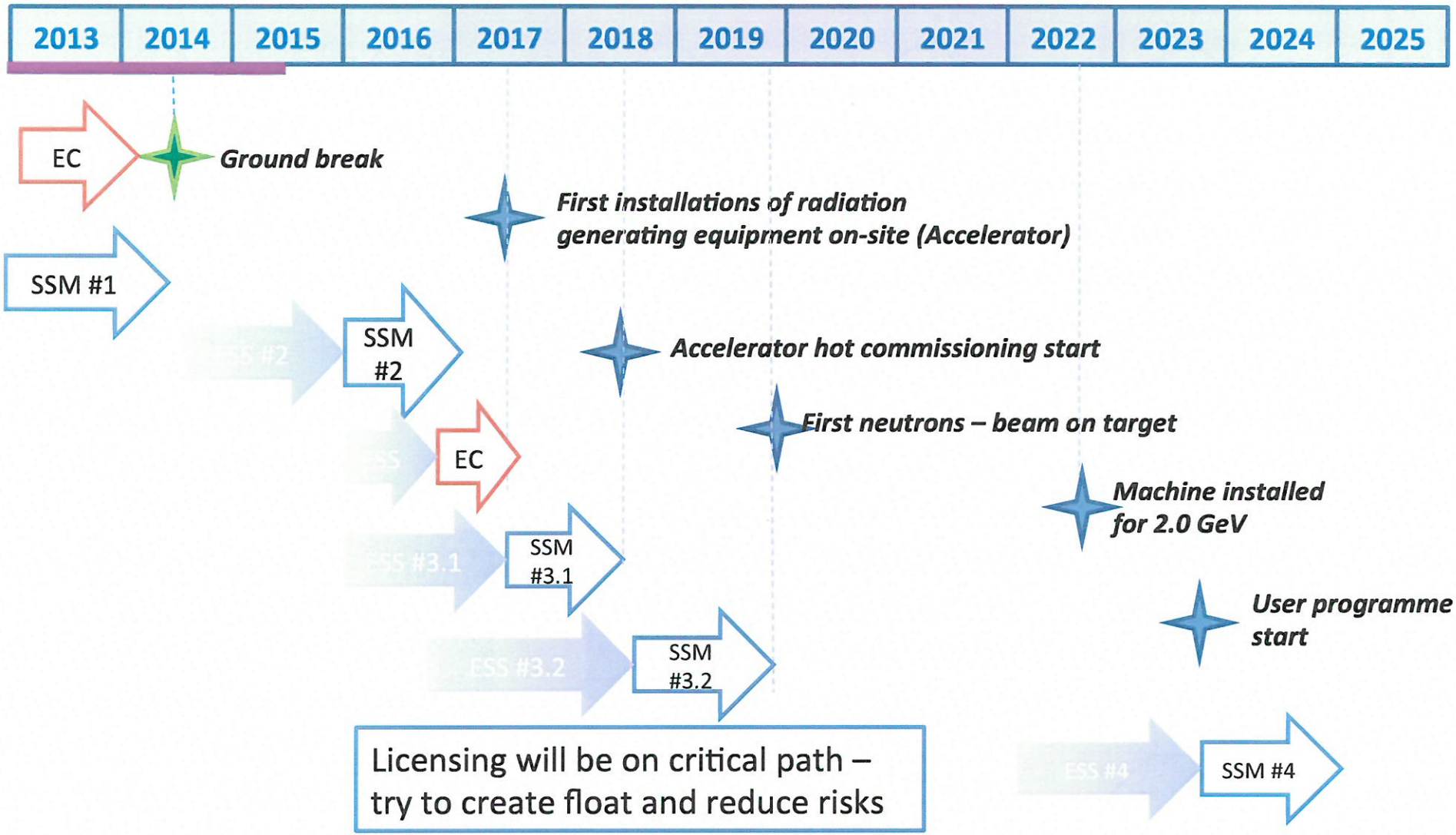

Occupational Health Safety - General

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- Occupational Safety – Design
  - Safety Officer (Bas-P)
    - Fire Safety
    - Electrical Safety
    - Cryogenic Safety
    - Pressure/Vacuum of systems
    - Chemical hazards
    - Heights/Lifting
- Occupational Safety – Construction
  - Safety coordinator (Bas U)
  - Electrical Safety
- Occupational Safety – Installation
  - Safety coordinator (BAS-U)
  - Electrical Safety

Safety issues - General

- The regulating authorities (SSM, EC etc.) have no experience from a large accelerator driven facility.
- Minor experience from neutron scattering instruments based on a small research fission reactor
- The legislation is based on that the licensee makes a risk assessment, define its hazards and propose mitigating actions and procedures to be followed.
- In some areas, e.g. electrical safety, more strict regulations can be applied..

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Fire- & Explosion Safety Program

