LA-UR-12-24088

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Title: Risk in the Weapons Stockpile

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Intended for: Summer Student Presentation
Report

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Risk in the Weapons Stockpile

By Bailey Noone

CCS-6

Maintenance and Security of the Nuclear Weapons Stockpile Involves Risk:

- Risk in General
- Risk in the Stockpile
- Managing Risk
 - Uncertainty
 - Frequency
 - Probability
- Management Effectiveness
- Conclusion

What is Risk?

- The Possibility of Loss or Injury
- Degree of Probability of Such Loss

What is Risk?

- Uncertainty + Damage
- Hazards / Safeguards

What is Risk Management?

- **Risk** – the probability and magnitude of a loss, disaster, or other undesirable event
- **Risk Management** – the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events

What is the Problem?

- Example : Studying or Sleeping
- Example : Southwest Airlines

The Stockpile

- Nuclear weapons: no full system test
- But they must work properly when needed
 - Example : A car that you must guarantee works, but you can't turn it on
- We use Design Diversity to increase the security and reliability of the stockpile...

The Stockpile

- Risks of Design Diversity
 - Common cause failures in seemingly independent designs
 - Costs
 - Quality control, testing, and inspecting
- Risks of no diversity
 - Common cause failure ruining whole batch

What is the safest, most economical, and reliable balance of design diversity?

The Stockpile

Should we produce weapons that are modernized and high-margin warheads or produce life-extended Cold War weapons?

- iLEP = incremental life extension programs
- RRW = reliable replacement warhead
- erLEP = extensive reuse life extension programs

Managing Risk

“You can’t manage what you can’t measure”

- Quantitative measures and probability must be used to accurately and effectively measure risk
- Ordinal scales?

Uncertainty Quantification

- In a situation where risk exists, uncertainty exists.
Different types of uncertainty are...
 - Aleatory : variation in samples and randomness
 - Epistemic : based on incomplete knowledge, subjective/ expert knowledge
- Uncertainty based on known, large samples is easier to deal with as opposed to uncertainty based on small or incomplete data samples
- Example : Airplanes

Frequency and Probability

- We convert a frequency distribution into a probability model to make predictions about future observations
- Example :

Figure 4 Percentage of accident cases associated with modes of aircraft movement.

Elements of Risk Analysis

1. Hazard detection and failure modes' identification
2. "Worst case" approach
3. Quasi-worst case and plausible upper bounds
4. Best estimates and central values
5. Probabilistic risk assessment/single risk curve
6. Probabilistic risk analysis and multiple risk curves

Effectiveness?

- Methods for determining effectiveness in risk management:
 - Statistical inferences based on large samples
 - Direct evidence of cause and effect
 - Component testing of risk management
 - A “check of completeness”

Conclusion

- When it comes to the nuclear weapons stockpile, risk must be as low as possible.
- Design and care to keep the stockpile healthy involves all aspects of risk management.
- Design diversity is a method that helps to mitigate risk.

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