



*CSNI Workshop on Evaluation of Uncertainties in  
Relation to Severe Accidents and Level II PRA  
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# Assessment of Phenomenological Uncertainties in Level 2 PRAs

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“The value of what one knows is doubled if one confesses to not knowing what one does not know”

Arthur Schopenhauer

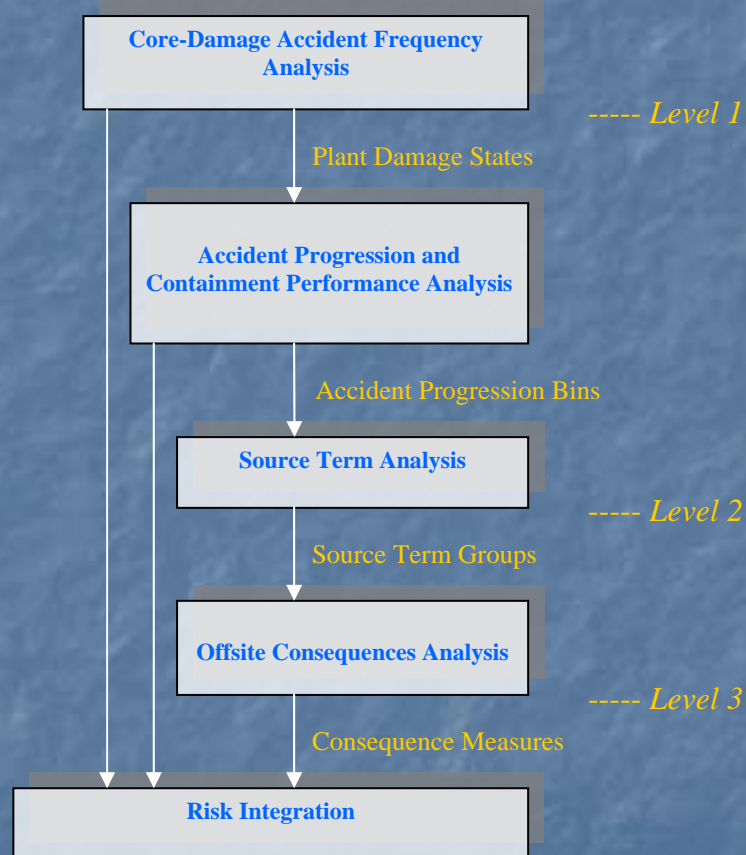


# OUTLINE

- Overview of PRA Process
- Phenomenological Uncertainties in Severe Accident Progression Analysis
- Uncertainties Associated with Source Term Analysis
- Risk Importance Measures for Phenomenological Issues