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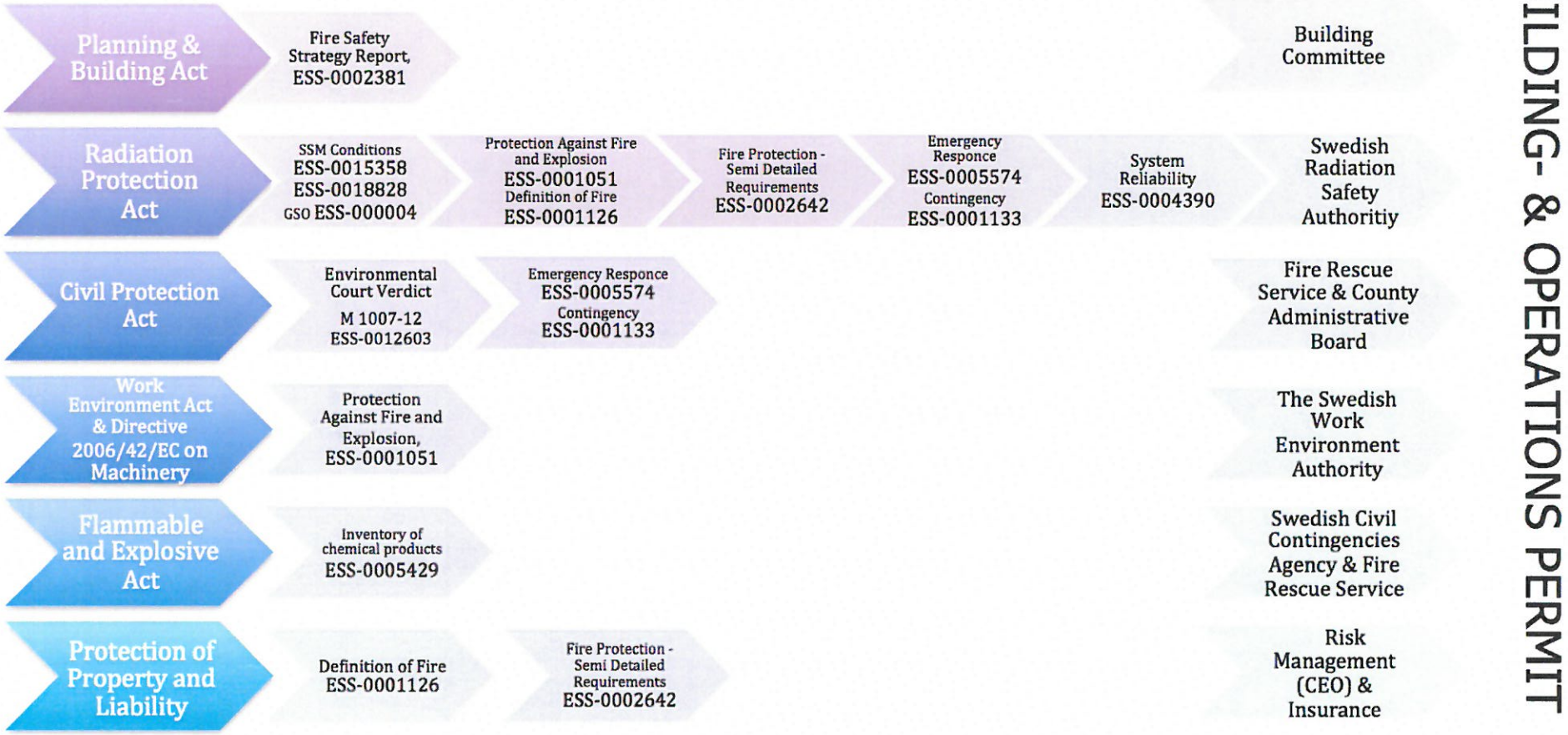

BUILDING- & OPERATIONS PERMIT

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Rad Safety "Probabilistic Requirement"

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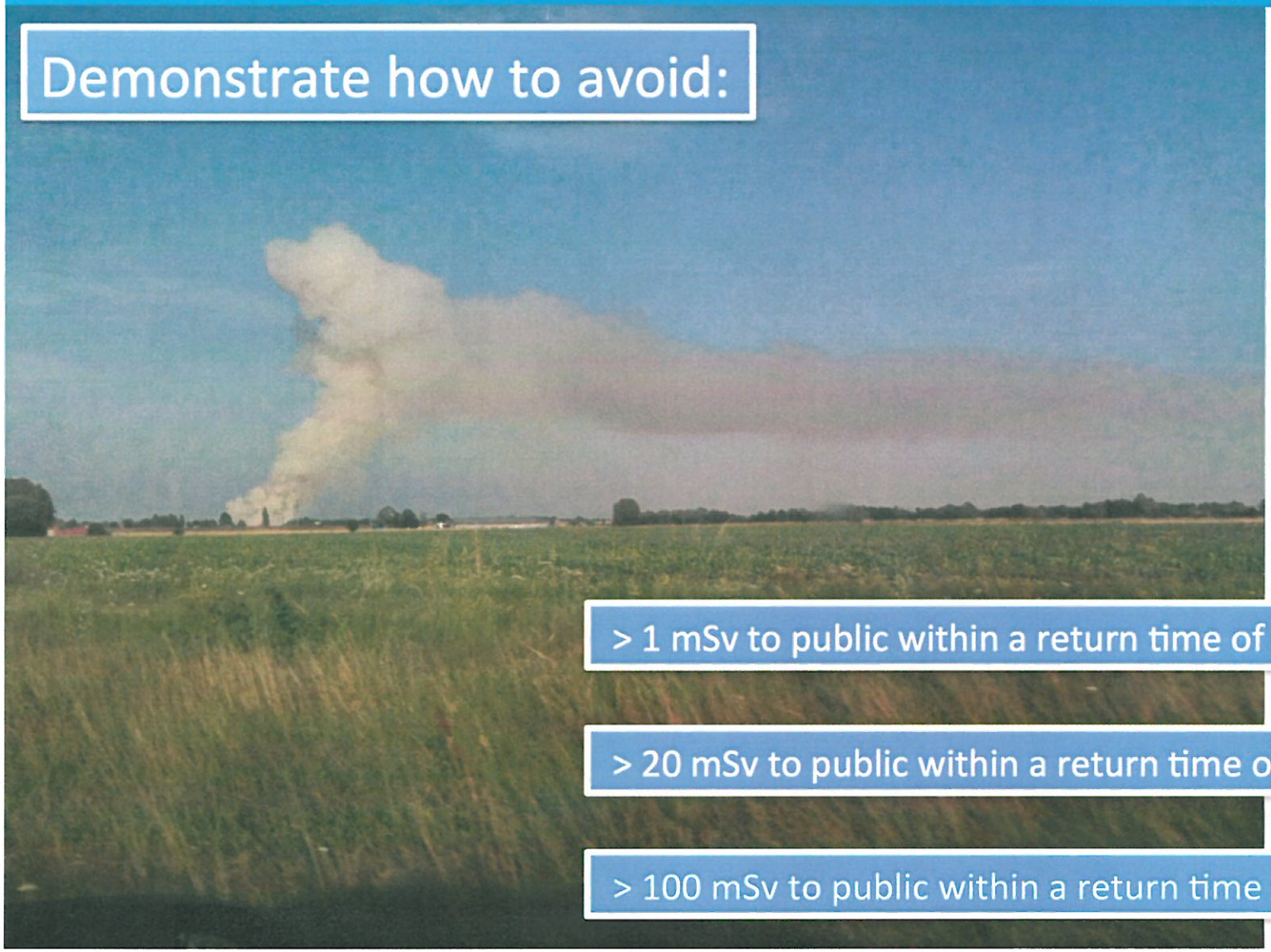
Demonstrate how to avoid:



- > 1 mSv to public within a return time of 10 000 years
- > 20 mSv to public within a return time of 1 000 000 years
- > 100 mSv to public within a return time of 10 000 000 years

