U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Mitigating Strategies Significance Determination Process (SDP) Development
Category 2 Public Meeting

January 29, 2015

Purpose

The development of a new SDP should receive early external stakeholder input via public meetings

Paraphrased from Inspection Manual Chapter (IMC) 0609, "The Significance Determination Process (SDP),"Section 07.01

Background

- EA-12-049 “Mitigating Strategies Order”
- NEI 12-06 and JLD-ISG-2012-01
- Overall Integrated Plans (OIPs) and Audits
- Temporary Inspection (TI) 2515/191
- Inspection and Oversight using the ROP (i.e., baseline inspection and SDP)
- IMC 0609, Appendix L, “B.5.b Significance Determination Process” revised to include Mitigating Strategies

Abbreviations

- IEF – Initiating Event Frequency
- CCDP – Conditional Core Damage Probability
- MS – Mitigating Strategies
- SDP – Significance Determination Process
- PDF – Probability Distribution Function
- DB – Design Basis
- BDB – Beyond Design Basis
- EE – External Event
- CDF – Core Damage Frequency
- AEF – Annual Exceedance Frequency

Areas to Develop

1) Technical basis for the MS SDP thresholds/outcomes (e.g., White, Yellow, Red)

2) Risk-informed MS SDP Framework

3) If MS are also used for design basis events:
   A. Distinguish between the At-Power SDP (IMC 0609, Appendix A) and the MS SDP
   B. Treatment of credit (PRA) in licensing and oversight (RIS 2008-015)

Threshold Basis

Objective: Provide a technical basis for the potential safety significance of findings identified during future inspection/oversight of MS (i.e., White, Yellow, Red thresholds).

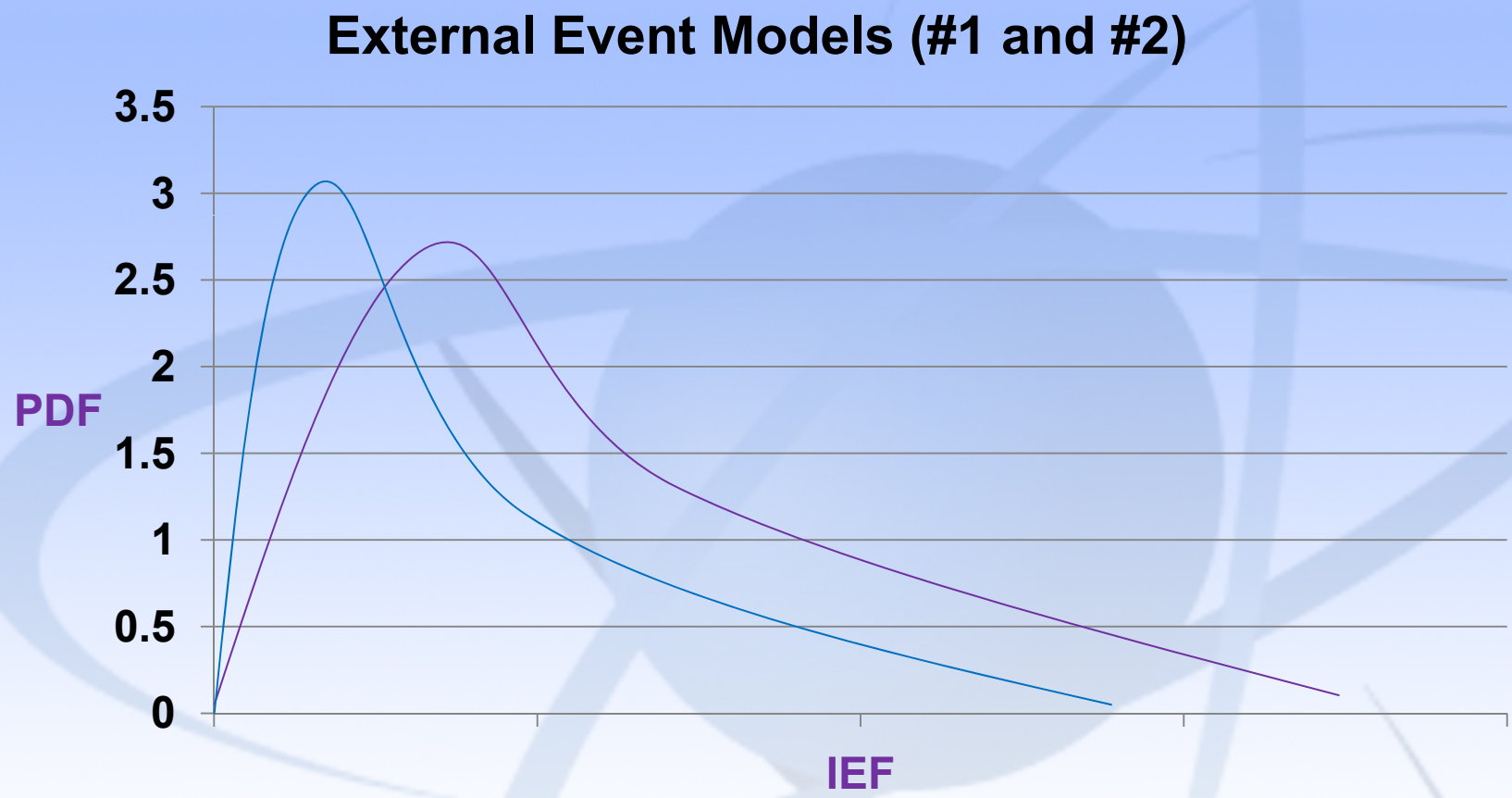
Approach: Conduct a generic quantitative bounding analysis, with some location-specific benchmarking, by simulating potential IEFs and mitigation strategy failure probabilities (i.e., CCDP)

