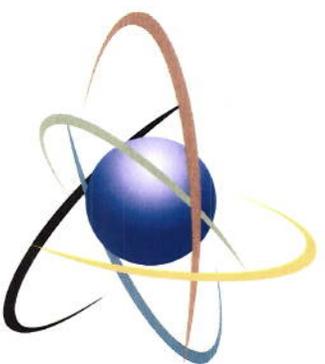


October 25, 2011

ATTACHED ARE SLIDES/HANDOUTS
WHICH WERE PRESENTED AT THE
10/05/11 "PUBLIC MEETING TO PERFORM TABLETOP
EXERCISES TO COMPLETE LICENSING
ISSUES AND TO DISCUSS THE REACTOR OVERSIGHT
PROCESS FOR NEW REACTOR"



U.S. NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Public Workshop on Risk-Informed Regulatory Guidance for New Reactors

Licensing topics

Contact: Donald A. Dube, Office of New Reactors, (301) 415-1483

October 5, 2011

Agenda

Morning session – licensing topics

- **RG 1.174**
- **Transition LRF-to-LERF**
- **Others, for example:**
 - **Risk-informed IST**
 - **ILRT interval extension**
 - **Alternative source term**
 - **50.46a**

Afternoon session - ROP

- **Rev. 2, May 2011**
 - **Left open the option for potential future changes regarding new reactors**
 - **In response to ACRS comment, reinstated consideration of impact on late containment failure (i.e., impacts not captured by CDF and LERF)**
 - **In response to Commission direction, activity underway to clarify defense in depth**
 - **SRM on SECY-10-0121: “Commission reaffirms that the existing ... quantitative metrics for implementing risk-informed decision making, are sufficient for new plants”**

Five Principles in RG 1.174

- Five principles for making risk-informed decisions
 - The proposed change:
 - Meets current **regulations** (unless exemption request)
 - Is consistent with the **defense-in-depth** philosophy
 - Maintains sufficient **safety margins**
 - Results in an increase in CDF or risk that is **small** and consistent with the intent of the Commission's Safety Goal Policy Statement
 - Will be monitored using **performance measurement** strategies.

From RG 1.174

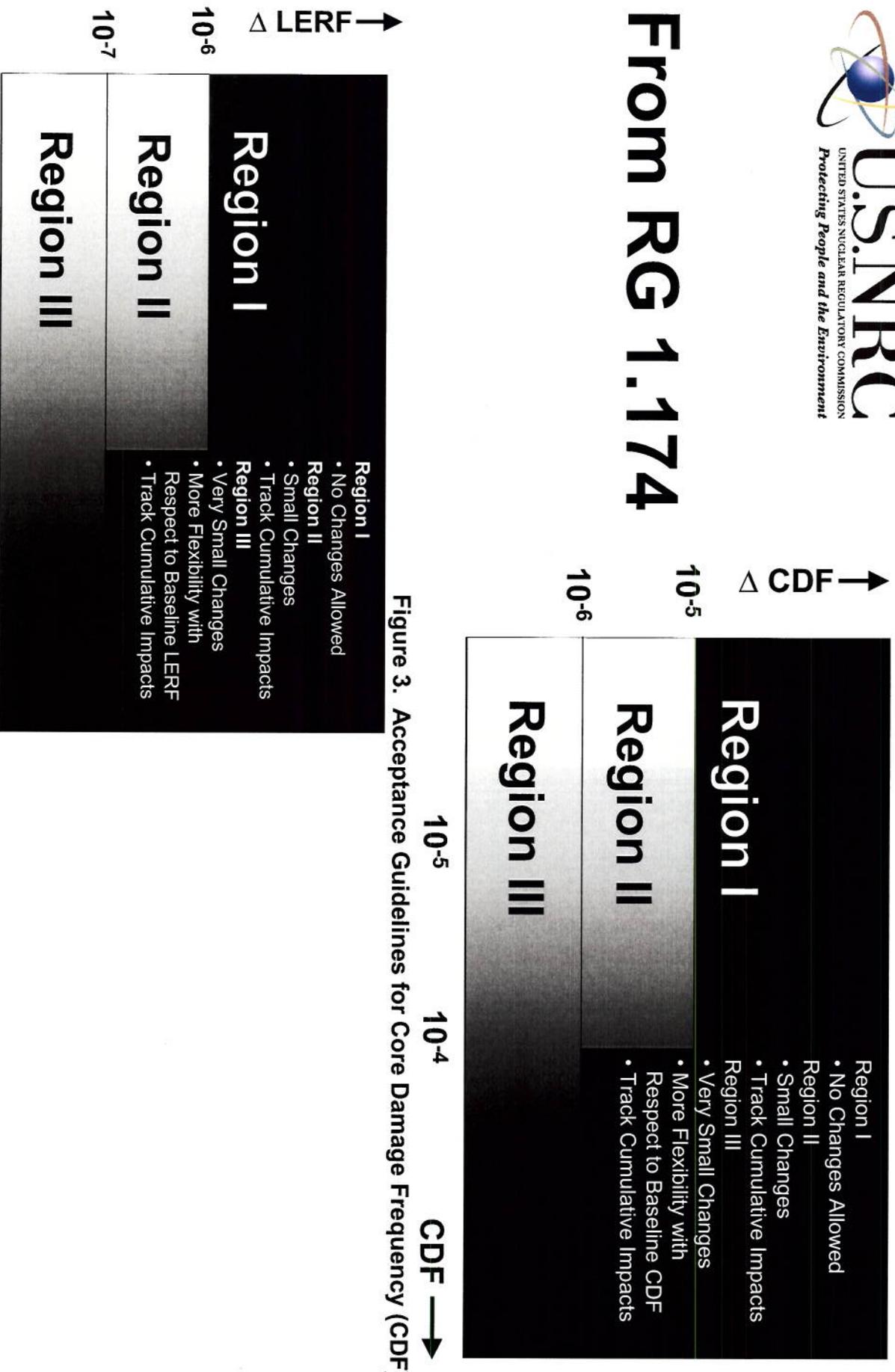


Figure 3. Acceptance Guidelines for Core Damage Frequency (CDF)

