Boiler damage:
Damage analysis and finding the cause

TI038

Version 1 (07/12)

Cause of damage to boiler systems

During a boiler system's operating time damage to the boiler system can occur. There can be a multitude of causes for damage. Before the boiler system is put into operation again, the damage must be properly rectified and a competent person allowed to put the boiler into operation again following an appropriate examination. The boiler manufacturer recommends this examination be carried out by an appropriately trained by manufacturer service technician or persons expressly authorised by boiler manufacturer for this work. Besides proper damage rectification and restoration of the system's operational readiness, in-depth analysis of the cause of the damage is essential to prevent the damage from reoccurring. This Technical Information should assist with finding the cause of damage and list the information needed for a comprehensive analysis. The information required will vary depending on the damage which has arisen.

Surveying the damage

Precise description of the damage using photos

Description of the operational situation in which the damage arose

Peculiarities (which have nothing to do with the damage at first glance)

Known transport damage

Documents needed for cause analysis

Commissioning report

Burner setting protocols

Last maintenance protocols

Records on water quality

The boiler's operating mode (load profile, supply/return flow temperatures, pressure, start-up/shutdown performance),

Condensate ratios

Comprehensive consideration of the system's situation (periphery), e.g. using a piping and instrument diagram

History of the boiler (past damage)

Initial clues for finding the cause

Water quality different to that in the "Water Quality Guidelines" Operating Instructions:

- coatings/corrosion on the water side (hardness, silicate, iron oxide, etc.)
- unsuitable dosing agent (film-forming amines, overdosing, caustic soda in salt-free operating mode, etc.)
- ingress of foreign objects via the condensate system (fats, oils, other organics)

Inspection of the flue gas side:

- coatings/corrosion on the flue gas side (soot, additives in the fuel, corrosive elements in the fuel (sulphur, chlorine, etc.), residues from intake air)
- flue gas routing (long flue gas line, number of bends, chimney discharge, chimney system design)
- supply air routing (external air intake, etc.)

Plant records: [1)]

- Controller settings (particularly performance regulation):
  - burner switching and tripping points too close together
  - very quickly set performance regulator
  - burner actuating time < 30 seconds (with continuously variable burners only)
- number of boiler starts, burner starts (limitation see TI030 or the "Shell Boiler" Operating Instructions)
- number of start-up processes from cold state
- operating times of the boiler in heat maintenance, boiler operation, off
- Burner settings:
  - excessive fuel input (excessive extraction from boiler)
  - calorific value fluctuations
  - differing fuel quality (sulphur content, viscosity, calorific value, density,

water content, other elements)
- differing gas flow pressure
- combustion quality (excess air, CO in the flue gas)

- Steam boilers in particular:
  - steam extraction history (pressure history)
  - feed water temperature history
- Hot water boilers in particular:
  - minimum return flow temperature observed
  - minimum supply flow temperature observed
  - spread observed as per the order confirmation
  - boiler flow during burner operation
  - temperature difference between the saturation temperature corresponding to the boiler safeguard pressure and the average medium temperature too low (risk of film boiling)
- Multiple-boiler systems in particular:
  - no sequence control concept
  - reciprocal boiler pressure relief
  - no hydraulic separation of the boilers (no non-return valves)
  - unsuitable heat maintenance system (problem: temperature stratification arising in the boiler)
    -> steam boilers: increased steam load or heat maintenance via the burner only over a longer time period (> 72 h)
    -> hot water boilers: flow only with network return flow water via supply/return flow without base integration (drain)
- Extraction performance/inspection of the consumer side:
  - excessive extraction from the boiler
  - consumer-side load profile with high load peaks
  - high load change speeds in a positive or negative direction

Control supplied by the customer:
- requirements of TI030 and other operating instructions met?
- special boiler wiring?

Burner supplied by the customer:
- requirements of TI030 met
- boiler/burner matching: does the burner used match the agreed features in the order confirmation (grid, flame-tube geometry)?
- manipulating speed of the burner servo motors/firing load change speed (requirements of TI030)

In the case of material damage:
- check material suitability (using maximum usage temperature/pressure)
- check the acceptance logs

Support from boiler manufacturer

Boiler manufacturer recommends the damage analysis and finding the cause be carried out by appropriately trained manufacturer service technicians or individuals expressly authorised by boiler manufacturer for this work. Just sending the relevant documents (see the "Documents needed for cause analysis" chapter) can be an initial help in itself.

[1)] see the following technical reports on this also: Technical Report 27 "Careful planning - carefree operation - avoidable stresses on shell/steam boilers" and Technical Report 11 "Costly errors - avoidable stresses on low-pressure and high-pressure hot water boiler systems"