



LA RIVELAZIONE INCENDI NELLE ATTIVITÀ DI DEPOSITO: CASI DI STUDIO E RAFFRONTO CON LE STRATEGIE TRADIZIONALI DI PROTEZIONE ATTIVA

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Safety Expo 2017, 20 settembre 2017



TEMI DEL SEMINARIO

Quali benefici introducono i sistemi di rivelazione incendi nelle attività di deposito?

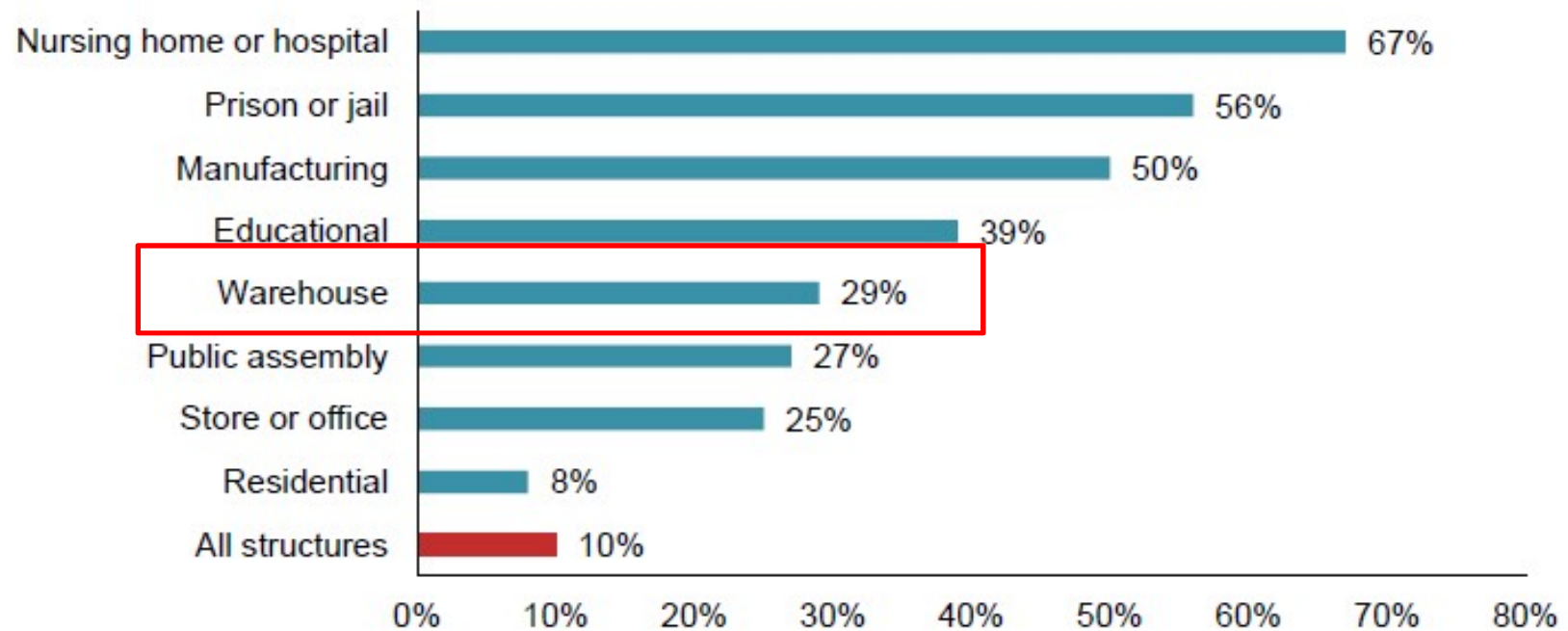
In quali circostanze la rivelazione è strategica nelle attività di deposito?





SPRINKLER IN DISCUSSIONE?

Figure 1. Presence of sprinklers in U.S. structure fires, by occupancy: 2010-2014



US experience with sprinkler, NFPA, luglio 2017



SPRINKLER IN DISCUSSIONE?

Table A.
Summary of AES presence and type in reported structure fires
2010-2014 annual averages