Public at 300 m from Target

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Definition of Fire

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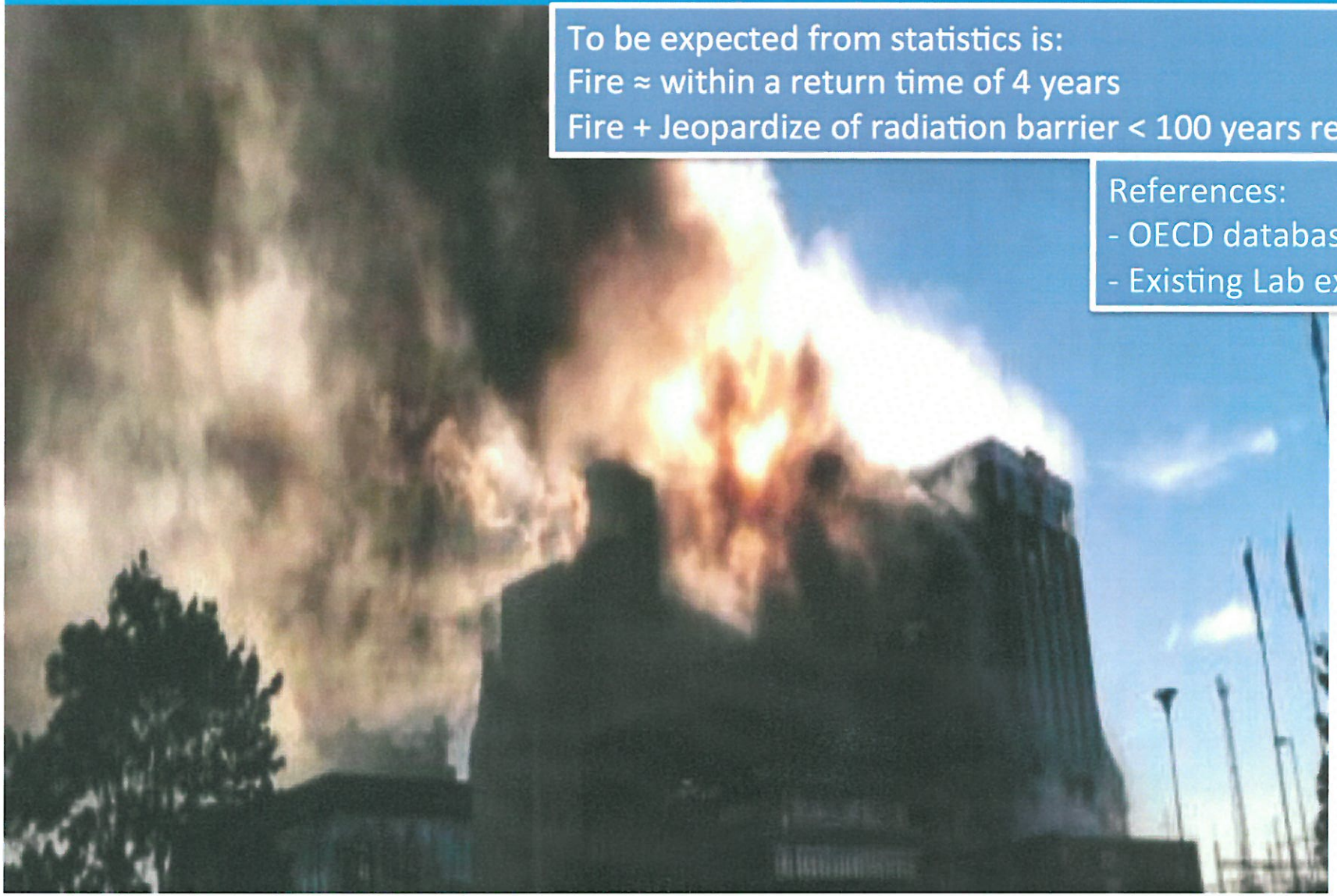
To be expected from statistics is:
Fire ≈ within a return time of 4 years
Fire + Jeopardize of radiation barrier < 100 years return time

References:
- OECD database
- Existing Lab experience



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Rad Safety "Deterministic requirement"

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1. Prevent start - "As far as reasonable practical, non- combustible materials should be used in installations"

2. Detect and extinguish quickly

3. Prevent spread

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Planning and Building Act

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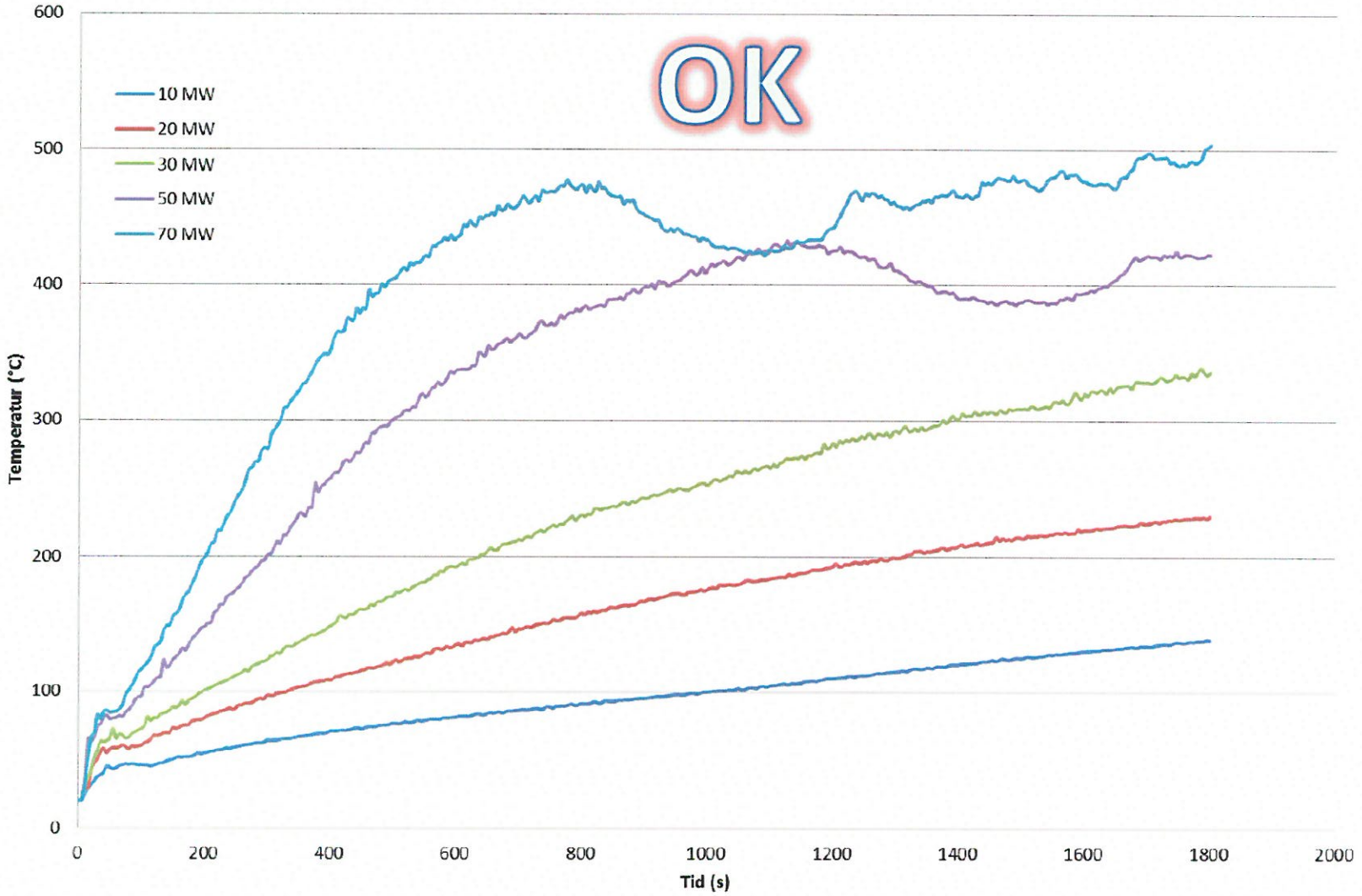