Figure 4. Acceptance Guidelines for Large Early Release Frequency (LERF)

Scope of Tabletop Cases

- **Previous workshops addressed major initiatives such as risk-informed inservice inspection of piping, technical specifications, and 50.69 SSC categorization**
- **Vast majority of DCD / FSAR Tier 2 changes will be addressed under 50.59-like change process**
- **What remains are Tier 1 changes: higher level system design functions and descriptions, and programs**
- **Highly unlikely to see license amendment request for complete removal of Tier 1 systems, so most likely changes will be regarding how the existing system is categorized, operated, and maintained**

Case Study: ESBWR Feedwater Isolation Modification

- Case 1: Design basis accident concern, impact on drywell pressure (pre-certification change)**
- GEH assessed various design change options so as not to impact previously reviewed PRA and risk profile
 - PRA-influenced modification, internal events
 $\Delta\text{CDF} \leq 10^{-8} \text{ /yr}$

Note:

- CDF (all quantified events & modes) $\sim 10^{-7} \text{ /yr}$
- Assume seismic CDF $\sim 3 \times 10^{-7} - 3 \times 10^{-6} \text{ /yr}$

Sources: PRA rev. 6 and ACRS PRA subcommittee transcripts 11/18/09



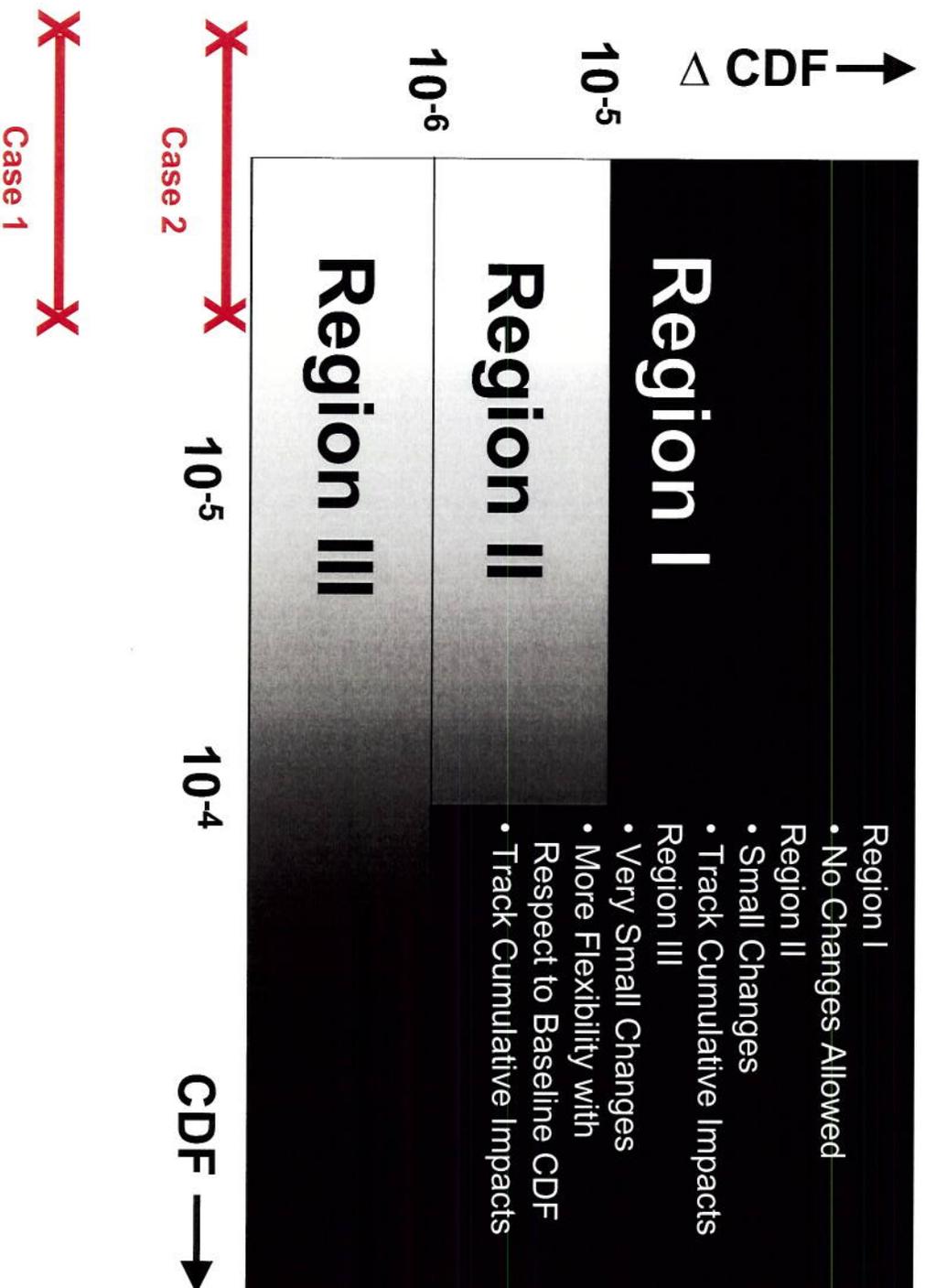
Hypothetical Case Study: ESBWR

**Case 2: Tier 1 change and license amendment to
remove standby diesel generators from RTNSS
along with removal from Tier 2 Availability
Controls Manual 19ACM**