Threshold Basis

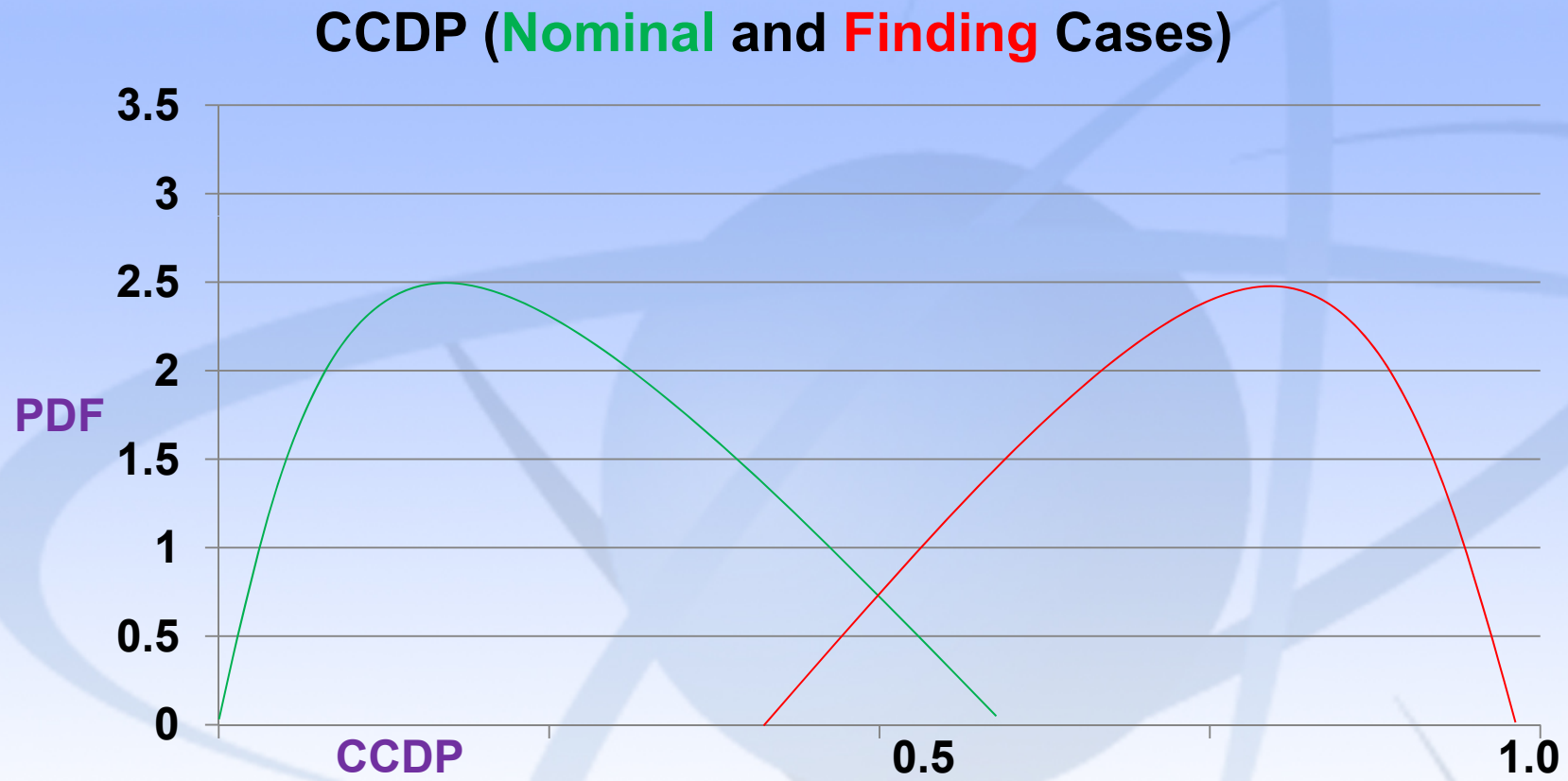
Key High-level Concepts:

