UNCERTAINTY

FACTORS OF UNCERTAINTY

- Randomness
- Phenomenological Ignorance
- Systematic Ignorance (Complexity, Sensitivity)
- Data Ignorance

IMPORTANT UNCERTAIN PHENOMENA

- Human Error
- Common Cause Failures
  - Internal
  - External
- Rare Events (e.g., Reactor Core Melt Progression)

TREATMENT OF UNCERTAINTY

- Statistical (via Standard Deviation)
- Sensitivity Analyses
- Subjective Probability Elicitation
- Research and Data Collection
- Assignment of Bias

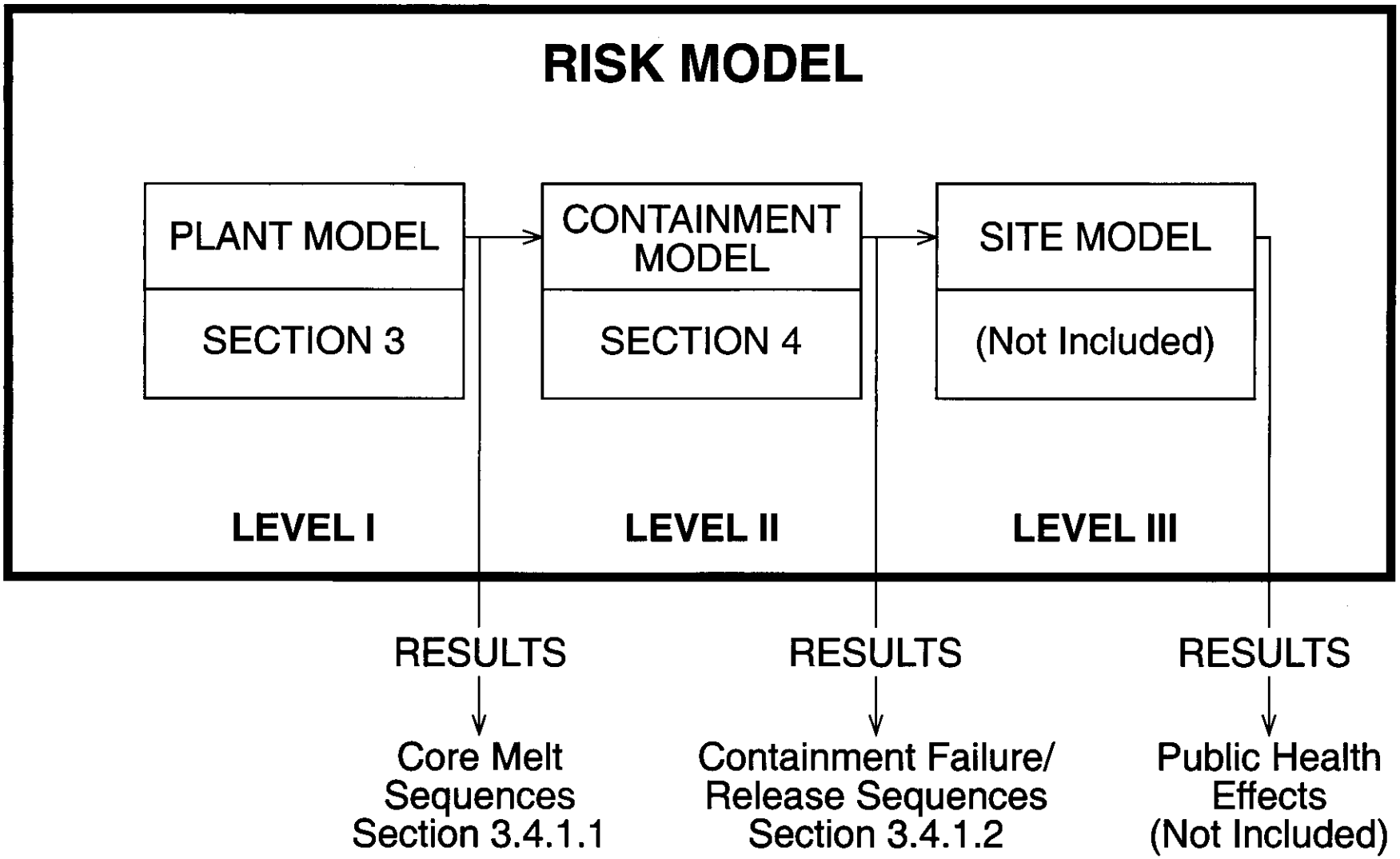
