ISO/TC 197 **N 503**

TC 197/WG11/TG1
Report
16 May 2010 - Essen

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Purpose of safety distances

- **Safety distances : a generic means for mitigating the effect of a foreseeable incident and preventing a minor incident escalating into a larger incident, as defined in EIGA IGC 75/05**

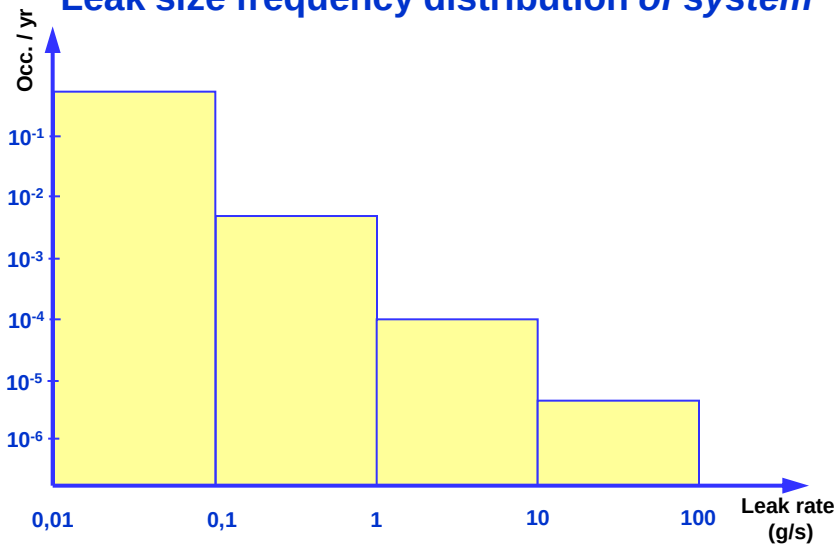
- **All readily applicable prevention and mitigation measures should be applied before considering mitigation by means safety distances. These are to be considered as one element of a comprehensive safety approach.**

- **Safety distances are not intended to provide protection against catastrophic events or major releases.** (This is to be achieved by other means, which the standard needs to address)

- **Safety distances can be defined taking into account a criterion on risk to exposures → "risk informed safety distances"**

Risk informed safety distances – Key elements

Leak size frequency distribution *of system*



Consequence model

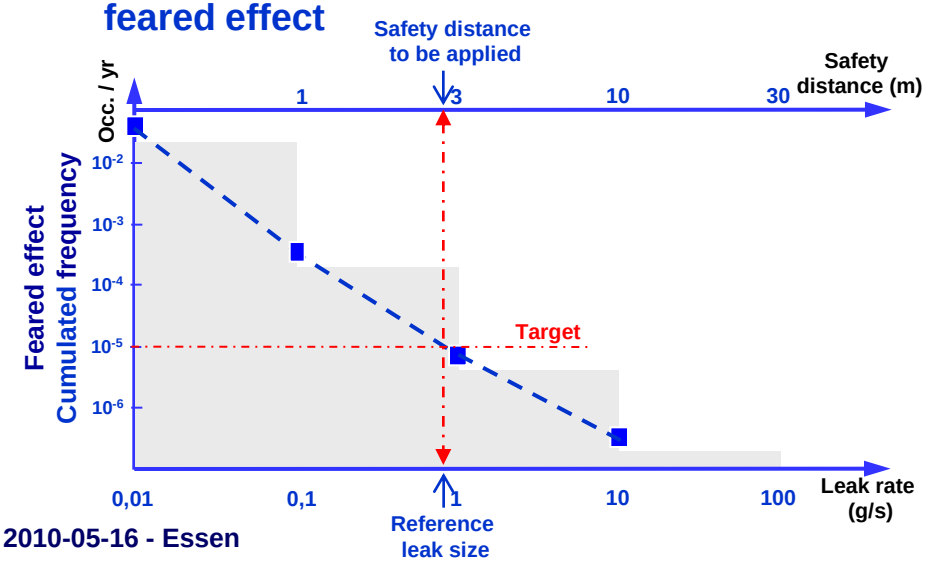
Targeted hazardous effect: Flammable atmosphere	Targeted hazardous effect: Thermal effects
$SD = 1{,}02 * LD * SP^{0,46}$ Or alternatively: $SD = 1{,}34 * LQ^{0,5}$	$SD = 0{,}84 * LD * SP^{0,46}$ Or alternatively: $SD = 1{,}11 * LQ^{0,5}$
With $LQ = 0{,}58 * LD^2 * SP^{0,92}$, which is equivalent to $LQ = 0{,}73 * LA * SP^{0,92}$	