$$\Delta\text{CDF} \leq 8 \times 10^{-8} \text{ /yr (bounding)}$$

Source: PRA rev. 6 Table 11.3-14

ESBWR Case Studies



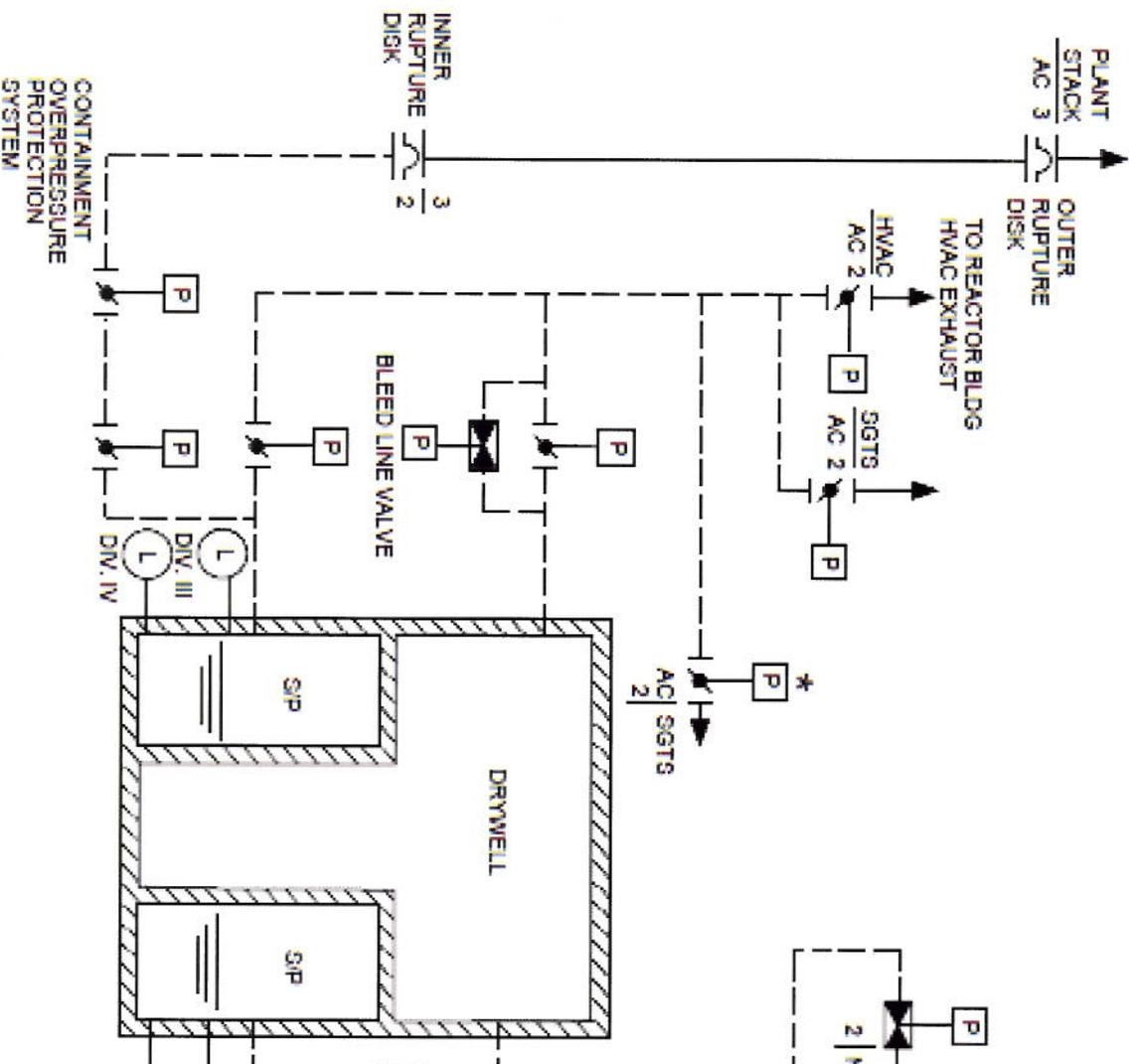
Hypothetical Case Study: ABWR

**Case 1: Tier 1 change to COPS (wetwell venting)
to reduce rupture disk setpoint from 104 psia to
lower value, and change two isolation valves
from normally open to normally closed with
operator action required for venting**

