

“Why the Culture of Safety is a Critical Concern for the Future Expansion of Nuclear Power”

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“Safety” = “safety and security”

- **Sometimes, I will use the word “safety” to discuss large nuclear accidents.**
- **Sometimes, I will include “security” when I use the word “safety.”**

Current situation: How safe are the current power reactors?

- **How likely is a large core-damage accident?**
 - Use PSA (probabilistic safety assessment)
 - A well-tested analysis method
- **Results?**
 - Core-damage frequency (CDF):
a few $\times 10^{-5}$ / year
 - Probability of a large release:
a few percent of CDF $\approx 10^{-6}$ / year

Assumptions to achieve this level of safety

- **NPP is well-designed and built, meets all applicable codes and standards**
- **NPP is well operated:**
 - **well-trained operators**
 - **well-trained maintenance staff**
 - **Information about problems is shared widely (internationally)**
 - **a strong safety culture, top-to-bottom**
 - **a strong, independent regulatory agency**

What limits the core-damage frequency to a few $\times 10^{-5}$ /year?

- **Current designs rely on:**
 - systems and components similar to existing technology
 - active systems
 - active operator intervention
- **How to do better?**
 - NPPs that rely on passive systems
 - NPPs with much less reliance on operator actions
 - NPPs using more modern control systems and sensors
 - NPPs less reliant on electrical power
- **Result?**
 - a factor of 10 (or better) decrease in core-damage frequency
 - a much lower frequency for a large release

What could cause a given NPP to fail to achieve these safety levels?

- **WEAK SAFETY CULTURE !**
 - less rigorous operator training
 - absence of a “questioning attitude”
 - less ability to raise safety (and security) concerns without fear
 - weak or unstable political and social atmosphere
 - management is too “top-down”
 - a weak regulatory agency
 - a politicized atmosphere
 - a culture with corruption

History: the 3 major NPP accidents

- 1979: Three Mile Island (US)
 - Poor operator training
 - Insufficient sharing of information and learning from experience
- 1986: Chernobyl (USSR)
 - Top-down management created an atmosphere where a questioning attitude brought punishment
 - A weak regulatory agency – analysis not required before performing an off-normal experiment
- 2011: Fukushima (Japan)
 - Inability of safety concerns to be acted upon at higher levels within the operating company
 - Government interference with nuclear operations
 - A weak regulatory agency deferred to the operating company
- **ALL OF THESE ARE SAFETY CULTURE ISSUES !**

Future expansion into “newcomer” countries ??

Safety culture is the major concern !

(... and this includes security and non-proliferation concerns too!)

Future expansion into “newcomer” countries ??

Safety culture is the major concern!

You can design and build them correctly, BUT:

BUT: You cannot operate them safely (and securely) if:

SOCIAL CULTURE

- culture filled with rampant bribery/corruption
- culture is not concerned with the safety of workers
- culture discourages a “questioning attitude”
- management culture is too “top down”

POLITICAL CULTURE

- regulatory agency is not independent of politics
- no long-term political commitment
- no national legislation committing to international Conventions
- weak legal (contracts) system, weak court system
- weak continuity of social, political institutions