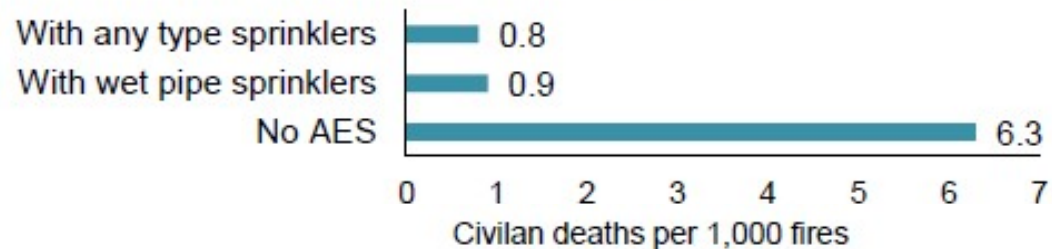
AES Presence of Type	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
AES present	57,430	(12%)	45	(2%)	1,259	(9%)	\$793	(8%)
Sprinkler present	49,840	(10%)	42	(2%)	1,148	(8%)	\$709	(7%)
<i>Wet</i>	43,540	(9%)	39	(1%)	1,058	(7%)	\$579	(6%)
<i>Dry</i>	4,770	(1%)	2	(0%)	69	(0%)	\$120	(1%)
<i>Other</i>	1,530	(0%)	1	(0%)	21	(0%)	\$10	(0%)
Non-sprinkler AES present	7,590	(2%)	4	(0%)	110	(1%)	\$84	(1%)
Partial system AES of any type	2,190	(0%)	5	(0%)	56	(0%)	\$66	(1%)
AES of any type not in fire area and did not operate	1,630	(0%)	2	(0%)	47	(0%)	\$75	(1%)
No AES present	422,180	(87%)	2,659	(98%)	13,241	(91%)	\$8,609	(90%)
Total	483,430	(100%)	2,711	(100%)	14,602	(100%)	\$9,544	(100%)

US experience with sprinkler, NFPA, luglio 2017

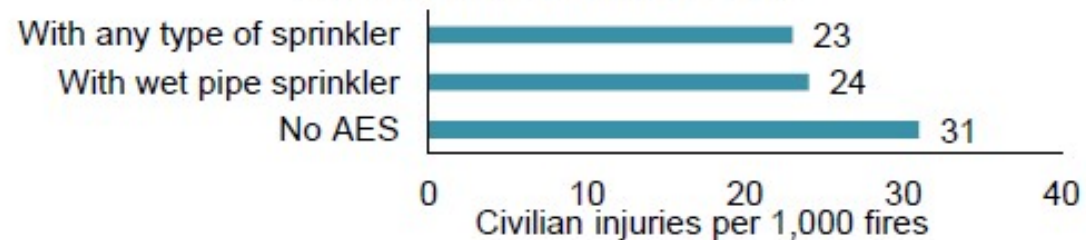


SPRINKLER IN DISCUSSIONE?

Civilian death rates per 1,000 fires in properties with sprinklers and with no AES: 2010-2014



Civilian injury rates per 1,000 fires in properties with sprinklers and with no AES: 2010-2014



US experience with sprinkler, NFPA, luglio 2017

Table 3.
Estimated Reduction in Civilian Deaths per Thousand Fires
Associated With All Types of Sprinklers,
by Property Use (Excluding Properties under Construction): 2010-2014 Annual Averages

Property Use	Without AES	With sprinklers of any type	Percent reduction from no AES	With wet pipe sprinklers	Percent reduction from no AES
All public assembly	0.7	0.0	100%	0.0	100%
Health care	0.9	0.3	71%	0.1	83%
Residential	7.5	1.1	85%	1.2	84%
Home (including apartment)	7.5	1.4	81%	1.6	79%
Dormitory or barracks	0.4	0.0	100%	0.0	100%
Hotel or motel	7.0	0.3	95%	0.0	100%
Rooming or boarding house	8.4	0.3	96%	0.4	96%
Residential board and care or assisted living	7.2	1.3	82%	1.5	80%
Store or office	0.9	0.3	68%	0.3	63%
Manufacturing facility	1.6	1.0	33%	1.2	21%
Warehouse excluding cold storage	2.7	0.6	79%	0.7	74%

Table 4.
Estimated Reduction in Average Direct Property Loss per Fire
Associated With All Types of Sprinklers
by Property Use (Excluding Properties under Construction): 2010-2014 Annual Averages

Property Use	Loss without AES	Loss with sprinklers of any type	Percent reduction	Loss with wet pipe sprinklers	Percent reduction from no AES
All public assembly	\$37,900	\$9,100	76%	\$8,900	77%
Health care*	\$14,900	\$4,000	73%	\$3,700	75%
Residential	\$19,200	\$7,100	63%	\$7,300	62%
Home (including apartment)	\$19,300	\$8,100	58%	\$8,500	56%
Dormitory or barracks	\$3,900	\$1,300	67%	\$1,400	65%
Hotel or motel	\$35,200	\$10,900	69%	\$10,700	70%
Rooming or boarding house	\$12,200	\$1,700	86%	\$1,800	85%
Residential board and care or assisted living	\$5,500	\$2,300	58%	\$2,400	55%
Store or office	\$52,400	\$26,100	50%	\$26,300	50%
Manufacturing facility	\$107,200	\$82,500	23%	\$70,900	34%
Warehouse excluding cold storage	\$90,700	\$138,300	no reduction	\$120,800	no reduction
All structures	\$20,400	\$14,200	30%	\$13,300	35%

Table 6.
Sprinkler Reliability and Effectiveness When Fire Was Coded as Not Confined and Large Enough to
Activate Sprinkler and Sprinkler Was Present in Area of Fire,
by Property Use: 2010-2014 Annual Averages

A. All Sprinklers

Property Use	Number of fires per year where sprinklers were present	Non-confined fires too small to activate or unclassified operation	Fires coded as confined fires	Number of qualifying fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All storage	660	140	220	300	86%	96%	82%
Warehouse excluding cold storage	360	80	90	180	84%	97%	81%

una storia di successo





PERCHE' DUNQUE LA RIVELAZIONE?

