

Reduction in the NSP Floor

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Potential Realism Improvement

The NSP Floor is at 1-in-1000 for an infinite duration fire.

This can be a significant contributor to control room abandonment likelihoods with lower heat release rate scenarios.

Identification of Relevant Guidance

The guidance in NUREG/CR-6850 Supplement 1 Table 14-1 states that a value of no lower 1E-3 should be used for NSP likelihood regardless of how much time is available until target damage.

Update Results from NUREG 2169 follow the same approach:

Non-Suppression Probability

Table 5-2
Updated numerical results for suppression curves (Originally, Table 14-1 from NUREG/CR-6850, Supplement 1)

Time (min)	T/G fires	HEAFs	Outdoor transformers	Flammable gas	Oil fires	Electrical fires	Transient fires	PWR containment (AP)	Containment (LPSD)	Welding	Control room	Cable fires	All fires
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	0.879	0.936	0.879	0.843	0.641	0.614	0.572	0.687	0.595	0.584	0.198	0.502	0.715
10	0.773	0.876	0.772	0.710	0.411	0.377	0.328	0.472	0.355	0.341	0.039	0.252	0.511
15	0.680	0.819	0.678	0.599	0.263	0.232	0.188	0.325	0.211	0.200	0.008	0.126	0.365
20	0.598	0.767	0.596	0.505	0.169	0.142	0.108	0.223	0.126	0.117	0.002	0.063	0.261
25	0.526	0.717	0.524	0.425	0.108	0.087	0.062	0.153	0.075	0.068	*	0.032	0.187
30	0.462	0.671	0.460	0.359	0.069	0.054	0.035	0.105	0.045	0.040	*	0.016	0.133
35	0.407	0.628	0.404	0.302	0.044	0.033	0.020	0.072	0.027	0.023	*	0.008	0.095
40	0.358	0.588	0.355	0.255	0.028	0.020	0.012	0.050	0.016	0.014	*	0.004	0.068
45	0.314	0.550	0.312	0.215	0.018	0.012	0.007	0.034	0.009	0.008	*	0.002	0.049
50	0.277	0.515	0.274	0.181	0.012	0.008	0.004	0.024	0.006	0.005	*	0.001	0.035
55	0.243	0.481	0.241	0.153	0.007	0.005	0.003	0.016	0.003	0.003	*	*	0.025
60	0.214	0.451	0.212	0.129	0.005	0.003	0.002	0.011	0.002	0.002	*	*	0.018
65	0.188	0.422	0.186	0.108	0.003	0.002	*	0.008	0.001	0.001	*	*	0.013
70	0.165	0.394	0.164	0.091	0.002	0.001	*	0.005	*	*	*	*	0.009
75	0.145	0.369	0.144	0.077	0.001	*	*	0.004	*	*	*	*	0.007
80	0.128	0.345	0.126	0.065	*	*	*	0.002	*	*	*	*	0.005
85	0.112	0.323	0.111	0.055	*	*	*	0.002	*	*	*	*	0.003
90	0.099	0.302	0.098	0.046	*	*	*	0.001	*	*	*	*	0.002
95	0.087	0.283	0.086	0.039	*	*	*	*	*	*	*	*	0.002
100	0.076	0.265	0.075	0.033	*	*	*	*	*	*	*	*	0.001

Proposed Approach to Enhance Realism

Reduce the NSP floor to $1E-5$.

The fire brigade composition and method of operation is similar to a reactor operational response crew.

There is a leader directing the actions of the fire brigade members. The leader will bring more and more resources to bear as the scenario progresses.

Proposed Approach to Enhance Realism - Limitation

This will effectively apply only to small fire scenarios. Large fire scenarios will have short times to damage which will have NSP already above the $1E-3$ Floor.

