Premature Failures of Machinery, Equipment & Pressure Part

Contract Re-evaluation to Recover Cost & Performance

Boiler's Pressure parts along with related Machinery, Refractory, other Equipment like Fan, Pump, Ash & Fuel Handling, ESP etc should give effective performance individually & collectively to produce desired contractual obligations.

Most of the time, Contractually, Boiler is guaranteed for ≥ 20 years of safe & reliable operation without any pressure part failures / troubles, if maintained as per OEM guideline.

Practically, Pressure Part tube failures take place within few month / year of operation, while ample allowances on thickness of pipe / tube were considered during detailed design engineering according to IBR / ASME and prudent engineering practices. In the same way, various machinery, equipments failures are also reported in short period of time.

During my Commissioning Experience, I understand that Most of the pressure part failures happen due to Flow Accelerated Corrosion (FAC), Circulation disturbances, Imbalance flow, Restriction in Thermal Expansion, Localised heating, Localised erosion, Faulty Design, Poor Commissioning practices & controls, Casing expansion v/s Pressure parts expansion, Puffing & oscillation movement of casing etc.

As per my knowledge, customer never get the correct & exact Root Cause Analysis. Reasons for failures are presented in bunch of suspect cause, most of them are diverted on customer's negligence & mistakes.

Remember that, If customer is able to prove that Premature failures like Pressure Part failures are mainly due to faulty design / inadequate engineering. Contractual obligation & Guarantees shall support you always to get re-engineering / replacement / modification of the pressure part, machinery & equipments for the period ≥ 20 years.

We never bother about the Premature failures because of getting a FREE replacement / FREE services to correct the same, but till only during the Defect Liability Period, may be 01 year or 02 year only. Please recognise that it is normally applicable to Machinery, Refractory & Equipments but not valid for Pressure Part, Faulty Design & Engineering Failures.

We indirectly appreciate the FREE support & after sale services by the OEM, But Actually, it is a process of hiding the Defects / Faulty Designs / Poor Workmanship & Quality / Shutdown cost / Production loss and finally Silently neutralise Contractual obligation.

If restoration is done without the identification of cause, it indicate that Defect & Root cause is still present and takes time to repeat failure due to new parts replacement / correction. After the Defect Liability Period is over, all the existing defects are Plant's Personnel Liability & Responsibilities. Upgraded Material & Thickness (if technically not required) or Upgraded Equipment as a replacement is hiding the actual fact.

EXAMPLES OF THE BOILER'S PRESSURE PART FAILURE'S PATTERN EXCEPT MATERIAL DEFECT:

1. **Roof Tube/Riser Failure- Faulty design case, circulation related, FAC**
2. **Water Wall Failure on higher elevation- Faulty design case, circulation related, FAC**
3. **Water Wall Failure on corner / seal boxes- Faulty design / erection related, Thermal Expansion related**
4. **Water Wall Failure on bend portion- FAC, Localised heating, Foreign Particles, Wrong velocity**
5. **Bed coil failure- Faulty design case, circulation related, FAC, Imbalance flow, Higher Metal temperature, Localised erosion**
6. **Primary Superheater Tube failure- Faulty design /erection related, Imbalance flow, Higher Metal temperature, Thermal Expansion related, Carry-over through drum internals, Wrong Steam velocity**
7. **Secondary Superheater Tube failure- Faulty design / erection related, Imbalance flow, Wrong Steam velocity, Thermal Expansion related, High spray water injection**
8. **Superheater Stub failure- Faulty design/erection case, Imbalance flow, Thermal Expansion related**
9. **Economiser tube failure- FAC, Higher Gas/Water velocity, Localised Erosion, Foreign Particles**
10. **Other Tube / Pipe Failures are due to Erosion, High gas velocity, Exposer due to Refractory failure, Fire side corrosion, Dissimilar Metal, Support Type & Orientation etc**