IMPORTANT SOURCES OF PRA UNCERTAINTY

- INCOMPLETE PROBLEM STATEMENT
- MODELING APPROXIMATIONS
- SYSTEM BEHAVIOR SENSITIVITY
- PHENOMENOLOGICAL IGNORANCE, INCLUDING:
  - HUMAN BEHAVIOR
  - SEVERE ACCIDENT PHENOMENA
  - EARTHQUAKE SEVERITY
- COMMON-CAUSE FAILURE MODES

DATA SOURCES

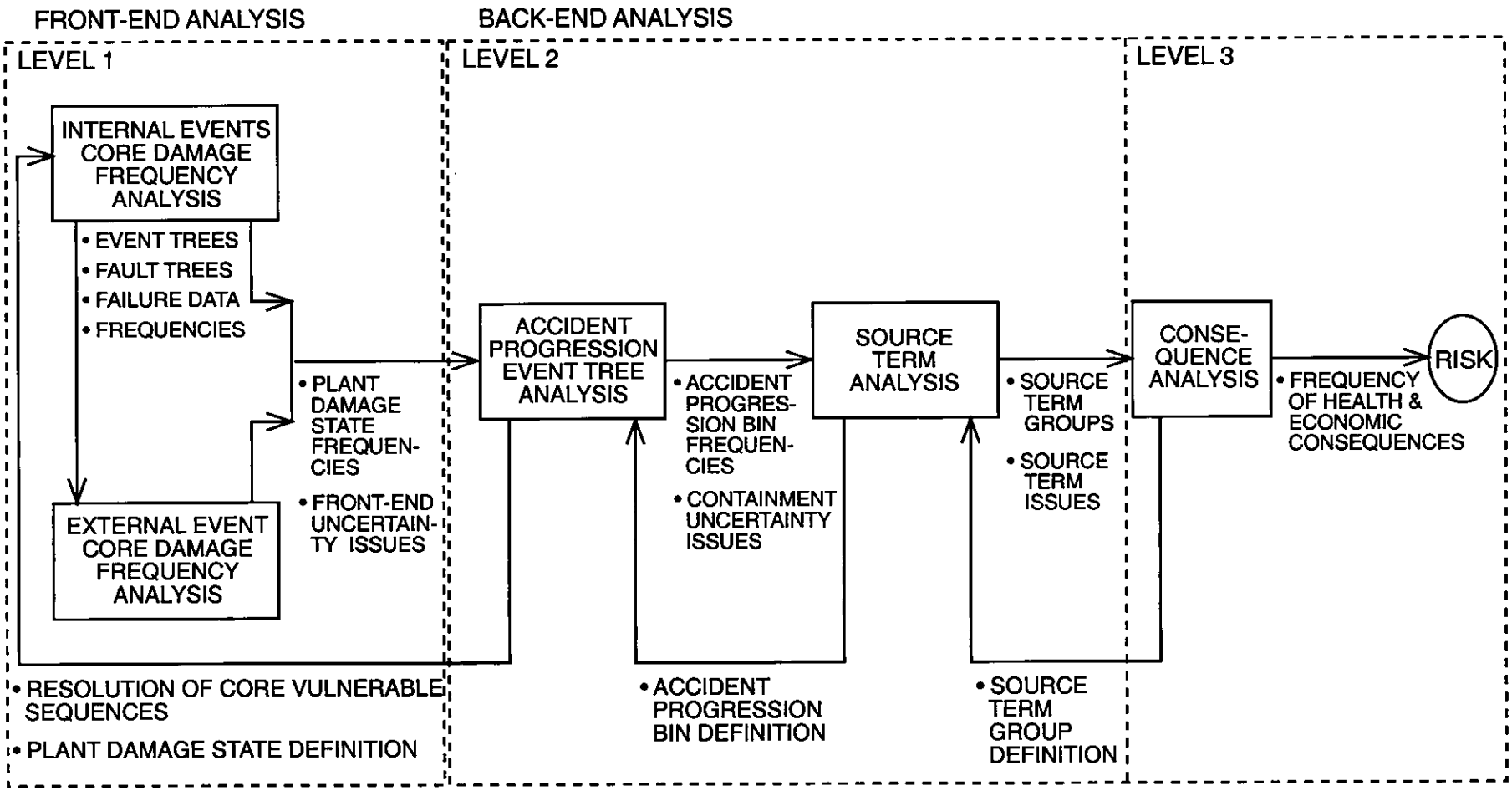
- Generic Data Bases (those available are strongly safety-oriented; e.g., NPRDS/EPIX, NRC, GADS, . . .)
- Plant-Specific Data
- New Tests
- Subjective Judgment and Modeling

