

CCC 6/INF.17

Sample application of IEC60079-10-1:2015 on a fuel cell power installation

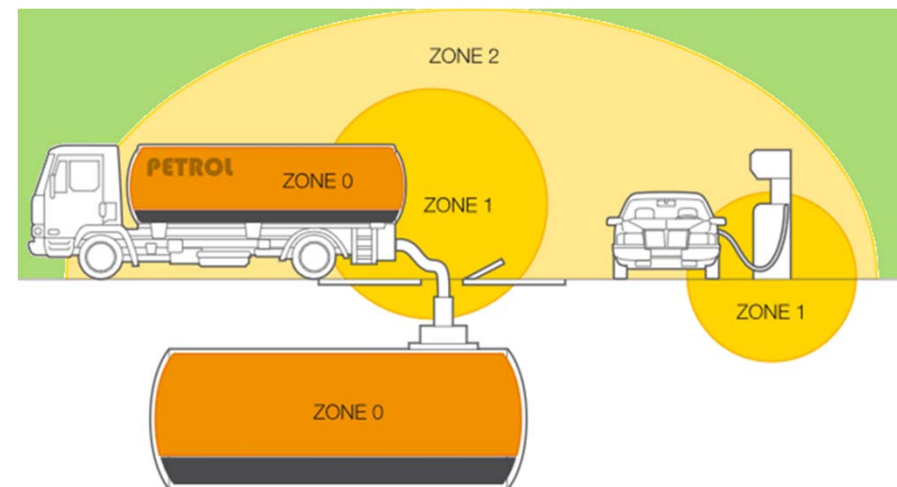
Dipl.-Ing. Keno Leites, thyssenkrupp Marine Systems GmbH
CCC 6, IMO, London, 10 September 2019



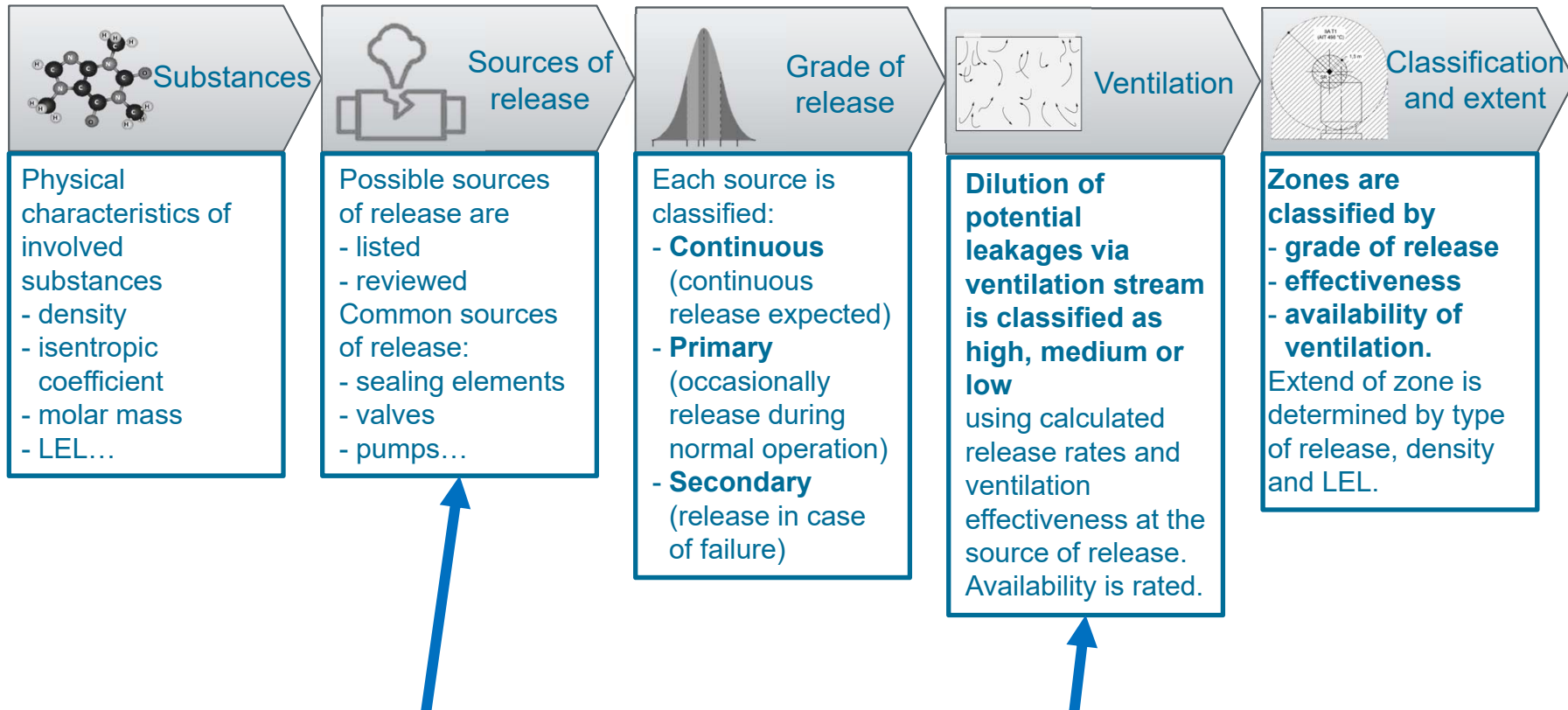
IEC 60079-10-1:2015 Classification of areas – Explosive gas atmospheres

