



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Hydrogen Refuelling Stations (HRS)

from research onto policy

Risk and safety distances in NL

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and the Environment
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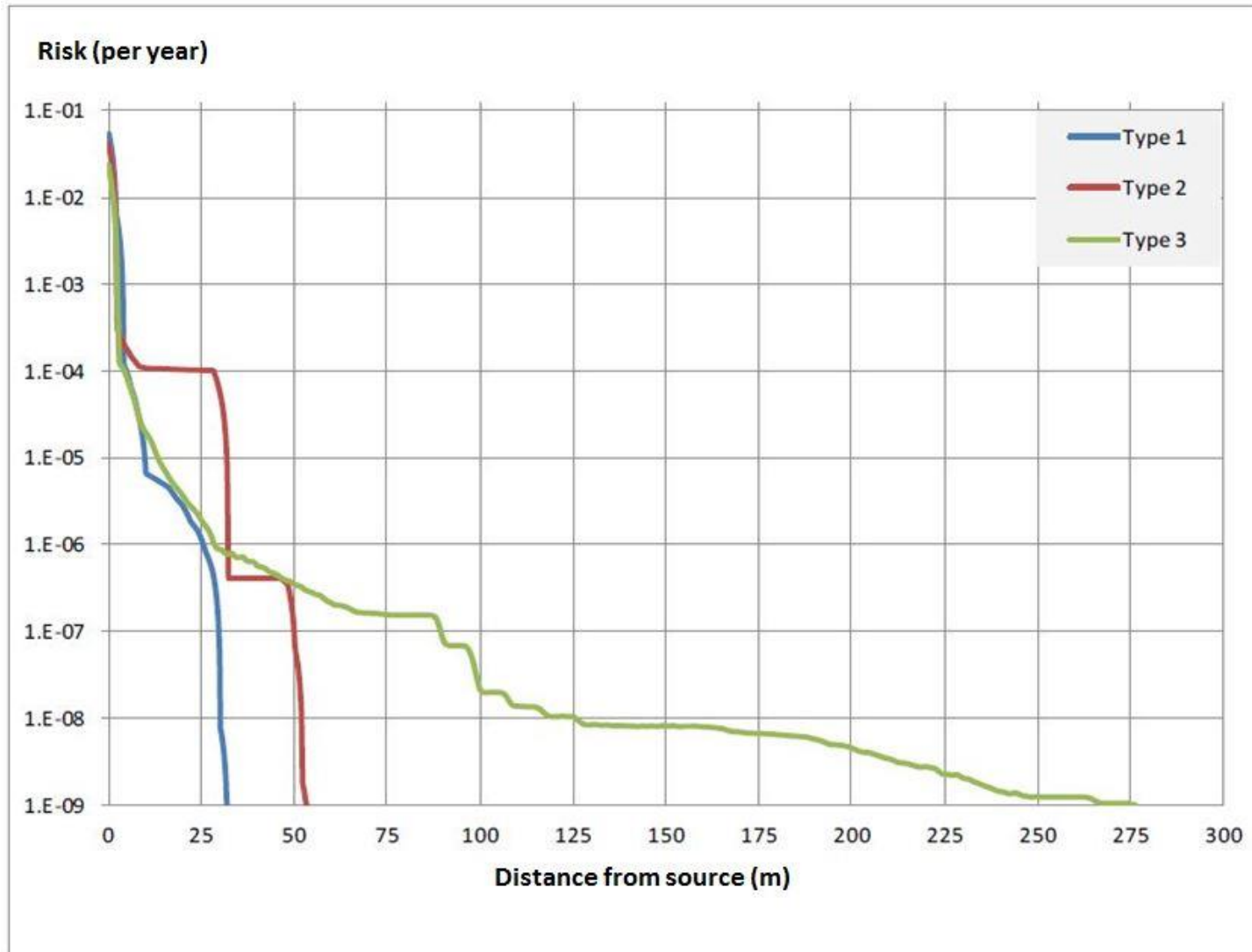
Content

1. 2016 calculations
2. comments H2-Industry
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2016: calculations on HRS (1000 kg per day)



Cases:

- Calculations SAFETI-NL 6.7
- 2 buffer storages (440, 950 bar)
- Composite hoses: Failure Frequency, a factor 10 lower
- Probability of direct ignition = 1

Results:

- Risk of 10^{-6} : 25 – 35 m
- Effect distance: 35 m – 500 m
- For LH2 large effect scenario. However a low frequency!