1. I depositi di ultima generazione introducono complessità nella protezione antincendio

Elevate altezze di deposito



Contenimento delle superfici



Automazione dei processi
(ASRS)

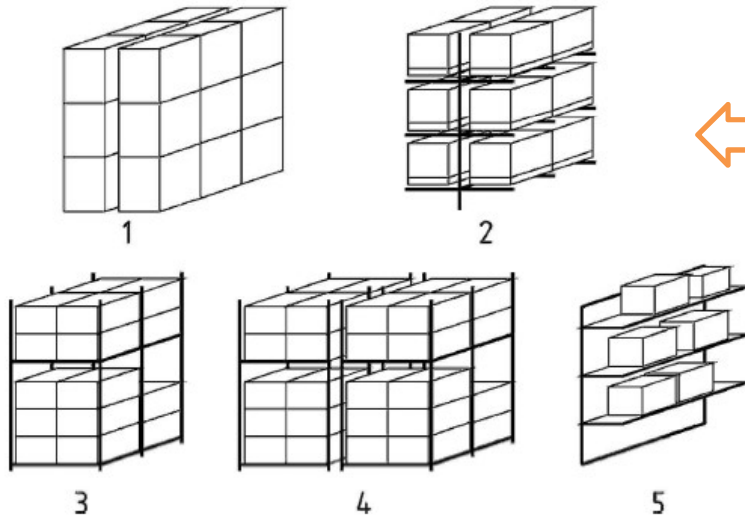


PERCHE' DUNQUE LA RIVELAZIONE?

figura 3 Configurazione del deposito

Legenda

- 1 Deposito con merci libere (ST1)
- 2 Deposito su scaffali per pallet (ST4)
- 3 Deposito con pallet accatastati (ST2)
- 4 Deposito con pallet accatastati in file multiple (ST3)
- 5 Deposito su scaffali con ripiani pieni o grigliati (ST5/6)





PERCHE' DUNQUE LA RIVELAZIONE?

2. Le **strategie di intervento** sono di natura difensiva (addetti antincendio/squadre di soccorso)
3. I **ritardi nella trasmissione dei segnali** agli addetti al servizio antincendio o alle squadre di soccorso sono risultati decisivi nella lotta contro l'incendio
4. La semplice rivelazione legata a pressostati/flussostati si dimostra tardiva

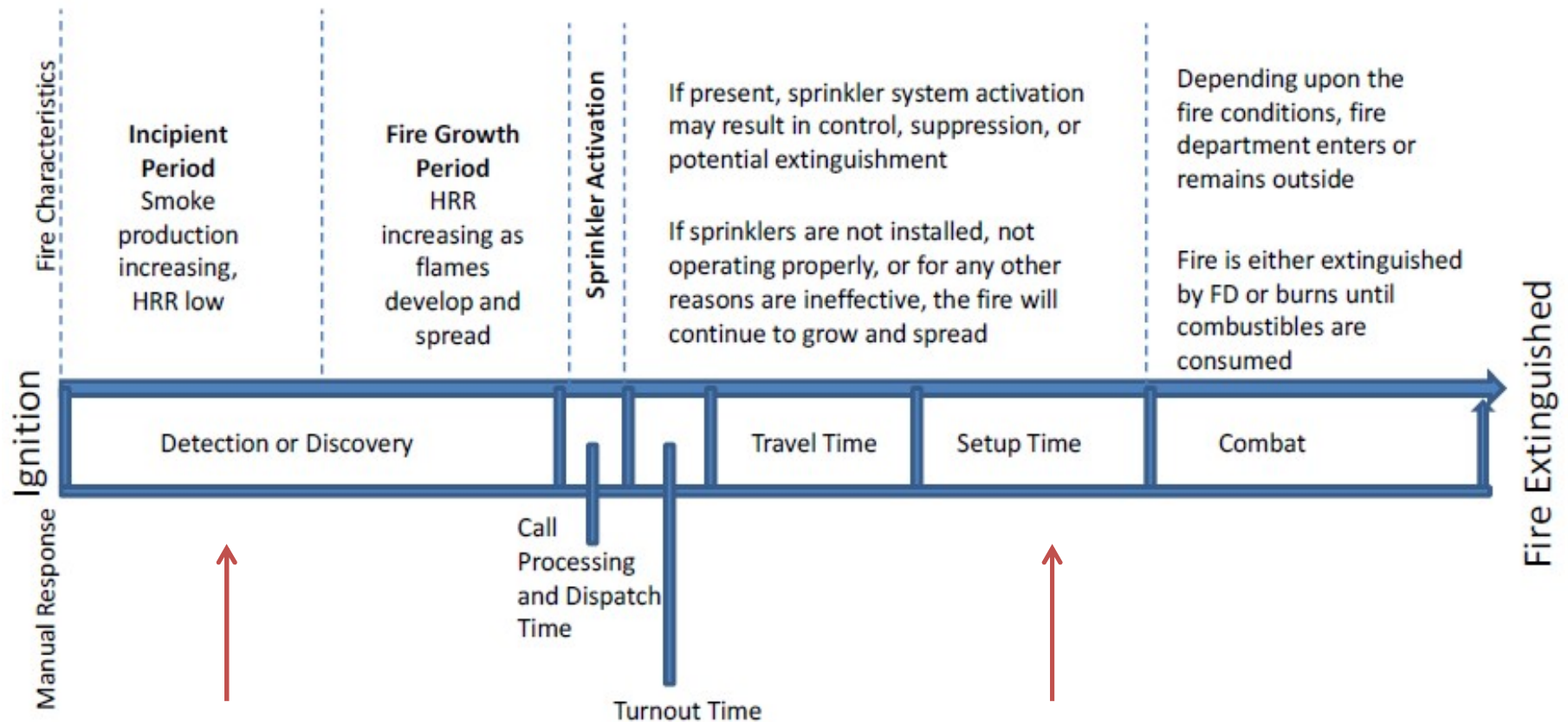
Nota: riforma della vigilanza privata in Italia

