



Safe Transportation and Storage of Ammonium Nitrate

A US Explosives Industry Perspective

Noel Hsu

DOT Safety and Disaster Assistance Working Group

Los Angeles, CA

May 31, 2016

IME

institute of makers of explosives





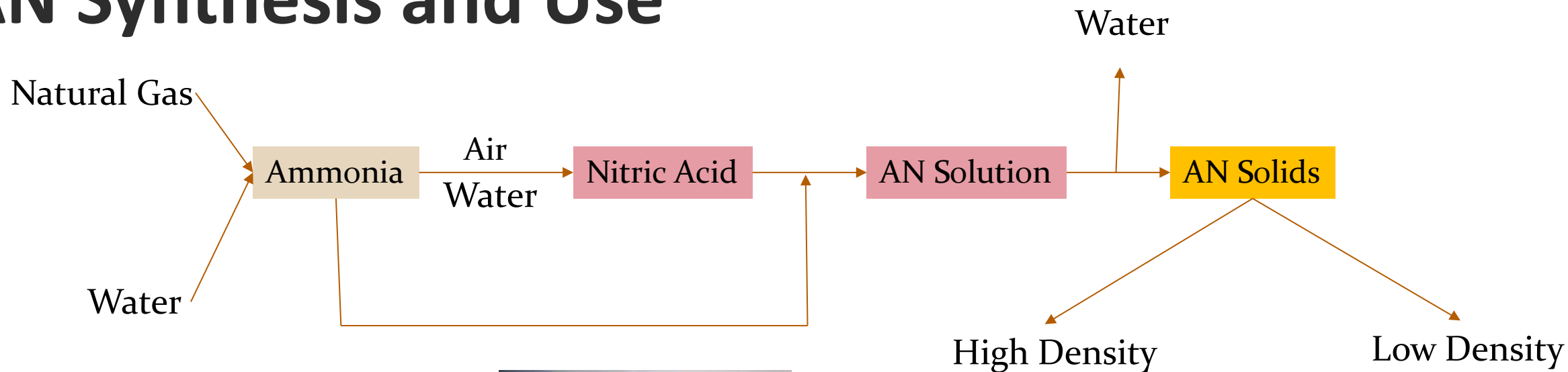
Topics

- AN Chemistry
 - Synthesis
 - Decomposition
 - Stimuli for explosion
- AN Incidents
- Regulations and Guidelines