Definitions

Zone 0	an area in which an explosive gas atmosphere is present continuously or for long periods or frequently
Zone 1	an area in which an explosive gas atmosphere is likely to occur periodically or occasionally in normal operation
Zone 2	an area in which an explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, it will occur for a short period only
Non-hazardous	



IEC 60079-10-1:2015 Classification of areas – Overall methodology

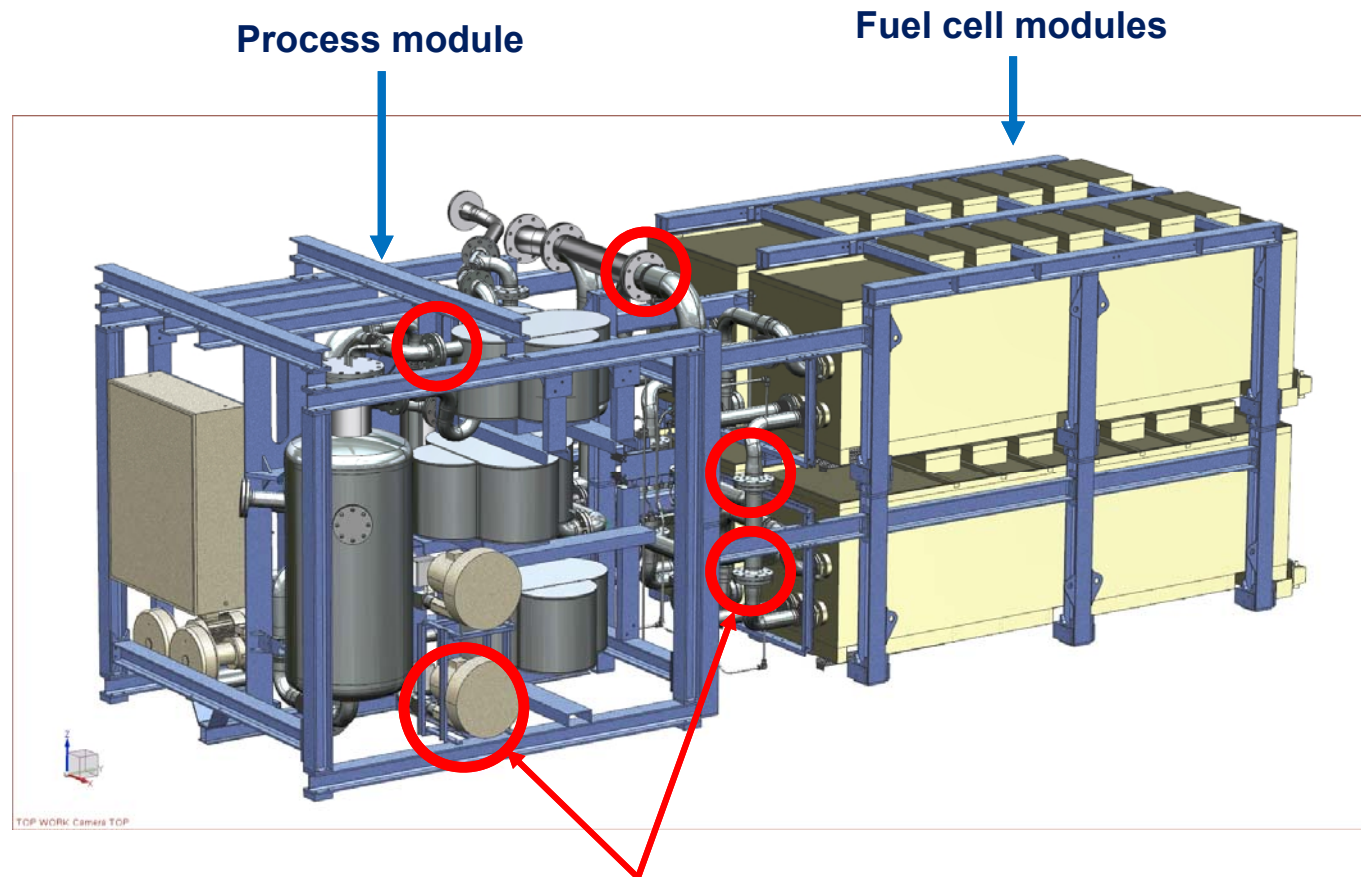


This methodology ensures safety since

- 1) every source of release is explicitly reviewed (Can the source be avoided? Can it be reduced?)
- 2) considering the local ventilation at each source helps to prevent build up of explosive atmospheres even directly at the source of release



IEC 60079-10-1:2015 Classification of areas – Example SchIBZ™

