

Theory to Practice: Experiences of a Former Nuclear Safety Chief

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Overview

- Role of Nuclear Power Today
- Nuclear Power Technology Presents Unique Challenges
- Safety is Vital
- Unique Institutions
 - Independence and Objective
- My Lessons from Fukushima

Nuclear Power Today

- The nuclear power industry remains a viable electricity option today for four basic reasons:
 1. countries wish to keep open the option to develop a nuclear weapons program
 2. countries wish to have a fuel diversity among their energy options
 3. countries lack their own domestic fossil or renewable fuel sources
 4. countries wish to abate air pollution, especially carbon dioxide especially true in the United States

Nuclear Is Unique

...“It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace.

The United States knows that if the fearful trend of atomic military build-up can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind.

The United States knows that peaceful power from atomic energy is no dream of the future. That capability, already proved, is here—now—today.”

— President Dwight Eisenhower, “Atoms for Peace” December 8, 1954

Nuclear Is Unique



The Lure of Safety

- Safety: freedom from the occurrence of injury, danger, or loss.
 - This is what the public hears when they hear nuclear plants are safe
 - The industry and regulators mean low probability of having a severe accident or compliance with standards
 - These two statements are very different
- Safety is a completely subjective determination
 - safety decision are influenced by public policy, government, science and culture
- No one can guarantee safety

The Nuclear Safety Institutions

- Two Primary Institutions for Nuclear Safety
 - Government Safety Authority
 - Power Plant Owners and Operators
- Secondary Institutions
 - Technical Support Organizations
 - International bodies such as the International Atomic Energy Agency
 - Industry standards organization such as ASME
 - Industry self regulatory organizations like INPO

Convention on Nuclear Safety

- Following Chernobyl greater effort was placed in stronger international cooperation and interdependence of safety authorities —> Convention on Nuclear Safety in 1994

ARTICLE 8. REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

ARTICLE 9. RESPONSIBILITY OF THE LICENCE HOLDER

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

- Operators are responsible for Safety many times government safety authority is believed to be

Characteristics of Effective Safety Authorities

- Independence — two types
 - Legal independence: Authority to make licensing, oversight and enforcement decisions exclusively
 - In practice there can be no such thing
 - Independent agency but not independent government
 - Safety authorities exist within the broader political institutions with more or less direct involvement
 - Technical Independence: Ability to make technical analyses separate from the nuclear power plant owners and operators
 - Most often achieved with an independent Technical Support Organization
 - In practice this can be more easily achieved than legal independence but safety authorities are still dependent on power plant owners and operators for details information about their plants

Characteristics of Effective Safety Authorities

- Objective Decision-Making
 - Decisions are expected to be made base solely on technical information
 - Not influenced by political or emotional factors
 - By definition not possible since safety is a policy matter
- All decisions of safety authorities are complicated decisions influenced by stakeholders, public policy, government, science and culture

Example from Fukushima

- Nuclear Regulatory Commission
 - Five Person Commission selected by political leaders: President and the Senate
 - 3800 person staff of lawyers, engineers, scientists and others
- Fukushima accident tested the agency decision-making during and after the accident

Fukushima Daiichi Accident

- A 9.0 magnitude earthquake occurred off the coast of Japan on March 11, 2011
- The earthquake triggered a tsunami which directly impacted four nuclear plant sites in Japan

