

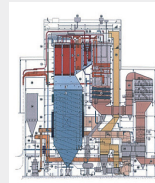
## 06 / Boiler sling rod load control

The tube bank, header and the like, which are the main equipment composing boiler body, get supported by the main body suspension structure, commonly called the Sling rod, which is installed onto the topmost place of the boiler section, named Penthouse. It is designed to maintain the balance in the way to support the entire loads of the boiler, in junction with boiler internal structure as a supporting point. However, influenced by the traveling of the loads in the course of operation of the plant, the support load exceeding the design load arises, resulting in uneven load distributions.

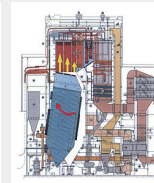
Whereupon, the comparative analysis between the design load and the measured load by each row of the Sling rod is to be conducted so that such biased loads could be reallocated evenly, by which ensuring overall stability and safety of the boiler equipment.

### | The problem of Sling rod load imbalance |

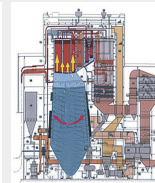
- If the load imbalances come about and go along, the distinction between the overload section and the underload grows apparent.
- The breaking-up and falling-out of the rod on the overload section.
- Leading to Tube damage, Header connection breakage, down to Boiler collapse.



Deformation of existing boiler



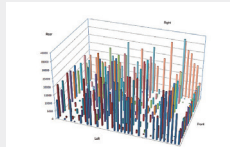
Deformation 1



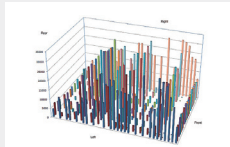
Deformation 2

### | Boiler support management |

Making a vital contribution to maintaining boiler integrity by evenly distributing imbalanced loads through the load adjustments of boiler tubes and headers



Load distribution diagram before load adjustment of the sling rod



Load distribution diagram after load adjustment of the sling rod

### | Sling rod load measuring and balancing |

Comparison of load characterization, by means of comparing design load and measured load for each row of Sling Rod



Sling rod load measurement



Sling rod balancing



## 07 / Piping vibration reduction solutions provided for

In the case abnormal vibrations take place in high temperature/pressure pipes and rotating equipment, such vibrations are measured up, so that the vibration reduction solutions can be provided for, through analysis and interpretation based on the results of such measurements.

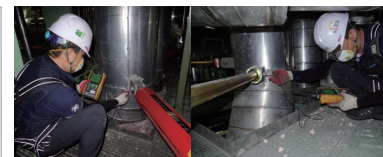
### Vibration reduction system

• Sway brace

• Smart damper



Vibration reduction device displacement interpretation through the modeling



Load measurement

# Engineering Service

# Pipe & Boiler Support Device Management

KLES have been rendering the Big-five domestic power companies and Korea Hydro & Nuclear Power Co., Ltd. with maintenance services related to pipes and boilers, and are actively engaged in working toward winning export projects. The safer and smoother maintenance services for pipe and boiler support devices are delivered taking full advantage of brand new technology-intensive products, technical competences, and veteran engineers.

## 01

### Types of Piping support devices

Class.	Description	Applications
Hanger	Rigid hanger	Used where vertical displacement is absent.
	Variable spring hanger	Used where vertical displacement is small (within 40mm)
	Constant hanger	Used where vertical displacement is large (over 40mm)
Snuuber	Snubber	A device to reduce the impact of an earthquake and water hammer (at a location with large thermal expansion displacement)
	Spring snubber	A device to prevent or diminish vibration (at a location with small thermal expansion displacement)
Restraint	Anchor	Piping all direction restraint
	Line stop	Piping axial direction restraint
	Guide	Piping lateral direction restraint

#### The need for 'Piping support device' management

In the course the power plant gets to run for a long time, the startups and shutdowns are repeated so countlessly that the number of cases of the damages provoked by stress concentration due to load imbalances turns to be increasing rapidly, therewith escalating the need for the management of the piping support devices.

- Sticking or falling-out of internal springs
  - Damages to Nameplate or Indicator
- Malfunction of pipe support devices
  - Interference with neighboring structures

#### Piping management Procedure



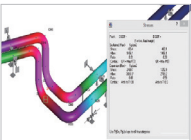
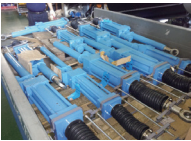
Breakage of Piping support device



Deformation of Piping support device

## 02

### Scopes of Management



#### 01 / Expansion joint

Expansion joints are purposely installed to prevent accidents proactively and reduce noises by means of absorbing excessive stress generated by pipeline expansion and contraction due to changes in pipe temperature, vibrations by pumps and boilers, and pipe displacements and damages from wind pressure, earthquake, ground subsidence, etc.

#### 02 / Hanger maintenance & reinstallation

KLES are carrying through the complete overhauls, inspections and evaluations with respect to various types of plant equipment, in cold state being shut down of plant operation according to mid- to long-term maintenance plans, related laws, and technical compliance standards, where making more than sure the highest level service is furnished under systematic and scrupulous schemes mapped out beforehand, taking full advantages of cumulative maintenance technology of the company, expertise workforces in each field, and exquisite tools and equipment. KLES are not only helping out bring equipment usages up by reducing the equipment failure rate while in operation through planned preventive maintenances, but also substantially contributing to the saving of plant operating expenses by realizing the optimization of the overhaul period downwards to the satisfaction for customer requirements.

#### 03 / Snubber & Damper repair & maintenance

Periodic inspection and maintenance procedures are very essential to maintain the performance of the snubber & damper installed on the power plant. KLES operate maintenance of the snubber & damper with the following procedures.

Check the snubber status → Surface cleansing → Disassembly and inspection of the internal condition → Internal cleansing → Maintenance (old consumables and aged parts to be replaced, oil replacement, etc.) → Reassembly → Painting → Performance evaluation

#### 04 / Inspection & Emergency maintenance

KLES play a contributive role in securing the integrity of facilities following commercial operation through participation in maintenance work during commissioning periods in the final stage of power plant construction, while exercising preventive inspections for efficient maintenance and management of the equipment already installed, until its commercial operation, and also carry out emergency restoration work for machines and high-temperature equipment that fail or malfunction during operation.

#### 05 / Pipe stress analysis at high/low temperature

High temperature & pressure pipes and LNG pipes (LNG of -162°C in the liquid state passes through the pipe) for power generation will be subjected to fatigue loads repetitively in the results of thermal contractions and expansions. By means of stress interpretation of the pipe system based on data of the actual operation history and the current state of pipes, the high-stress section can be sorted out and thereby the integrity of the pipes gets to be assessed.