RISK MODEL OVERVIEW



Courtesy of U.S. NRC.

INTEGRATED LEVEL 3 PRA FRAMEWORK



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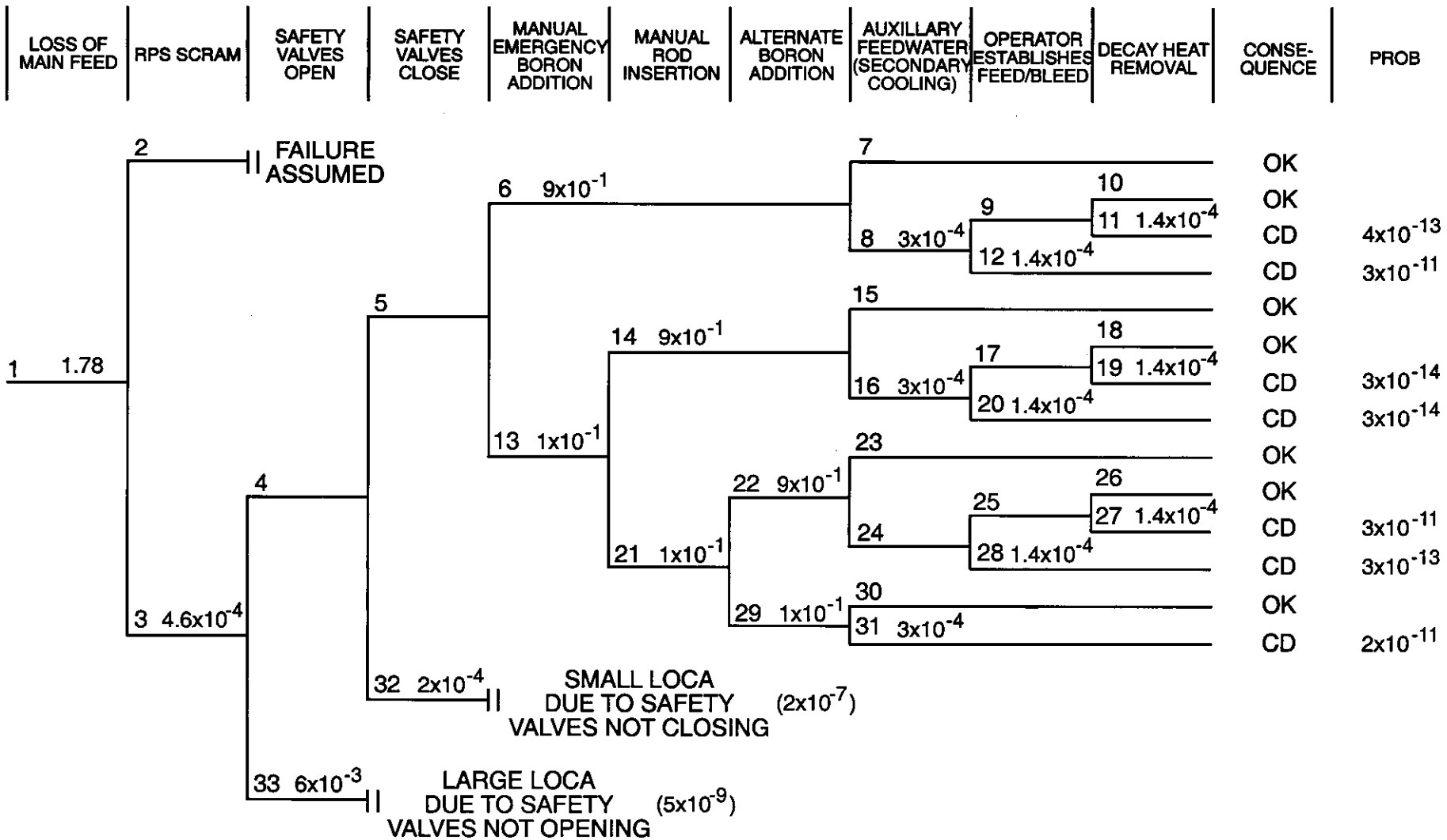