SD : safety distance in m ; LD : leak diameter in mm
SP : service pressure in MPa ; LQ : leak flow in g/s ; LA : leak area in mm2

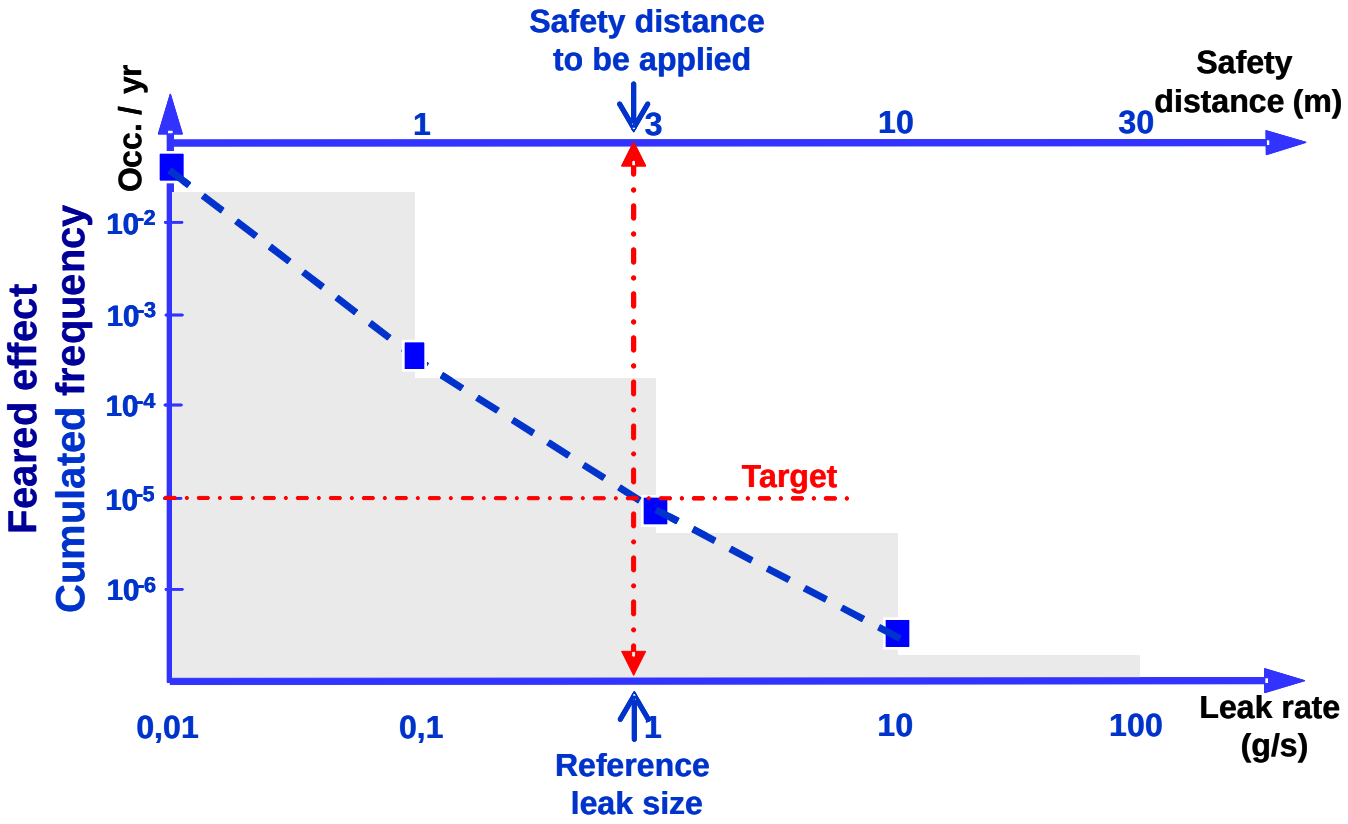
Probability that the leak will have the feared effect on the exposure

1. **Probability that the leak will generate dangerous phenomena : probability of ignition**
2. **Probability that the phenomena will impact the exposure : geometric factor**
3. **Probability that the phenomena (flash fire, fire, overpressure) will have the feared effect on the exposure (typ. 1)**

Application of risk criterion on Frequency of feared effect



Determination of safety distance by application of risk criteria



Risk informed safety distance

Three possible outcomes, when considering the need for a safety distance :

1. **No separation required because probability of hazardous effects from source is too low**