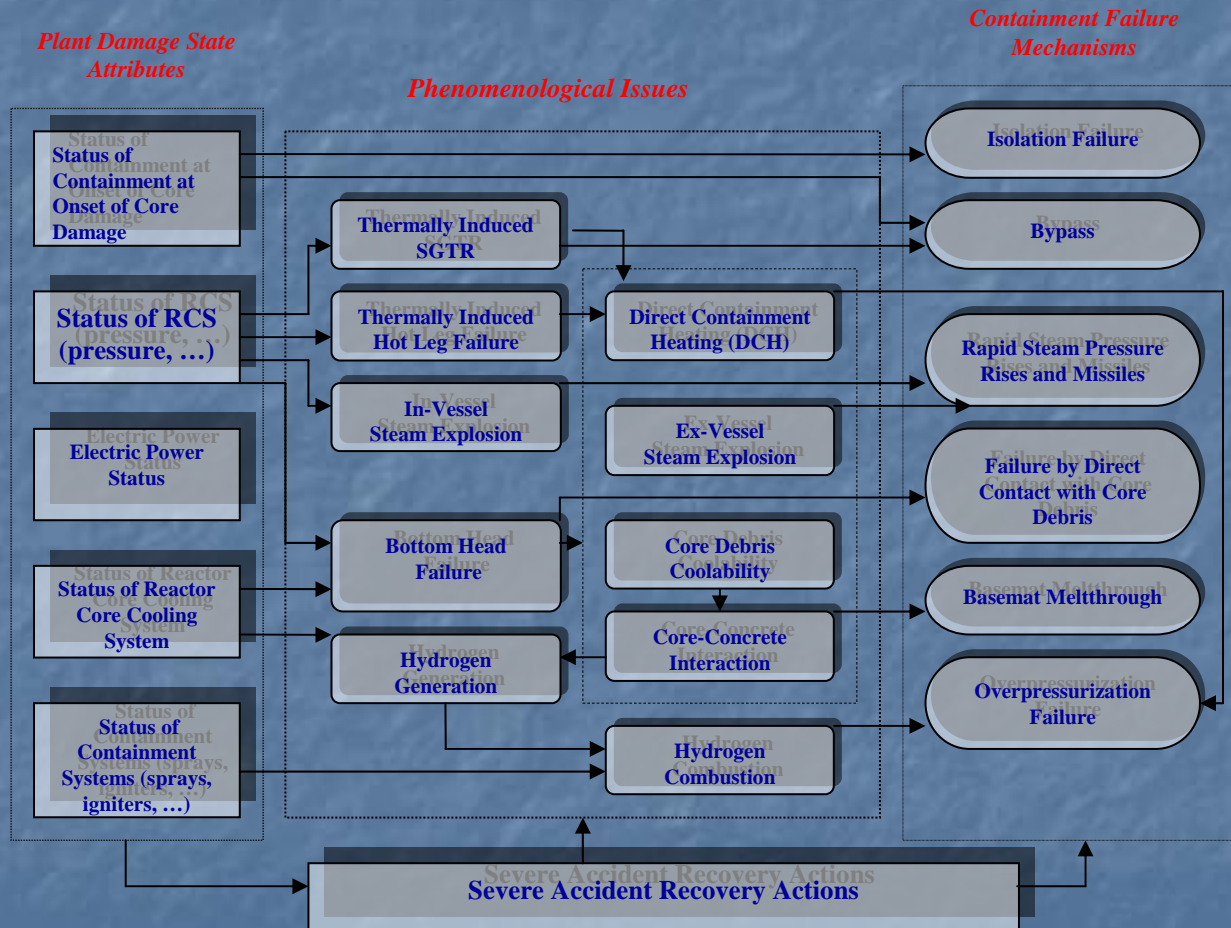
# Elements of the PRA Analytical Process