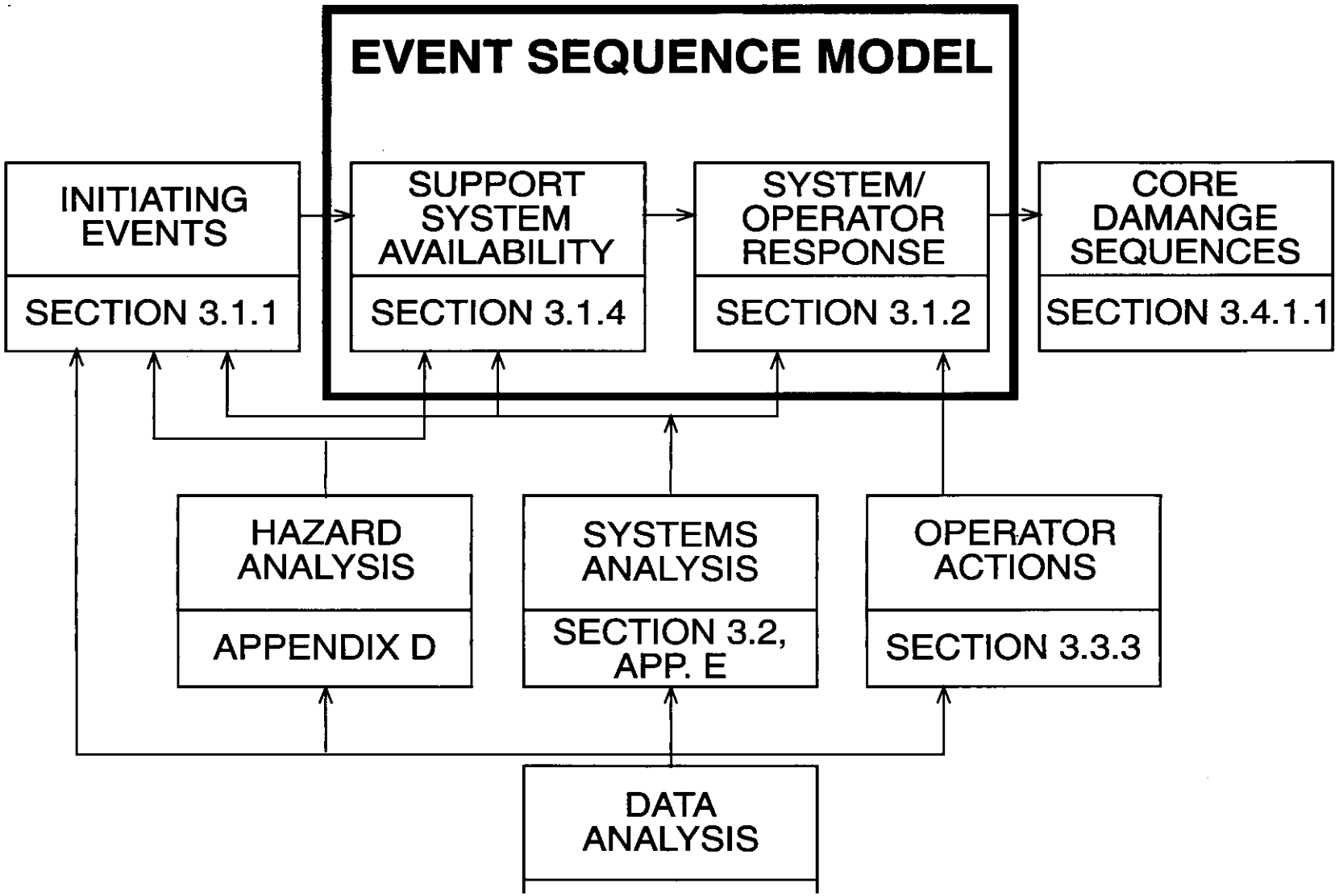
QUANTIFIED ATWS SEQUENCE EVENT TREE

ANTICIPATED TRANSIENT WITHOUT SCRAM



Courtesy of U.S. NRC.