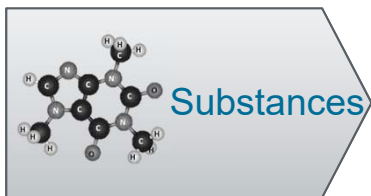


Sources of release*

* Here fuel cell stacks are within an enclosed atmosphere due to an additional physical barrier. They are not considered a source of release due to the high temperatures inside the enclosed fuel cell modules, which is above the lower flammable limit of all substances involved.

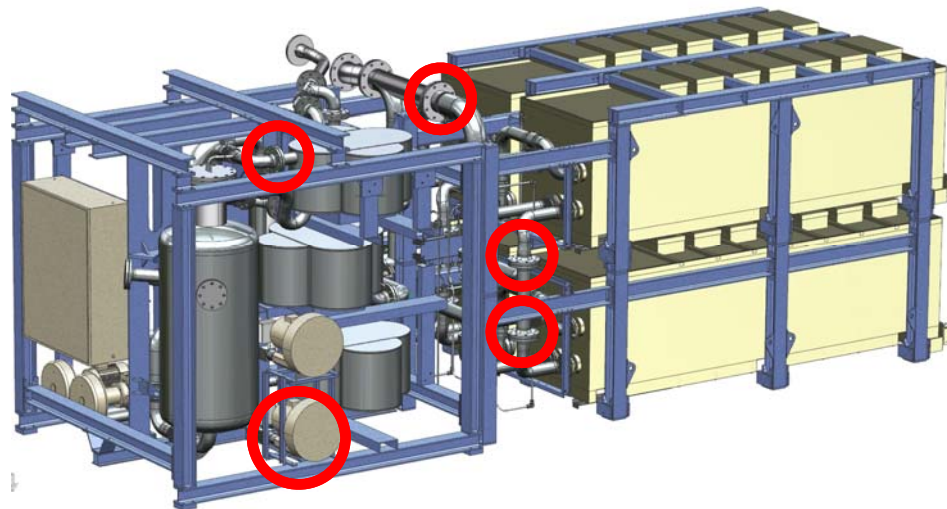


IEC 60079-10-1:2015 Classification of areas – Example SchIBZ™



Substances

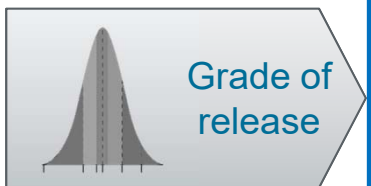
- Hydrogen
- Methane
- Carbon monoxide



Sources of release

- Fuel Cell Modules*
- Pipe connections
- Compressors
- Exhaust

Significant source:
- Pipe flanges



Grade of release

- No sources during normal operation, only in case of failure
- Leakage for a short period only, due to ESD concept