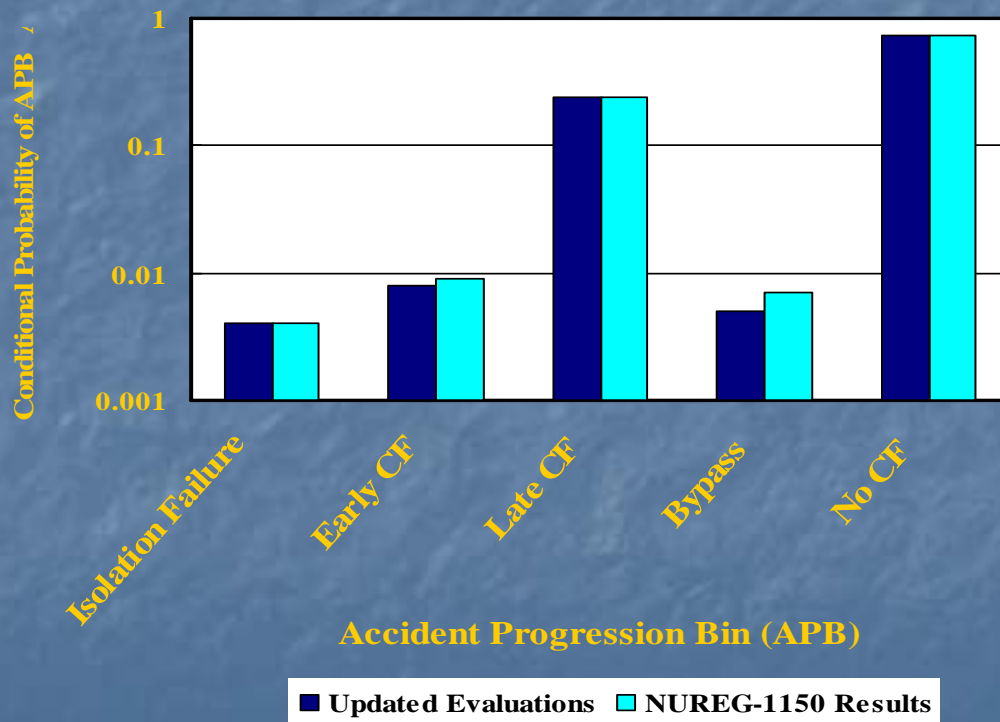
# Severe Accident Progression

## Phenomenological Issues & Containment Failure Mechanisms



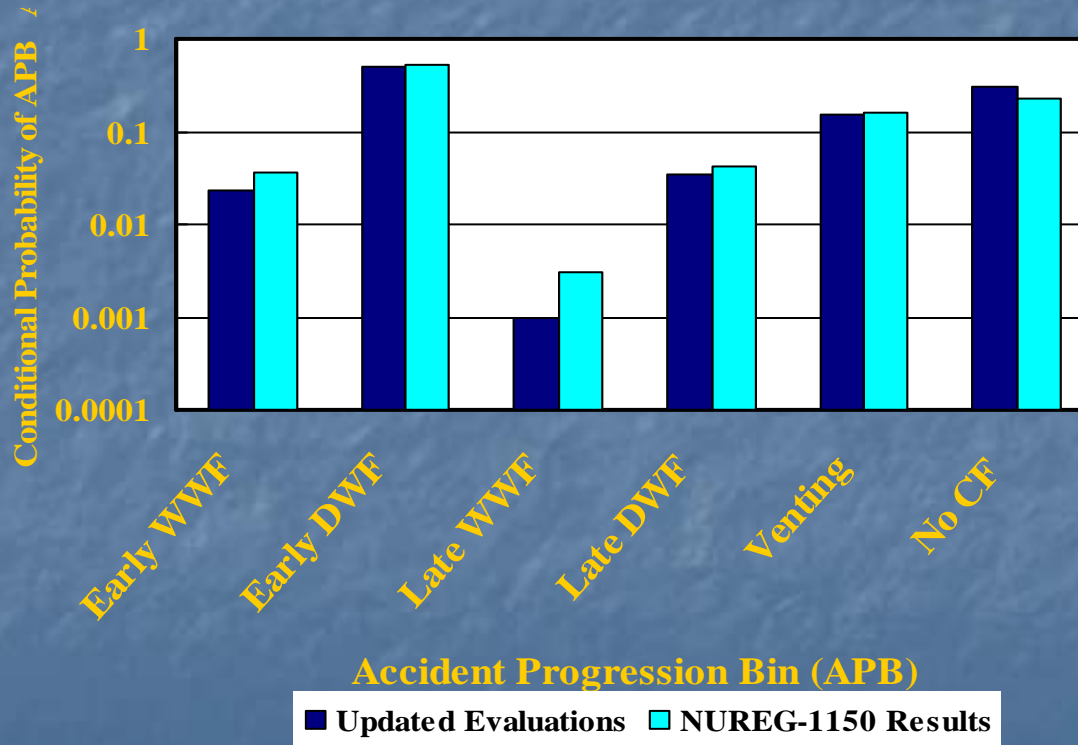


# Conditional Probability of Accident Progression Bins for Internal Events at Zion