- **Metric is ΔCDF or the increase in risk due to an inspection finding above a nominal/baseline risk profile.**
- **IEFs of concern are BDB EEs.**
- **Seeking an order of magnitude result; not a specific point estimate outcome**

Initiating Event Frequency Model



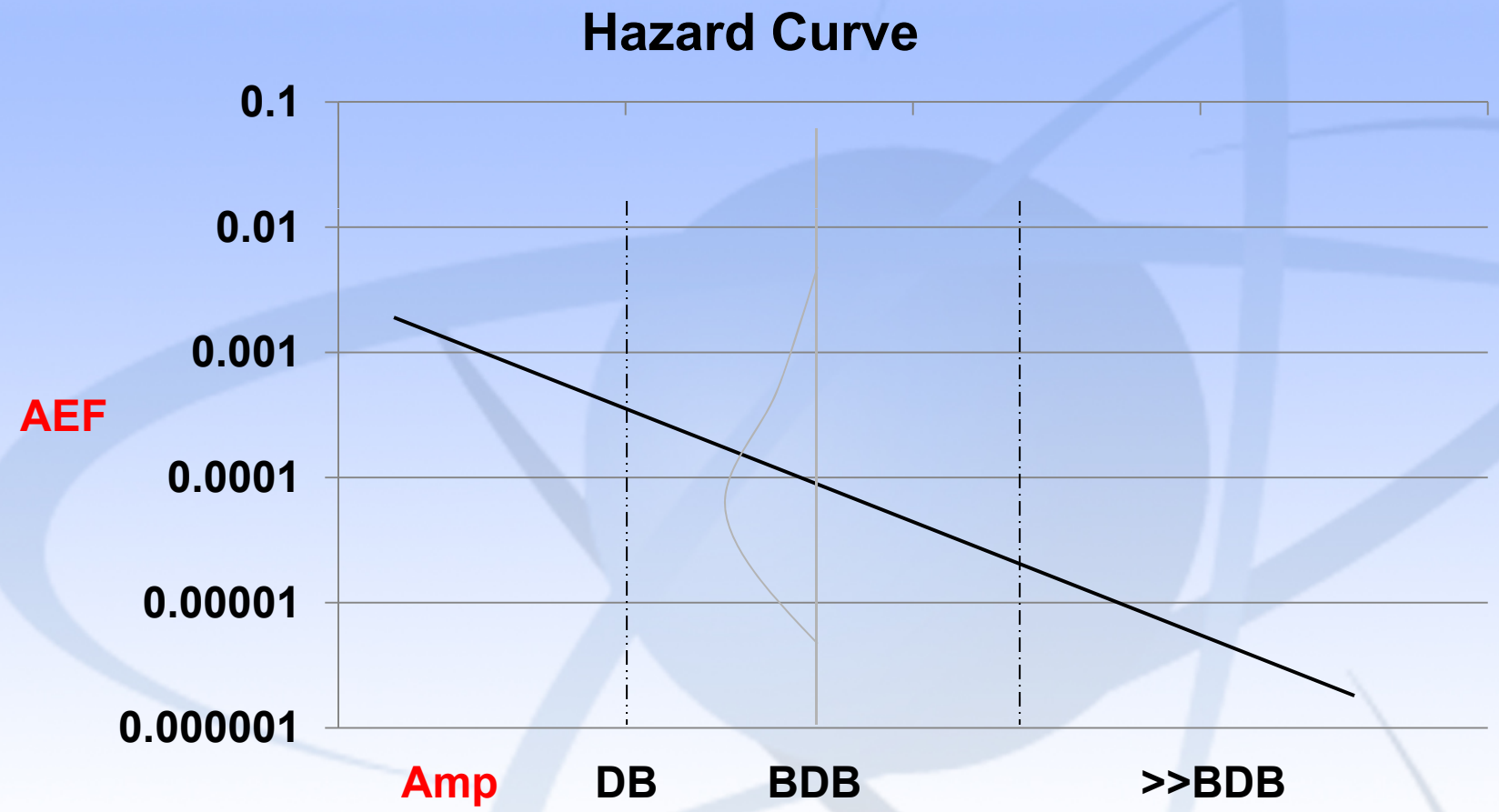
Mitigating Strategies Failure Model



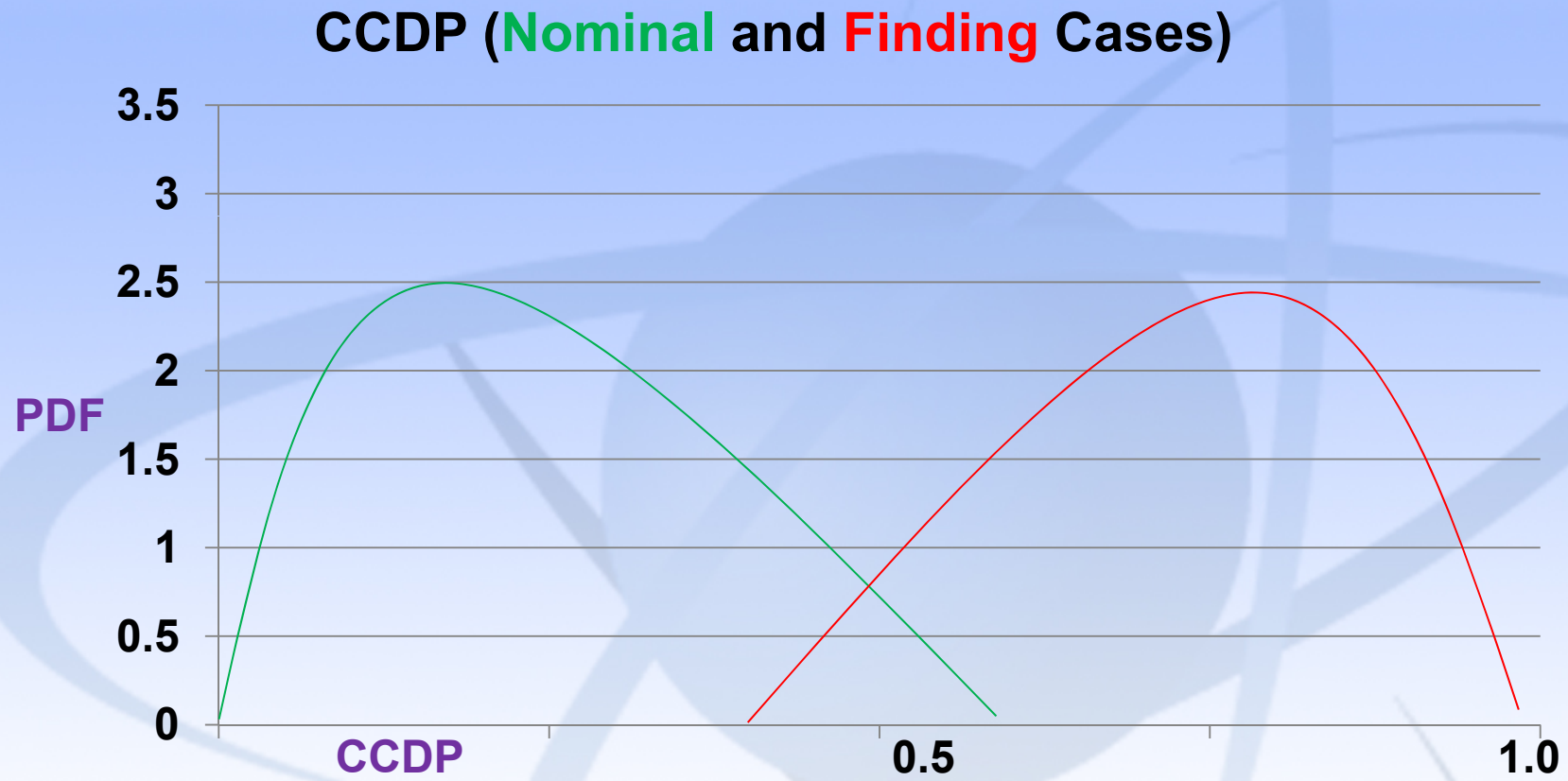
Simulation and Sampling Process

- Sample from EE#1 (frequency)
- Sample from CCDP nominal (probability)
- Multiply EE#1 and CCDP nominal samples
- Result is a CDF nominal sample result
- Repeat sampling process 100,000 times
- Average sampling results (mean, sigma)
- Repeat process for EE#2
- Combine the EE#1 and #2 nominal results
- Repeat process using EE#1 and #2 with the CCDP finding
- Calculate a ΔCDF (i.e. $CDF_{find} - CDF_{nom}$)

Seismic Example



Seismic Example



Seismic Example

$$CDF_{nom} = (IEF_{\text{samp } 1\ldots N}) \times (CCDP_{G\ \text{samp } 1\ldots N})$$

$$CDF_{find} = (IEF_{\text{samp } 1\ldots N}) \times (CCDP_{R\ \text{samp } 1\ldots N})$$

