Treatment of Fatigue & Fracture Design Code Issues

- What else do we need?
  - Environment (Corrosion & irradiation) – metallurgy?
  - Fracture based procedures - mandatory or non -mandatory?
  - Background Documents – updating of experience & examples
  - Welds – consistency of approach regarding margins & treatment (at least for new reactors – 60 yrs)
  - High Temperature – not just an extension of low temperature procedures
  - Materials – extend the temperature range/ materials & properties
    - World Wide Webb based access?

Treatment of Fatigue & Fracture Design Code Issues

- General Remarks
  - Consistency of Approach
  - Trust in ASME + Mechanistic understanding
  - Creep Problems more uncertain than fatigue
  - Fracture and Cracks not openly treated at the design stage
  - Treatment of welds - Too simple? – Too small
  - Materials - Specific to Codes

Treatment of Fatigue & Fracture Design Code Issues

- WHY
- Background Documents? - not widely available
  - Examples –
    - Finite Element Codes – papers with little detail

      Numerical Tools
- Experience – Commercial in Confidence
- Is there sufficient information?

Treatment of Fatigue & Fracture Design Code Issues

- HOW
- Elastic procedures -(crack initiation)
  - Sigma d procedure
  - In-Elastic procedures - specialist

    creep Laws - F.E. Linked
    - Numerical Tools ?-
- Is this sufficient?
  - Fracture Mechanics Procedures?

Treatment of Fatigue & Fracture Design Code Issues

- WHERE
- Sections for shells, Boxes, Pipes
  - Welds
  - Stress raisers
  - Maximum Temperature, high stress gradients
- Is this sufficient?
  - Environment?
  - Corrosion? – Check List

Treatment of Fatigue & Fracture Design Code Issues

- WHEN
- Safety Classifications, component classifications
  - 1,2,3
- Service Levels
    - A,B,C,D
    - AOO,AOC,ES
- Temperature, cycles
  - < Ti
  - 1 <10 < N
- Is this sufficient?
  - Experience?
  - All loads

Treatment of Fatigue & Fracture Design Code Issues

- WHAT
- Mechanisms of concern
  - LCF, HCF, interaction
  - Creep, creep/fatigue
  - Fracture?
- Loads to consider
    - Primary & Secondary
- Material properties
  - Fatigue curves, formulae, stress strain curves, etc.)
  - Fatigue curves, creep rupture, etc.
  - Toughness?
- Is this sufficient?
  - Environment, metallurgy?

Treatment of Fatigue & Fracture Design Code Issues

- DESIGN CODE

- WHAT? Mechanisms of concern / Loads to consider/ material properties
- WHEN? To apply them (Design checks, service levels…)
- WHERE? To apply them (Shells, boxes, pipes, …….)
- HOW? Simple procedures, special procedures
- WHY? Background Documents? Examples?

Treatment of Fatigue & Fracture Design Code Issues

- Low Temperature
  - LWR (ASME, RCC-M, KTA, MITI….)
  - WWER (PNAE. ……)
- High Temperature
  - FBR (RCC-MR, Japanese, ASME (NH)…)
  - HTR ?