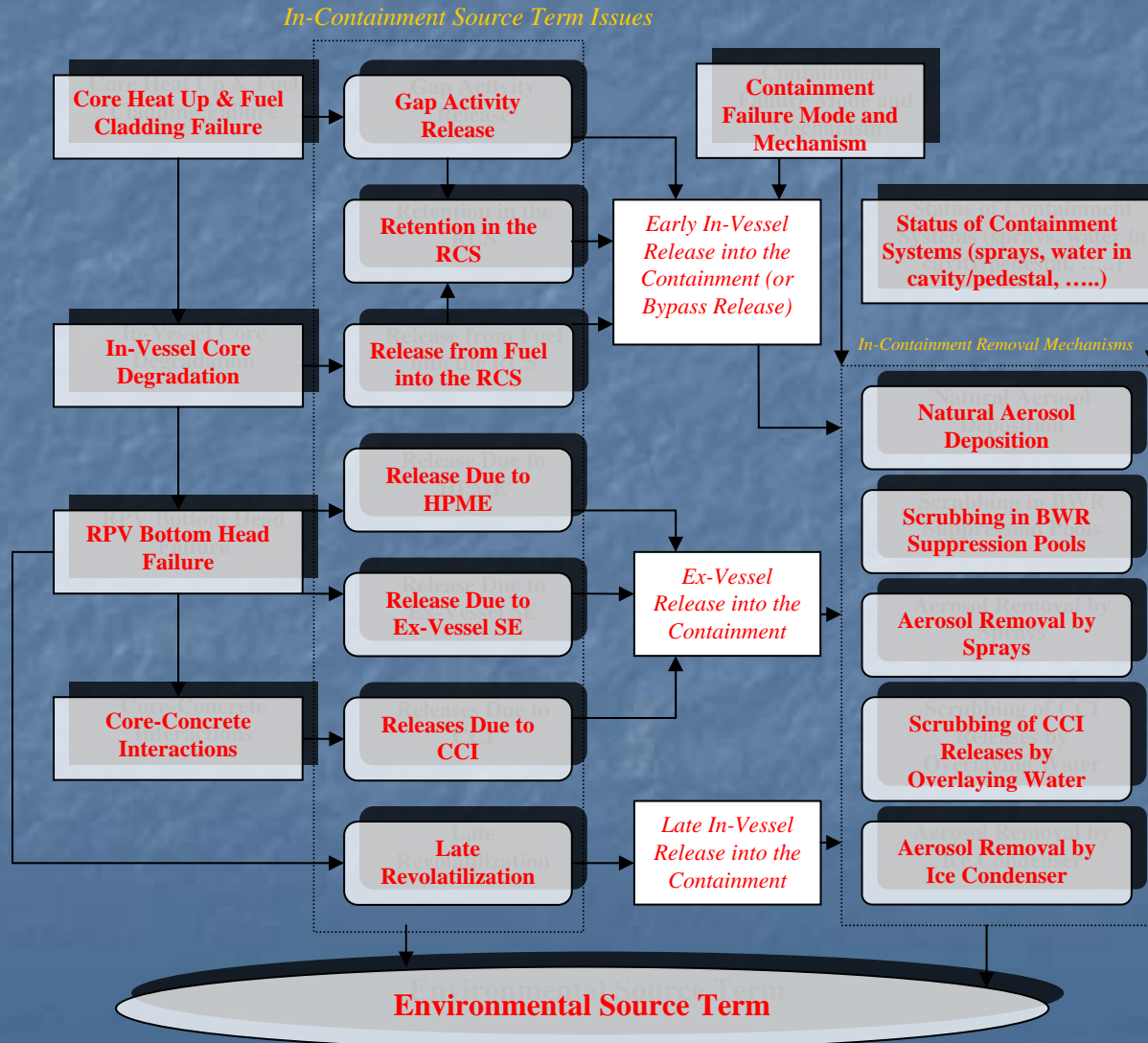
# Conditional Probability of Accident Progression Bins for Internal Events at Peach Bottom





# Source Term Analysis

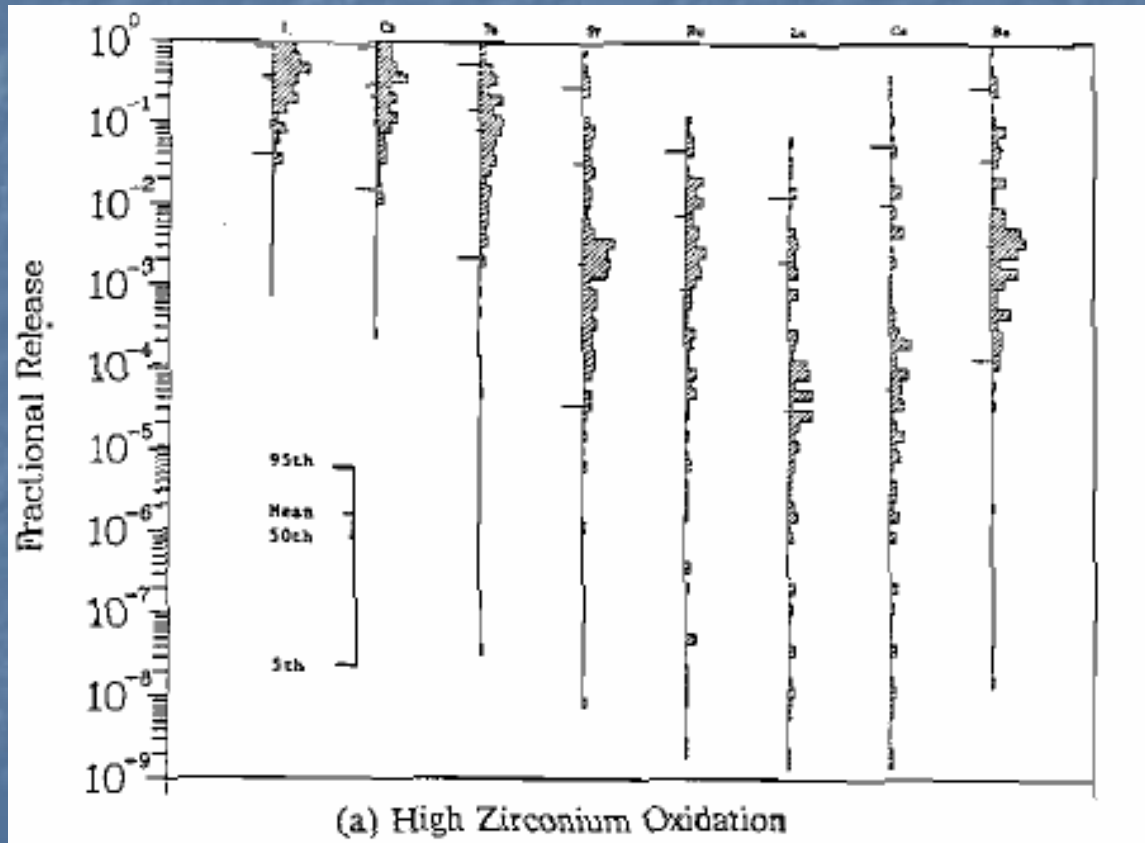
## Source Term Issues and In-Containment Removal Mechanisms