$$\Delta CDF = CDF_{find} - CDF_{nom}$$

Assumptions and Simplifications

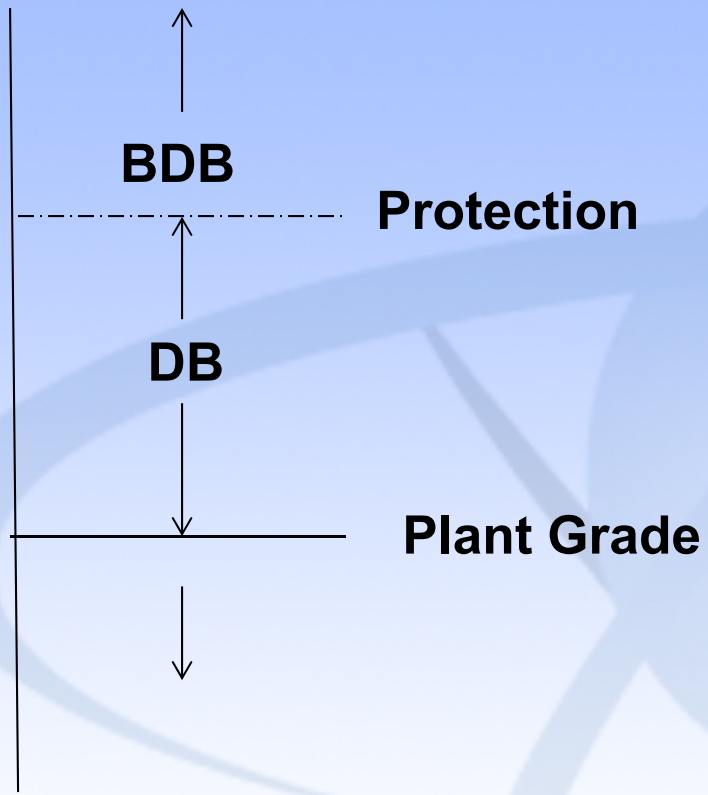
- CCDP sample is independent of the IEF sample
- CCDP models are generic, bounding, and are based on best judgment
- SSC fragilities not taken into account explicitly
- Cut-off for the >>BDB is based on best judgment
- Multiple seismic frequencies (i.e., Hz) not factored in, but could be
- Limit EEs to seismic, high winds, flooding.
- Overall, each site is unique (hazards and plant response) so a generic analysis can over (and under) estimate unit-specific significance

Other EE Hazards

- High winds (tornadoes, hurricanes)
- Flooding
  - Challenges:
    - Lack of hazard curves
    - Multiple flooding mechanisms
    - Large step changes in flood heights and plant response

Flooding

Flooding Diagram



BDB

$$P(CD) = P(CD|fld>prot)\ P(fld>prot)$$

DB

$$P(CD) = P(CD|grd<fld<prot)\ P(grd<fld<prot)$$

Flooding

P(CD) = P(CD|flood>prot) x P(flood>prot)

P(CD|flood>prot) = CCDP (MS response)

P(flood>prot) = BDB IEF

Flooding

P(CD|flood>prot) = CCDP (MS response)

1) FLEX stored at DB protection
2) FLEX stored at > DB protection
3) FLEX stored at >> DB protection
4) FLEX stored with time to move

Note: FLEX here refers to portable equip.

Flooding

P(flood>prot) = BDB IEF

1) R 2.1 < DB
2) R 2.1 > DB
3) R 2.1 >> DB
4) Local Intense Precipitation Only
5) Dam failures, riverine, storm surge

How to Factor in Flooding?

- If quantification is problematic due to lack of a hazard curve(s), then flooding could be factored in qualitatively to the seismic and high winds quantitative estimates.

Adding it all Up…

Summing the ΔCDF contributions from:

1) **Seismic**
2) **High winds**
3) **Flooding**

Benchmark - sample locations

Examples:

1) **Mid-west, lake…or river**
2) **South-east, river…or ocean**
3) **North-east, ocean…or river**
4) **West-coast, ocean…or river**

If MS used for DB events

- IMC 0609, App A or App M should be used.
- However, the inspection finding most likely would most likely be applicable to both DB and BDB cases, since each finding is independently assessed there should not be two characterizations of the safety significance
- Most likely the DB case would have more safety significance

Credit for MS in DB events

- RIS 2008-015, "NRC Staff Position on Crediting Mitigating Strategies Implemented In Response to Security Orders in Risk-informed Licensing Actions and the Significance Determination Process"
- Need to develop a new RIS because the B.5.b and MS will be covered by a single SDP
- Should the content of the RIS change? Be clarified?

Actual SDP Framework

- Decision tree logic VS Quantification
- Are both options possible?

EX: Based on the inspection finding, rank the effect/degradation on the MS functions of:

1) Core cooling (e.g., low, medium, high)
2) Containment
3) Spent Fuel Pool cooling

Next Steps…

- Incorporate feedback received during this meeting
- Develop a list of action items to accomplish over the next several months
- Hold another Category 2 public meeting in late March/early April
- Finalize draft SDP for pilot by the end of the summer (i.e., TI-2515/191 start)

Questions

QUESTIONS???