Challenges to Structural Mechanics

Jim Lang

SMiRT 16

August 13, 2001

Looking to the Future

- Projections of power needs dictate actions
  - Conserve
  - Maintain current supply
  - Add more
  - Strengthen grid
- No single source can provide enough
- Environmental concerns highlight nuclear benefits
  - Extend the licenses of existing plants
  - Build new ones

EPRI

Nuclear Plant License Renewal Is On A Roll

- Economically and technically attractive
- Already renewed for 3 plants
- Many more in the pipeline
- Renewal process is becoming faster
- ***Need to settle metal fatigue***

ASME Fatigue Design Approach From The 50s

- Design criteria:
  - Cycle metal samples to failure in air
  - Construct failure curve of stress vs cycles
  - Apply factor of 2 on stress or 20 on cycles to cover variations
- Design analysis:
  - Calculate fraction of fatigue life consumed by each stress cycle
  - Ensure cumulative fraction is <1

EPRI

Have We Properly Addressed Water Environments?

- Question has been raging for 30+ years
  - Complex set of environmental interactions
  - Existing approach is serving us well
- Degenerates to partitioning the factor of 20

  Reserve 4, 3 or 1.5 for water effects?
- We're now applying to operating equipment

  Consider water environment for years 40 to 60

EPRI

A Philosophical Suggestion:

- Reserve conservative design rules and processes for design of robust equipment
- Evaluate operating equipment with “best estimate” tools
  - What is “real”
  - Tack on conservatism afterwards
  - Keep an eye on practicality
- Use probabilistic risk analysis to guide the focus

EPRI