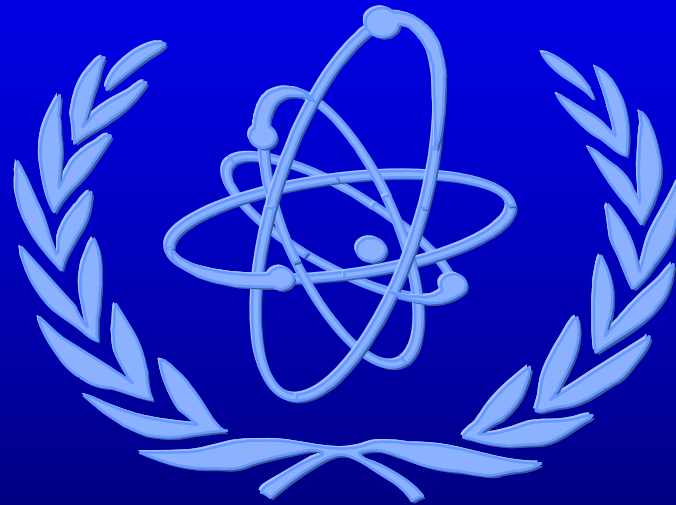


MODULE 9:

Level 2 PSA Results



Outline of Discussion

- Parameters for describing results of a Level 2 PSA
 - Results of a Level 2 study as stand-alone
 - Data required to support Level 3 PSA
 - Information to support severe accident management studies
 - Dangers to avoid in comparing results to studies of other plants
-

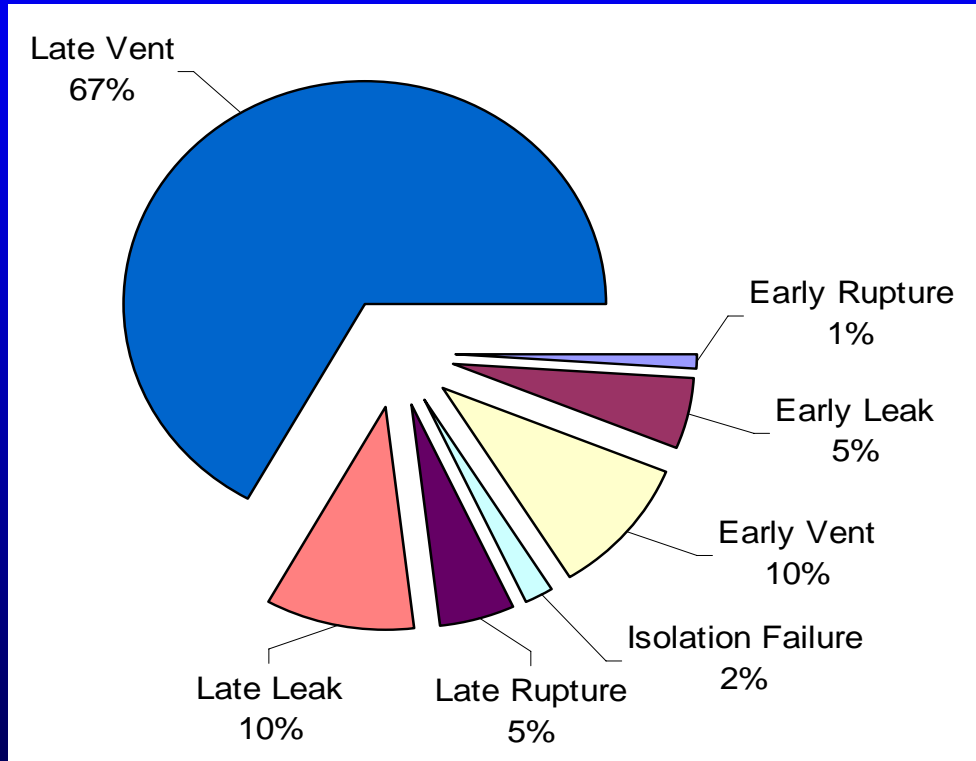


Level 2 PSA Results as Stand-alone Information

- Quantitative measures of a plant's response to severe accidents include:
 - **Containment performance**
 - ❖ Conditional probability of containment failure by “mode” (time, size & location)
 - **Source term**
 - ❖ Probability of exceedance for source terms of various magnitude
 - ❖ Frequency of a release greater than a criterion
 - For example, “large early” release as defined in by regulators in the USA or the U.K.