(DM 269/2010, DM 115/2014, UNI CEI EN 50518-1, 2 e 3:2014, UNI EN 54-21:2006)



QUANDO SCEGLIERE LA RIVELAZIONE?

Fire Protection Research Foundation, *Fire Detection in Warehouse Facilities*, Final phase I report, gennaio 2012 (www.nfpa.org/Foundation)

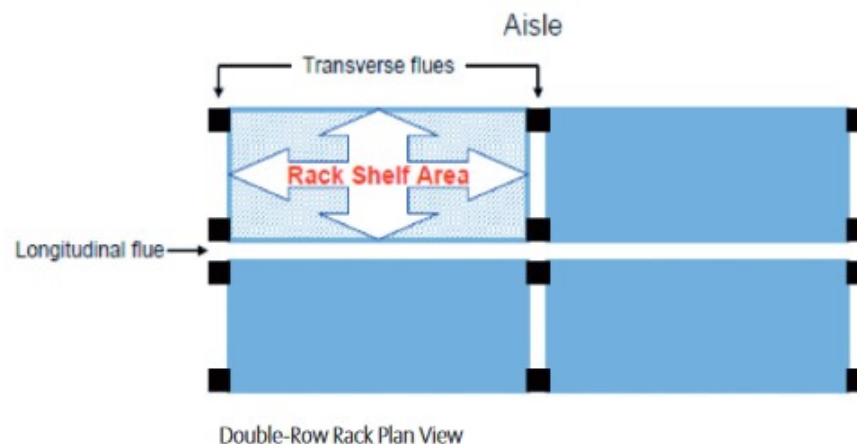




QUANDO SCEGLIERE LA RIVELAZIONE?

Ipotesi di lavoro

1. Deposito di superficie pari a 9.290 mq
2. Costruzione metallica dell'edificio
3. Configurazione del deposito: deposito su scaffali per pallet a doppia fila
4. Distanza tra le merci (interstizi): 15 cm in entrambe le direzioni
5. Larghezza minima dei corridoi tra gli scaffali: 1,2 m





QUANDO SCEGLIERE LA RIVELAZIONE?

Table 1 – Characteristic Warehouse Building Sizes, Commodities Stored, Sprinkler Types and Designs

Design	Commodity	Building Height		Sprinkler Temp.		Sprinkler Response	Delivered Water Density		In-rack Sprinklers	Height of Sprinkler Above Floor		Height of Sprinkler above Storage	
		[ft]	[m]	[°F]	[°C]		[gpm/ft ²]	[mm/min]		[ft]	[m]	[ft]	[m]
W1	Class II	15	4.6	165	74	Ordinary	0.17	6.9	No	15	4.6	3	0.9
W2	Plastic	15	4.6	165	74	Ordinary	0.6	24.4	No	15	4.6	3	0.9
W3	Class II	40	12.2	165	74	Quick	1.42	57.9	No	40	12.2	5	1.5
W4	Plastic	40	12.2	165	74	Quick	1.59	64.8	No	40	12.2	5	1.5
W5	Class II	100	30.5	165	74	Ordinary	0.3	12.2	Yes	15*	4.6	10	3.0
W6	Plastic	100	30.5	165	74	Ordinary	0.45	18.3	Yes	15*	4.6	10	3.0



QUANDO SCEGLIERE LA RIVELAZIONE?

