



## Creep-Fatigue Crack Initiation

Over the course of a component's or material's lifetime, if it is subject to high temperature and cyclic loading conditions, there is the risk of crack initiation. Dependent on the safety implications the formation of a crack may, subject to further assessment, be permissible under safety and operating standards, or may require immediate action.

EASL have extensive experience dealing with many complex industrial creep-fatigue crack initiation problems, particularly those using the EDF Energy R5 volume 2/3 high temperature defect assessment procedure.

With years of providing clients with clear, fit for purpose and reliable assessments, we can deliver cost-effective solutions and advice on the potential effects of creep-fatigue loading. Whether it's civil nuclear structures, petrochemical, defence or more, we can provide the assurance you need.

### What is Creep-Fatigue Crack Initiation?

When operating at high temperature and cyclic loading conditions, materials could potentially be subjected to a significant creep-fatigue degradation mechanism. Initiation is an assessment of the formation of a small crack from an initially defect-free condition under cyclic loading at high temperature conditions. Following the initiation of a defect, continued high temperature operation can lead to further crack growth and damage to the structure, leading to adverse safety implications and repair or replacement costs and plant downtime that could have easily been prevented through early detection of issues using a creep-fatigue crack initiation assessment.

Creep is a thermally activated, time dependent mechanism which can lead to formation of cavities in the material and possibly ultimate failure of a component under load. Creep can occur in plastics and metals.

Fatigue is an event that occurs under the action of cycling loads. The energy imparted by the applied loads creates an irreversible absorption of energy which leads to a zone of cyclic plasticity and hence damage.

The creep-fatigue mechanism for the initiation of a crack from an initially defect-free structure involves a stress concentration which is sufficient to cause cyclic plasticity. Cyclic loading on its own would just cause fatigue damage, but if the structure operates at high temperature conditions, creep damage can accumulate as well.

The key feature of creep-fatigue is the interaction of plasticity and creep. In the absence of cyclic plasticity, any secondary (displacement-controlled) stresses would continuously relax under the action of creep and in the long term, creep would eventually be driven by primary (load-controlled) loads alone.

Primary stress driven creep damage is typically modest. However, the presence of cyclic plasticity may cause the creep dwell stress to be reset on each load cycle, resulting in each dwell cycle at high temperature to start creeping from the same initial stress level.

This leads to the relaxation of secondary stress being renewed on every cycle, thus considerably enhancing the creep damage. The creep-fatigue degradation mechanism when active can be a very onerous damage mechanism.

### EASL's Creep-Fatigue Crack Initiation Services

As part of a whole assessment of creep events, or an inspection of creep-fatigue crack initiation in particular, EASL deliver a specific service to each client. Using real world conditions, we work with the client to produce impartial and independent assessment that is realistic and clear.



We have previously worked with a wide range of clients from civil nuclear, power generation and petrochemical through to defence to analyse the structural integrity of materials for creep-fatigue crack initiation services. With a highly qualified team, ranging from entry level graduates through to experience PhD engineers, we can provide the most appropriate level of assessment for a cost-effective and efficient service.

Our service results in a full report, outlining the findings of our assessment to provide clarity to inform a client's judgement. Often, a crack in components may not necessarily require immediate action, and these parts can continue to successfully function without failure for several years. Bringing our expert insight, we can deliver results that help at all stages from design to operation, from design code to safety case.

To find out more about our range of creep and fatigue assessments take a look at our service pages, or, if you'd like to find out more about our creep-fatigue initiation assessment services, please fill in our contact us below.

#### Related Services

- Fatigue
- Degradation Review
- Creep Rupture