The Role of Administration in Nuclear Criticality Safety

presented by

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for

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Positive attributes of a good nuclear criticality safety (NCS) administration are provided in 3 of the 18 ANSI/ANS-8.XX standards requiring clear lines of:

- Authorities
- Responsibilities, and
- Accountabilities

ANSI/ANS-8.XX **consensus** standards

- **ANSI/ANS-8.1, "Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors"**
- **ANSI/ANS-8.10, "Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement"**
- **ANSI/ANS-8.19, "Administrative Practices for Nuclear Criticality Safety"**

The overarching NCS administrative role is described in ANSI/ANS-8.1, ¶4.1.1 *Responsibilities*

*Management **shall** clearly establish responsibility for nuclear criticality safety. Supervisors should be made as responsible for nuclear criticality safety as they are for production, development, research, or other functions. Each individual, regardless of position, **shall** be made aware that nuclear criticality safety in his work area is ultimately his responsibility. This may be accomplished through training and periodic retraining of all operating and support personnel. Nuclear criticality safety differs in no intrinsic way from industrial safety, and good managerial practices apply to both.*

Administrator and Employee responsibilities include, but are not limited to:

- Knowledge and expertise commensurate with job authorities and responsibilities
- Commitments
- Accountabilities
- Staffing, Education, Training
- Involvement

Additional roles and attributes of effective administration can be found in:

- ANSI/ANS-8.XX standards
- Good management practice references and text books

and

- **Findings of quality accident investigations – examples to follow**

Texas City, TEXAS – 16 April 1947

- **What?** Largest industrial accidental explosion in US history – Cargo ships *Grandcamp* (2,300 tons AN) and *High Flyer* (1,000 tons AN)
  - 581 people killed
  - 5,000 people injured
  - 2,000 people displaced from destroyed homes
  - People thrown to the ground 10 miles away
  - Felt in Louisiana 100 miles away
  - Two-ton anchor hurled 1.6 miles and found in a 10-foot crater

