Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical | Fertilizer | Chemical | Refinery | Engineering | Automobile

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Fitness for service(FFS)

Awareness and its significance

Fitness for service(FFS) is a systematic quantitative engineering analysis performed to demonstrate the structural integrity of an in-service component.

Following conditions calls for fitness for service assessment

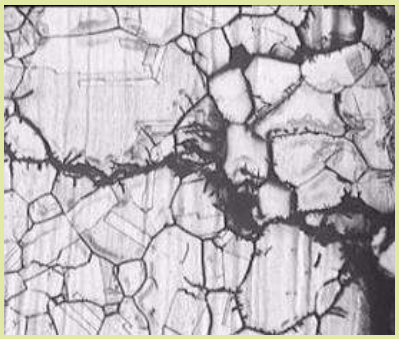
- Presence of a flaw by cracking mechanism or deterioration by thinning mechanism
- Material properties change and / or metallurgical damage
- Concerns on not meeting current design standards or best practices
- Concerns on current operating conditions or fault scenarios
- Changes in operating conditions which are more onerous than current
- Operation under high temperature creep environment
- Operation under mechanical or thermal fatigue environment

The codes used for construction of a pressure vessel (ASME, Sec VIII Div 1 or 2) are applicable for the purpose of design and fabrication inspection. Once the equipment shifts out of the fabrication shop, there are probabilities of damage to equipment under various circumstances, viz. during transportation, during on site lifting and installation, during process overrun at the time of commissioning or later during normal operation due to ageing or during occasional process upsets.

API 579/ASME FFS-1 is a standard derived for certifying equipment for its fitness after being subjected to any of the above conditions. The damages could be in form of mechanical, operational, metallurgical degradation or general / localized corrosion.

The purpose of fitness-for-service is thereby not to continue the component in its service beyond its serviceable life, but to ensure utilization of full potential concerning present damage assessment. Generally, fitness for service assessment becomes essential when the equipment has undergone some serious operational misshapen where it might be operated at severe conditions than for which the equipment was originally designed had crossed or flaws such as localized corrosion or cracks are observed or other design limiting factors. FFS is carried out on static equipment such

Microstructure of the Month



Magnification:*100X*

Etchant: *Aqua-regia*

MOC: *ASTM A403 Gr.304H*

Component: Reformer tube

Observation: IGSCC is noticed in the general microstructure of austenite. The cracking has initiated from ID and showing mainly inter-granular stress corrosion cracking. Microstructure shows heavy carbide precipitation at grain boundaries in oxalic acid etched condition.

Useful hints: The failure of reformer tube is from stub side HAZ that has occurred by polythionic acid inter-granular stress corrosion cracking from ID.

as reactors, distillation columns, absorbers, strippers, reformers, fired heaters, heat exchangers, piping and Storage tanks, Utility plant items: such as furnace tubes, boiler drum, de-aerators, headers, economisers

The outcome of FFS is:

- Whether the equipment is safe for operation in stipulated OEM limits?
- If not, what process modifications / de-rating can allow the equipment to be continued in use – for example with lower plant load.
- If equipment's condition is 'just-tolerable' what would be the expected operating life.

Additionally, the fitness for service assessment of components can help setting up proper inspection schedules, modified maintenance procedures and more of online monitoring systems. The exercise in totality tends to assure safe and more economic operations of the plant. The FFS procedures are complex, needing the state-of-the-art analytical, metallurgical, mechanical tests, and involve the multidisciplinary engineering analyses.

A combination of physical testing and interpretation thereof, identifies a principally affecting damage mechanism under the prevailing operating conditions. The test results further can be deployed for theoretical calculations of component's fitness for prescribed design specifications. Often, the irreversible damages to the equipment also call for alteration in original design and production specifications, for example lower rate of production or reduced stress condition, keeping view of the feasibility of running the equipment.

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