Sample Curve Changes

Control Room			Transients			Electrical Fires		
	0.324			0.111			0.098	
Time	<u>NSP with Floor 1E-3</u>	<u>NSP with Floor 1E-5</u>	Time	<u>NSP with Floor 1E-3</u>	<u>NSP with Floor 1E-5</u>	Time	<u>NSP with Floor 1E-3</u>	<u>NSP with Floor 1E-5</u>
0	1	1	0	1	1	0	1	1
5	0.198	0.198	5	0.57	0.57	5	0.61	0.61
10	0.039	0.039	10	0.33	0.33	10	0.38	0.38
15	0.0077	0.0077	15	0.19	0.19	15	0.23	0.23
20	1.52E-03	1.52E-03	20	0.11	0.11	20	0.14	0.14
25	1.00E-03	3.01E-04	25	0.06	0.06	25	0.09	0.09
30	1.00E-03	5.95E-05	30	0.04	0.04	30	0.05	0.05
35	1.00E-03	1.18E-05	35	0.02	0.02	35	0.03	0.03
40	1.00E-03	1.00E-05	40	0.01	0.01	40	0.02	0.02
50	1.00E-03	1.00E-05	50	3.81E-03	3.81E-03	50	7.63E-03	7.63E-03
60	1.00E-03	1.00E-05	60	1.25E-03	1.25E-03	60	2.88E-03	2.88E-03
			70	1.00E-03	4.11E-04	70	1.08E-03	1.08E-03
			80	1.00E-03	1.35E-04	80	1.00E-03	4.09E-04
			90	1.00E-03	4.42E-05	90	1.00E-03	1.54E-04
			100	1.00E-03	1.45E-05	100	1.00E-03	5.82E-05
			110	1.00E-03	1.00E-05	110	1.00E-03	2.19E-05
			120	1.00E-03	1.00E-05	120	1.00E-03	1.00E-05

Control Room Abandonment Improvement (w NUREG 2178)

<u>Bin, i</u>	<u>HRR (kW)</u>	<u>SF</u>	<u>Time To Abandonment</u>	<u>NSP wo Floor</u>	<u>SF*NSP wo Floor</u>	<u>Contribution wo Floor</u>	<u>NSP with Floor</u>	<u>SF*NSP with Floor</u>	<u>Contribution with Floor</u>
1	34	0.161	33	2.27E-05	3.65E-06	0.65%	1.00E-03	1.61E-04	14.0%
2	130	0.554	25	3.04E-04	1.68E-04	30.05%	1.00E-03	5.54E-04	48.5%
3	221	0.205	22	8.02E-04	1.64E-04	29.38%	1.00E-03	2.05E-04	17.9%
4	310	0.059	19.1	2.05E-03	1.22E-04	21.71%	2.05E-03	1.22E-04	10.6%
5	400	1.61E-02	17.25	3.74E-03	6.00E-05	10.72%	3.74E-03	6.00E-05	5.3%
6	490	4.03E-03	15.67	0.0062	2.51E-05	4.49%	0.0062	2.51E-05	2.2%
7	579	9.72E-04	13.8	0.0114	1.11E-05	1.99%	0.0114	1.11E-05	1.0%
8	669	2.35E-04	12.59	0.0169	3.98E-06	0.71%	0.0169	3.98E-06	0.35%
9	759	5.47E-05	11.82	0.0217	1.19E-06	0.21%	0.0217	1.19E-06	0.10%
10	848	1.25E-05	11.3	0.0257	3.21E-07	0.06%	0.0257	3.21E-07	0.03%
11	938	2.90E-06	10.76	0.0306	8.88E-08	1.59E-04	0.0306	8.88E-08	7.77E-05
12	1,028	6.53E-07	10.46	0.0337	2.20E-08	3.94E-05	0.0337	2.20E-08	1.93E-05
13	1,118	1.46E-07	10.01	0.0390	5.71E-09	1.02E-05	0.0390	5.71E-09	4.99E-06
14	1,208	3.25E-08	9.68	0.0434	1.41E-09	2.53E-06	0.0434	1.41E-09	1.24E-06
15	1,462	9.24E-09	8.64	0.0608	5.62E-10	1.00E-06	0.0608	5.62E-10	4.92E-07
				Pr(ab)	5.60E-04		Pr(ab)	1.14E-03	

The reduction of the floor can provide a 20% to 50% reduction in the likelihood of control room abandonment. The benefit is on larger side for control room modeling that credits NUREG 2178 which has a much higher likelihood of lower HRR fires.

Industry Benefit

The maximum site benefit is about 10% reduction in CDF/LERF. The average industry benefit is about 5% reduction in CDF/LERF

Questions

