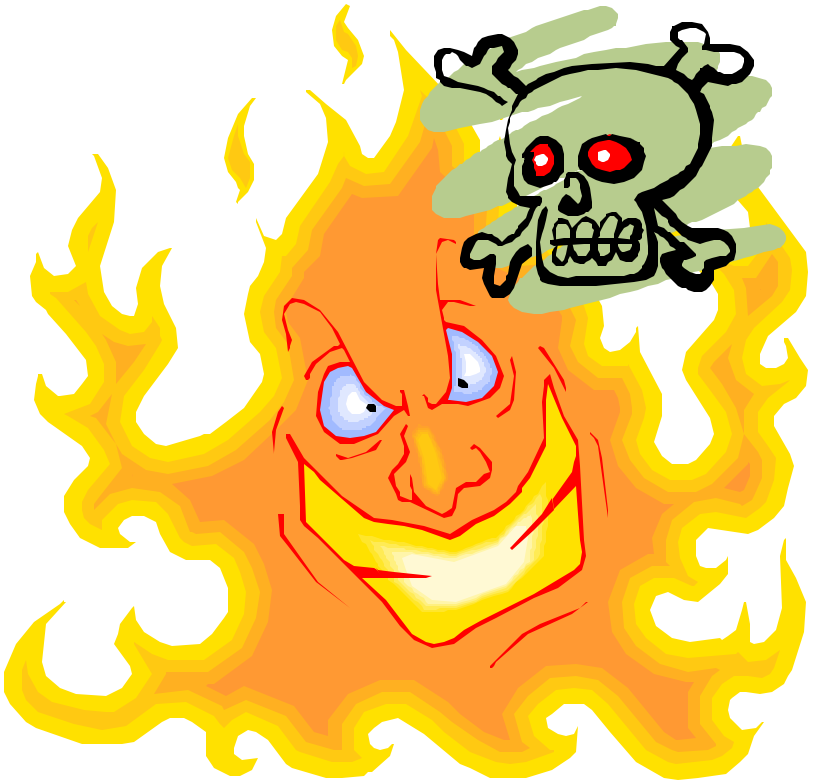
Combustion Products and Toxicity



Is Every Fire a Hazardous Material Emergency?

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NFPA Says……

"Combustion products produced in a fire are always toxic and extremely hazardous to life safety."

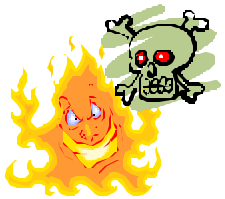
"Smoke, even of 'average' toxicity is still <u>very</u> toxic."

NFPA Fire Protection Handbook, 17th Edition, Section 3, Chapter 1

From whence we came….

- Pre-1991 Orders
  - Radiological only
  - Aligned with NRC
- Post-1991
  - Non-rad on par with rad materials
  - Aligned with EPA, OSHA, DOT
- Common conceptual basis
  - “Stealthy toxics”
  - Need recognition/warning to protect people

The Situation:



- Order/EMG provides many opportunities for interpretation
- Parsing/selective interpretation yields conclusions contrary to intent of the whole
- Combustion products from fire can be construed as “hazardous material release” per Order definitions

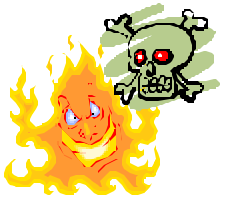
First Big Question

Q: Should combustion products be included in our working definition of “hazardous materials” and fires as “hazardous material release”?

A: NO

- Inconsistent with basic Order intent
- Every facility would require haz mat program
- Contrary to prevailing U.S. emergency management practice

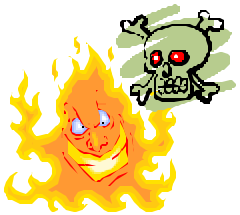
Second Big Question



Q: Are explosives enough worse (in terms of toxic combustion products) that they should be treated differently as potential sources of airborne hazardous materials?

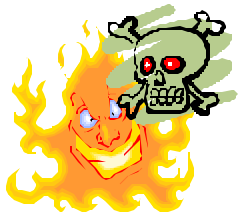
A: In a word, No.

How to we know?



- Pantex: combustion emission factors for explosives
- NIST: Smoke component yields from room-scale fires.
- Comparison of quantities burned to produce ERPG-2 concentration at 100 m

The Comparison



- From Pantex model: NOx yields for TNT, RDX, TATB and HMX

- From NIST data: HCN and HCL yields for
  - Sofa cushions (polyurethane foam & fabric)
  - Bookcases (particle board & laminate)
  - Electrical cable (PVC insulation & sheath)

The Comparison

Amount of toxic gas needed to exceed applicable ERPG-2 (15 min-ave) at 100 m

NO_2	0.78 kg
HCN	0.32 kg
HCl	0.83 kg

Mass burned in 15 minutes to produce ERPG-2 concentration at 100 m

Material	Toxic Gas	Mass	SCTR*
Electrical cable	HCl	3.95	5.4
TNT	NO_2	11.8	1.8
TATB	NO_2	18.3	1.2
Sofa cushion	HCN	21.3	1.0
RDX	NO_2	36.8	0.58
HMX	NO_2	37.1	0.57
Bookcase	HCN	128	0.17

*Sofa Cushion Toxicity Ratio

CHOICES

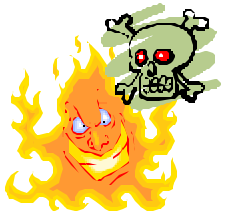
A

B

C

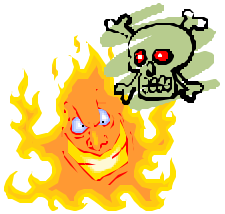
D

Other considerations



- Military regards blast & missiles as primary hazard from explosives (DoD 6055.9 STD)
- DOT Emergency Response Guidebook (Guide 112) stresses blast/missile hazard as basis for protection guidance
  - Fire reaches cargo = explosion imminent
  - Isolate & evacuate to 800/1600 m
  - Fire may produce “irritating, corrosive and/or toxic gases”

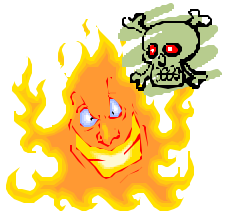
Conclusions



1. “Ordinary” fires should not be analyzed in an EPHA or classified on basis of potential combustion product releases.

2. Toxic emissions from fires involving explosives are not significantly different from other “ordinary” fires.

Conclusion (cont'd)



3. Any emergency planning for conventional explosives should be based on blast/missile hazards, not combustion product toxicity.

4. Explosives should be analyzed as dispersible toxic chemicals only if in a form (liquid, powder) that represents a plausible air-dispersible source.

Forthcoming NA-41 Policy

Revised EMG will reflect these conclusions.