2. **Separation is a suitable mean to achieve risk target :**

   → Specify acceptable separation on basis of risk target

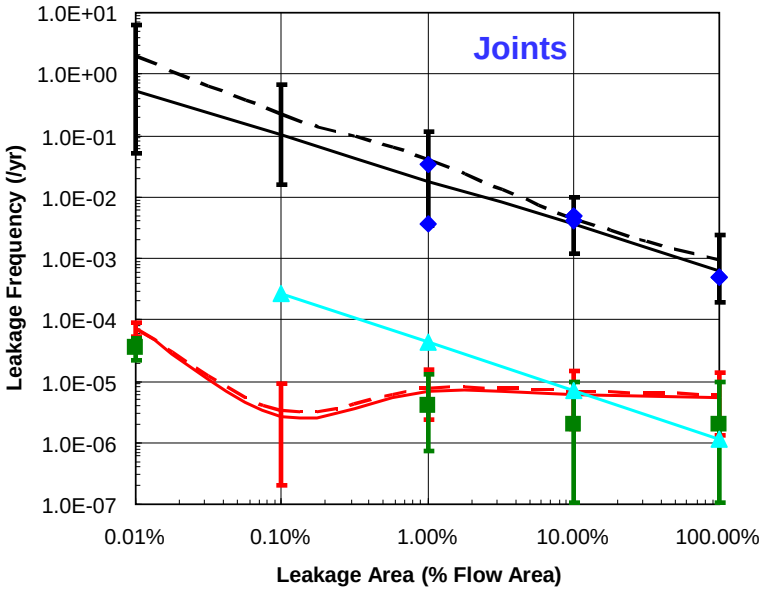
3. **Safety distance is not a suitable means of protection because frequency of hazardous effects from large leaks is too great.**
   Alternative means of prevention/mitigation are required

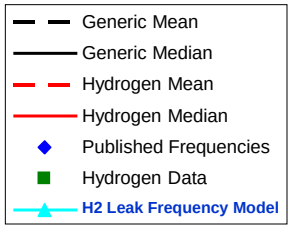
Progress/changes since Oct 2009

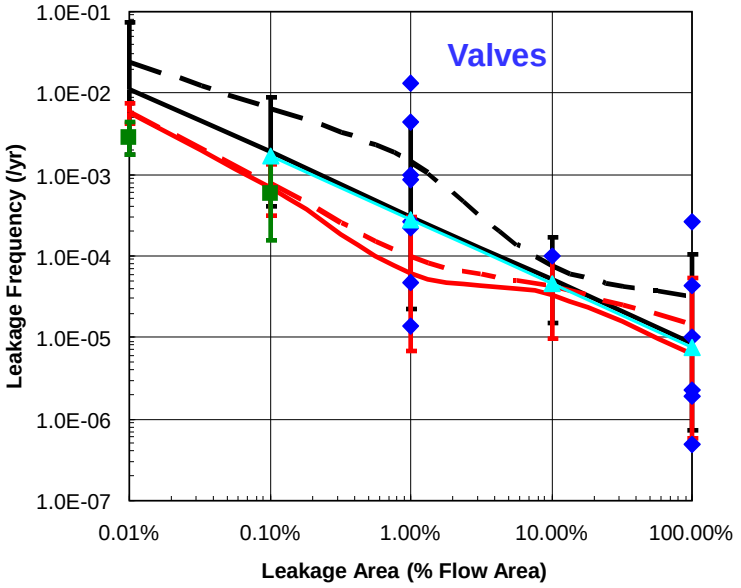
- Checking of correct application of statistical data
- Statistical data for hydrogen systems applied more conservatively
- Verification that the model is applied conservatively
- Increased stringency of risk criteria for non-critical exposures
- Focus on providing a good table ;
  → formulas used instead of table only for systems requiring larger distances than those provided in the table

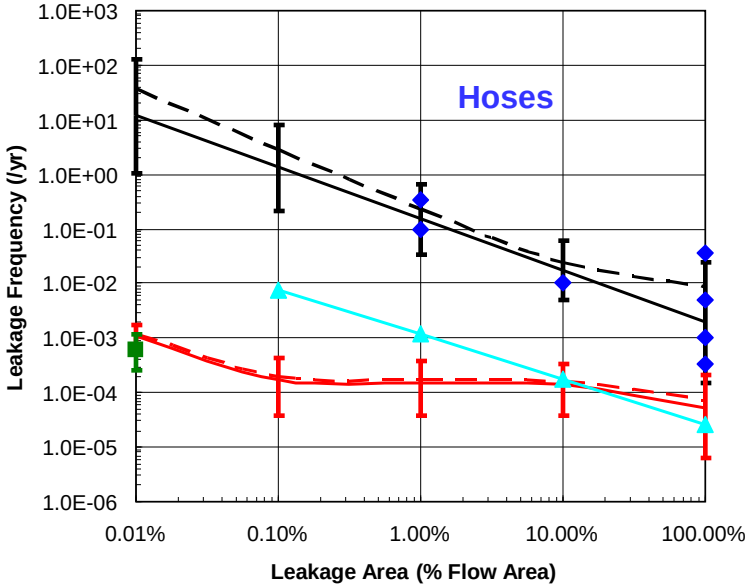
Derivation of leak frequency model from component leak statistics

