Engineering Criticality Assessment (ECA)

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During the life cycle of oil and gas or petrochemical assets it is required to assure that the safety critical elements (pipeline, pressure vessels, risers, piping, valves, etc.) are fit for service over their design life.

To achieve this, a multi-disciplinary engineering approach (as shown by the ECA triangle below) called Engineering Criticality Assessment (ECA) is widely used.

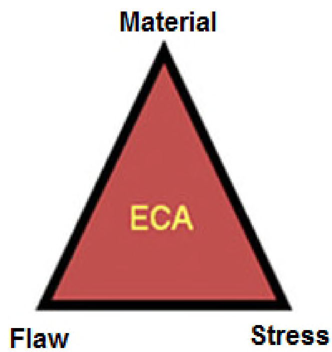

Figure 1. ECA Triangle

Material properties including maerials fracture toughness is required to be obtained using standardized fracture toughness testing on specimens such as SENB or SENT specimens (See Figure 2).

Figure 2. SENT Fracture Toughness Testing

The procedure is based on fracture mechanics and using a diagram called Failure Assessment Diagram (Figure 3) in order to assess safe or unsafe operation of an asset.

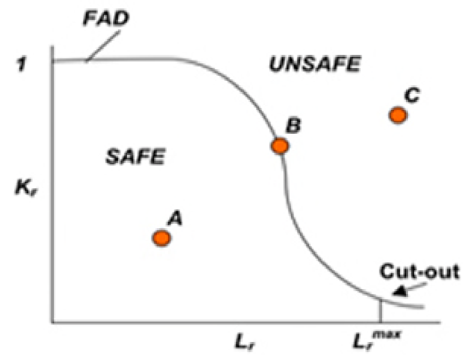

Figure 3. Failure Assessment Diagram (FAD)

Depending on the stage at which an ECA assessment is performed (detailed design, fabrication, operation, retirement), the purpose and outcome of this type of analysis would be different as detailed below:

- Design stage; as part of the material selection process including development of flaw acceptance curves for welds
- Fabrication stage; to assess significance of manufacturing flaws detected by NDT inspections
- Operation stage; to assess significance of flaws detected during the routine inspections of in-service equipment and/or significance of operational change and to decide on the continued operation
- Retirement stage: to establish remaining life of equipment and to decide on whether the component can be utilized beyond its intended design life.

Benefits of ECA

Z-Subsea believe that by performing ECA the following benefits could be achieved which all could potentially result in reducing cost of labor, material and engineering and consequently reduce the design/operational cost:

- Avoid unnecessary shutdowns/repairs and hence assuring safe and continuous operation
- Provide guidance for acceptability of fabrication induced flaws which could be outside the acceptability of current codes (Figure 3)
- Establish NDT, materials and quality acceptance criteria

- Save cost by continued operation and avoiding unnecessary Post Weld Heat Treatment (PWHT)

Delivering Specialist ECA

Z-Subsea integrity team has been actively involved in the development of ECA related codes and standards such as BS7910, DNV OS-F101 (Appendix A), SINTAP and FITNET and use of codes such as DNV RP-F108, API579-1/ASME FFS-1. That said we are confident and fully up-to-date with the cutting edge developments on the relevant/international standards which could be passed on to our clients in their projects.

Z-Subsea integrity engineering team devote their substantial expertise to assist both offshore and onshore oil and gas and petrochemical industries in dealing with go/no-go type decision through the whole life cycle of the assets dealing with assessment of various types of damages including:

- Fracture
- Fatigue
- Crack-like defects (girth weld defects)
- Corrosion (internal or external)
- Stress-corrosion cracking
- Third party damages (dents, gouges, etc.)

Combined with support from well-established Materials/Corrosion and advanced analysis in-house teams, Z-Subsea can conduct sophisticated analyses addressing the following challenging subjects:

- HP/HT operations
- Deepwater applications
- Sour environments
- Arctic loading condition
- Installation/operations under high plastic deformation e.g. Reeling and/or HPHT operations (Figure 4).

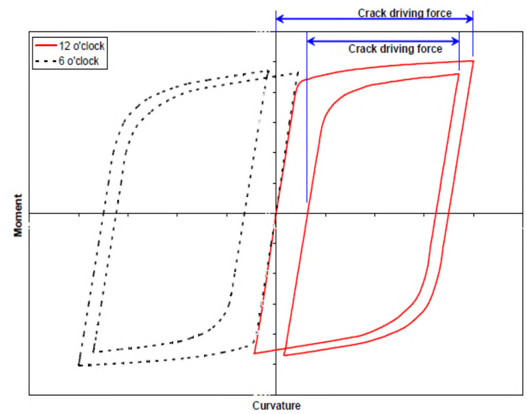

Figure 4. Introduction of Plastic Strain During Reeling Installation

The outcome of ECA would be in the form of tolerable defect sizes (acceptable flaw depth versus defect length) for a project full life cycle (Figure 5), indication of fatigue life of a welded/non-welded component and determination of the inspection intervals.

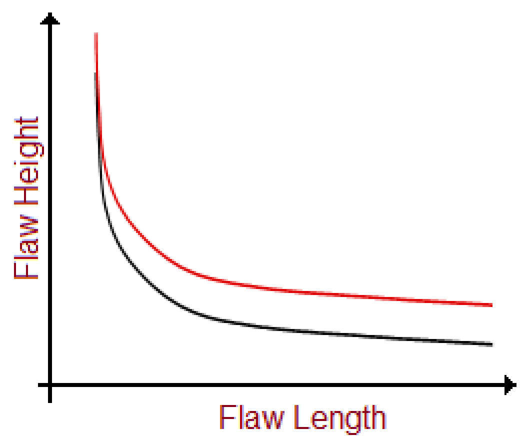

Figure 5. Flaw Tolerance Curve Obtained From ECA