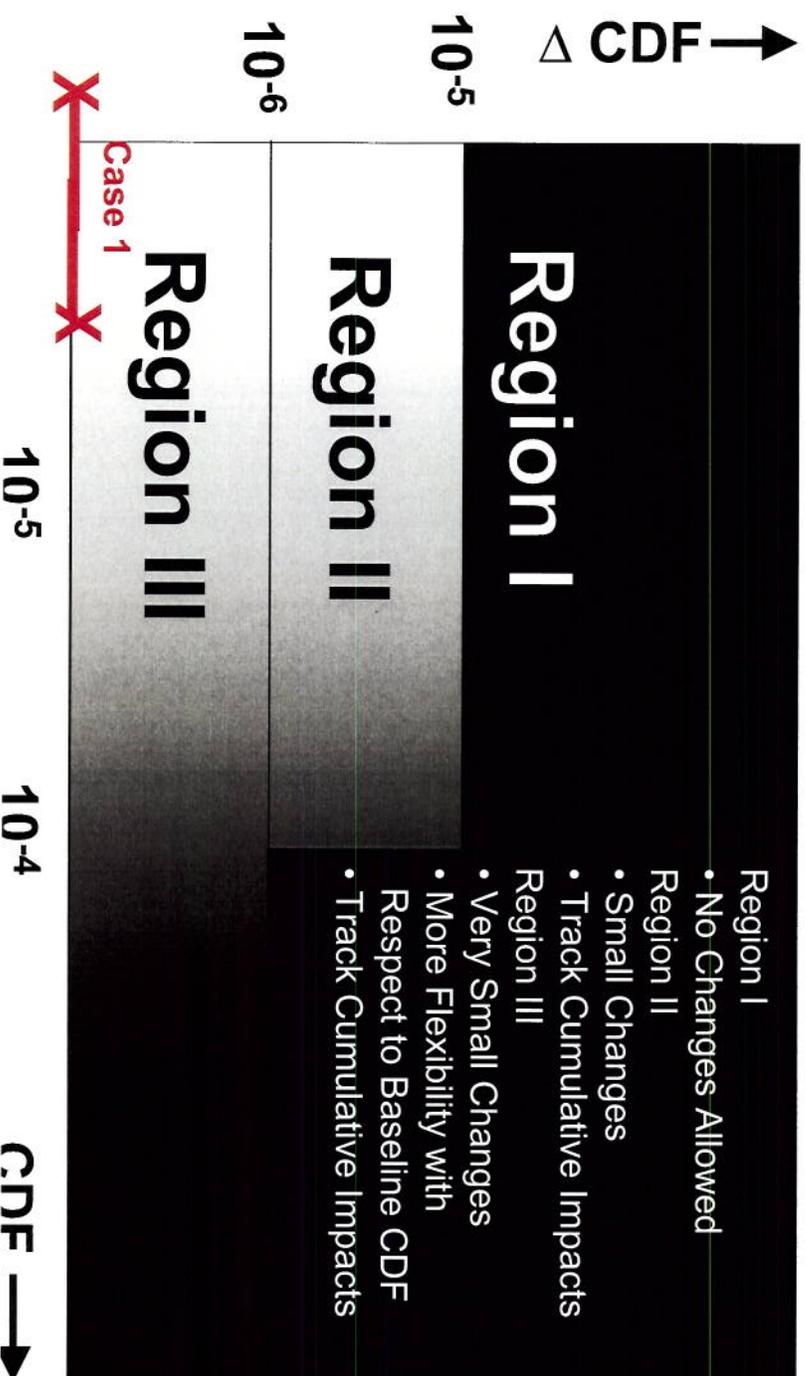
Δ CCDF $\sim 10^{-7}$ /yr

Sources: ABWR SPAR Model, and DCD rev. 4 Section 2.14.6

ABWR Atmospheric Control System (relevant portion)



ABWR Hypothetical Case



From RG 1.174 Section 2.1.1

Defense-in-depth philosophy is maintained if the following occurs:

- A reasonable balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation
- Over-reliance on programmatic activities as compensatory measures associated with the change in the LB is avoided
- System redundancy, independence, and diversity are preserved commensurate with the expected frequency, consequences of challenges to the system, and uncertainties (e.g., no risk outliers)
- Defenses against potential common-cause failures are preserved, and the potential for the introduction of new common-cause failure mechanisms is assessed
- Independence of barriers is not degraded
- **Defenses against human errors are preserved**
- The intent of the plant's design criteria is maintained

Hypothetical Case Studies: U.S. EPR

- CDF (all quantified events & modes) $\sim 6 \times 10^{-7}$ /yr
- Assume seismic CDF $\sim 3 \times 10^{-7}$ – 3×10^{-6} /yr

Case 1: EDGs and SBO DGs hypothetically found after installation to have strong common-cause coupling; licensee proposes change to Tier 1 and to accept design as-is via risk-informed license amendment:

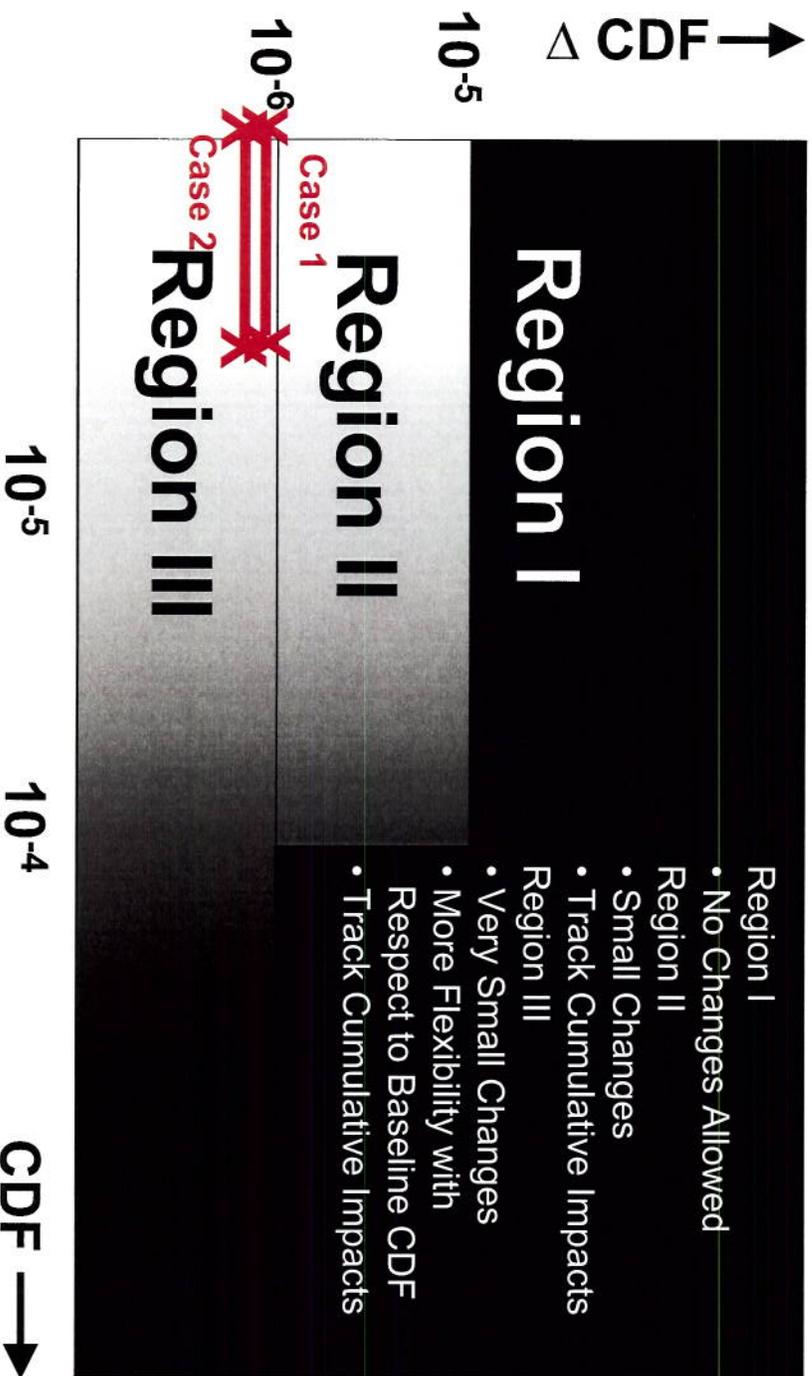
$$\Delta \text{CDF} \leq 9 \times 10^{-7} \text{ /yr}$$