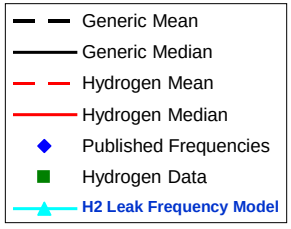
(from SNL analysis)

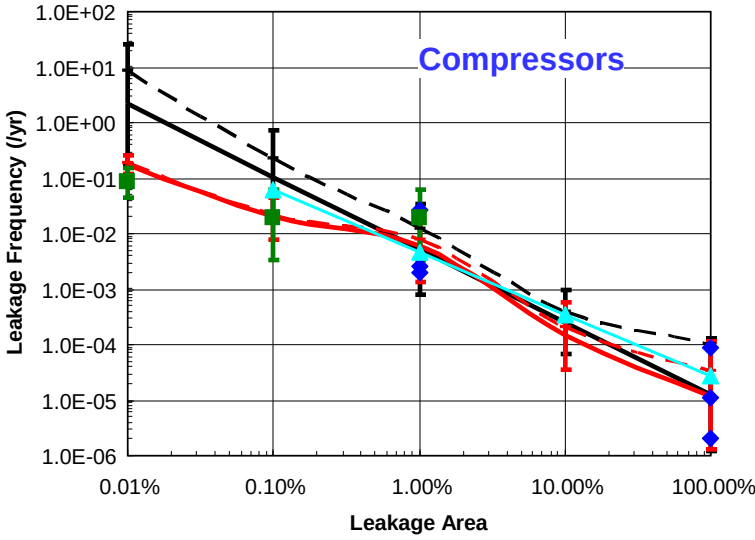










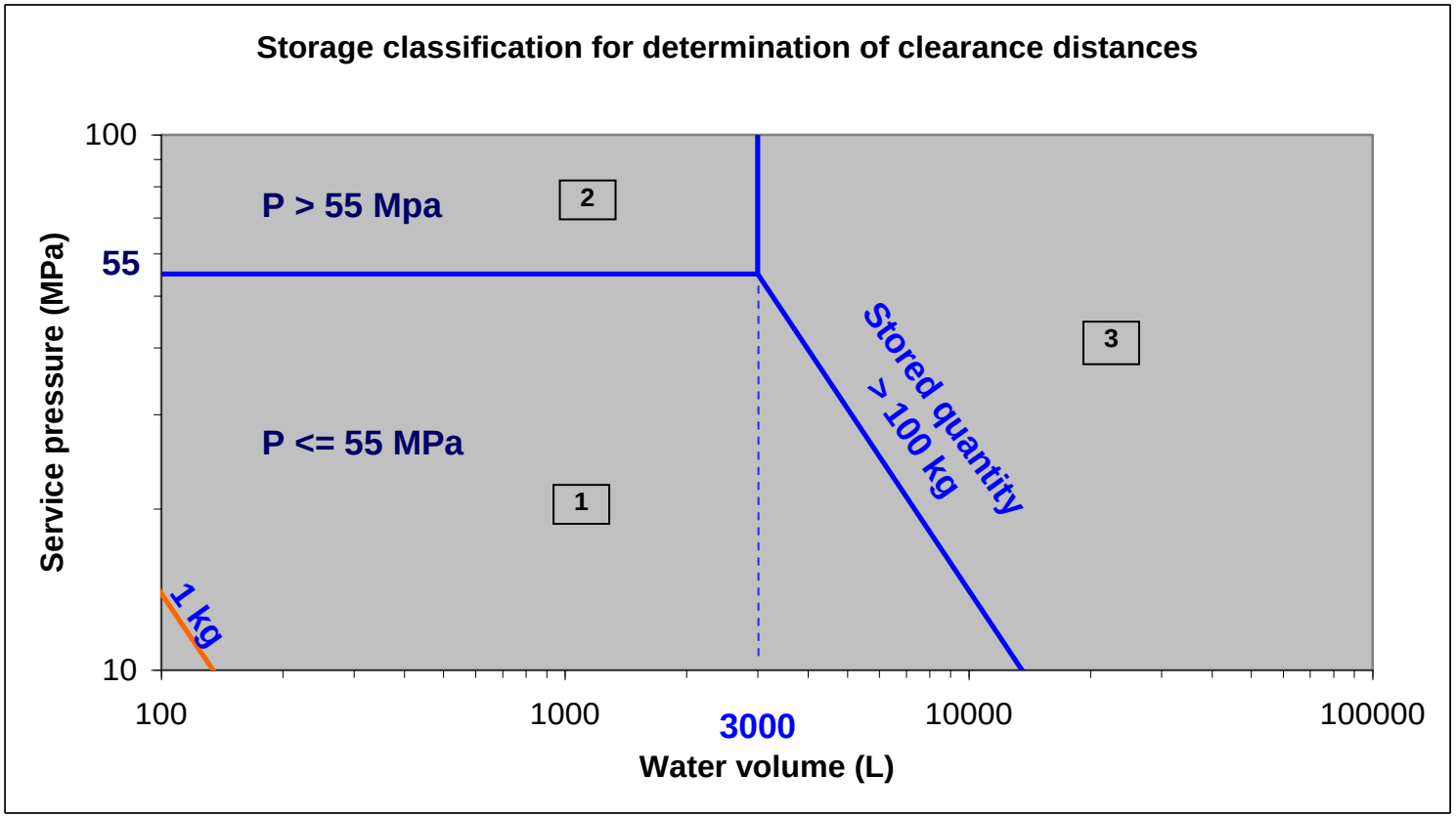


Reference leak size in function of leak probability and type of exposure

Reference leak sizes			Ref leak size	
			Non-critical exposure Targ : 1 10^{-5}	Critical exposure Targ : 4 10^{-6}
System types	Passive	Very Simple Gas Systems Ref : LPI = 15	-	0,09%
		Simple Gas System Ref : LPI = 60	0,16%	0,48%
		Complex Gas System Ref : LPI = 135	0,42%	1,30%
	Non passive	Process System Ref : Compressor & LPI = 135	0,65%	1,81%

Categorization of GH2 storage systems in fuelling stations

- Pressure introduced as a parameter where most relevant for determining safety distances, i.e. small systems
- Boundaries defined according to equipment types in use



Standard safety distances for passive GH2 systems

Distance in meters

Exposures or Sources of hazard	Safety distances (m)	Passive hydrogen systems							
		Category 1 (SP <= 55 MPa)			Category 2 (55 < SP <= 110 MPa)			Cat. 3 (Q > 100 kg)	
		VS	S	C	VS	S	C	S	C
	Occupied buildings - openable openings and air intakes	1,5	4,0	6,0	2,0	5,0	8,0	7,0	10,0