# Uncertainty Distributions for Early In-Vessel Releases into the Containment

*PWR, Low RCS Pressure (NUREG/CR-5747)*





# Risk Importance Measures for Phenomenological Issues

- It is desirable to assign some ranking of “risk importance” among various phenomenological issues that are considered in a plant PRA model.
- Risk importance measures for phenomenological issues can be useful for assessing potential accident management strategies as well as for developing research priorities to reduce the overall uncertainty.



# Risk Importance Measures Commonly Used for Ranking PRA Basic Events or SSCs

**Risk Achievement Worth, RAW**

$$RAW_i = R_i^+ / R_0$$

**Fussell – Vesely, FV**

$$FV_i = (R_0 - R_i^-) / R_0$$

**Risk Reduction Worth, RRW**

$$RRW_i = R_i^- / R_0$$

where:

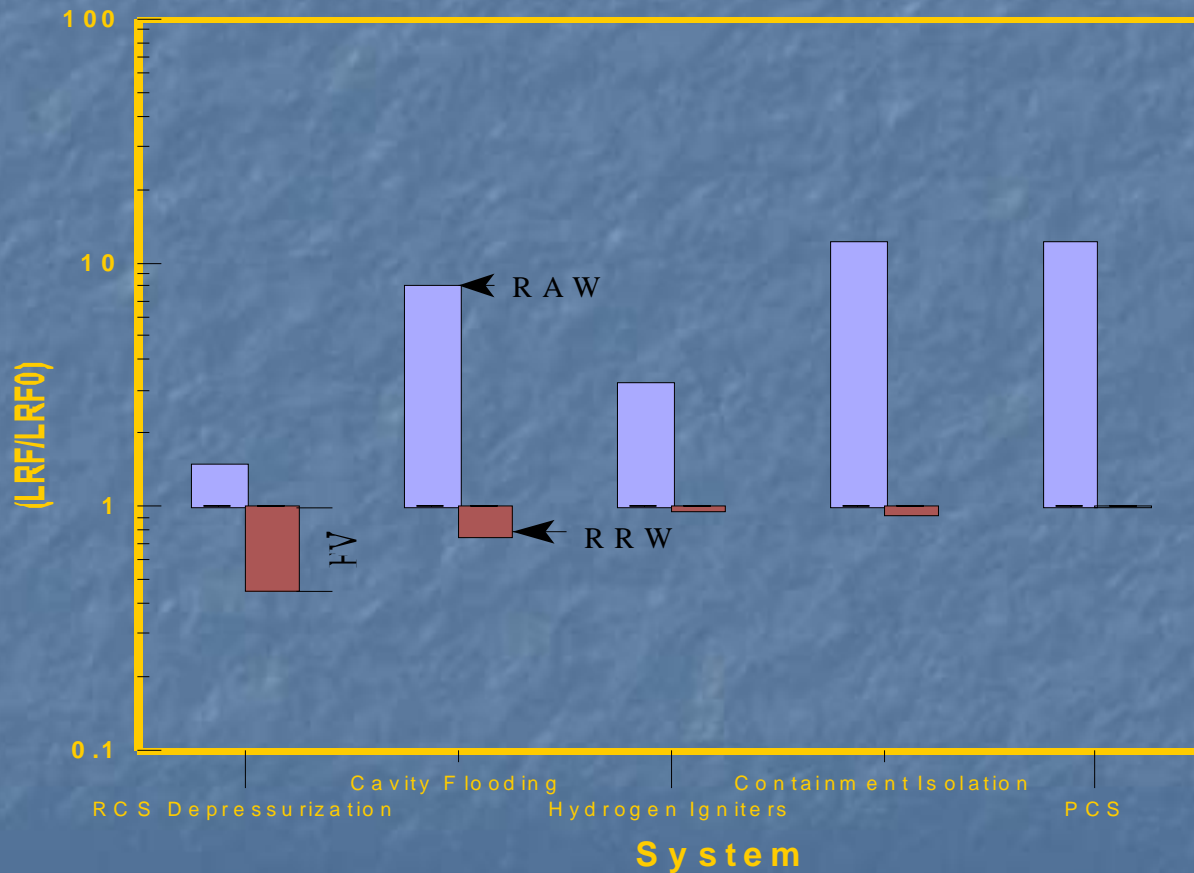
$R_i^+$  = overall risk with the probability of basic event  $i$  set to 1 (the event has occurred or the equipment is failed),