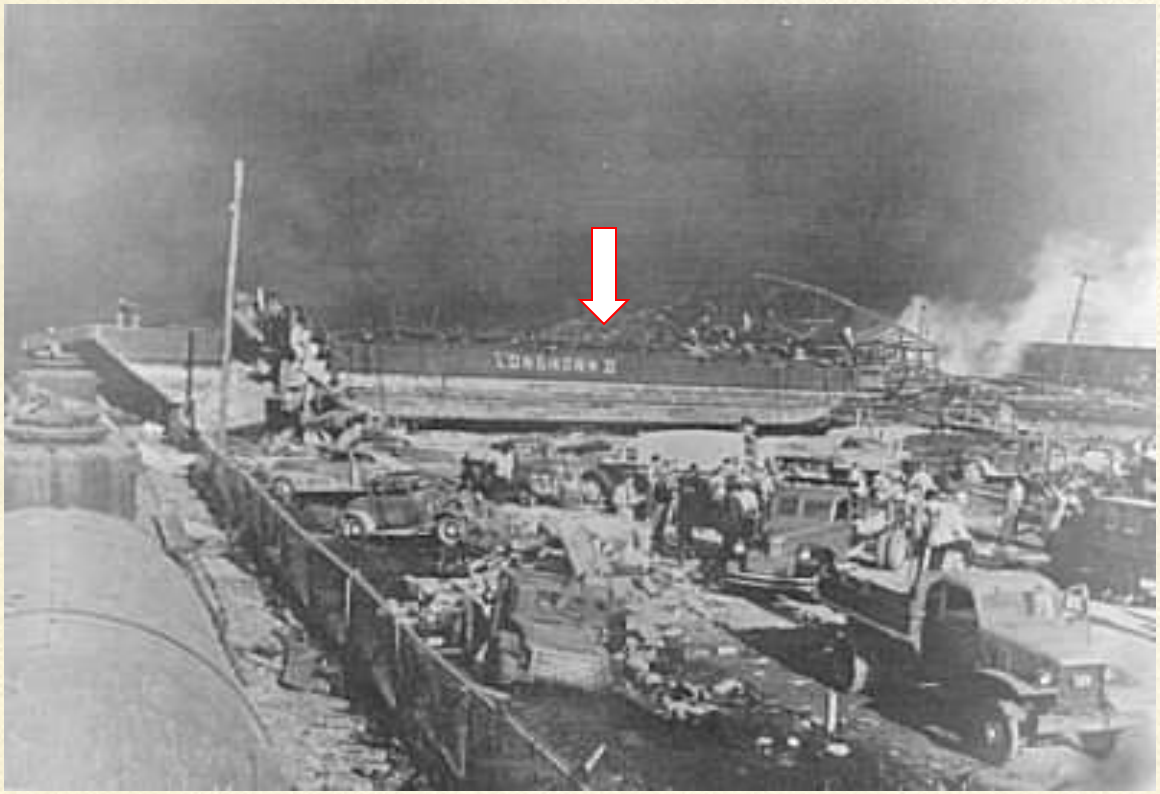
- **Why?** Ignorance and expediency

Texas City, TEXAS – 16 April 1947

Fire fighters just prior to detonation

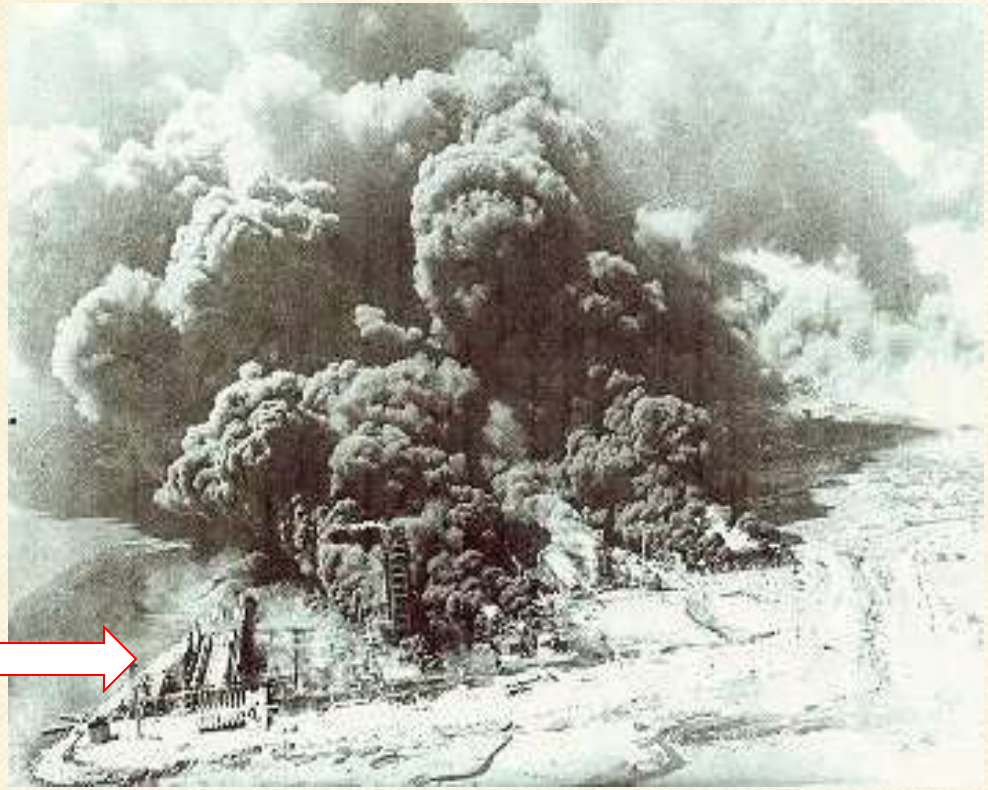
Texas City, TEXAS – 16 April 1947

Longhorn II barge washed ashore by resulting tidal wave



Texas City, TEXAS – 16 April 1947

Ground zero on other side of smoke & fire



These are city blocks

Bhopal, INDIA – 3 December 1984

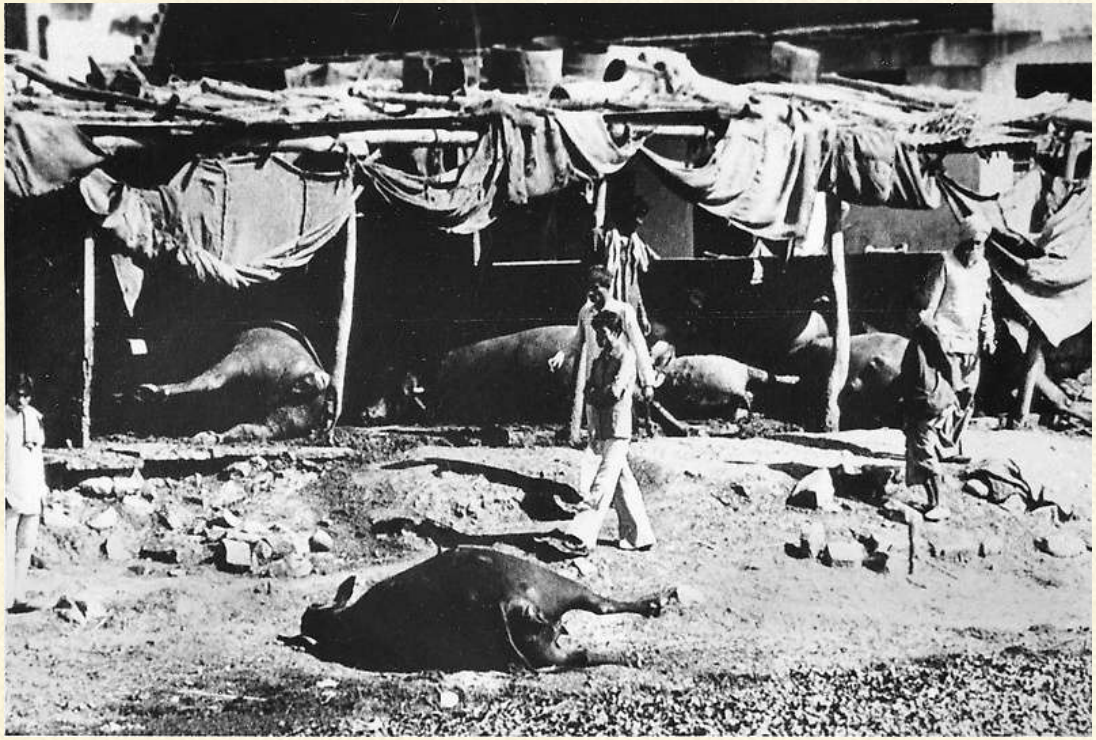
- **What?** Perhaps the largest industrial accidental poisoning in world history – Union Carbide India Ltd pesticide facility leaked methyl isocyanate gas to the environment
  - About 16,000 people killed
  - About 560,000 injured from exposure
- **Why?**
  - Cost cutting (equipment undersized for the operations)
  - Staff reduction (ignorant and incorrect operation of equipment)
  - Lack of staff training
  - Lack of maintenance (crucial gauges inoperable)
  - Dismissal of safety concerns identified by employees

Bhopal, INDIA – 3 December 1984

A crude "water curtain" to isolate potential leaks to the environment/public

Bhopal, INDIA – 3 December 1984

The MIC gas poisoning killed untold animals



and

Bhopal, INDIA – 3 December 1984

PEOPLE

Bhopal, INDIA – 3 December 1984

Leak site decades later

Cape Canaveral, FLORIDA – 28 January 1986

- **What?** A faulty O-ring seal allowed hot gases from the shuttle solid rocket booster to impinge on the external propellant tank thereby initiating a break up of the U.S. Space Shuttle *Challenger*
  - Killing 7 astronauts
  - Destroying the
    - Mission
    - Multi-million $ shuttle

- **Why?**
  - Inadequate O-ring failure trend analyses
  - Lack of problem reporting requirements
  - Misrepresentation of the significant/critical importance of the O-rings
  - Lack of involvement in critical discussions – “stove piping”
  - Subordination of safety, reliability, and quality assurance organizations under the supervision of the very organizations they were to monitor