Case 2: risk-informed change to Tech Specs proposed to allow one train OOS all the time:

$$\Delta \text{CDF} \leq 8 \times 10^{-7} \text{ /yr (bounding)}$$

Source: FSAR Tier 2, rev. 2, Table 19.1-104 on sensitivity studies

U.S. EPR Hypothetical Cases



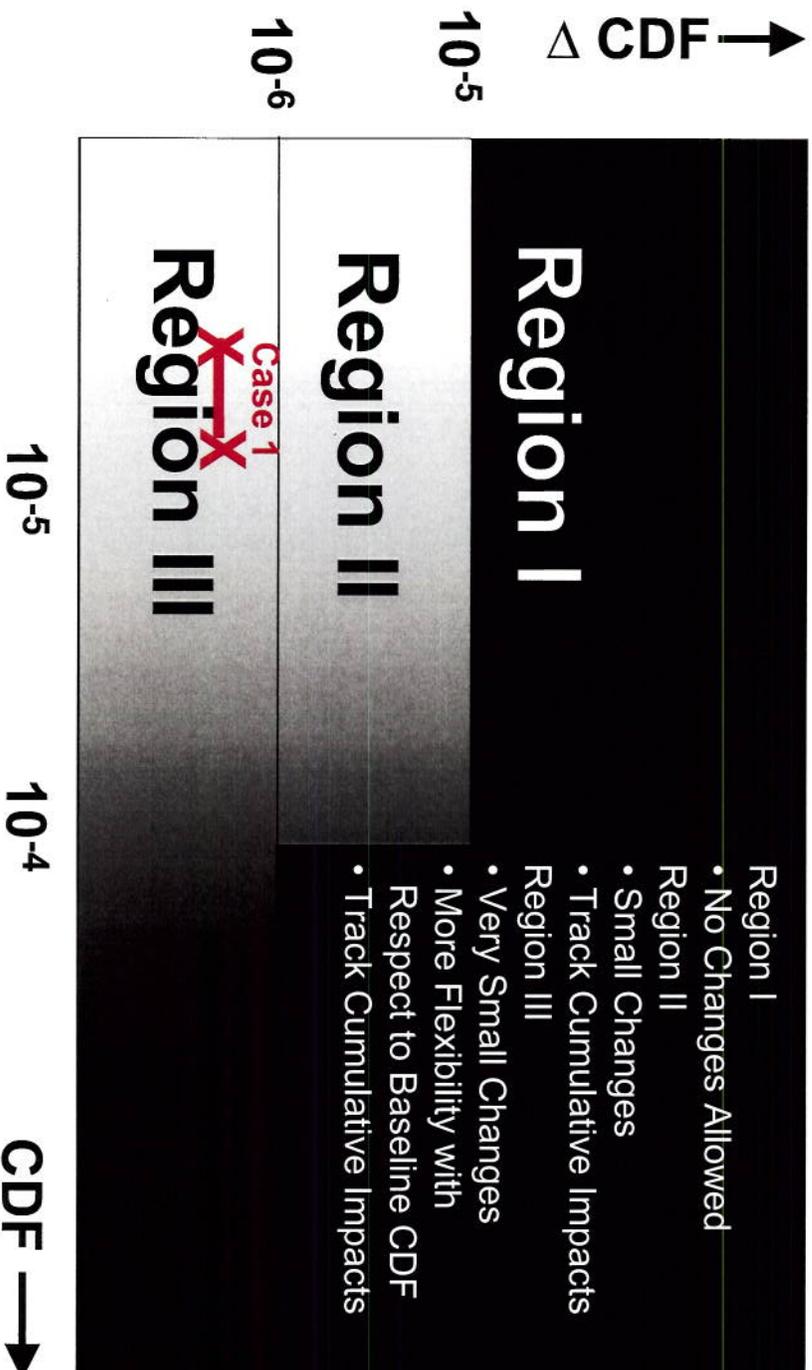
- CDF (all quantified events & modes) $\sim 4 \times 10^{-6}$ /yr
- Assume seismic CDF $\sim 3 \times 10^{-7}$ – 3×10^{-6} /yr