Example Containment Performance Results



- A breakdown of various containment failure modes:
 - Across total core damage frequency (frequency-weighted average)
 - For each PDS
 - For a specific accident sequence



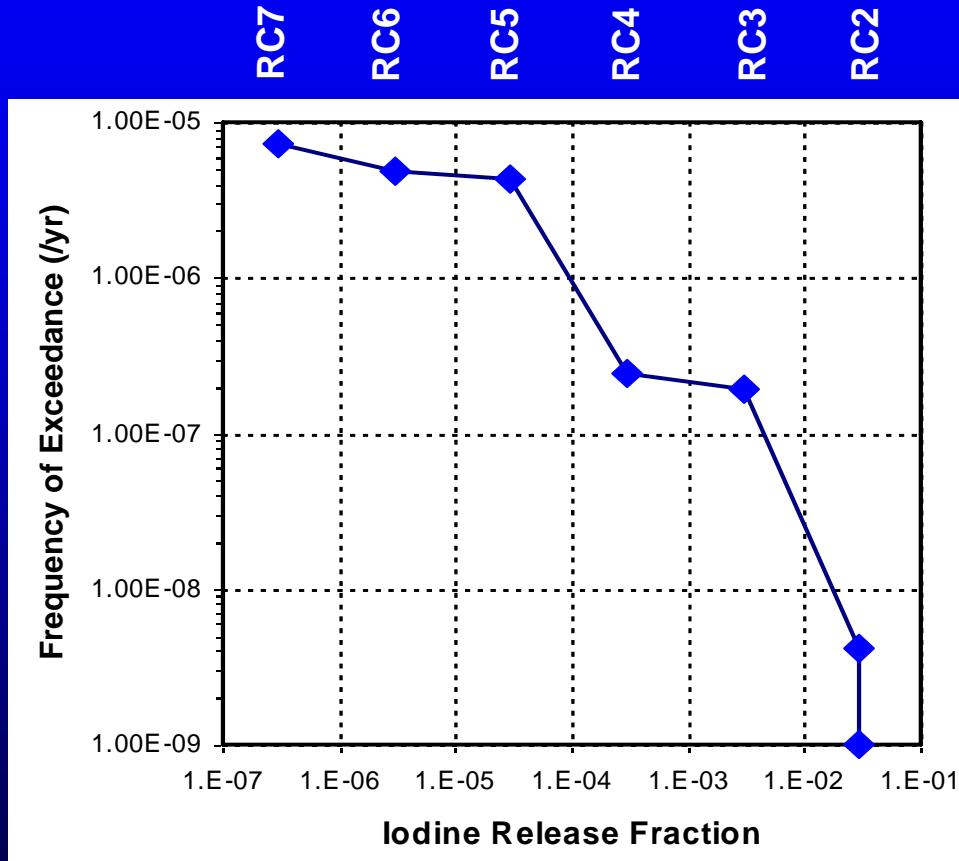
Containment Performance Results (2)

Tabular results provide quick comparison of a Baseline analysis to Sensitivity Cases

| Analysis Case | | Isolation Failure | | Early Containment Failure | | Late Containment Failure | | Containment Vented | No Failure |
|-------------------|-------------------------|-------------------|---------|---------------------------|---------|--------------------------|---------|--------------------|------------|
| | | Leak | Rupture | Leak | Rupture | Leak | Rupture | | |
| Baseline | | < 0.1% | 1.1% | < 0.1% | < 0.1% | 7.2% | 0.9% | 90.7% | < 0.1% |
| Sensitivity Cases | Station Blackout Only | < 0.1% | 5.4% | < 0.1% | < 0.1% | 16.2% | 0.3% | 78.0% | < 0.1% |
| | No Containment Vent | < 0.1% | 1.2% | 0.2% | < 0.1% | 35.8% | 2.9% | -- | 60.1% |
| | No Containment Flooding | < 0.1% | 1.2% | < 0.1% | < 0.1% | 61.8% | 1.6% | 35.3% | -- |
| | No Vent & No Flooding | -- | 1.2% | 0.2% | < 0.1% | 85.9% | 12.7% | -- | -- |



Example Source Term Results



- Many ways to describe source term results:
 - Frequency of exceeding different release magnitude
 - Conditional probability of a “large” release
 - For each PDS
 - For a specific containment failure mode