Cape Canaveral, FLORIDA – 28 January 1986

As stated by Dr. Richard P. Feynman, member of the *Presidential Commission on the Space Shuttle Challenger Accident*,

> *"NASA and Thiokol accepted escalating risk apparently because they 'got away with it last time.' The decision making was: 'a kind of Russian roulette. ... (The Shuttle) flies (with O-ring erosion) and nothing happens. Then it is suggested, therefore, that the risk is no longer so high for the next flights. We can lower our standards a little bit because we got away with it last time. ...' You got away with it, but it shouldn't be done over and over again like that."*

Cape Canaveral, FLORIDA – 28 January 1986

Indelible images of the progression of destruction

Texas City, TEXAS – 23 March 2005

- **What?** Third largest U.S. oil refinery operated by British Petroleum exploded and burned
  - 15 people killed
  - 180 people injured
  - Alarmed the community (duh)
  - Resulted in greater than $1.5 billion loss
- **Why?**
  - Work environment encouraged procedural deviations
  - Procedures did not reflect actual practice
  - Ineffective and insufficient communication among operations personnel
  - Malfunctioning instrumentation
  - Poor computerized control board display

Texas City, TEXAS – 23 March 2005

- **Why?** (continued)
  - Ineffective supervisory oversight and technical assistance during unit startup
  - Refining and corporate management decisions resulted in insufficient staffing
  - Operator fatigue (12-hour shifts were the norm)
  - Inadequate operator training
  - Failure to establish effective safe operating limits
  - Failure to heed lessons learned at BP's Grangemouth, Scotland refinery accident in 2000 reported in 2003

Texas City, TEXAS – 23 March 2005

Some of the explosions, fires, and ash

International Date Line, PACIFIC OCEAN – 11 February 2007

- **What?** Six Lockheed Martin F-22 Raptor fighter jets go “deaf, dumb, and blind”
  - U.S.’s most sophisticated computer controlled “fly-by-wire” stealth fighter jets were being flown from Hawaii to Japan on their first deployment across the International Date Line (IDL)
  - New computer-controlled "fly-by-wire" systems for the F-22 were used throughout the aircraft for radar, fuel management, communications, navigation, and flight controls
  - While crossing the IDL the F-22s lost their radar, navigation, part of their communications, and fuel management systems
  - Refueling tankers had to escort the F-22s back to Hawaii

International Date Line, PACIFIC OCEAN – 11 February 2007

- **Why?**
  - Computer software had a “few” lines of code that could not accommodate the Global Positioning System (GPS) time change
  - Failure to consider, thoroughly verify, and test software
  - Surely the prior October 1984 IDL event for the Northrop GI-1001 prototype F-20 Tighershark “fly-by-wire” software was considered – right?

    Fortunately,
    - Flight controls were not impaired
    - Sufficient fuel was available for aircraft
    - Some limited communication capabilities remained
    - The F-22s were not engaged in combat
    - The weather was clear for visual contact with refueling tankers

International Date Line, PACIFIC OCEAN – 11 February 2007

The "seeing-eye dog" escorting the "warrior" home

Recall –

Additional roles and attributes of effective administration for nuclear criticality safety can be found in:

- ANSI/ANS-8.XX standards, specifically -8.1, -8.10 and -8.19
- Good management practice references

and

Findings of quality accident investigations

Thoroughly read, understand, and remember the report,

"A Review of Criticality Accidents, 2000 Revision"

LA-13638, McLaughlin, Thomas P. et al

Considerations for the Role of Administration in Nuclear Criticality Safety from:

- **John D. Rockefeller, Jr (1941)**
- **Joe Sutter (2006)**
- **John Fitzgerald Kennedy (1961)**
- **Abraham Lincoln (1864)**

(read the proceedings for quotations and references)

- **Recall and learn from the past**
- **Recognize the conditions and limitations of the present**
- **Excel in the future**

by

Raising the Bar for the Modern Era of Nuclear Criticality Safety

My wish for you is to

"Live long and prosper"