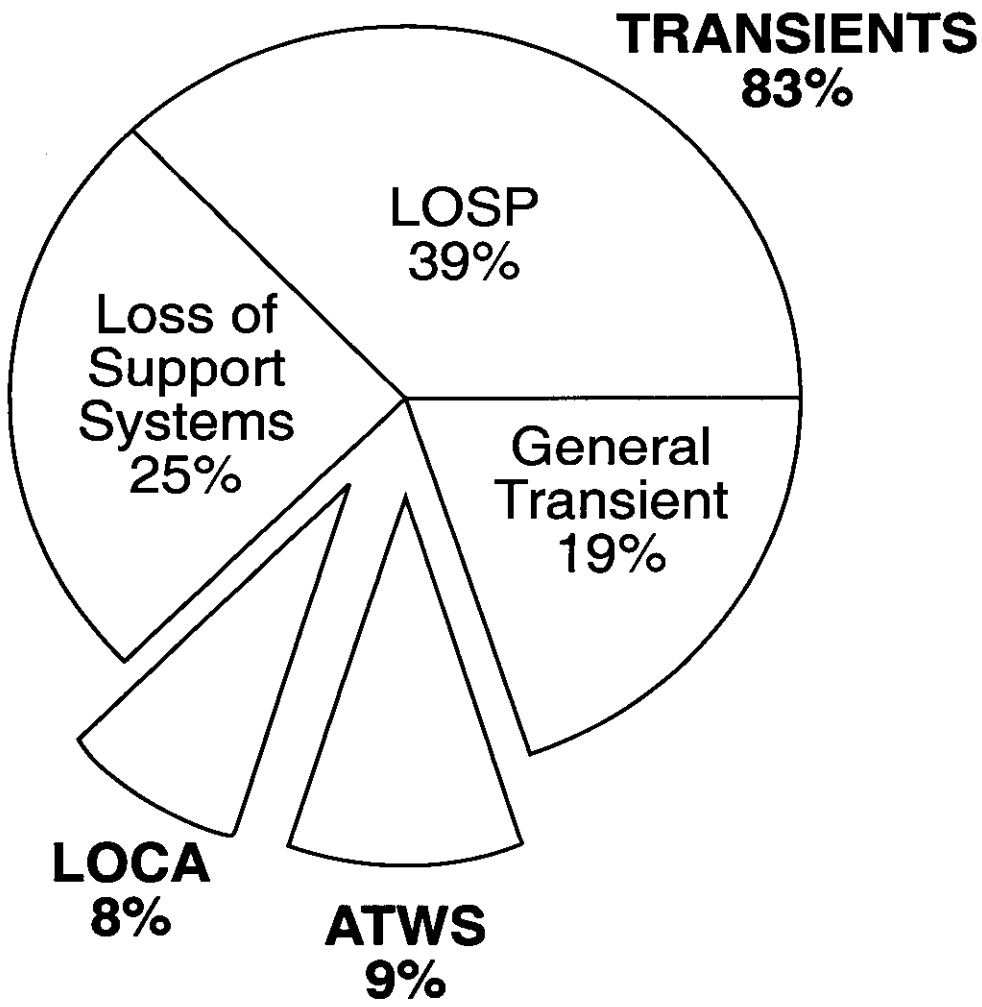
PLANT MODEL OVERVIEW (WITH IPE REPORT SECTION REFERENCES)



Courtesy of U.S. NRC.