	Occupied buildings - bay-windows	-	5,0	8,0	-	7,0	12,0	9,0	15,0
	Unoccupied buildings - openable openings and air intakes	-	2,0	3,0	-	3,0	5,0	4,0	5,0
	Buildings of combustible material	1,5	3,0	5,0	2,0	4,0	7,0	8,0	8,0
	Flammable liquids above ground <= 4000 L	1,5	2,0	3,0	-	2,5	4,0	8,0	8,0
	Flammable liquids above ground > 4000 L	1,5	3,0	5,0	2,0	4,0	7,0	8,0	8,0
	Underground flammable liquid storage - vents and fill openings	-	3,0		-	3,0		5,0	5,0
	Stocks of combustible material	1,5	2,0	3,0	-	2,5	4,0	8,0	8,0
	Flammable gas storage above ground > 500 Nm3	1,5	2,0	3,0	-	2,5	4,0	8,0	8,0
	Facility lot line	-	2,0	3,0	-	3,0	5,0	4,0	5,0
	Areas not subjected to restrictions of activity	-	2,0	3,0	-	3,0	5,0	4,0	5,0
	Pedestrian and vehicle low-speed passage ways	-	2,0	3,0	-	3,0	5,0	4,0	5,0
	High voltage lines and trolley or train power line	-	5,0		-	5,0		10,0	
	Other overhead power lines	-	5,0		-	5,0		5,0	
	Roadways	-	5,0		-	5,0		5,0	

Work remaining for DIS publication

- **Safety distances for H2 Venting**
- **Leak hypothesis for definition of Hazardous Locations**
- **Forklift refueling in warehouses - prevention of hazardous atmosphere *(new)***