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Loss of property

Level	Economical (SEK) /Out time
Insignificant	< 1,2 M < 1 day
Moderate	< 8,4 M < 1 week
Major	> 7 M€ => AUT SUPPRESSION
Catastophic	> 50 M€ => AUT SUPPRESSION + ANALYSIS

Insurance business


Combustible Shielding
Borated paraffin
Borated polyethylene
Paraffin
Polyethylene

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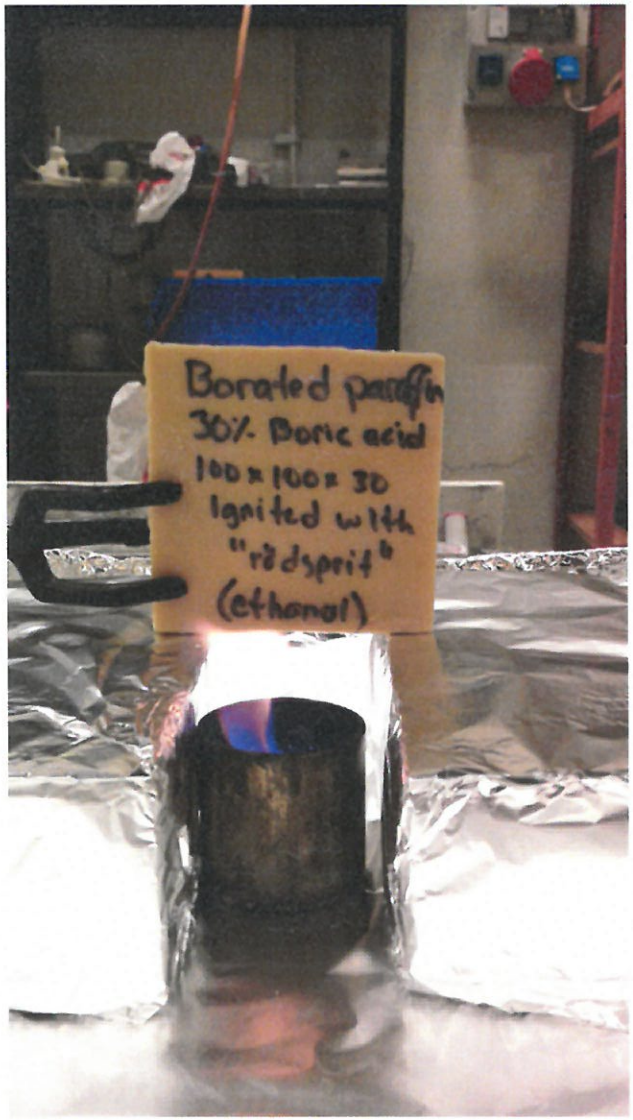
Borated Paraffin (wax)



Paraffin:
Melting point appr. 70°C
Ignition point appr. 300°C

Fire load min 5 times higher than normal !
Apply “Protected Fire Load” - principle

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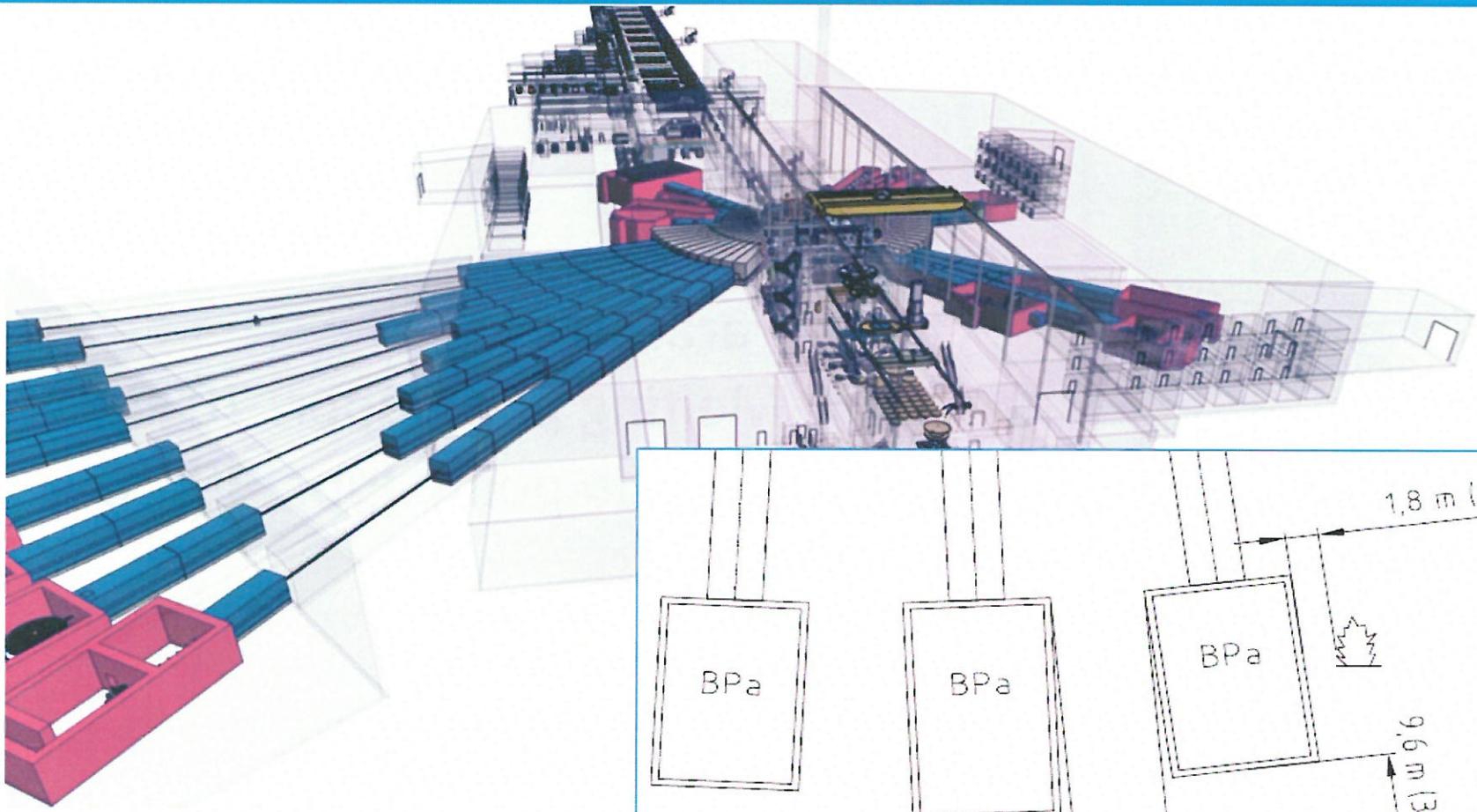

