

Supplementary Information

Title: Risk assessment of hydrogen refueling stations in urban areas using independent protection layer (IPLs) of protection analysis (LOPA) and RISKCURVES

Table S1. Summary of with/without IPLs

No	Components	Type of used IPLs		Leak frequency (/year)		
		Passive	Active	Without IPLs	After Passive	Active
1	Dispenser	P2, P6	A2	9.88E10-5	9.88E10-9	9.88E10-7
2	H2 storage (HP)	P1, P3, P4, P6	A1, A2	1.02E10-4	1.02E10-12	1.02E10-7
3	H2 storage (LP)			1.02E10-4	1.02E10-12	1.02E10-7
4	Tube trailer			1.80E10-4	1.80E10-12	1.80E10-7
5	Compressor	P6	A1, A2	4.24E10-6	4.24E10-8	4.24E10-9
6	Priority panel	P6	A1, A2	3.84E10-5	3.84E10-7	3.84E10-8

Table S2. Summary of individual risk for each position

No	Analysis Position	IPLs		
		Without IPLs	Passive	Active
1	I	2.54E10-4	4.15E10-8	9.66E10-7
2	II	2.30E10-9	2.30E10-11	2.30E10-12
3	III	7.636E10-5	7.13E10-9	7.18E10-7

Table S3. Summary of societal risk with/without IPLs

No	Components	Without IPLs		Passive IPLs		Active IPLs	
		Contribution (%)	Value	Contribution (%)	Value	Contribution (%)	Value
1	Dispenser	47.3	1.11E-03	175	1.11E-07	90	1.11E-05
2	H2 storage (HP)	8.74	2.05E-04	3.17E-04	2.01E-12	1.66	2.05E-07
3	H2 storage (LP)	1.69	3.97E-05	6.23E-05	3.97E-13	0.321	3.97E-08
4	Tube trailer	40	9.40E-04	1.48E-03	9.40E-12	7.61	9.40E-07
5	Compressor	0.336	7.88E-06	124	7.88E-08	0.0638	7.88E-09
6	Priority panel	1.9	4.47E-05	702	4.47E-07	0.362	4.47E-08