Comments from Industry

- › Fixed safety distances is not flexible enough
- › SAFETI-NL 6.7 used out-dated models for modelling release and effects of hydrogen
- › Probability of direct ignition 1 is not realistic: vapour cloud explosion is not taken into account

- › In consultation with the Dutch Ministry: Matrix method HRS
 - Work done by AVIV
 - Used SAFETI-NL v. 8.8
 - Used probability of direct ignition = 0.7



2022: Matrix safety distances HRS

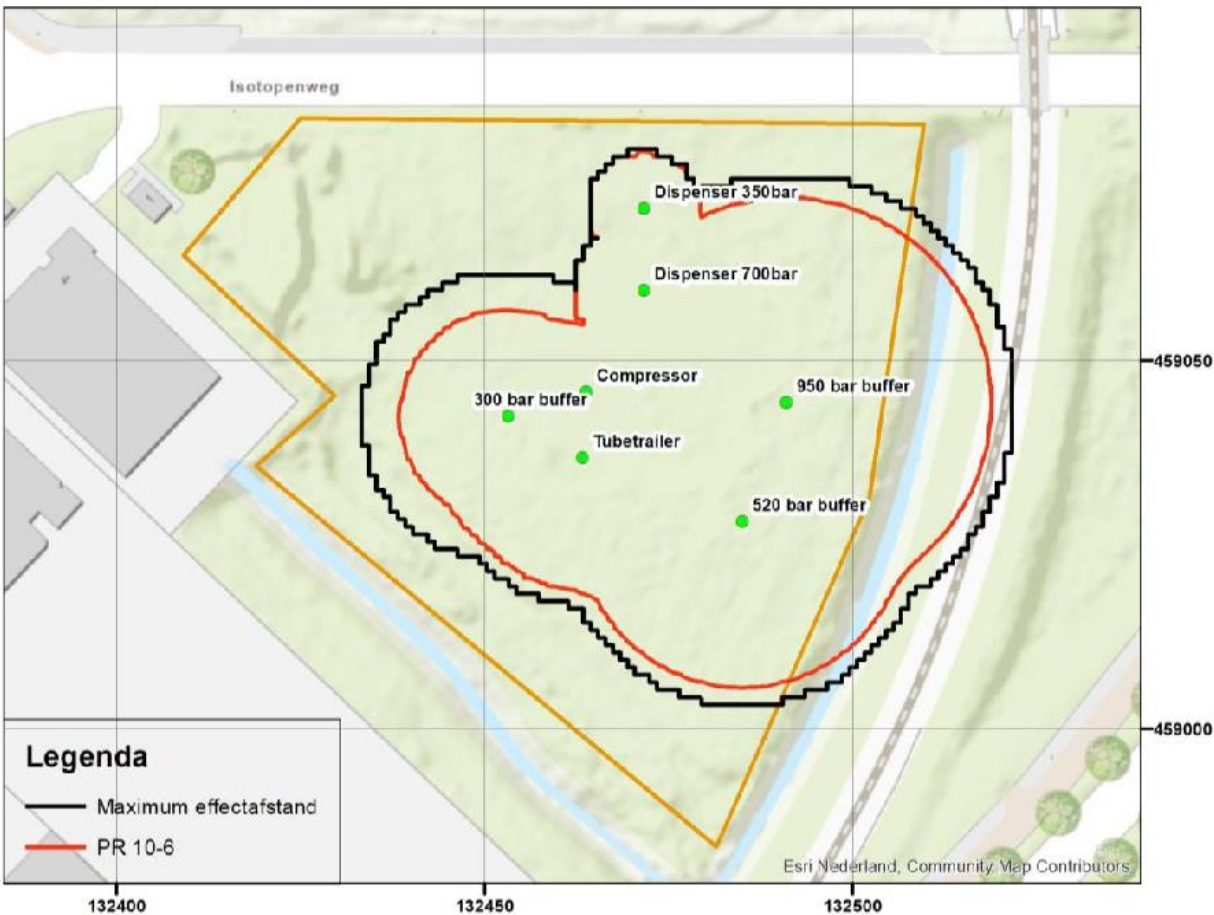
HRS equipment:

- › Tubetrailer: 540 kg, 300 barg, 9 tubes, 2850 l/tube, piping 10mm:
- › Compressor: continuously in use, piping 10 mm
- › 300 bar buffer: cilinder-pack of 12 cilinders, 2.4 m³ per cilinder
- › 520 bar buffer: cilinder-pack of 6 cilinders, 1.6 m³ per cilinder
- › 950 bar buffer, cilinder-pack of 5 cilinders, 0.4 m³ per cilinder
- › Dispenser 350 bar: piping 6.3 mm
- › Dispenser 700 bar: piping 6.3 mm.