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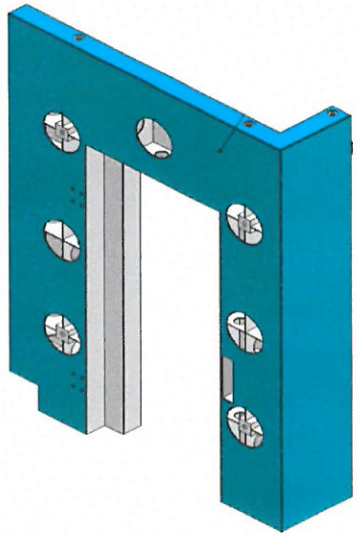
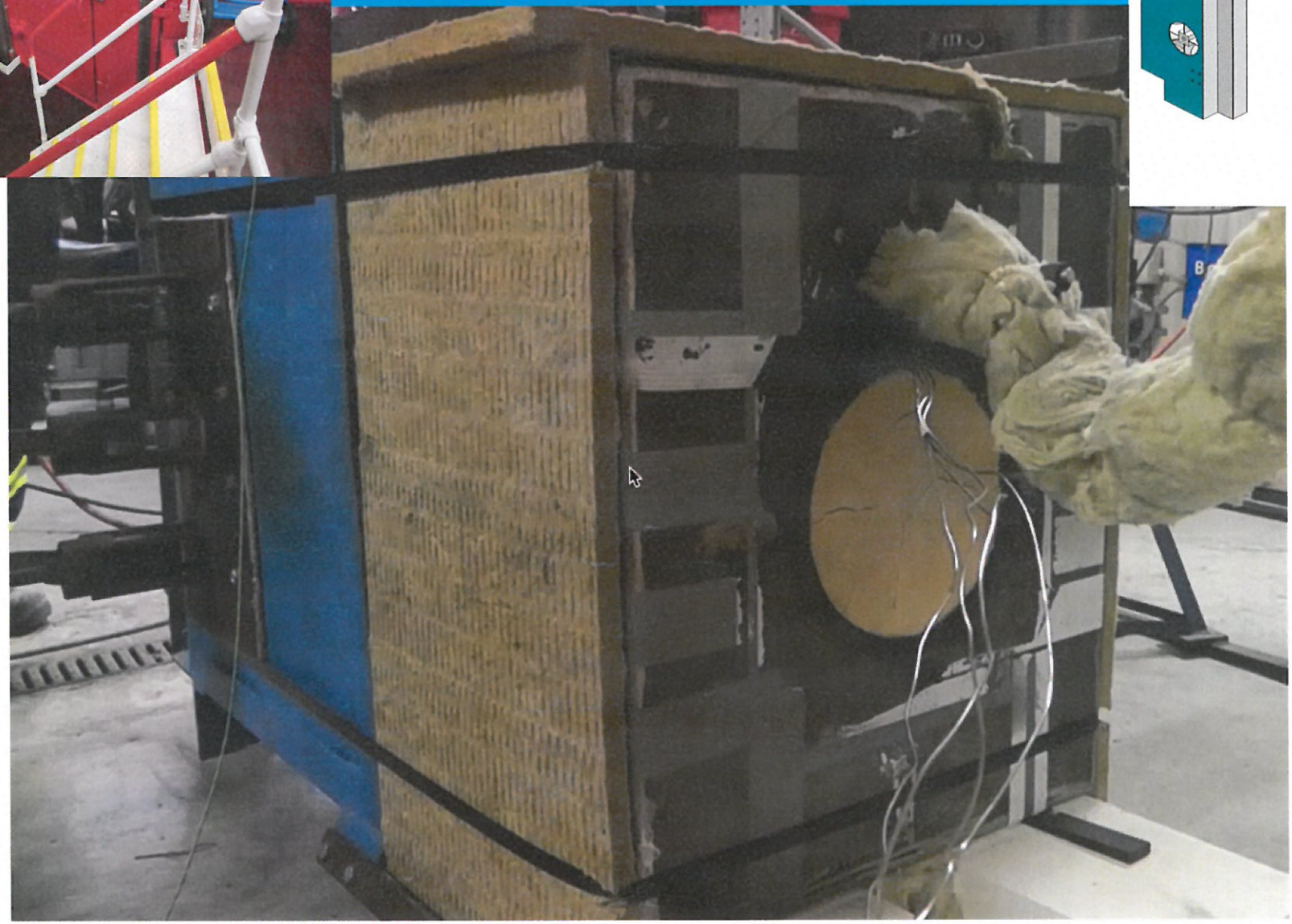
“Protected fire load principle”