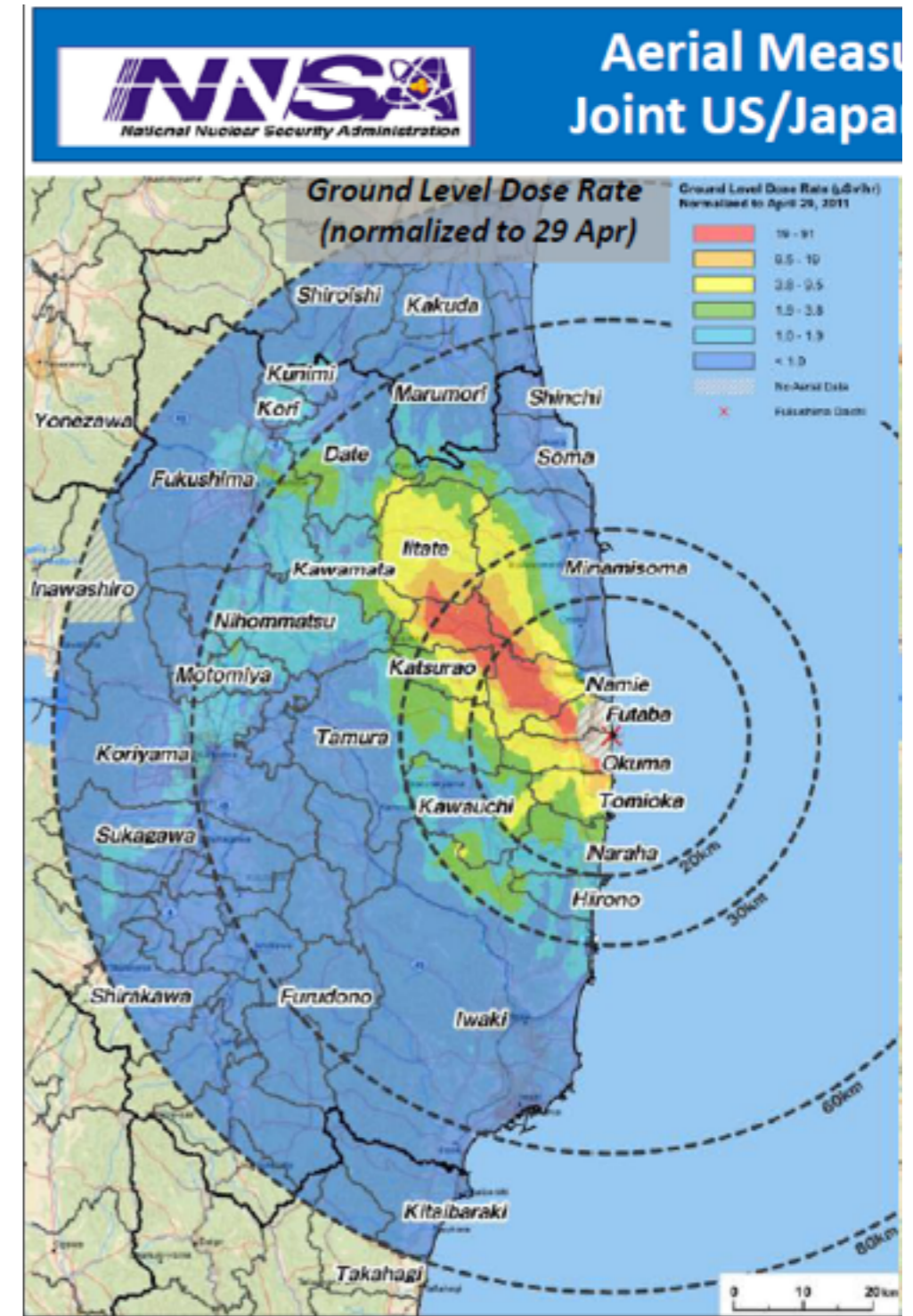


Fukushima Accident - US Response

- There were two primary issues the NRC and US government were concerned about
 - extent of radiation contamination —> 50 mile recommendation
 - significant contamination of land around the reactor sites
 - the condition of the spent fuel pools
 - spent fuel fires can cause widespread contamination
- possible evacuation of Tokyo - an unthinkable scenario
 - was it possible? some in Japan thought so...

Fukushima Accident — 50 Mile

- On Wednesday March 16, the US government recommended US citizens stay at least 50 miles away from the reactors
- very different from the initial Japanese government evacuation instruction
- very controversial in the US because US plants are required to prepare for 10 mile evacuations



Fukushima Accident Domestic Response

- On March 21, the Commission met to receive a briefing on the accident
- Two days later the Commission issued a unanimous direction to create a short and long term task force to review the accident
- Only the short term task force ever finished

Fukushima Accident — Response

Summary of Overarching Recommendations

6. SUMMARY OF OVERARCHING RECOMMENDATIONS

This section presents the Task Force's recommendations for improving the safety of both operating and new nuclear reactors. It also addresses recommended improvements in the NRC programs for the oversight of reactor safety. The recommendations are based on the Task Force's evaluations of the relevant issues identified from the Fukushima accident. Appendix A of this report proposes an implementation strategy and offers further details on these recommendations.