CONTIBUTIONS TO CORE DAMAGE FREQUENCY

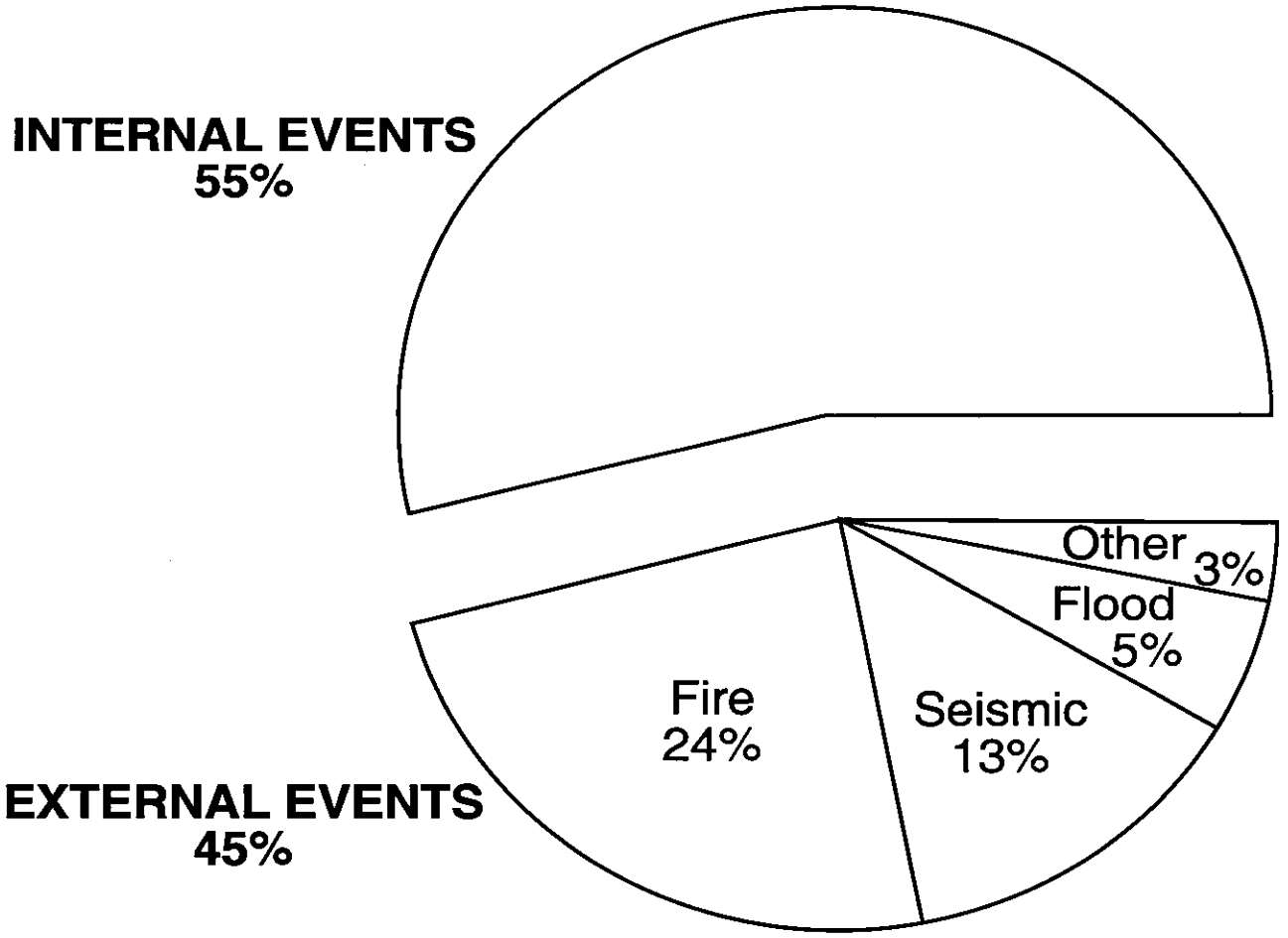
Accidents Grouped by Initiating Event



Courtesy of U.S. NRC.

