

The U.S. Army Corps of Engineers' Redundancy, Robustness and Resiliency Part of Safety Assurance Review: What Does It Mean/What Do They Want?

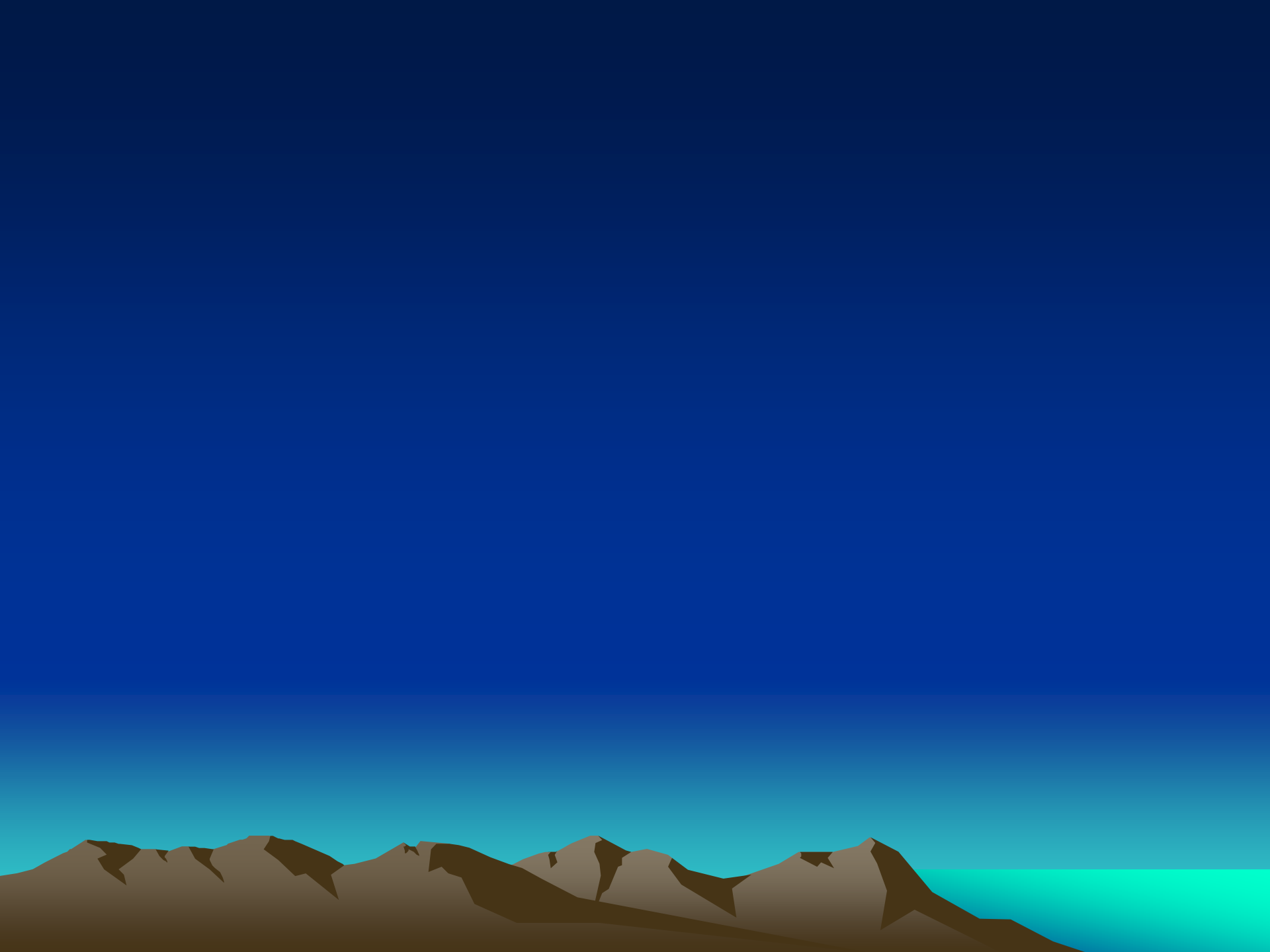
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Basis of the 3 Rs Requirement

