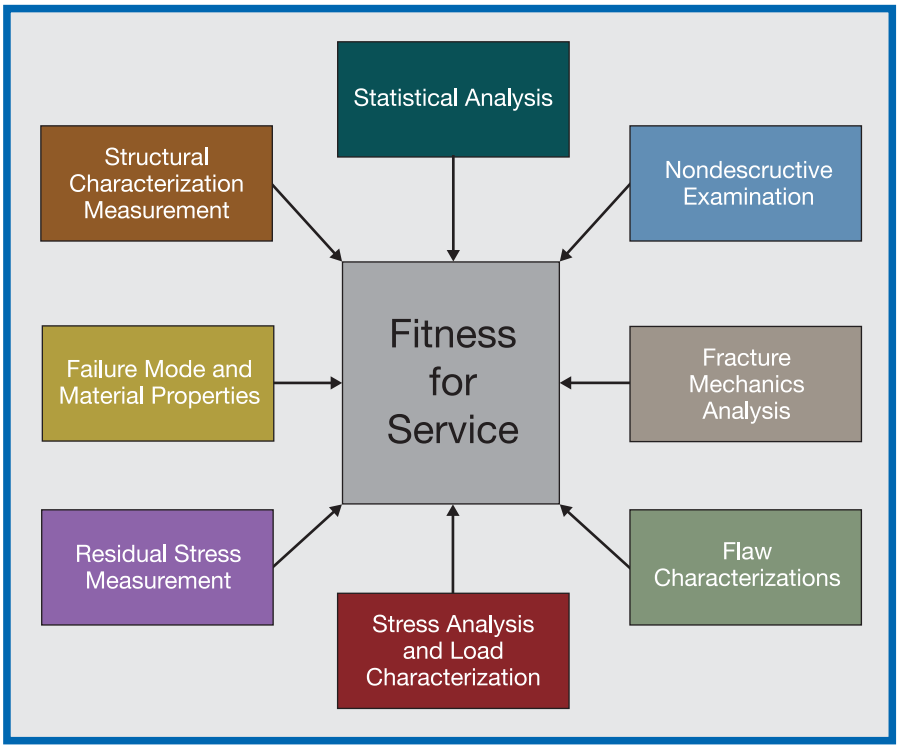
Enhanced Fitness for Service

Stress Engineering Services, Inc. is an employee owned professional engineering consulting company. Founded in 1972, we successfully complete over 3,000 projects per year for more than 800 clients worldwide. Our engineers have an average of 20 years experience, many of them with advanced degrees. Because a large number have previously worked directly for oil and gas companies, our engineers have an extensive understanding of operating equipment and plants.

FRACTURE MECHANICS ANALYSIS

Fracture Mechanics Analysis combines input from all six aspects shown to relate applied stresses, existing flaw sizes, flaw growth rates and failure modes in order to predict remaining vessel life if operation continues. It is possible to evaluate either life-extending or more aggressive operating variation.

Incorporating older vessels into new process cycles can dramatically change operating conditions. Stress Engineering Services can evaluate probable results based on the vessel's current condition and the planned changes in operation.



RESIDUAL STRESS MEASUREMENT

Stress Engineering Services uses the Blind Hole Drilling technique to measure stress near a weld or defect inside a pressure vessel. This provides important information that can be used for determining the likelihood of crack propagation during the next usage cycle. Measured residual stresses are also a permanent record that can be useful for future vessel analysis.

STRUCTURAL CHARACTERIZATION MEASUREMENT

Vessel performance during service loading is measured with strain gages, thermocouples and transducers placed in known problem areas. Data is then recorded over an extended period of operation. In addition to determining realistic operating conditions, the results can be input into a structural analysis.

FAILURE MODE & MATERIAL PROPERTIES

Because long-term aging effects occur at elevated temperatures, present material properties may be quite different from what they once were. The best evaluation can be done by testing material removed from these vessels.

Non-destructive testing, such as in-situ metallography, can be used to evaluate the micro-structure and identify the degree of aging and creep damage. These inputs allow us to establish the likely material properties and how they relate to the time-dependant failure modes.

STATISTICAL ANALYSIS

Fracture mechanical tools, such as the Failure Assessment Diagram (FAD), are powerful and simple to apply. Many fracture mechanics tools are based on elastic-plastic fracture mechanics theory and are a deterministic approach to the fitness for service problem. A probablistic approach can reduce this conservatism by including the variability of critical parameters.

A probablistic approach also provides a way of including data that is not know accurately. For example, it may be impractical to examine 100% of the weld on a structure for crack indications. In these cases, an Extreme Value Probablistic Anlaysis can be used to estimate the longest and deepest cracks for the entire weld length.

STRESS ANALYSIS / LOAD CHARACTERIZATION

When operating loads, such as pressure and temperature, are changed for a vessel, a stress analysis by hand calculation or computer finite element model should be performed to assure overall compliance with codes, such as ASME Section VIII, Div. 1 and 2, or API 510.

For flawed vessels, the same analysis techniques are used to determine the stress conditions locally near the defect. These results are used in conjunction with fracture mechanics tools and procedures to estimate the critical crack sizes and growth rates (FAD and PD6493).

We use non-linear finite element programs, such as ANSYS and ABAQUS, to determine the stress distribution at critical sections near the crack tip. For special cases, the J-Integral value is determined for the specific crack geometry.

NONDESTRUCTIVE EXAMINATION (NDE) AND FLAW CHARACTERIZATION

NDE is an effective means of obtaining information about the current condition of a vessel's materials. This can include corrosion, cracks, creep, erosion, localized thin spots and material degradation.

OUR MULTIDISCIPLINARY TEAM OF PROFESSIONALS PROVIDE EXPERT TURNKEY FITNESS FOR SERVICE SOLUTIONS. WE CAN HELP YOU MAKE PRACTICAL AND FACT-BASED DECISIONS ABOUT PRESSURE VESSEL OPERATION.

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