The Task Force makes the following overarching recommendations, as stated in the preceding sections of this report:

Clarifying the Regulatory Framework

1. The Task Force recommends establishing a logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances defense-in-depth and risk considerations. [Section 3]

Ensuring Protection

2. The Task Force recommends that the NRC require licensees to reevaluate and upgrade as necessary the design-basis seismic and flooding protection of SSCs for each operating reactor. [Section 4.1.1]
3. The Task Force recommends, as part of the longer term review, that the NRC evaluate potential enhancements to the capability to prevent or mitigate seismically induced fires and floods. [Section 4.1.2]

Enhancing Mitigation

4. The Task Force recommends that the NRC strengthen SBO mitigation capability at all operating and new reactors for design-basis and beyond-design-basis external events. [Section 4.2.1]
5. The Task Force recommends requiring reliable hardened vent designs in BWR facilities with Mark I and Mark II containments. [Section 4.2.2]
6. The Task Force recommends, as part of the longer term review, that the NRC identify insights about hydrogen control and mitigation inside containment or in other buildings as additional information is revealed through further study of the Fukushima Dai-ichi accident. [Section 4.2.3]
7. The Task Force recommends enhancing spent fuel pool makeup capability and instrumentation for the spent fuel pool. [Section 4.2.4]
8. The Task Force recommends strengthening and integrating onsite emergency response capabilities such as EOPs, SAMGs, and EDMGs. [Section 4.2.5]

Strengthening Emergency Preparedness

9. The Task Force recommends that the NRC require that facility emergency plans address prolonged SBO and multiunit events. [Section 4.3.1]
10. The Task Force recommends, as part of the longer term review, that the NRC pursue additional EP topics related to multiunit events and prolonged SBO. [Section 4.3.1]

Summary of Overarching Recommendations

11. The Task Force recommends, as part of the longer term review, that the NRC should pursue EP topics related to decisionmaking, radiation monitoring, and public education. [Section 4.3.2]

Improving the Efficiency of NRC Programs

12. The Task Force recommends that the NRC strengthen regulatory oversight of licensee safety performance (i.e., the ROP) by focusing more attention on defense-in-depth requirements consistent with the recommended defense-in-depth framework. [Section 5.1]

Fukushima Accident — Response

- Three orders issued in March 2012
 1. Spent fuel instrumentation
 2. Interim enhancements of b5b
 3. Hardened vents for Mark I and II BWR designs
- Remaining issues being addressed through longer term actions

Fukushima Accident Domestic Response

- Station Blackout Rulemaking — the most crucial of all the issues
 - Current requirements only demand US plants “cope” with total loss of electrical power for eight to sixteen hours.
 - That is far too short based on the Fukushima accident
 - Task Force recommended 72 hour “coping” time
 - Current rulemaking proposal would not adopt a new coping time, but focus on mitigating station blackout events
- Rulemaking not anticipated to be completed until 2017
- Then plant modifications will need to be made, a process that could take an additional number of years.

Fukushima Accident Domestic Response

- Seismic Reevaluations
 - Deterministic plant modifications to be done by Dec 2016 for Central and Eastern US plant for modifications not requiring outages.
 - Modifications requiring outages get another 2 outages to be completed after Dec 2014.
 - 2 outages is between 3 and 4 more years, so Dec 2017 to Dec 2018.
 - True sophisticated evaluations will not be done for years after. Some plants not until 2020. That doesn't even include the needed plant modifications
- Filtering of Hardened Vents
 - Commission rejected
- Majority of the post-Fukushima reforms are being done through an industry voluntary initiative to stage portable equipment to provide emergency power and water supplies

Fukushima happened in March 2011.

Contrast This With New Reactors

- There are currently 4 newly licensed reactors under construction in the U.S.
 - 2 at the Vogtle plant site in Georgia
 - Issued February 9, 2012
 - 2 at the V.C. Summer plant site in South Carolina
 - Issued March 30, 2012
- I opposed because there was no relation to Fukushima
- Major financial investment in addition to Fukushima Reforms

Future: New Reactors – Status

- How are they doing? **FAILING**
 - Vogtle Project is at least 39 months behind schedule with \$7 billion in cost overruns
 - Vogtle 3 is expected to come online in 2019, Vogtle 4 one year later
 - V.C. Summer is similarly behind schedule and over budget
- This is acceptable spending but modifying plants for safety is not

Conclusion

- Nuclear Power Oversight and Regulation is a complex mix of politics, public policy, science and stakeholder input
- There is no such thing as a perfect safety
 - all plants can have accidents
 - no safety regulator or power plant owner can change that