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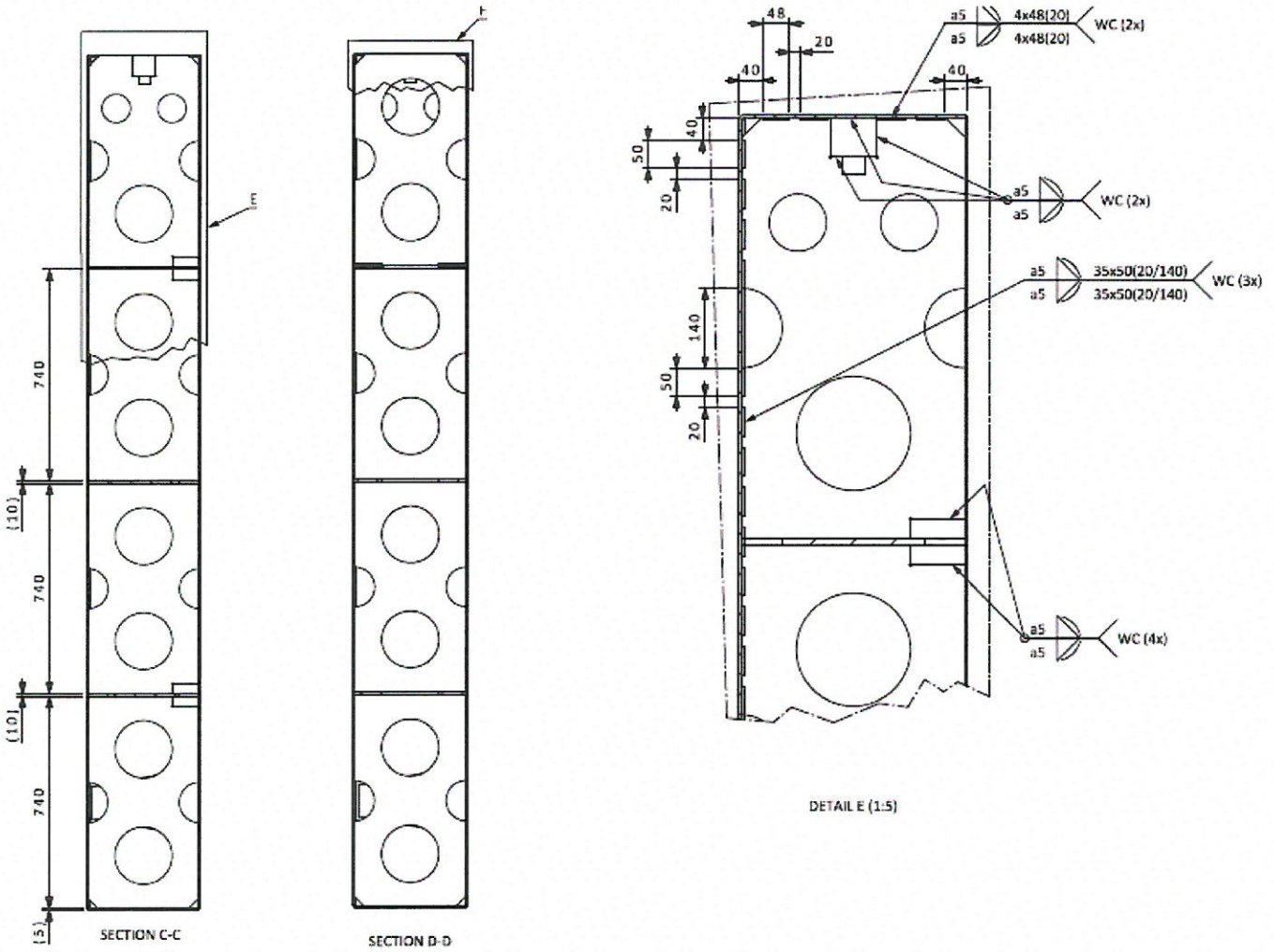
High level of quality control will apply!



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Polyethylene (PE)
unprotected fire load exceeds 30 MW => efficient manual fire fighting not possible

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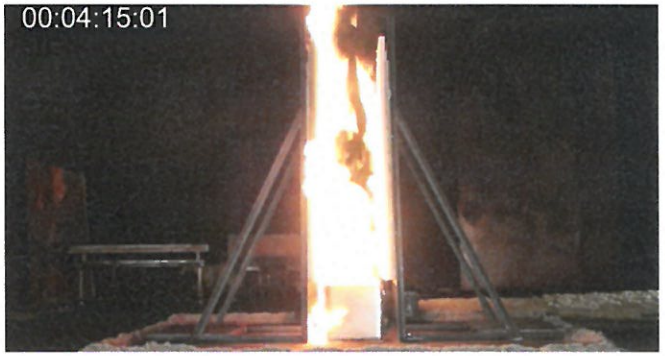
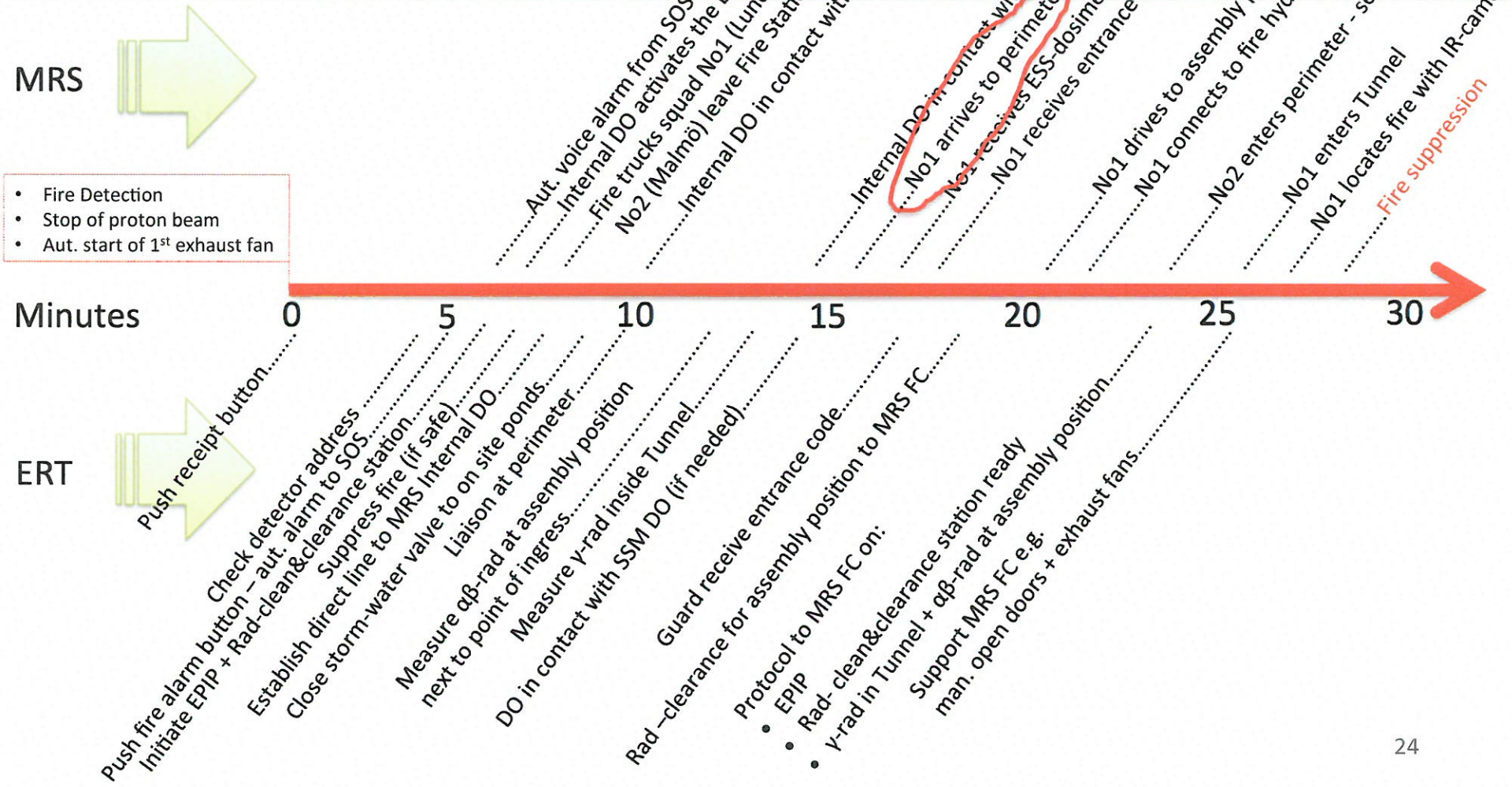


