Engineering Ethics Seminar

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Outline

1. Definitions
2. Engineering Decision Making
3. Personal and Professional Ethics
4. Attributes of Professional
5. 4-Criteria for Safe Designs
6. NSPE Canons
7. Case Study - Challenger
8. NSPE Test

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Definitions

- **Ethics: :** a set of moral issues, as in moral guidelines, duty and obligation; the principles of conduct governing an individual or a group.
- **Morals:** modes of conduct, conforming to a standard of right behavior.

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Definitions

- **Right:** correct in accordance to moral guidelines.
- **Wrong:** not morally right or just, unfair, improper.
- **Legal:** Can be morally right or wrong.

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Engineering Decision Making

1. Economic Analysis
2. Risk Analysis
3. Ethical Analysis

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Engineering Ethics

- Rules and standards governing the professional conduct of engineers.
- Applies to situations involving engineers in their professional lives.

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Personal Ethics?

How we treat others in our day-to-day lives.

Professional Ethics?

Involves choices on an organizational level. Relationships between two corporations, company & government, company & individuals, society.

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Attributes of a Professional

1. Membership in profession requires formal education.
2. Work requires sophisticated skills, use of judgment, exercise discretion.
3. Societies or organizations establish standards for admission to profession and standards of conduct.
4. Practice of the profession benefits mankind, looks out for the public's welfare.

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4-Criteria for Safe Designs

1. Design must comply with applicable laws.
2. An acceptable design must meet the standard of acceptable engineering practice.
3. Alternative designs that are potentially safer must be evaluated.
4. The engineer must foresee potential misuses of the product by the client and must design to avoid these problems.

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NSPE Fundamental Canons

1. **Hold paramount the safety, health and welfare of the public.**
2. **Perform services only in areas of their competence.**
3. **Issue public statements only in an objective and truthful manner.**
4. **Act for each employer or client as faithful agents or trustees.**
5. **Avoid deceptive acts. Be honest.**
6. **Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.**

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Examples of Ethics in Technology Gone Astray

- Hyatt Regency Walkways Collapse
- Challenger Explosion
- 3-Mile Island
- Pinto Automobile
- Ford/Firestone Tire Controversy
- Deepwater Horizon
- Exxon Valdez

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January 28, 1986

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The Cause

- Unseasonably cold temperatures led to sealing failure by rubber O-Rings on the aft field joint in right solid rocket booster

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The Underlying Causes

- Inadequate joint design
- Lack of understanding of limits of the design
- Inadequate management systems
- Institutional arrogance
- Failure of technical communication
- Bad luck
- All of the above

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Contributing Factors

- Previous launch delays
- Sustained WNW winds
- The teleconference
- The Ice Team
- Wind shear

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The Teleconference

- The evening of January 27, 1986
- Called to address technical concerns specific to the effect of low temperature on SRB joint performance
- Participants included technical and management personnel
  - NASA Kennedy Space Center
  - NASA Marshall Space Flight Center
  - Morton-Thiokol, Inc.

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The Thiokol Engineers

- O-Ring Task Force
  - Charged with analyzing O-ring charring and blow-by
  - One of several teams studying shuttle anomalies
- January 27, 1986
  - 7:30 am: An ordinary start
  - Noon: The call from KSC
  - Afternoon: Preparation of charts
  - Late afternoon: Briefing with Bob Lund, VP of Engineering
  - 6:00 pm: The Telecon begins

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Teleconference Participants

Kennedy Space Center (KSC), FL
- Allan McDonald, Thiokol, SRB PM
- Larry Mulloy, NASA MSFC SRB PM
- Stan Reinartz, NASA MSFC Shuttle PM

Thiokol Plant, Utah
- Jerry Mason, Sr. VP Utah Ops.
- Cal Wiggins, VP and GM Space Ops
- Joe Kilminster, VP Space Booster Progs.
- Robert Lund, VP Engineering
- O-Ring Task force members
  - Arnie Thompson
  - Brian Russell
  - Roger Boisjoly

Marshall Spaceflight Ctr, Huntsville, AL
- George Hardy, Deputy Dir. S&E
- NASA Engineering Team

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The Teleconference

- 6:45: Introductions
- 7:00: Technical discussion of the data
- 7:45: The engineering recommendation and NASA reaction
- 8:00: The offline caucus
- 8:30: The reversal
- 8:45 – 9:45: The drive home

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Thirty Minutes

- In thirty minutes, the engineering recommendation, based on incomplete data, was reversed

How do we prepare ourselves for those thirty minutes?

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NSPE TEST

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