Deposito	Altezza di deposito	Note
W1	3,7 m, due livelli	Sprinkler a soffitto
W2	3,7 m, due livelli	Sprinkler a soffitto
W3	10,7 m, sette livelli	ASRS, ESFR sprinkler
W4	10,7 m, sette livelli	ASRS, ESFR sprinkler
W5	27,4 m, diciotto livelli	ASRS, in rack sprinklers
W6	27,4 m, diciotto livelli	ASRS, in rack sprinklers





QUANDO SCEGLIERE LA RIVELAZIONE?

Table 2 – Warehouse Fire Incidents

Fire Scenario	Description	Scenario Details			Potential Fire Growth		
		Ignition Area	Potential First Material Ignited	Potential Ignition Cause	Incipient Period	Growth Rate	Max Size
F1	Intentional ignition	High rack, floor level in flue	External cardboard box, gasoline	Intentional	Virtually none	Extremely rapid	Extremely large
F2	Top of rack ignition	High rack, top level, top surface	Cardboard box	Exploding light bulb	Highly variable	Variable, potentially rapid	Extremely large
F3	Shipping and receiving ignition with spread to high rack	Shipping and Receiving, adjacent to high rack	Non-racked pallets of the stored commodity, spreads to high rack	Radiated heat from operating equipment	Highly variable	Variable, depending on geometric configuration and combustible materials	Extremely large
F4	Shipping and receiving ignition without spread to high rack	Shipping and receiving, remote from high rack	Non-racked pallets of the stored commodity, unable to spread to rack storage	Radiated heat from operating equipment	Highly variable	Variable depending on geometric configuration and combustible materials	Limited to available fuel in area
F5	Long incipient period from smoldering or overheat	Electrical equipment	Wire insulation	Electrical overheat/ arcing	Long, overheat fire condition with delayed transition to flaming	Variable	Variable



QUANDO SCEGLIERE LA RIVELAZIONE?