secondary grade of release

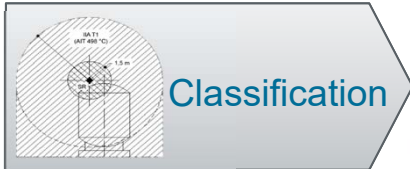
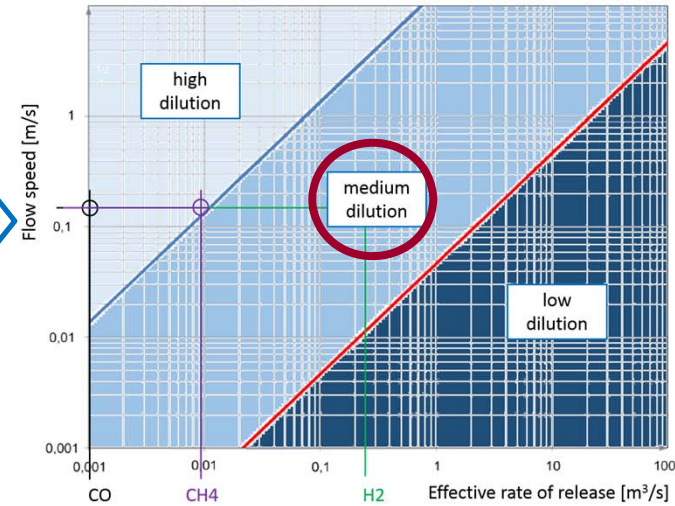


IEC 60079-10-1:2015 Classification of areas – Example SchIBZ™



Ventilation

- Highest calculated release characteristic is 0.23 m³/s for Hydrogen
- Mean ventilation velocity is 0.15 m/s
- Availability of ventilation is considered good



Classification

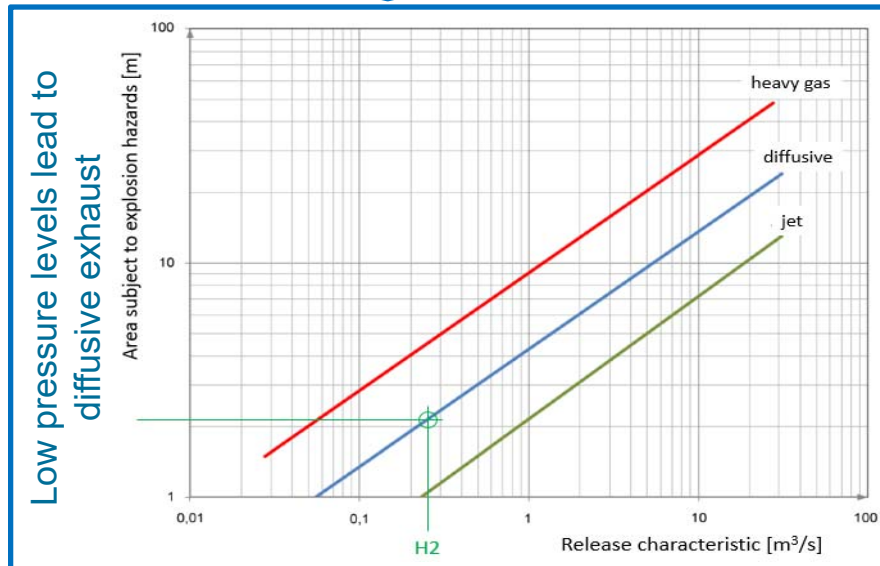
Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non-hazardous (Zone 0 NE) ^a	Zone 2 (Zone 0 NE) ^a	Zone 1 (Zone 0 NE) ^a	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	Non-hazardous (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0 ^a
Secondary ^b	Non-hazardous (Zone 2 NE) ^a	Non-hazardous (Zone 2 NE) ^a	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0 ^a



