Risk Informed View of Infrastructure Safety

Risk = f(Hazard, Likelihood, Performance, Consequences)

What are the hazards and how likely are they to occur?

How will the infrastructure perform in the face of these hazards?

Who and what are in harms way? How susceptible to harm are they? How much harm is caused?
Perceived Risk of Toddler/Stove encounter

- **Likelihood of Occurrence**
  - Unlikely
  - Likely

- **Severity of Consequences**
  - Minor
  - Major

- **Perceived Risk**:
  - "Oven Mitts"
  - "Baby Gates"
Tolerability of Risk (USACE)

- Risks that are Commensurate with Benefits
- Risks that Society does not believe are negligible
- Risks that owners keep under review
- Risks that are reduced further if warranted (ALARP)
What is a SYSTEM?

- $Q_i$: Inflow
- $Q_b$: Reservoir
- $Q_o$: Outflow
- $L_i$: Probability of Levee Failure
- Reservoir 1
- Reservoir 2
System Risk

Risk Concepts

• Transformation of Risk
  • “If you build it they will come” – Hazard Creep
  • Slow steady rising water becomes catastrophic wall of water

• Transferred Risk
  • Reducing floodplain area upstream may cause faster higher volumes of water downstream
  • Protecting one side of the river may cause larger faster floods on the other side of the river.
Modeling Conditional Risk

System Concepts

• Systems are predictably Unpredictable
  • If this earthquake happens, then that dam fails… but the dam can fail for other reasons too…

• Event trees cannot reasonably span
  • Capturing all possibilities require massive event trees

• Event based Monte Carlo is better
  • Computational times can be excessive
Progression of Time

Temporal Concepts

- Past events impact future events
  - State of computational elements must be preserved
- Things change based on actions
  - Maintaining consistent base vs alternative scenarios is difficult because people take different actions based on alternatives.