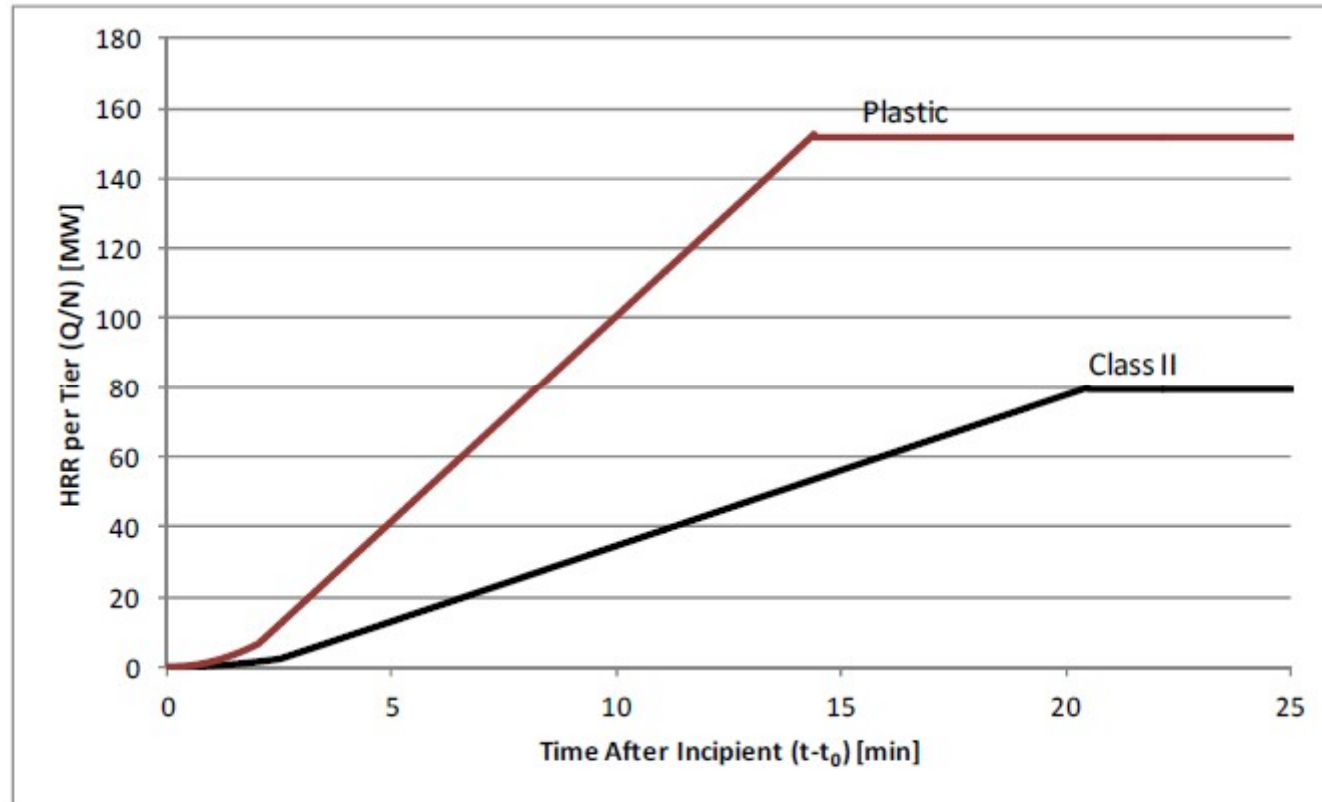


Figure 4 – Estimated heat release rate per tier of double row rack storage after incipient fire period ends and rapid flame growth begins. Spread across aisles is not included in this analysis.



QUANDO SCEGLIERE LA RIVELAZIONE?

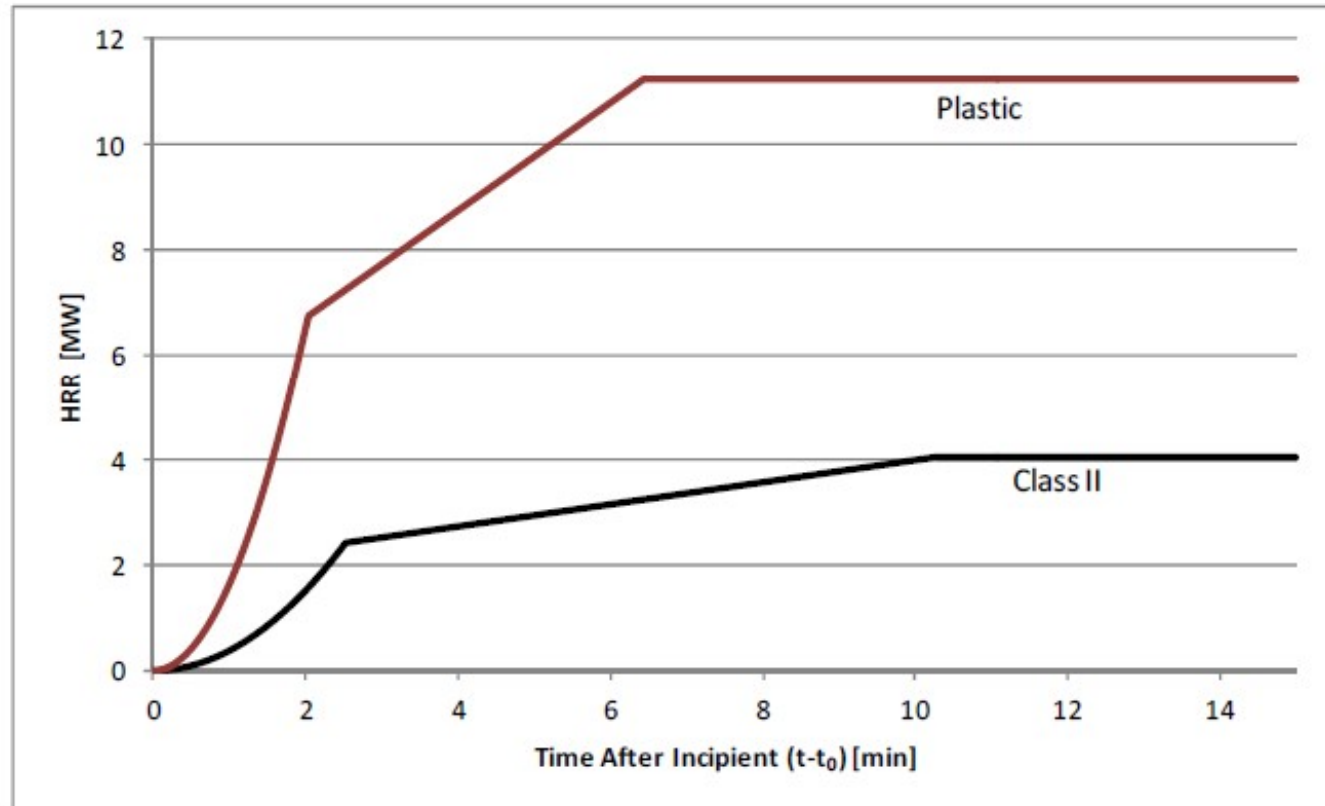
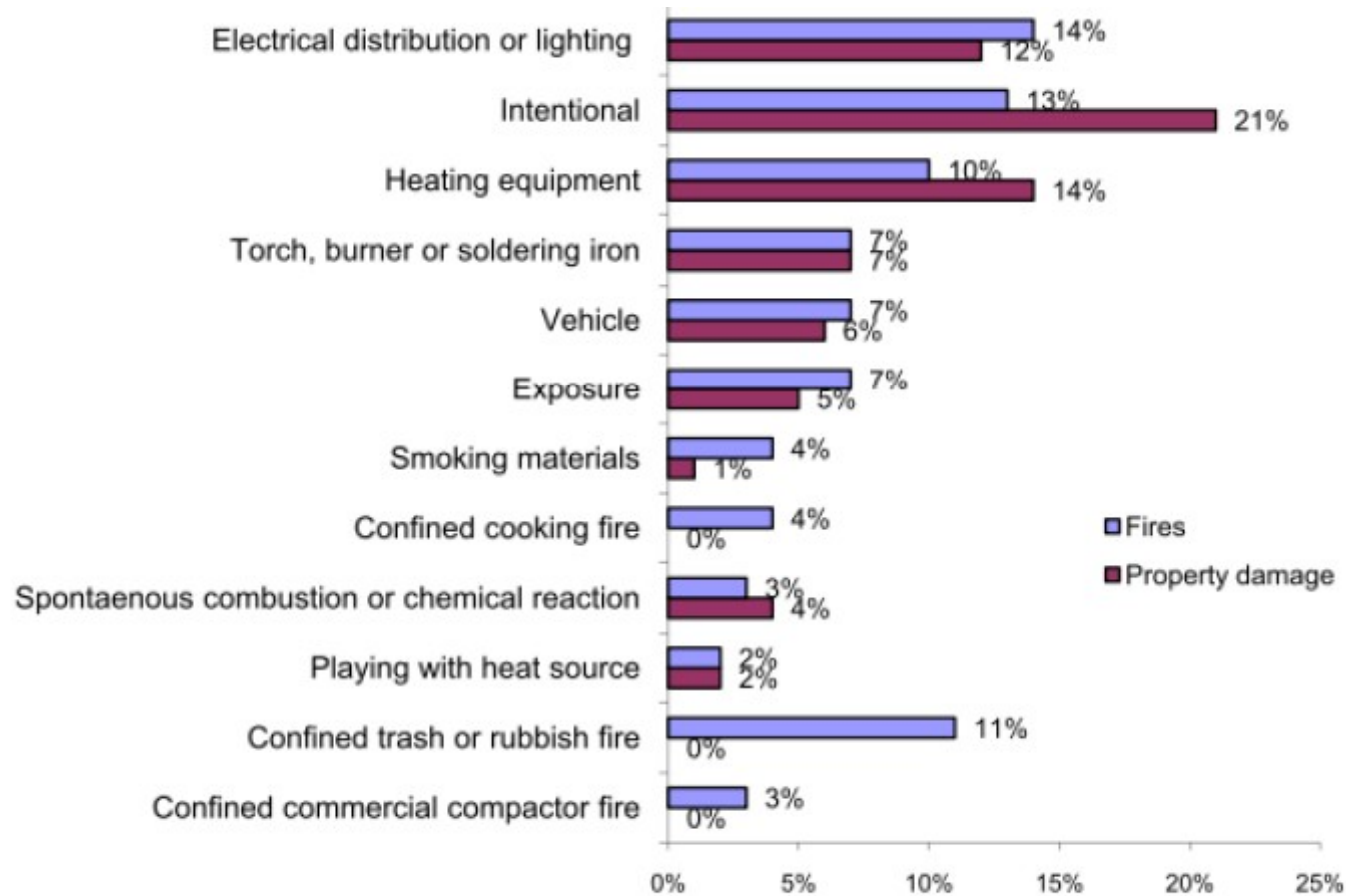