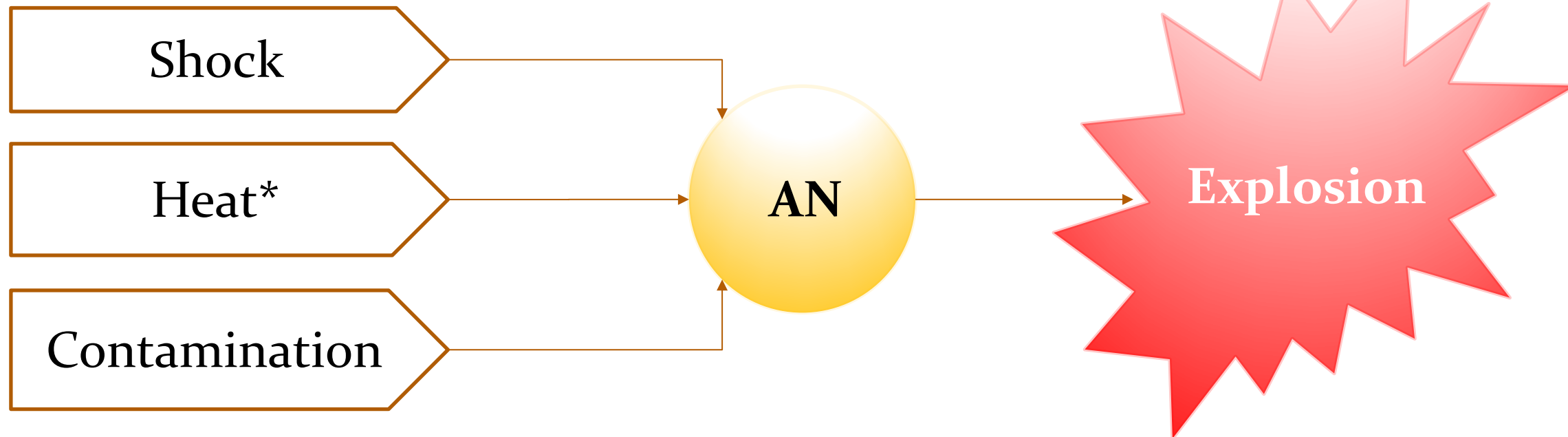


AN Synthesis and Use



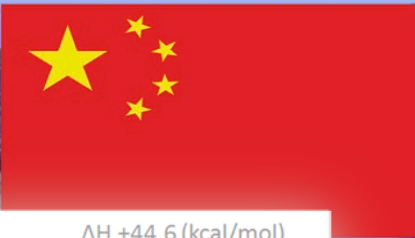


Stimuli for Explosion



* Primary concern in transportation



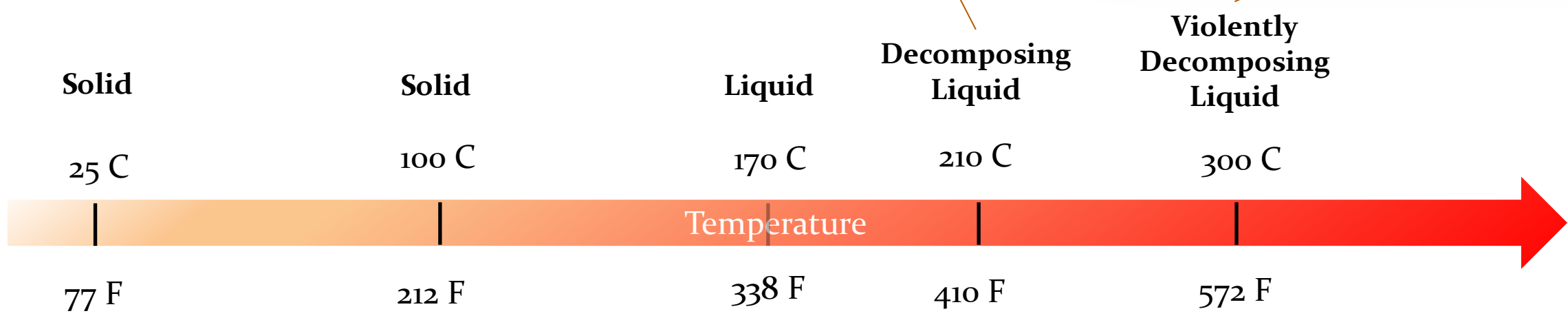


Effect of Heat

Nitrous Oxide + Heat

1. $\text{NH}_4\text{NO}_3 \rightleftharpoons \text{NH}_3 + \text{HNO}_3$ $\Delta H +44.6$ (kcal/mol)
2. $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2\text{H}_2\text{O}$ $\Delta H -8.8$
3. $2\text{NH}_4\text{NO}_3 \rightarrow 2\text{N}_2 + \text{O}_2 + 4\text{H}_2\text{O}$ $\Delta H -28.2$
4. $2\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2 + 2\text{NO} + 4\text{H}_2\text{O}$ $\Delta H -6.6$
5. $3\text{NH}_4\text{NO}_3 \rightarrow 2\text{N}_2 + \text{N}_2\text{O}_3 + 6\text{H}_2\text{O}$ $\Delta H (-20.8$ from data)
6. $4\text{NH}_4\text{NO}_3 \rightarrow 3\text{N}_2 + 2\text{NO}_2 + 8\text{H}_2\text{O}$ $\Delta H -22.2$
7. $5\text{NH}_4\text{NO}_3 \rightarrow 4\text{N}_2 + 2\text{HNO}_3 + 9\text{H}_2\text{O}$ $\Delta H -29.4$

