Southwest Research Institute®

Fitness-For-Service

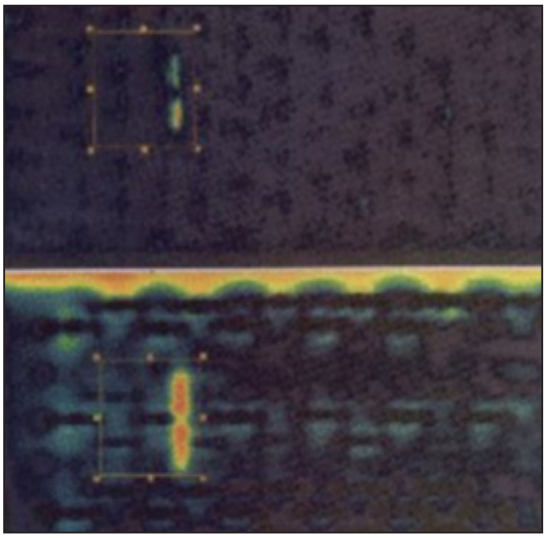
Fitness-For-Service assessment is a multidisciplinary engineering evaluation that is performed to demonstrate the structural integrity of an inservice component that may contain a flaw or damage. Southwest Research Institute® (SwRI®) uses the guidelines in API 579-1/ASME FFS-1 and FITNET to determine if pressurized equipment containing flaws identified by inspection can continue to operate safely for the remainder of its service life or inspection interval.

Flaws Assessed

- Crack-like flaws including environmental cracking, delaminations, dents and gouges
- General and localized corrosion
- Widespread and localized pitting
- Blisters and hydrogen damage
- Weld misalignment and shell distortions

Engineering Services

- **Structural engineering** analysis of static, dynamic or thermal loading by classical methods and finite element analysis
- **Fracture mechanics engineering** using NASGRO® to assess crack-like flaws for fracture and fatigue crack growth
  - Includes over 60 stress intensity factor models including weight function solutions for general nonlinear stress gradients plus residual stress gradients
  - Uses the NASGRO crack growth equation, which includes the near-threshold and near-instability regions of crack growth and accounts for stress ratio effects
  - Includes a material database of crack growth rate and fracture toughness data
- **Materials engineering** to identify material damage mechanisms, establish corrosion/erosion rates, and determine material properties including strength, crack growth rate and fracture toughness
- **Nondestructive examination engineering** using methods such as ultrasonics, electromagnetics, magnetostrictive sensor-based guided waves and x-rays to detect, characterize and size flaws or quantify the amount of damage
- **Probabilistic analysis** using NESSUS® to determine the dependence of the safety margin on the variations and uncertainties of the input parameters and estimate the probability of failure
- Other methods include Section VIII, Division 3 of the ASME BPVC and the USAF/FAA Damage Tolerance Approach



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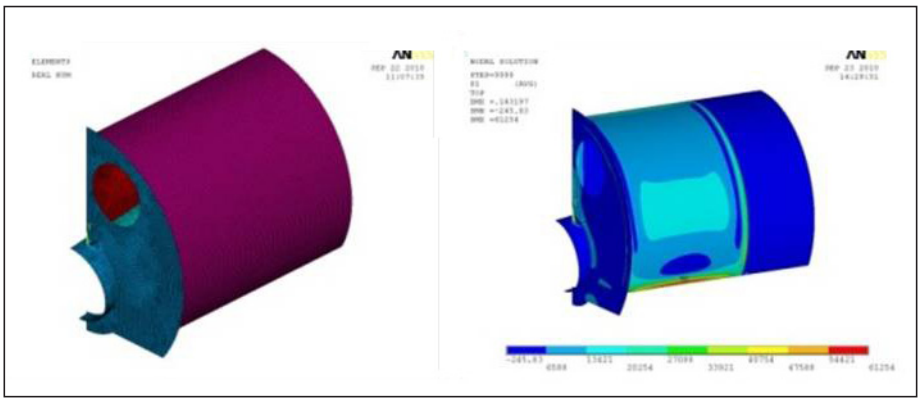
Ultrasonic (top) and eddy current (bottom) imaging of a surface crack in a cladded material



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Finite element analysis of a pressure vessel

KEYWORDS

Corrosion

Crack

Pitting

Blister

Hydrogen Damage

Weld Misalignment

Shell Distortion

Structural Engineering

Static Analysis

Dynamic Analysis

Finite Element Analysis

Fracture Mechanics

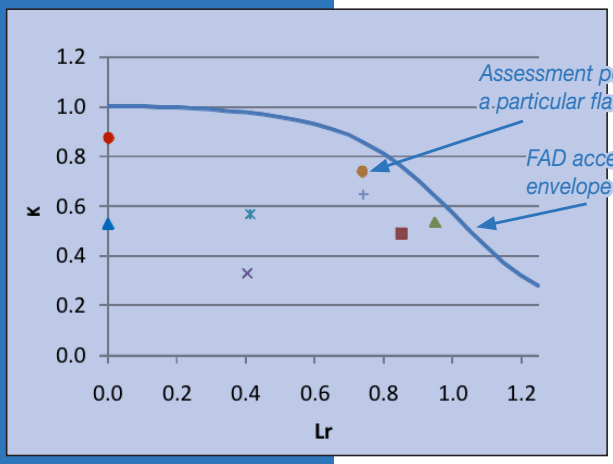
Fatigue Crack Growth

Fracture Toughness

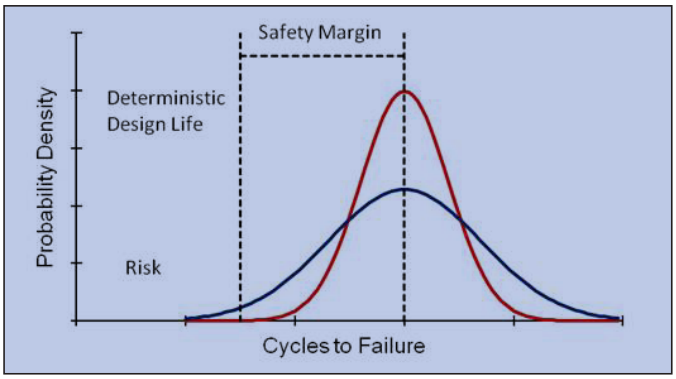
Safety Margin

Damage Tolerance

Leak Before Break



Failure assessment diagram used for fitness-for-service assessment of crack-like flaws



Probabilistic analysis used to predict the variation in number of cycles to failure due to variations in operating conditions, material properties and inspections. Overlap of variation in cycles to failure and retirement time is the probability of failure. The probabilistic sensitivity factors identify which parameters can be changed or controlled to reduce the probability of failure or extend the useful life.

Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,000 employees who perform contract work for industry and government clients.

We welcome your inquiries.

For additional information, please contact:

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