Pre Fire Plan

Dat. 2015-03-05

Abbreviation

EPIP	Emergency Power Insulation and Grounding Plan
ERT	ESS Emergency Response Team
MRS	Municipal Rescue Service (Räddningstjänsten Syd)
DO	Officer on Duty
FC	On site Fire Commander



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Wax and PE in Instrumental Buildings

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- Install sprinkler in instrument cave
- Install sprinkler in hall ceiling
- Allow only redesign of 1 instrument simultaneously OR apply 5 m safety distance
- Keep HGV on 10 m distance to unprotected fire load
- Keep field offices/labs on 2 m distance to unprotected fire load
- Paraffin is protected in steel containers if fill-holes are turned inwards
- PE is protected behind fire rated cladding

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PE - during construction

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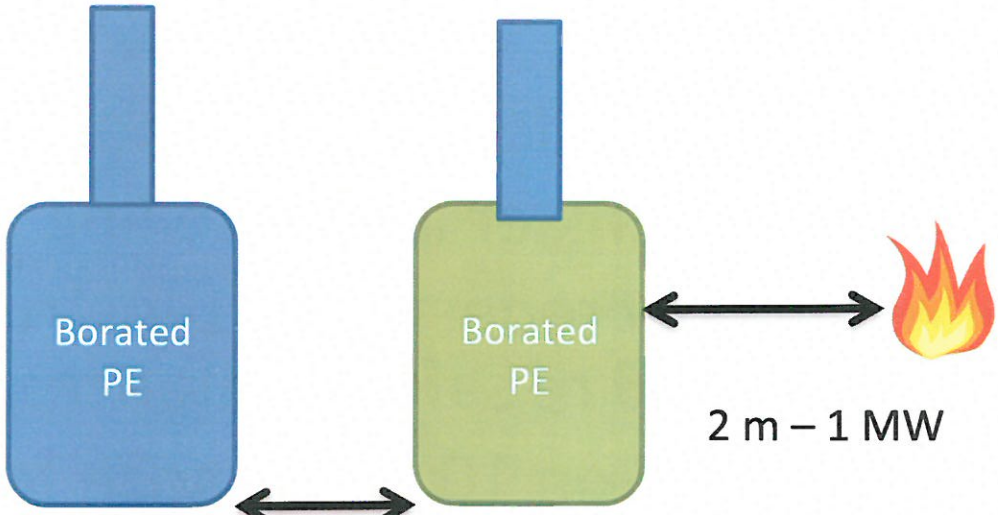
1GF + 1GA

60 mm



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Safety distance vs cladding

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Safety distance (m)		HRR (MW) 1	5	6 SPRINKLER	30 HGV
1	*Radiation (W/m2)*	*27 866*	*120 000*	*120 000*	*120 000*
	1 layer gypsum board (GF)(°C)	251	437	437	437
	2 layers gypsum board (GF+GA) (°C)	153	257	257	257
	3 layers gypsum board (GF+2xGA) (°C)	95	155	155	155
	GF+GA+Mineral wool (mm)	20	60	60	60
3	*Radiation (W/m2)*	*3 096*	*15 481*	*18 577*	*92 887*
	1 layer gypsum board (GF) (°C)	78	192	210	401
	2 layers gypsum board (GF+GA) (°C)	-	119	129	236
	3 layers gypsum board (GF+2xGA (°C)	-	-	-	143
	GF+GA+Mineral wool (mm)	20	20	20	60
5	*Radiation (W/m2)*	*1 115*	*5 573*	*6 688*	*33 439*
	1 layer gypsum board (GF) (°C)	44	111	123	272
	2 layers gypsum board (GF+GA) (°C)	-	-		164
	3 layers gypsum board(GF+2xGA (°C)	-	-	-	101
	GF+GA+Mineral wool (mm)	20	20	20	30

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Explosion- "deterministic requirement"

Similar approach for radiological- as for conventional safety

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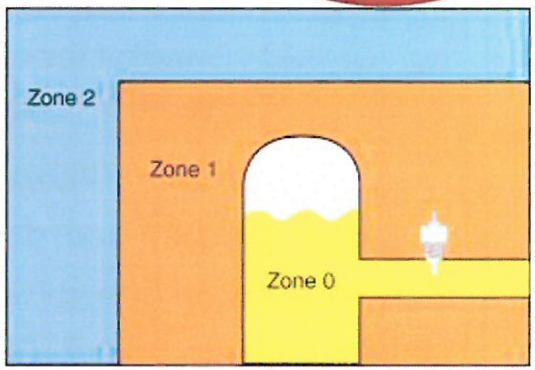
Prevent explosions to occur