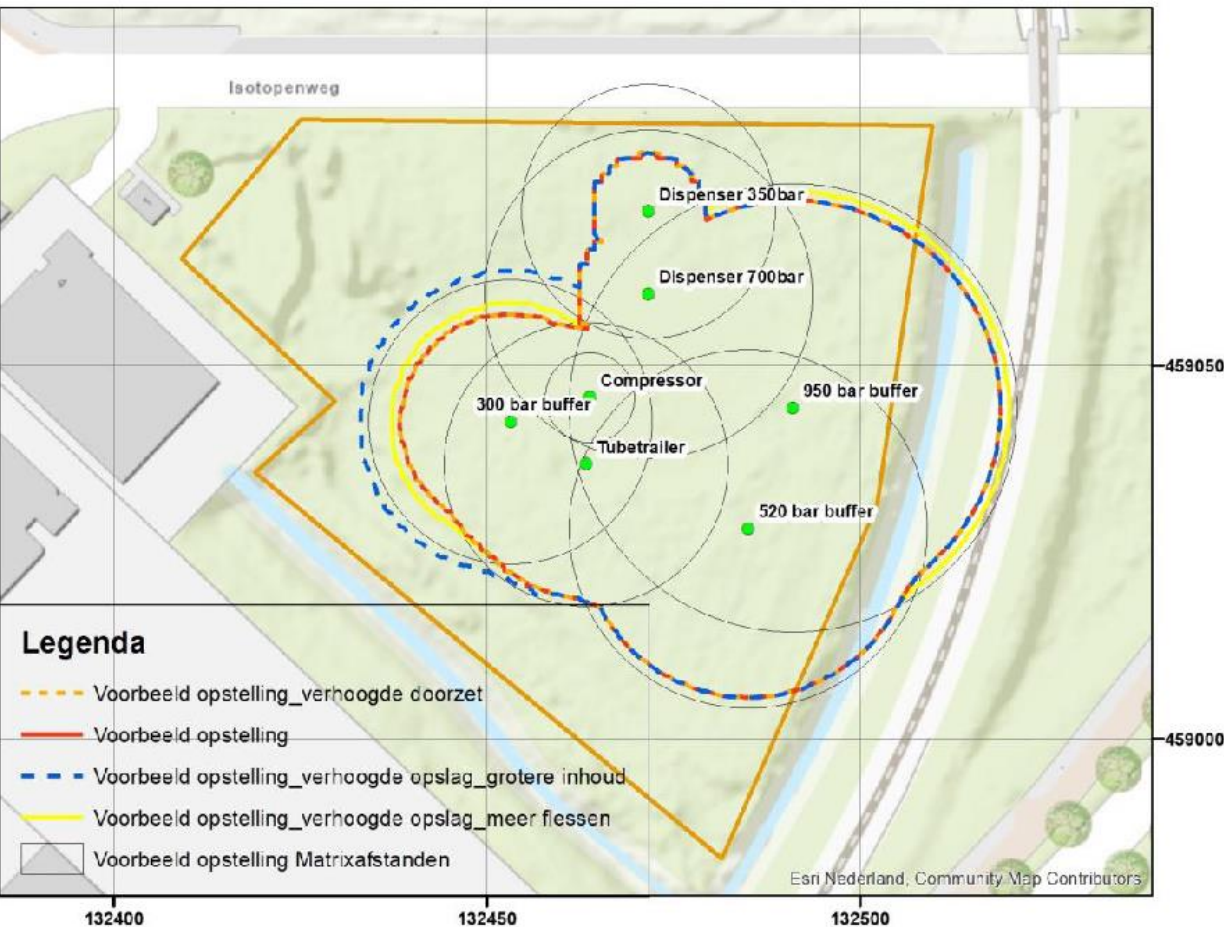


Conclusion

- › Risk contour 10^{-6} equals (more or less) the maximum effect distance (1% lethality)
- › Maximum effect distance is determined by effect distance flame jet
- › For each equipment determine effect distance of flame jet at largest connection
- › Approach risk distance with maximum effect distance



Maximum effect distance vs Risk contour 10^{-6}



Sensitivity study Risk contour 10^{-6}

Result

- › Effect distances of flame jet equals risk contour 10^{-6} more or less
- › Also for
 - higher delivery of 3000 kg/day
 - 2-3 times volume in storage cylinders
 - a factor 3-4 times more cylinders in storage
- › Except for dispensers
 - Solution: reduction factor 0.75 for dispensers



Problem:

assumption effect distance determined by flame jet?!

For vessels with large volume or low pressure this assumption is not valid.
In those cases the effect distance of instantaneous release is larger then for flame jet

- Study into the validity range of this assumption
- Restriction: Matrix is valid for pressure > 30 bar and vessel volumes max 3 m³

Inhoud per cilinder [m ³] Druk [bar]	2	2.5	3	3.5	4	4.5	5		Lek [10 mm]
30	7	7	8	8	9	9	10		6
300	16	18	19	21	22	23	24		19
520	19	21	23	25	26	28	29		24
950	23	25	27	29	31	32	34		30
1250	24	27	29	31	33	35	36		33



Outcome:

Matrix for safety distance HRS (GH₂)

<div>Diameter [mm]</div> <div>Pressure[bar]</div>	5	6	8	11	16	20	35	50
0-30	5	6	7	10	15	18	31	43
30-300	13	16	20	27	39	48	79	110
300-520	16	19	25	34	48	59	98	135
520-950	20	24	31	42	60	73	121	168
950-1250	22	26	35	46	65	80	133	184

- Diameter is size of the largest connection
- Safety distance for HRS: for dispensers correction factor is 0.75



Questions