IEC 60079-10-1:2015 Classification of areas – Example SchIBZ™



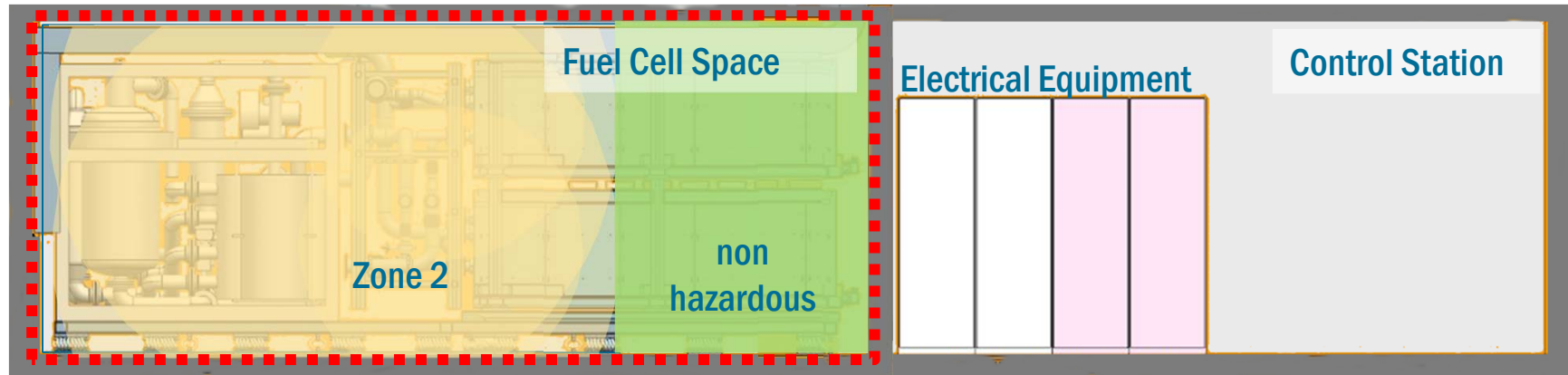
Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non-hazardous (Zone 0 NE) ^a	Zone 2 (Zone 0 NE) ^a	Zone 1 (Zone 0 NE) ^a	Zone 0	Zone 0 → Zone 2	Zone 0 → Zone 1	Zone 0
Primary	Non-hazardous (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 1	Zone 1 → Zone 2	Zone 1 → Zone 2	Zone 1 or Zone 0 ^a
Secondary ^b	Non-hazardous (Zone 2 NE) ^a	Non-hazardous (Zone 2 NE) ^a	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and extra Zone 0 ^a



Zone extent is 2.1 m (25% LEL)