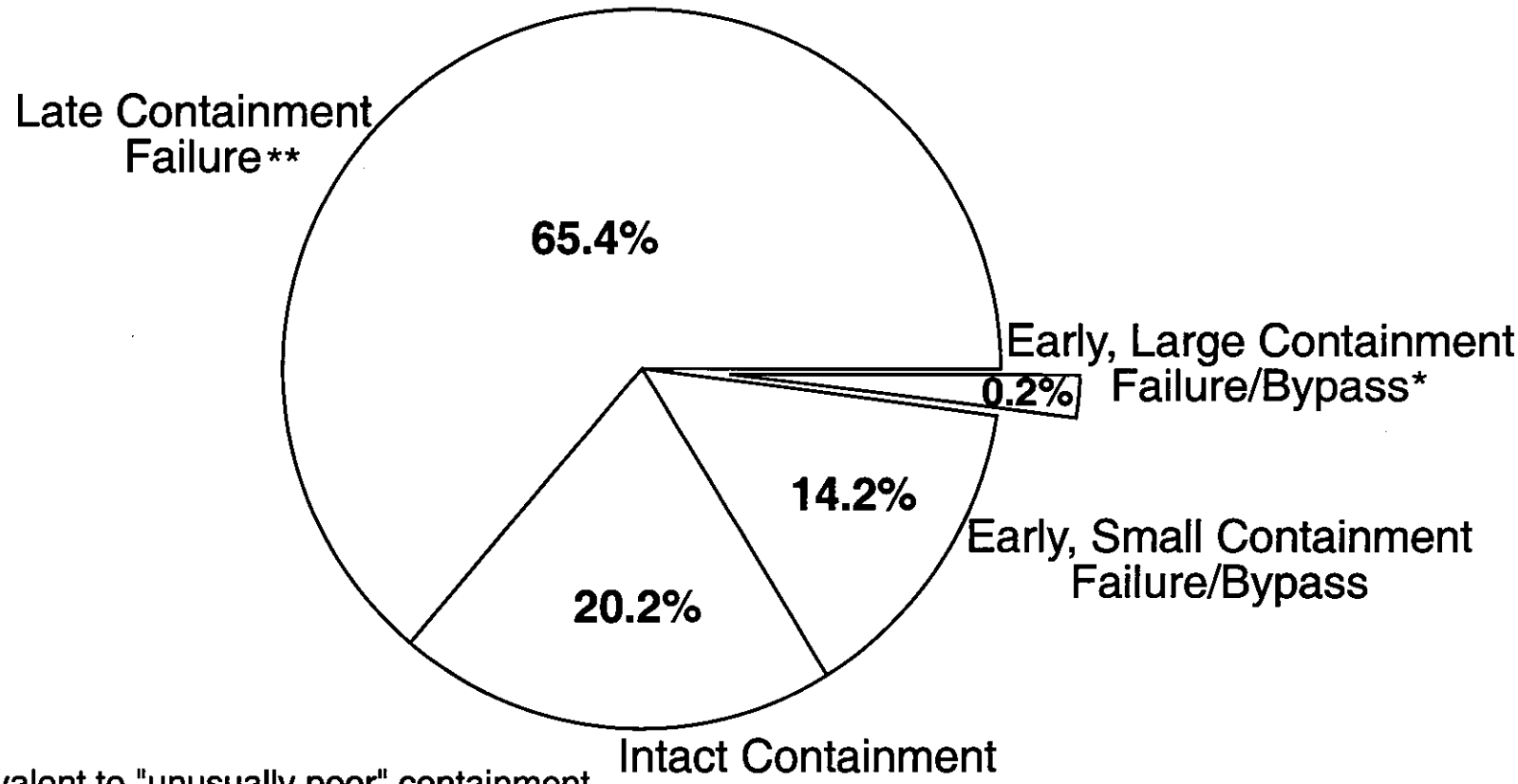
CONTIBUTIONS TO CORE DAMAGE FREQUENCY

Accidents Grouped by Internal and External Initiating Event



Courtesy of U.S. NRC.

