Creep-Fatigue Crack Growth

Whether it's for civil nuclear, power generation, defence, oil or gas over time creep-fatigue can take effect leading to damage, fracture or even worse failure. If left unchecked, this can lead to expensive, unexpected remedial work, unplanned outages and in extreme cases injury of people.

EASL can supply a cost-effective and pragmatic assessment, providing an independent service with clear advice on which to base decisions.

What is Creep-Fatigue?

Creep is the time dependent deformation of a material under load operating continuously at elevated temperature and can occur in both plastics and metals when the temperature is at or above one third of the melting temperature. Fatigue arises when a material is subjected to cyclic loading due to time-varying pressure, temperature or other structural loading. Creep and fatigue can lead to the formation of cracks.

Cracks caused by creep-fatigue initiation, or a remnant of the manufacture or construction, can continue to grow and potentially cause significant adverse effects on structural integrity. Frequently creep crack growth combines with fatigue crack growth to generate creep-fatigue crack growth.

The amount of fatigue crack growth depends on the magnitude of the loading cycle and the number of cycles. Creep crack growth depends on the temperature and loading, and the exposure time. Creep crack growth is significantly influenced by the material in which the growth occurs, for instance growth rates in different parts of the weldments can differ significantly.

The type and direction of loading, be it normal or parallel to the crack, also significantly affects the creep crack growth rate. Stresses that remain after the welding process can also significantly affect the crack growth, although the reduction of these with time, relaxation, can be taken into account.

The process is highly non-linear and there are methods in which an initially high predicted crack growth rate can be reduced by accounting for the effects of defect incubation, secondary stress relaxation, plasticity and the effect of crack growth on secondary stresses. A scoping analysis can be carried out to estimate an upper bound to the crack growth. If this does not generate satisfactory result more complex methodologies can be used to reduce the calculated crack growth.

EASL's Creep Fatigue Crack Growth Services

When approaching a potential creep-fatigue crack growth problem, often a client will come to us with hypothetical or real-world concerns of a crack in a susceptible material operating in a high temperature environment. Taking ownership for the problem, we will seek to contextualise the issue by investigating the conditions the material is put under.

Using specialist procedures such as R5 and R6, we will then assess any possible defects and their potential severity, and a report outlining this principal findings resulting from the assessment will be presented for discussion with the client. This can range from demonstrating the defect to be of no significant consequence or alternatively a worst case scenario, providing clarity for any preventative actions.

Frequently our reports can go on to be incorporated into a safety case for civil nuclear power stations, or an industrial safety case for wider ranging instances of creep-fatigue. If you're working with materials operating in a high temperature environment under intense loading, we can help to provide you with a clear view of the safest and most cost-effective solution taking into account your operating conditions to provide information you can trust.

If you'd like to find out more about our previous work, take a look below at our case studies. If you'd like to find out more about our related services, take a look below at our solutions and other services. To see how EASL can help with your creep-fatigue crack growth needs, get in touch through our contact section.

Related Services

- Creep Fatigue Initiation Assessment
- Creep Rupture
- Safety Case