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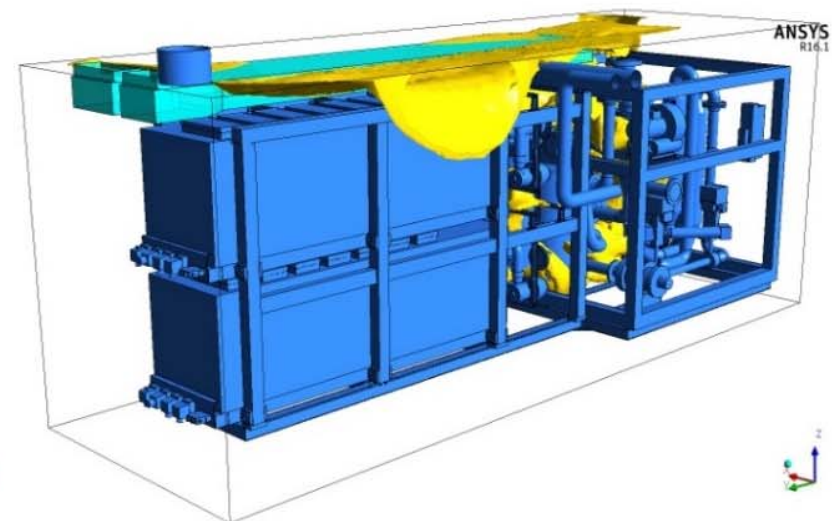
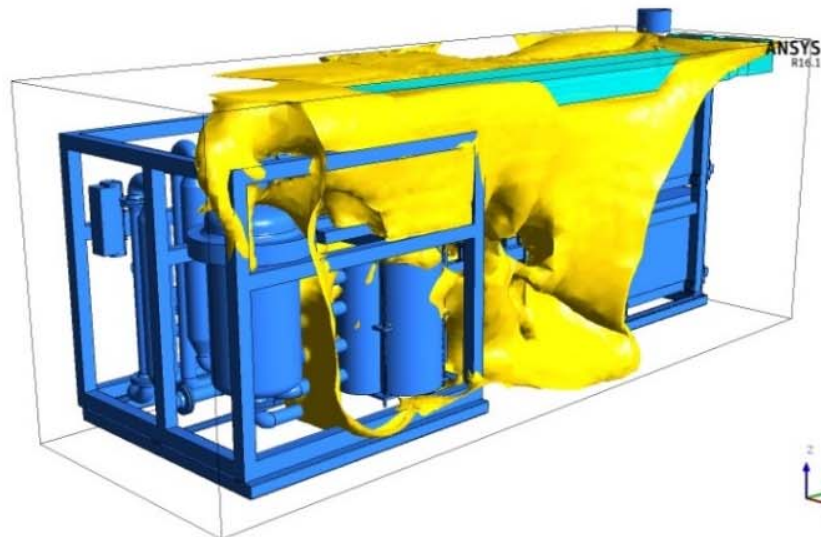
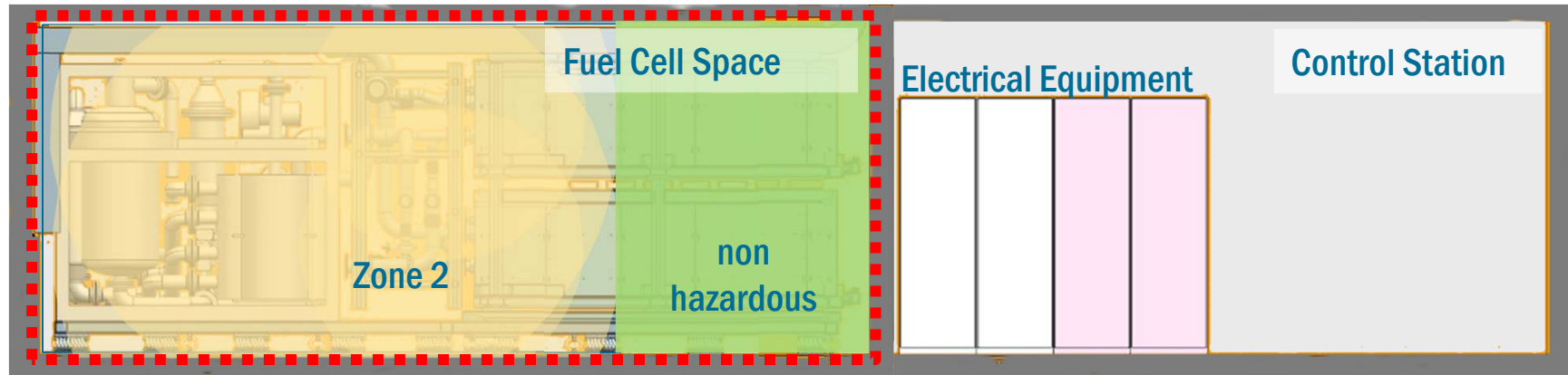


Conclusion

- As a result of IEC 60079-10-1:2015 the fuel cell space contains a limited zone 2
- The remaining space is non hazardous
- Application of IEC 60079-10-1:2015 ensures the goal of equal safety of the system compared to conventional systems by reviewing all potential sources of release and the ventilation at a local level



IEC 60079-10-1:2015 Classification of areas – CFD-calculation of 25% LEL surface



Thank you

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