Figure 5 – Estimated HRR after incipient period of 4 pallets in 2 x 2 array ignited in the shipping and receiving area.



QUANDO SCEGLIERE LA RIVELAZIONE?



Leading causes of warehouse structure fires 2003–2006

Table 5 – Sprinkler Activation Times and HRR at Activation for Each Fire Scenario in Each Warehouse Design

Warehouse	Commodity	Fire Scenario	Height of Sprinkler Above Top of Storage [m, ft]	Sprinkler Activation After Incipient [min]	HRR at Time of Sprinkler Activation [MW]
W1 4.6 m (15 ft)	Class II	Intentional	0.9 (3.0)	0.9	0.6
		Top Rack	0.9 (3.0)	1.1	0.4
		Ship/Rec	3.5 (11.5)	1.5	0.8
		Incipient	NA		
W2 4.6 m (15 ft)	Plastic	Intentional	0.9 (3.0)	0.6	1.0
		Top Rack	0.9 (3.0)	0.7	0.8
		Ship/Rec	3.5 (11.5)	0.9	1.4
		Incipient	NA		
W3 12.2 m (40 ft)	Class II	Intentional	1.5 (5)	0.6	0.8
		Top Rack	1.5 (5)	1.0	0.3
		Ship/Rec	11.1 (36.5)	2.5	2.3
		Incipient	NA		
W4 12.2 m (40 ft)	Plastic	Intentional	1.5 (5)	0.4	1.5
		Top Rack	1.5 (5)	0.7	0.7
		Ship/Rec	11.1 (36.5)	1.5	3.5
		Incipient	NA		
W5 30.5 m (100 ft)	Class II	Intentional	0.3 (1.1)*	0.8	0.5
		Top Rack	3.1 (10)	1.4	0.7
		Ship/Rec	29.4 (96.5)	$T_{max} = 36^{\circ}\text{C} (96^{\circ}\text{F})^{**}$	
		Incipient	NA		
W6 30.5 m (100 ft)	Plastic	Intentional	0.3 (1.1)*	0.6	1.0
		Top Rack	3.1 (10)	0.9	1.3
		Ship/Rec	29.4 (96.5)	$T_{max} = 50^{\circ}\text{C} (122^{\circ}\text{F})^{**}$	
		Incipient	NA		