CONTAINMENT PERFORMANCE RESULTS
(Conditional Failure Probability Given Core Damage)



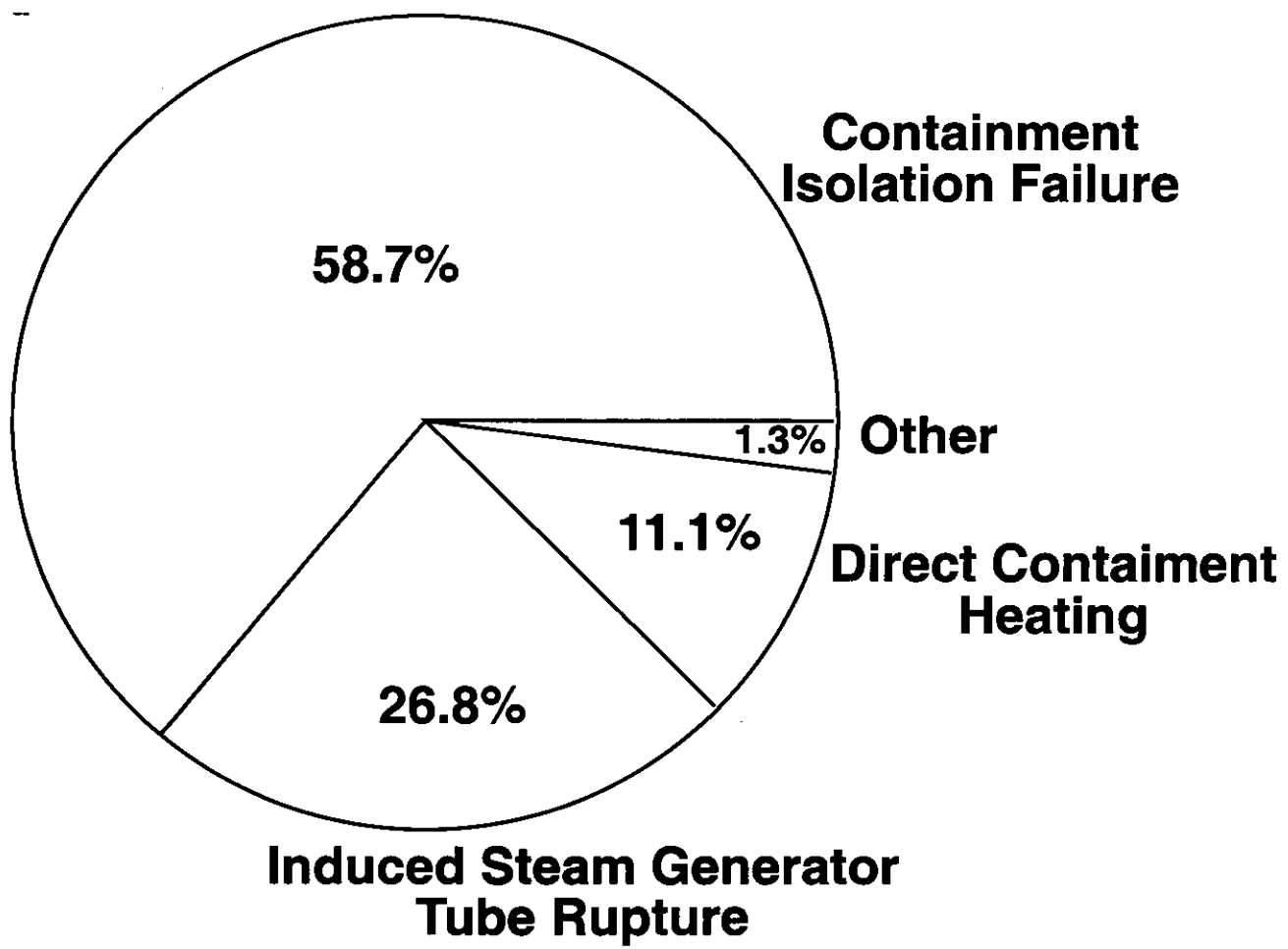
* Equivalent to "unusually poor" containment performance, as defined in GL 88-20

**The containment failure probability of late containment failure is believed to be overestimated relative to containment intact. No credit has been taken for post-core melt recovery actions.

Courtesy of U.S. NRC.

CONTAINMENT FAILURE MODE CONTRIBUTIONS TO EARLY, LARGE CONTAINMENT FAILURES/BYPASS

("Unusually Poor" Containment Performance)



Courtesy of U.S. NRC.