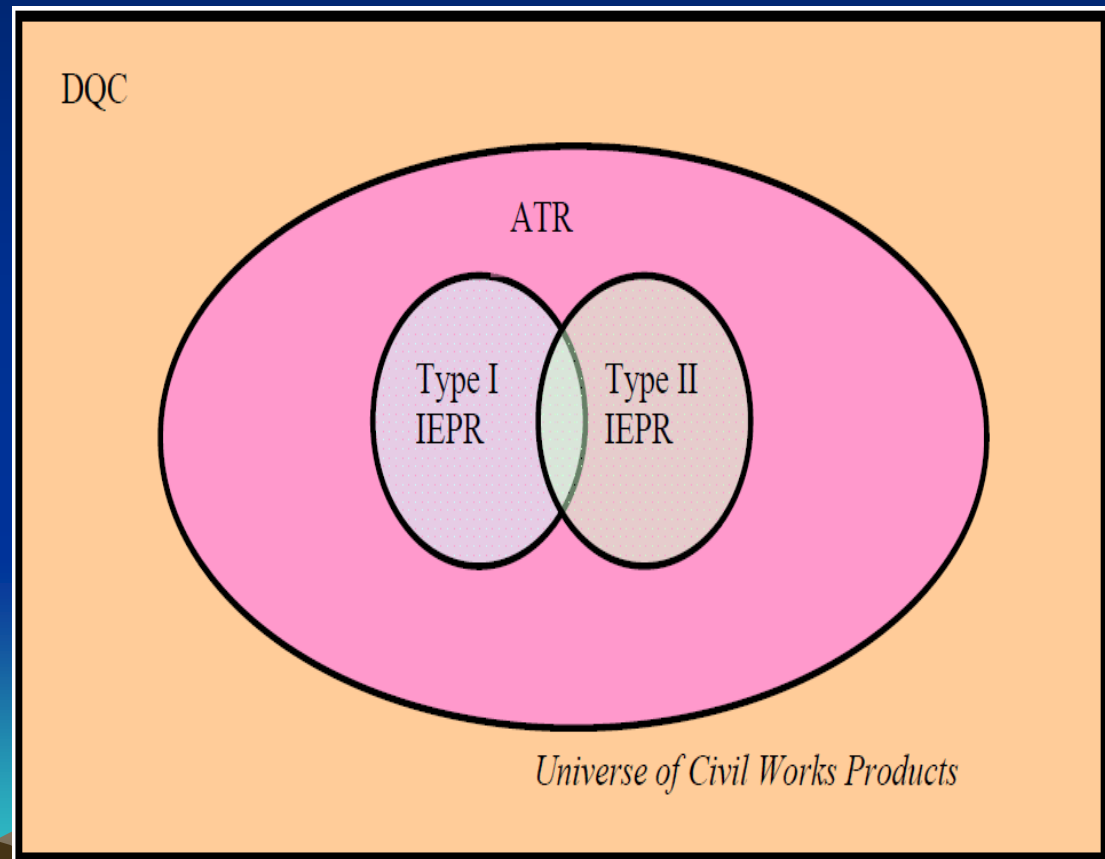
- EC -1165-2-209, “Civil Works Review Policy”

ATR – Agency Technical Review
(Formerly Independent
Technical Review)

IEPR – Independent External
Panel Review

Type I – Decision

Type II - Implementation



What is a Type II IEPR?

- Conducts Safety Assurance Review (SAR) on design and construction activities
- SAR on projects where potential hazards pose a significant threat to human life
- Reviews the design and proposed construction activities prior to initiation of physical construction and periodically until construction activities are completed
- As part of the SAR, the IEPR is tasked to explain how the project addresses the 3 Rs



What Does the COE Say on the 3 Rs?

- Redundancy

“The duplication of critical components of a system with the intention of increasing reliability of the system, usually in the case of a backup or failsafe.”

Example: Backup generators and power from 2 different power grid systems for pumps



What Does the COE Say on the 3 Rs?

- Resiliency

“The ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances.”

Example: Emergency action plans including when to evacuate and flood fighting



What Does the COE Say on the 3 Rs?

- Robustness

“The ability of a system to continue to operate correctly across a wide range of operational conditions (the wider the range of conditions, the more robust the system), with minimal damage, alteration or loss of functionality, and to fail gracefully outside that range.”

Example: Crest and landside protection of a levee to prevent erosion of the levee if overtopped.



Challenges in the 3Rs

- Conservative Design or Robust
- Reasonableness
- Implementation



Conservative or Robust

- Since Katrina More Conservative Designs
- Assumption that New Design Criteria provide a Robust Design
- What Was Once Robust is now Standard of Care



Reasonableness

- When does a 3R Recommendation become Unreasonable or a New Alternative
- Many things that could make a design more robust, redundant, or resilient
- Large costs may trigger an economic justification requirement



Addressing the 3 R's

- Design Conservatism

- Hydraulic Design Assumptions


- Design water surface elevations assumes neither up - nor downstream levees breach or fail for the design event or greater
 - Assumes all levees are at authorized height and urban areas have 200-year protection
 - Assume all levees can be overtopped without failure

- Geotechnical Design Assumptions

- Seepage analysis performed assuming Steady State analysis



Addressing the 3 R's

- Use Assumptions that Create Worst Condition
 - No Upstream Levee failures in Hydraulic Analysis
 - Use Assumptions that Show Consideration of All Possible Outcomes
 - No Waterside Clay Layer for Seepage Calculations
 - Make sure Parameter Envelopes include Most Test Results (Not too many outliers)
 - Not an Average; Lowest Results
 - If in Doubt; Spend a little Money to be Sure
 - Complete short Gaps in Cutoff Walls
 - Add a Relief Well if just meeting Criteria
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Conclusions

- Safety Assurance Review required and needed
- Doing a 3R Check probably insures that conservatism is in the project and may surface weak areas
- Experience so far is that Corps is not looking for unrealistic added features but just a check that design is sound
- Now part of the process in getting Section 408 approval so just “Get ‘Er Done”



Questions
and
Comments?