Gases + Heat

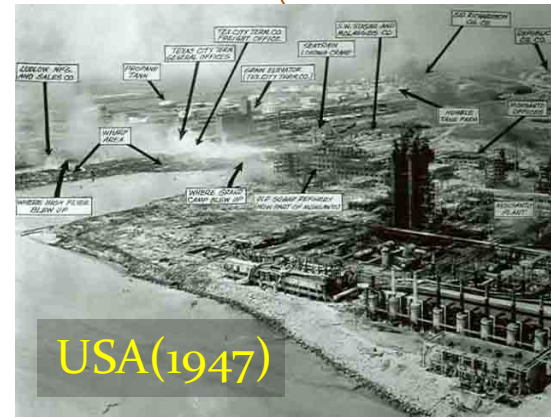




AN Incidents (Fire)

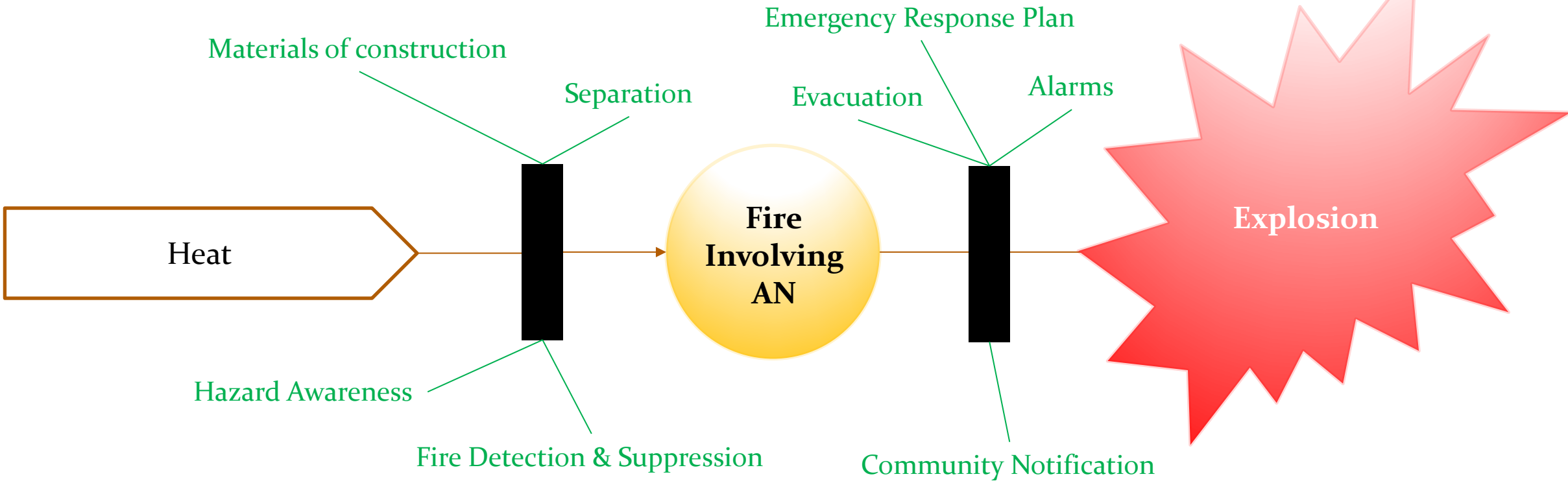
Explosion

No Explosion





Controls (Storage & Transportation)





Regulatory

Non-Regulatory

Department of Transportation

Department of Labor

Environmental Protection Agency

Department of Justice

U.S. Coast Guard

Department of Homeland Security

AN Regulations and Guidelines

National Fire Protection Association

Institute of Makers of Explosives (IME)





谢谢

Thank You

noel.hsu@orica.com

IME

institute of makers of explosives