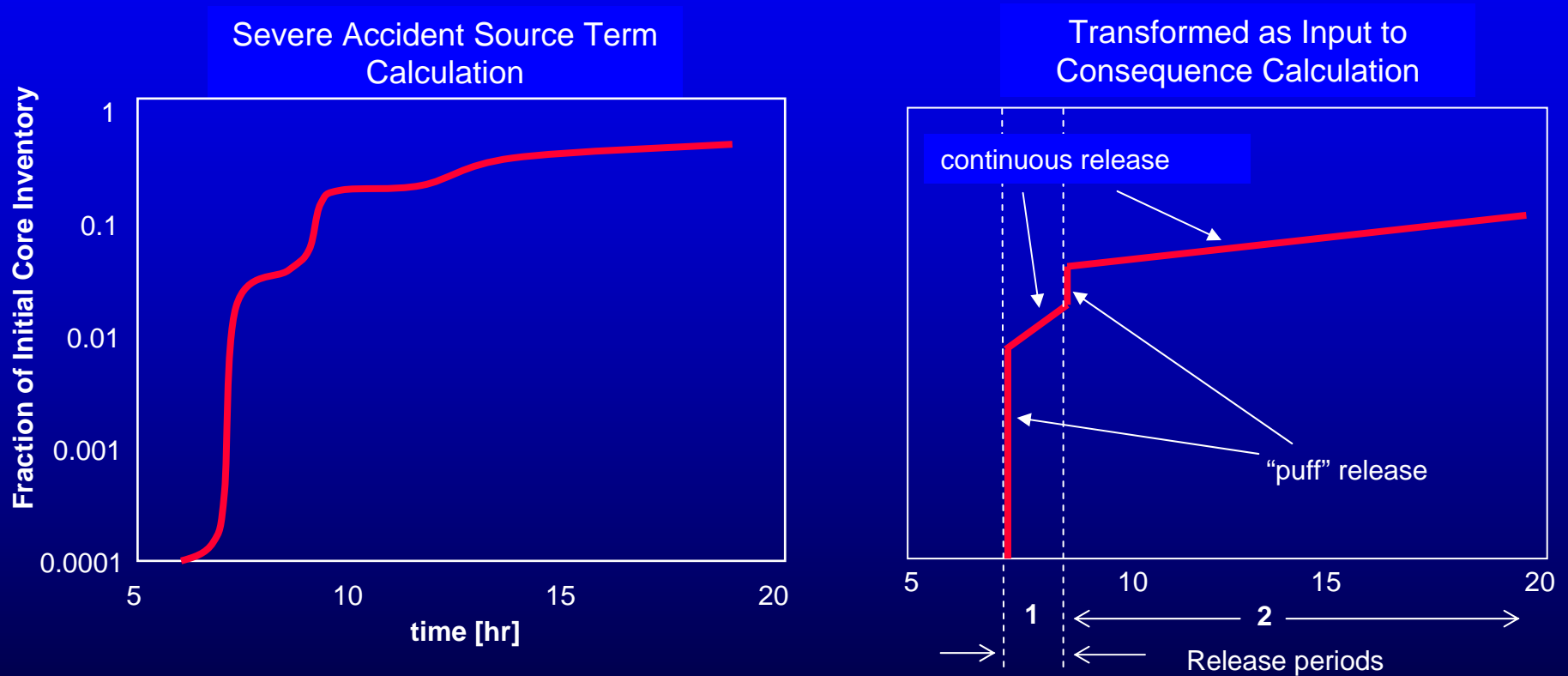


Level 2 PSA Results as Input to Level 3 Analysis

- **Data requirements**
 - **Frequency of a spectrum of source terms**
 - **Source term described by**
 - ❖ Released mass of each radionuclide species as a function of time
 - ❖ Energy of release(s) -- carrier gas enthalpy
 - ❖ Elevation of release(s)
 - **Time-variations in release usually simplified**
 - ❖ Level 3 consequence codes usually require continuous release history be converted to step functions
-



Reducing Level 2 Source Term Information to Level 3 Input



Cautions:

Comparing Level 2 PSA Results

- Results of a Level 2 PSA must be interpreted with a clear understanding of study objectives and modeling assumptions
 - Differences in objectives/assumptions between studies can preclude meaningful comparisons of results
 - State of knowledge in severe accident behavior has changed considerably over the past 20 years
 - Comparisons of results between new and old studies may reflect changes in knowledge; not plant-specific differences in performance.
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Examples of False Comparisons

- Conditional Probability of “Early” containment failure or a “Large” release
 - Different studies use different definition of “early” and “large”
 - Source terms for “similar” sequences
 - General terms such as “station blackout” or ATWS are not specific enough to permit plant-to-plant comparisons of source terms.
-



Use of Level 2 PSA in Severe Accident Management

- PSA results provide a basis for setting priorities
 - **Prevention (Level 1) versus Mitigation (Level 2)**
 - **Causes of early or large releases (i.e., root causes of high consequences)**
 - PSA results can be used to “measure” value of proposed accident management measures
 - **Change mode of containment failure (e.g., vent versus structural failure)**
 - **Reductions in magnitude of releases (e.g., fire water as surrogate for containment spray)**
-



Level 2 PSA Results: Summary

- **Results of a Level 2 PSA can be expressed in many different ways**
 - **Qualitative information on severe accident progression and mechanisms for containment failure**
 - **Quantitative information on failure probability and resulting radionuclide release**
 - **Comparisons of results to those from other studies must be done with caution**
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