Case 1: CTGs and AAC CTGs hypothetically found after installation to have strong common-cause coupling via application software; licensee proposes change to Tier 1 and to accept design as-is via risk-informed license amendment:

$$\Delta \text{CDF} \leq 5 \times 10^{-7} \text{ /yr}$$

Source: DCD Tier 2, rev. 3, Section 19.1.4.1.2

US-APWR Hypothetical Cases



Hypothetical Case Studies: AP1000

- CDF (all quantified events & modes) $\sim 5 \times 10^{-7}$ /yr
- Assume seismic CDF $\sim 3 \times 10^{-7}$ – 3×10^{-6} /yr
- Case 1: Tier 1 change and license amendment to remove the following from the D-RAP list along with removal from investment protection controls in Tier 2:
 - Both service water pumps and cooling tower fans

$$\Delta \text{CDF} \leq 1.6 \times 10^{-7} \text{ /yr (bounding)}$$

Source: PRA rev. 8, Table 50-12

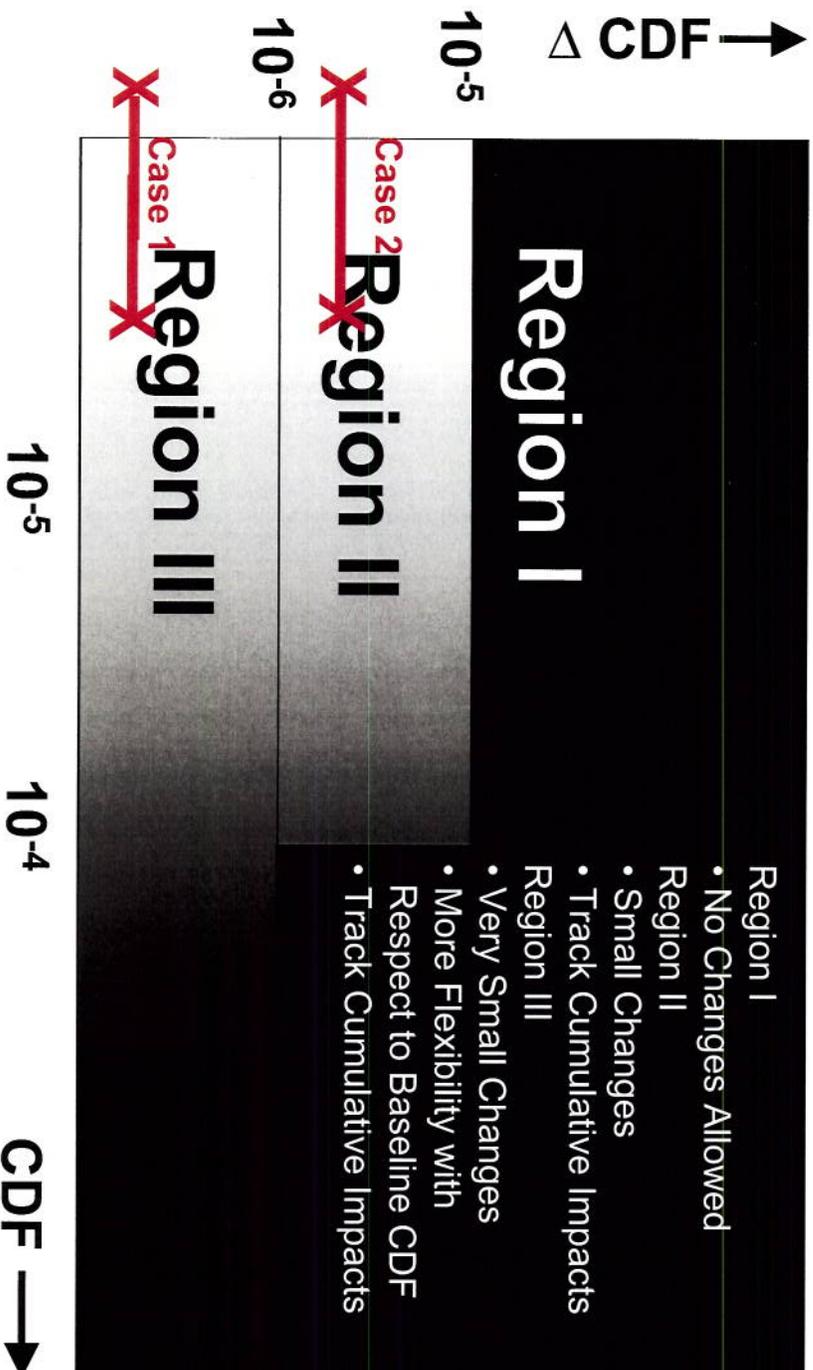
Case 2: Tier 1 change and license amendment to remove the following from the D-RAP list along with removal from investment protection controls in Tier 2 (where applicable):

- Both start-up feedwater pumps
- Both non-safety diesel generators
- Both RHR pumps
- Both CVCS makeup pumps
- Digital actuation system (manual DAS retained)

Δ CDF $\leq 1.9 \times 10^{-6}$ /yr (bounding)

Source: PRA rev. 8, Section 50.6

AP1000 Hypothetical Cases



Options for Changes to RG 1.174 to Address New Reactors

- **Option 1: no changes**
- **Option 2: based on tabletop exercises, provide Commission with compelling reasons to change acceptance guidelines, keeping in mind the following from the SRM :**
 - **“If the staff concludes that the enhanced safety margins for new plants will significantly decrease without regulatory policy changes, the staff should clearly explain how ‘significant’ (in the context of decreasing safety margins) was defined to support the recommendations.”**
- **Option 3: assess impact of change on enhanced severe accident design features of new reactors**

Some Thoughts Under Option 3

- **Address impact of change on the reliability and performance of the enhanced safety features of the new reactor design**
- **May need to first demonstrate to Commission that there is a ‘significant decrease in enhanced safety margin’ even for this option**
- **Examples include**
 - **Features that address containment performance goals in SECY-93-087 and SECY-90-016**
 - **Features that reduce risk (e.g., ESBWR Table 19.2-2)**
 - **PRA based insights (e.g., U.S. EPR Table 19.1-108)**

Option 3 Examples (cont.)