$R_i^-$  = overall risk with the probability of basic event  $i$  set to 0 (the event is impossible or the equipment is totally reliable), and

$R_0$  = overall base-case risk

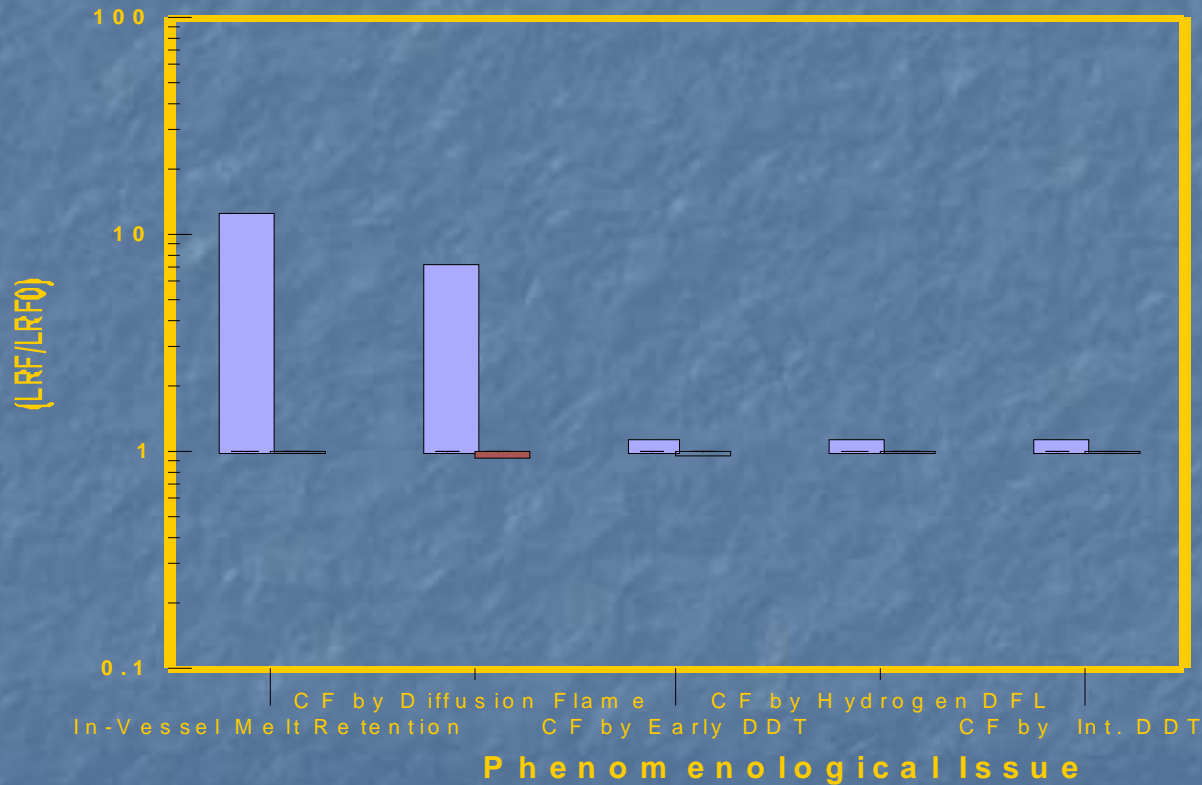


# Risk Importance Measures for Post Core-damage Mitigation Systems in AP1000 Design





# Risk Importance Measures of Severe Accident Phenomena in AP1000 Design





# Summary

- An assessment of the phenomenological uncertainties associated with Level 2 PRAs was presented.
- Development of risk importance measures for phenomenological issues was also discussed.