Gas turbine condition assessment
Improving asset safety and reliability

Services
- Independent technical review
- Destructive examination of components
- Thermal analysis
- Finite element stress analysis
- Defect assessment using fracture mechanics.

Durability and integrity of components

One way of reducing maintenance costs is to extend the life of a gas turbine’s hot section components, for example, through reheat treatment and repair. The resulting decisions can have a significant effect on the cost of running a power plant.

Whilst life extension of hot section parts may well be possible, especially for the older lower technology machines, it is necessary to ensure that the condition of these components has been properly assessed.

Edif ERA can provide a range of analysis, depending on the particular requirements of the case. However, the objective in all cases is to provide confidence that the components can be reliably and safely operated for longer, or to unambiguously demonstrate that they should be replaced.

Edif ERA’s specialists have successfully assessed hundreds of blade sets as well as other components like disc posts and large combustion chambers. The methods used range from destructive-based techniques through to detailed engineering analysis and fracture mechanics.
Components assessed:

- **Turbine blades:**
  - General Electric: Frame 5, 6B, 7E, 9E, 9FA
  - Mitsubishi Heavy Industries: 251B, MF111, 701D, DA, F
  - Westinghouse: 501D
  - Siemens: SGT 1000 (V64.3), SGT 2000E (V94.2)
  - Siemens Industrial: SGT 100 (Typhoon), SGT 200 (Tornado), SGT 600 (10B), TD 4000, TB5000

- **Vaness:**
  - General Electric: Frame 6B, 9E
  - Mitsubishi Heavy Industries: 701D, F.

- **Other components:**
  - Combustion hardware and discs.

Many turbine components have limited lives. Although the OEMs give indicative refurbishment and replacement lives, these are not based on site specific considerations.

By examining service run components in detail, it is possible to review their condition and assess the potential for further safe and reliable operation. Edif ERA has developed procedures to assess their condition and the effect of refurbishment and repairs on properties.

There are various techniques that can be used, depending on the circumstances. These range from destructive examination of blades through to a full stress analysis and fracture mechanics assessment of defects present in running components. These approaches are outlined below.

For blades and vanes, this would be to definitively establish the suitability of the parts for another duty cycle, with or without refurbishment. For more complex cases, such as those involving fracture mechanics assessments, the output could be in the form of the safe cyclic life to the next inspection.

**Destructive examination**
- Standardised examination schemes for blades and vanes
- Bespoke schemes for special circumstances
- Detailed characterisation of the bulk alloy microstructure
- Determination of the condition of the coatings
- Assessment of the condition of internal surfaces, including the level of attack to uncoated material
- Direct mechanical testing for property characterisation
- Temperature estimations from structural changes, if required.

**Turbine thermodynamic models**
- Create a thermodynamic performance model of the complete gas turbine
- Create mean-line aerodynamic models of all stages
- Calculate the external boundary conditions on the aerofoils and platforms
- Estimate the cooling flows for the aerofoils.

**Thermal analysis**
- Coupled heat transfer analysis
- Determine component temperature distribution as an input to structural analysis
- CFD (computational fluid dynamics), if required.

**Analytical models**
- Reverse engineer component geometry
- 2D or 3D finite element analysis
- Elastic/inelastic analysis (with plasticity or creep, as necessary)
- Incorporation of suitable material properties
- Fatigue crack growth and/or creep and plasticity calculations
- Formal fracture mechanics assessment, eg, to BS 7910.

The output of the analysis is a set of clear engineering recommendations for the operator.