- **From U.S. EPR Table 19.1-108:**
 - **Closing containment hatches and penetrations:**

The ability to close containment hatches and penetrations during Modes 5 & 6 prior to steaming to containment is important. It is assumed that procedures and training will be developed that encompass this item.
 - **Cable separation in the MCR Cable Spreading Area:**

Due to divisional separation measures in the MCR Cable Spreading Area, a fire in the cable spreading area is assumed to disable only one electrical safety division. Non-safety division cables are also assumed to be separated from the safety divisions.

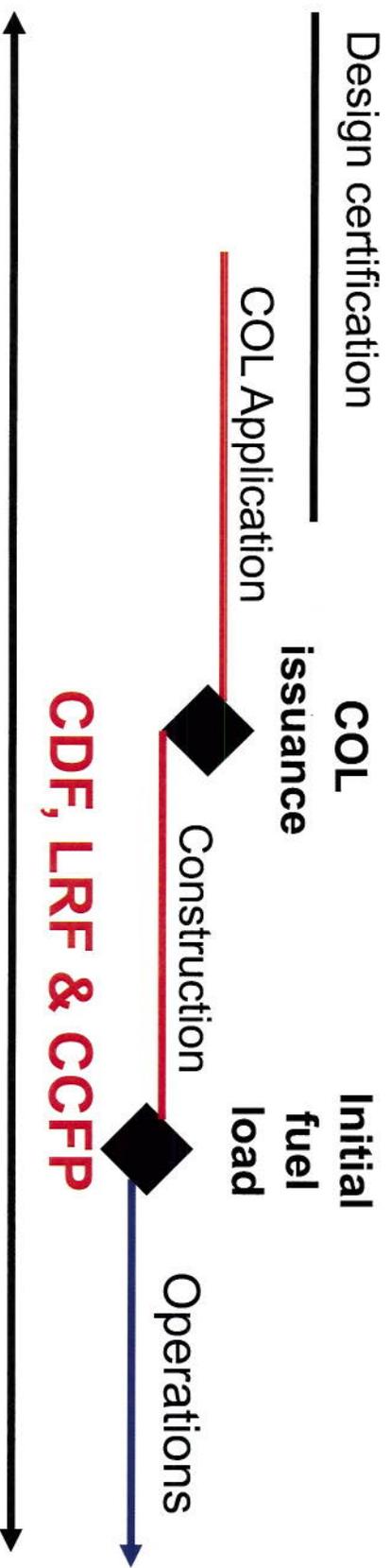
Option 3 (cont.)

- **For changes to the licensing basis, one might potentially define a ‘significant decrease in the enhanced level of safety’ by a change whereby the capability of the feature was degraded to the point that it no longer satisfied the criteria for being included in a list of features reducing risk.**
- **Is this too stringent based on content of the tables?**
- **Discuss under**
 - **2.1 Evaluation of Defense-in-Depth Attributes and Safety Margins, or**
 - **2.2 Evaluation of Risk Impact, Including Treatment of Uncertainties, or**
 - **New section**

LRF-to-LERF Options

- **Option 1: continue use of LRF (& CCFP) indefinitely**
- **Option 2: continue use of LRF (& CCFP) indefinitely and add LERF at initial fuel load**
- **Option 3: transition from LRF to LERF at initial fuel load; discontinue all use of LRF (& CCFP) thereafter**

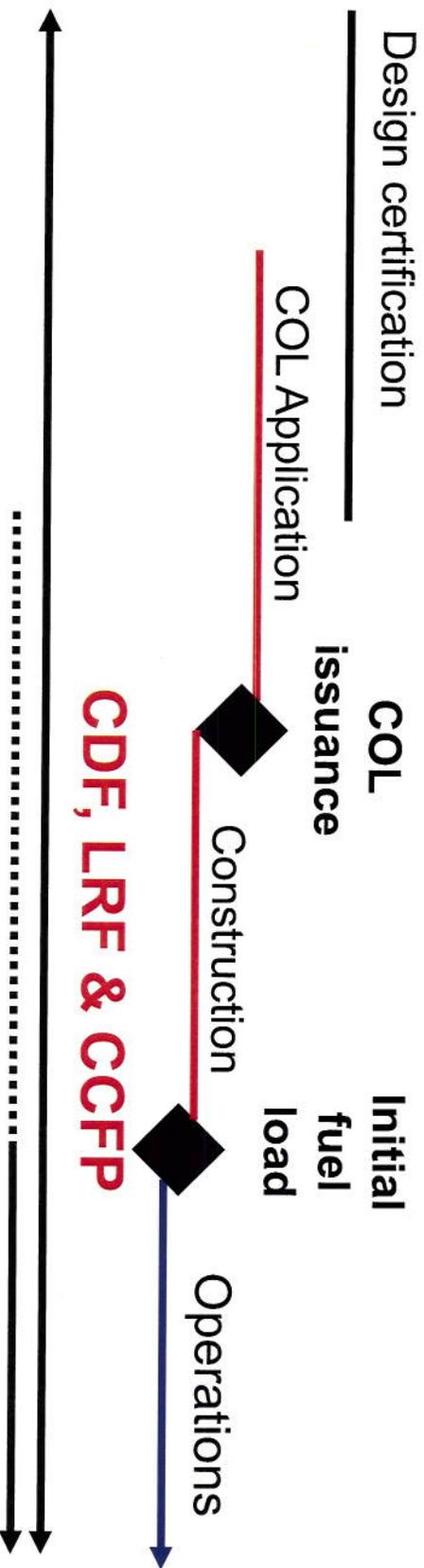
Option 1



Option 1

- **Advantage**
 - **Maintains definition and use of risk metrics consistent with original license application and staff review per FSEER**
- **Disadvantages**
 - **No existing definition & guidance on use of LRF**
 - **May be inconsistent with SRM direction in which Commission “reaffirms that the existing ... quantitative metrics for implementing risk-informed decision making, are sufficient for new plants”**