QUANDO SCEGLIERE LA RIVELAZIONE?

Approximate Sprinkler Activation Times and HRR at Activation for Intentional Ignition (F1) Fire Scenario

			Sprinkler Present and Effective		
Intentional Ignition in flue space at base of high rack area	Commodity	Warehouse Design Height	Height of Sprinkler Above Top of Storage [m,ft]	Sprinkler Activation After End of Incipient Stage [min]	HRR at time of sprinkler activation [MW]
	Class II	W1 (15 ft)	0.9 (3.0)	1	<1
		W3 (40 ft)	1.5 (5)	<1	1
		W5 (100 ft)	0.3 (1.1)*	<1	<1
	Plastic	W2 (15 ft)	0.9 (3.0)	<1	1
		W4 (40 ft)	1.5 (5)	1	1-2
		W6 (100 ft)	0.3 (1.1)*	<1	1

Rivelazione: NO!



QUANDO SCEGLIERE LA RIVELAZIONE?

Approximate Sprinkler Activation Times and HRR at Activation for Top Rack Storage Ignition Scenario (F2)

Intentional Ignition in flue space at base of high rack area	Commodity	Warehouse Design Height	Sprinkler Present and Effective		
			Height of Sprinkler Above Base of Fire [m, ft]	Sprinkler Activation After End of Incipient Stage [min]	HRR at Time of Sprinkler Activation [MW]
	Class II	W1 (15 ft)	0.9 (3)	1	<1
		W3 (40 ft)	1.5 (5)	1	<1
		W5 (100 ft)	3.1 (10)	1-2	<1
	Plastic	W2 (15 ft)	0.9 (3)	<1	<1
		W4 (40 ft)	1.5 (5)	<1	<1
		W6 (100 ft)	3.1 (10)	<1	1-2

Rivelazione: SI (fase di ignizione)



QUANDO SCEGLIERE LA RIVELAZIONE?

Approximate Sprinkler Activation Times and HRR at Activation for Shipping and Receiving Fire Ignition Scenario (F3, F4)

		Sprinkler Present and Effective			
Intentional Ignition in flue space at base of high rack area	Commodity	Warehouse Design Height	Height of Sprinkler Above Top of Storage [m, ft]	Sprinkler Activation After End of Incipient Stage [min]	HRR at Time of Sprinkler Activation [MW]
	Class II	W1 (15 ft)	3.5 (11.5)	1-2	<1
		W3 (40 ft)	11.1 (36.5)	2-3	2-3
		W5 (100 ft)	29.4 (96.5)	$T_{\max} = 36^{\circ}\text{C} (96^{\circ}\text{F})^{**}$	
	Plastic	W2 (15 ft)	3.5 (11.5)	<1	1
		W4 (40 ft)	11.1 (36.5)	1-2	3-4
		W6 (100 ft)	29.4 (96.5)	$T_{\max} = 50^{\circ}\text{C} (122^{\circ}\text{F})^{**}$	

Rivelazione: SI (fase di ignizione), se la trasmissione del segnale avviene 10-15 min prima della fase di propagazione



QUANDO SCEGLIERE LA RIVELAZIONE?

Scenario F5 (surriscaldamento cavo elettrico)



Fase di ignizione molto lunga, produzione di fumo



Rivelazione: SI (fase di ignizione), soluzione strategica





QUALI CONCLUSIONI?

1. Segnalazione precoce dell'incendio essenziale se
 - t fase incipiente > 10-15 minuti
 - t rivelazione \approx inizio t incipiente
2. Rivelazione ancor più efficace in presenza di addetti antincendio (t intervento < 3 minuti)
3. Rivelazione efficace per i depositi più alti di 12 m anche in presenza di impianti sprinkler, per scenari di incendio derivanti da aree di carico/scarico
4. Rivelazione indispensabile negli incendi con lunghi tempi di ignizione (es. di natura elettrica o da rifiuti)
5. Rivelazione di fumo (precoce) come scelta tecnologica preferenziale



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