

**UCS Perspective on
Considering Economic
Consequences in the
NRC's Regulatory
Framework**

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UCS Recommendation

- **UCS recommends that the NRC adopt Option 3 + Option 2**
- **In our view, it is unlikely that the NRC's inadequate treatment of economic consequences can be fully addressed through changes to the voluntary regulatory analysis guidelines alone**
- **New requirements may be needed**

Economics=Safety

- **UCS believes the distinction between land contamination/economic consequences and public health and safety is a false dichotomy**
- **Economic consequences are determined to a large extent by the radiological standards for land resettlement and reuse**

More staff analysis needed

- **SECY-12-0110 does not contain quantitative analysis needed to answer a key question:**
 - **Does NRC's current regulatory framework adequately address events that could cause "unacceptable" land contamination (e.g. Fukushima) yet would not result in significant emergency phase exposures and health effects?**

Examples to consider

- **Use of large early release frequency (LERF) rather than large release frequency (LRF) in risk-informed regulation for operating reactors**
- **Spent fuel storage**
- **Non-power reactors**
- **Fuel cycle facilities with large land contamination potential (MOX plant, reprocessing plants)**

LERF vs. LLRF

- **Control of LERF is used as a subsidiary objective of the Quantitative Health Objectives**
 - e.g. RG 1.174
- **But LERF alone does not fully address the risk of land contamination**

LERF

- **LERF: “The frequency of a rapid, unmitigated release of airborne fission products from the containment to the environment that occurs before effective implementation of offsite emergency response, and protective actions, such that there is a potential for early health effects.” – draft NUREG-2122**
- **According to this definition, no large early release (arguably) occurred at Fukushima**

LLRF

- **LLRF [Large Late Release Frequency]: “the frequency of late releases that have sufficient magnitude to cause severe health effects, but which occur in a timeframe that allows effective emergency response and protective actions so that the offsite health effects will be significantly reduced compared to those of a large early release.” – draft NUREG-2122**
- **According to this definition, a large late release (arguably) did occur at Fukushima**

LRF

- **“LRF [Large Release Frequency] is the frequency of an unmitigated release of airborne fission products from the containment to the environment that is of sufficient magnitude to cause severe health effects, regardless of its timing.” -- Draft NUREG-2122.**

Example:

Combustible Gas Control

- **Threat to containment from combustible gases can occur both “early” and “late” in core damage accident**
 - **Early (hours to 1 day), e.g. hydrogen explosion at vessel breach**
 - **Late (order of days), e.g. overpressure failure or explosion from gases generated by core-concrete interactions, radiolysis**

Risk-informing 10 CFR 50.44, “Combustible Gas Control”

- **In 2000, NRC staff prepared a technical feasibility study on risk-informing 10 CFR 50.44**
- **One proposed “defense in depth” option would have required a demonstration that “any risk significant core damage accident does not result in an unacceptably large LERF and LLRF as a result of combustible gases...”**

Risk-informing 10 CFR 50.44

- **NRC ultimately chose to address only early (<24 hour) combustible gas control issues through regulation and left longer term control to industry via voluntary Severe Accident Management Guidelines**
 - **Requirement for hydrogen recombiners was eliminated even though they could be useful for > 24-hour gas control**
 - **Supported by a very crude, generic regulatory analysis (Peach Bottom, assumed off-site damages from late containment failure of \$24 million)**
 - **Result: some licensees credited recombiners for severe accident mitigation but did not maintain them**

An LRF Safety Goal

- **If limits on LLRF/LRF had been part of the Safety Goals then a more robust regime for long-term containment protection might be in place now and the NRC would not have to play catch-up after Fukushima on issues such as the need for filtered vents**
- **For new reactors, LRF is evaluated as part of the safety review**
 - **Staff has inexplicably proposed to switch from LRF to LERF (SECY-12-0081)**

Spent fuel safety/security

- **Safety limits that are based on limiting individual doses may not be adequate for controlling land contamination**
- **Design-basis dose limit for an ISFSI is 5 rem TEDE at the controlled area boundary (10 CFR § 72.106(b))**
 - **What land contamination patterns could result from such an accident? How large an area would exceed EPA PAGs?**
- **Beyond design-basis pool accidents may have small LERF but large LLRF**

Other facilities

- **Non-power reactors: licensees evaluate individual doses from the “maximum hypothetical accident” but not the potential economic consequences of land contamination**
- **Fuel cycle facilities: individual dose thresholds are used to determine high and intermediate consequence events, but the corresponding economic consequences of land contamination are not assessed**

A word about MACCS2

- **MACCS2, as used by the staff and industry in backfit analyses, SAMAs/SAMDAs and regulatory analyses, is a very crude and inadequate tool for calculating off-site economic consequences**
 - **Consequences of land contamination are very sensitive to site-specific factors**
 - **Use of “average” weather results and generic values tend to wash out distinctive site- and event-specific phenomena**
 - **Contaminated area to the NW of Fukushima**

Conclusions

- **Land contamination and its economic and human consequences are important considerations that are inconsistently and inadequately accounted for in NRC's regulatory framework**
- **The NRC should consider regulatory changes to require formal and more rigorous analysis of land contamination issues in licensing actions**

Acronyms

- **ISFSI: Independent Spent Fuel Storage Installation**
- **LERF: Large Early Release Frequency**
- **LLRF: Large Late Release Frequency**
- **LRF: Large Release Frequency**
- **PAG: Protective Action Guide**
- **SAMA: Severe Accident Mitigation Alternative**

Acronyms

- **SAMDA: Severe Accident Mitigation Design Alternative**
- **UCS: Union of Concerned Scientists**