Option 2

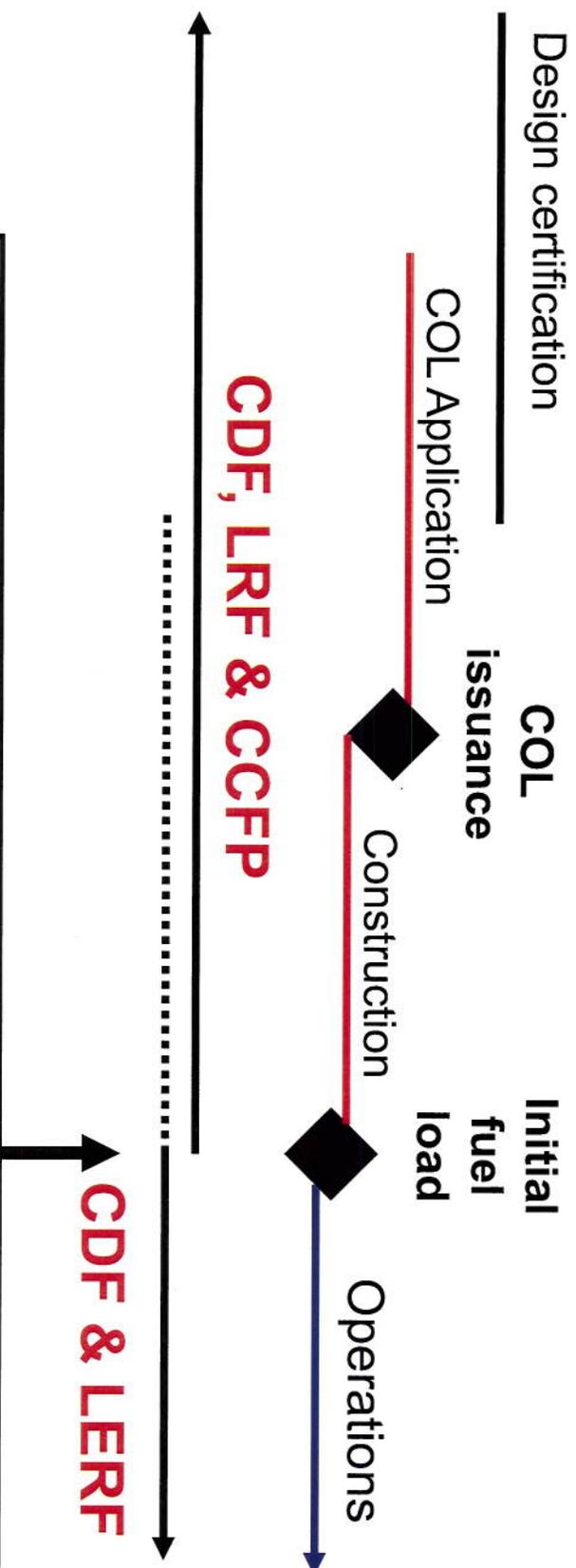


- LERF first calculated no later than initial fuel load. Along with CDF, used for RG 1.174 acceptance guidelines.
- LRF measured against new reactor goal of 10^{-6} /yr only and CCFP against 0.1

Option 2

- **Advantages**
 - Continued use of LRF & CCFP maintains definition and use of risk metrics consistent with original license application
 - Supports calculation of late containment failure impact per rev. 2 of RG 1.174
 - Use of CDF & LERF for risk-informed changes to licensing basis consistent with RG 1.174 for currently operating reactors
- **Disadvantages**
 - Added confusion by tracking both LRF & LERF
 - May be viewed as inconsistent with SRM direction
 - Added burden on licensees

Option 3



- LERF first calculated no later than initial fuel load.
- Along with CDF, used for RG 1.174 acceptance guidelines.
- Last use of LRF & CCFP

Option 3

- **Advantages**
 - **Consistent with SRM direction**
 - **Harmonizes metrics for all operating reactors, both current and new, going forward**
- **Disadvantages**
 - **LRF & CCFP, part of original design objective in design certification, no longer tracked**
 - **LRF not available to assist in determining impact on late containment failure**

Thoughts on Transition to LRF

- Industry may wish to continue to use their current design-specific definitions of LRF & CCFP; no redefinition required
- However, going forward on new design applications, advantageous if
 - A “large release” definition is based on release fractions for large LWRs or absolute activity (curies) for SMRs
 - A CCFP definition based on containment functional failure, not necessarily the ratio of LRF/CDF

Transition to LRF (cont.)

- **For Option 3:**
 - **The PRA at the time of initial fuel load is a logical transition point**
 - **Final calculation of LRF at initial fuel load (for continuity and benchmark against previous versions of the PRA reviewed by the staff) and**
 - **First calculation of LERF no later than initial fuel load to establish a baseline going forward**
- **In conjunction with LRF, LERF may be calculated prior to initial fuel load for risk-informed application submittals**



Other Risk-Informed Activities

- **Risk-informed IST (RG 1.175)**
- **ILRT interval extension (NEI 94-01)**
- **Alternative source term (RG 1.183)**
- **50.46a**
- **Others**



Next major steps affecting stakeholders

- **February 2012: Draft Commission paper with recommendations**
- **February 2012: Public communications brochure complete**
- **March 2012: public meeting**
- **March-April 2012: ACRS briefings**
- **Late May 2012: Commission paper for notation vote**