Gas turbine failure investigation
Improving asset safety and reliability

Services
- Independent technical review
- OEM liaison
- Root cause analysis
- Engineering recommendations on future risk minimisation
- Return-to-service support
- Expert witness in litigation and arbitration.

Root cause analysis and implications

Failures can occur even in the best run power plant. When they happen, there is an inevitable tension between efforts to return a turbine to service as quickly as possible and carrying out a failure investigation.

To minimise the likelihood of a repeat failure, it is necessary to carry out an appropriate investigation. An immediate question is, who should carry this out? The power station, the OEM, the loss adjustor or an independent party?

Some turbine failures, as in other types of equipment, can be satisfactorily investigated by the plant engineering personnel. However, many failures require a more in-depth technical investigation. Additionally, the natural biases and vested interests of the various parties may interfere with the determination of the root cause(s) behind the event.

Edif ERA can act independently, or in conjunction with other interested parties such as loss adjustors and the OEM, in carrying out a suitable root cause analysis.
Experience includes:

- **Turbine blades and nozzles:**
  Many different unit types.

- **Discs:**
  - General Electric: Frame 9FA
  - Westinghouse: 701DA
  - Fiat: TG20
  - Siemens: SGT 100
  - Alstom: Model 13E2.

- **Combustors:**
  - General Electric: Frame 9FA
  - Westinghouse: 701D
  - Siemens: SGT 600, 1000

- **Compressors:**
  - General Electric: Frame 6B, 7EA, 9FA, LM6000
  - Siemens: SGT 700, 1000, 4000
  - Alstom: Model 11D

- **Other components:** SGT 1000, Solar Titan.

In carrying out an investigation, Edif ERA can draw upon its knowledge and understanding of gas turbine design, degradation, repair, operation and maintenance. This is then combined with a systematic investigation framework, such as fishbone or ‘cause and effect’.

The objectives of the work are to identify the root cause(s) and to make sound engineering recommendations to avoid repeat failures.

The main stages are:

**Site investigation**
- Interview staff connected with the failure event
- Witness disassembly of the machine
- Conduct initial examination of the components
- Secure parts for more detailed examination and quarantine them.

**Data collection and review**
- Review short and long-term operational data
- Review maintenance records.

**Component evaluation**
- Metallurgical examination of damaged and undamaged components
- Characterisation of failure processes, eg thermal fatigue cracking, attack from inside the blade, creep, inappropriate heat treatment, defective or inadequate repairs.

**Analytical considerations**
- Carry out relevant engineering analyses. These could be related to thermodynamic performance, heat transfer and component temperatures, fluid flow, fracture mechanics and crack growth.

**Conclusions**
- Identify the root cause(s) through a process of systematic investigation and elimination of potential factors
- These could be technical and/or human factors.

**Recommendations**
- Identify realistic engineering steps which can be taken to break the chain of causation
- Recommend additional monitoring or control steps which should be put in place.

**Expert witness**
- Edif ERA has direct experience of preparing expert witness statements and appearing in court for litigation and arbitration hearings.