- Eliminate by design
- Provide ventilation to avoid LLE

Minimize risk

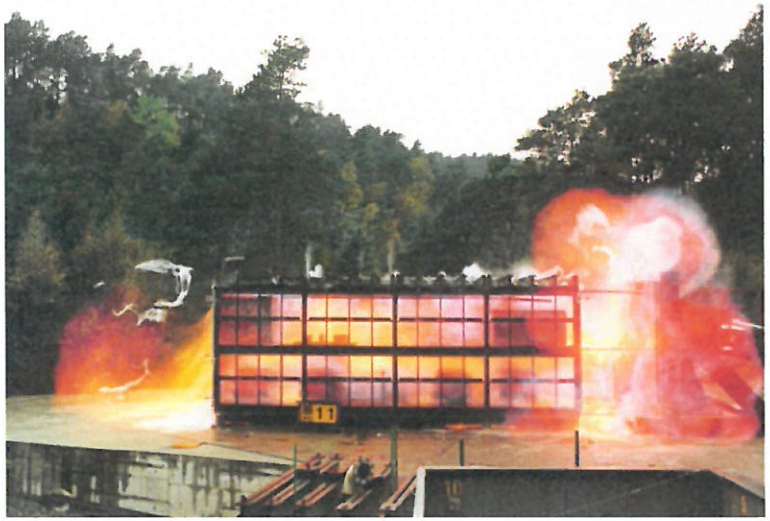
- Eliminate ignition sources
- Limit quantities, adequate storage
- Inert atmospheres



Limit consequences

- Channel the force from personnel and barriers, use blow-out panels

Results from pilot cases



EXAMPLES:

Hydrogen **room moved** from High Bay to Vent Rooms
- To avoid effects from secondary explosion

Hydrogen **bottle reduced** at Ion Source
- To reduce damage effects

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D03 - Instrument Building

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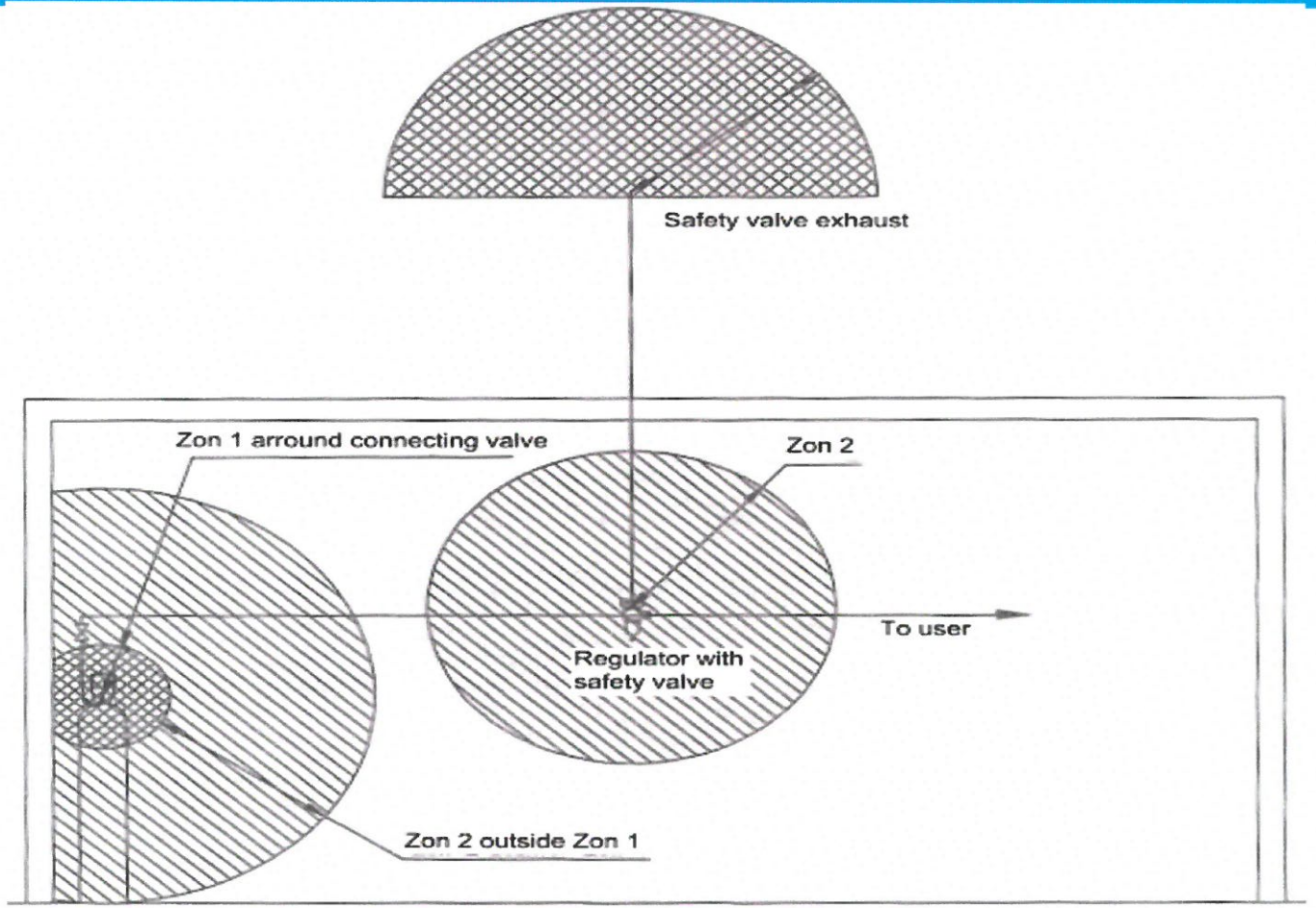
Hydrogen cylinder connected to instrument cave:

- **Zone 1**: 0.5 meters around connection valve.
- **Zone 2**: 1.5 meters outside zone 1. If the space has a floor area of less than 8 m^2, zone 2 is extended to include the entire compartment.

Possible position of cylinder

Area Classification Definitions



Zone 1 Zone 2

Temperature class T1
Explosion group IIC

Leak inside instrument cave

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- **peak** overpressure 1 bar, most likely total destruction of the cave
- **side-on** overpressure (p_0) in the event of a cylinder explosion.....

Distance from cylinder [m]	p_0 [kPa]	Expected damage
5	60	Demolition of railroad boxcars
10	20	Distortions of buildings with steel frame, minor damage to heavy machinery
15	10	Slight distortion of steel frame buildings

Most likely H_2 accident scenario:

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Ignite on outflow and form a jet flame

EXAMPLE:

- A leak (hole/opening) with a diameter 0.5 cm (corresponding to a connecting pipe) results in a jet flame with a length of about 1.2 meters