BOILER COMMISSIONING ACTIVITY is most crucial activity in the plant during stabilisation. Normally, Customer avoid interfering in the commissioning activities as it comes under OEM's prime responsibility. Due to this approach, OEM is free to manage all defects and later it is transferred to customer under head of poor operation & maintenance. Follow Standard Code (BS, VGB etc) to maintain Boiler Water Chemistry to avoid conflict with OEM on failure

EXAMPLES ON THE COMMISSIONING PATTERN OF BOILER:

1. **Improper Handling & Storage of machinery, Equipments, Refractory, Insulation & Pressure parts is lead to premature failure & act as a starting point of troubles to all concern**
2. **Flushing of Pipe lines, Headers & Vessel - No Cleaning before erection, No Bypass arrangement for Valves & crucial Instruments, Ignorance of Spool piece fit-up & temporary arrangement, Un-clear flushing completion criteria lead to damage the internal parts of valves / equipments. Specific details & critical steps need to highlighted to minimise repair & maintenance work.**
3. **Boiler preservation after hydraulic test, usually ignore due to cost implication & system incompleteness, is essential for pressure part**
4. **Leak tightness test @ 100 mmwc min. pressure is essential for casing, ducting, panel etc, before applying insulation on pressure part & other surfaces.**
5. **Spring supports & Other supports installation on pipes, ducting & other areas require a drawing check criteria. Customer need to demand for a protocol highlighting the installation quality of supports, Cold load setting before operation, Hot load checking during operation.**
6. **Instruments & Valves installation require a drawing, orientation, calibration, testing & details check criteria. Check all instruments calibration & testing certificates.**
7. **Insulation should be DRY and always avoid water ingress before & after application.**
8. **Insulation application on piping, tanks, vessels & flat surface are required for a drawing check criteria. Customer need to demand for a protocol highlighting the quality & workmanship of insulation & cladding, before & after application.**
9. **Quality Defects, Poor workmanship & Poor Material defects hide under the layer of Insulation.**
10. **Details in Pre-Commissioning & Commissioning Protocol - Specific details & critical checks are not highlighted by OEM to get customer signed on protocol.**

11. **Individual Machinery, Equipment, Superheater, Economiser performance test / audit** to access the design output / parameters as declared to customer, to analyse defects, if any, in early phase.
12. **Details of Commissioning Process** - Specific process parameters & critical details are not cover & highlight in detailed technical documents. Few Examples of inadequacy & poor commissioning:-
    A. **Refractory Dry-out activity** may complete at any favourable steam drum pressure and furnace temperature value. **Refractory application areas may not contain temperature sensor in required location.** In-accuracy & adjustment of temperature sensor is another practice. Low steam drum pressure is not providing sufficient temperature on inner side layer of refractory (near to tube surface) lead to premature failure of refractory.
    B. **Alkali Boil-out activity** may complete in one shot chemical addition in steam drum without maintaining desired chemical strength in boiler drum water during the process tenure. Boiler Blow-down started from initial phase without adding chemicals. Activity may complete without testing of essential parameters like Iron, Phosphate, Oil & Grease. **If Alkali boil-out results are not coming out to be favourable for OEM, long time boiler blow-down technique is used by OEM** to replace boiler drum water with fresh feed water to meet the desired alkali boil-out results.
    C. **Steam Blowing activity** is totally dependent on customer's hurries. Acceptance criteria according to material hardness, Mirror Finish (N3) Target Plate, Steam blowing pressure, Thermal cycle gap, Disturbance factor (Cleaning Force ratio), Difference between drum pressure in steam blow cycle & duration of blow
    D. **Most of the Safety valves** are not designed @110% MCR loading condition to save cost. Thermal Expansion reading at this stage need to be captured for All pressure parts including casing expansion as per Thermal expansion movement diagram to know the behaviour of boiler.
    E. **Steam Dryness Test** at drum outlet to access the performance of drum internals is essential to avoid superheater failure due to carry over and to determine steam purity.
13. **Correction factor & Internal setting in DCS** to obtain desired parameters & result are not informed to customer's team & access is not provided to all.
14. **Review & Implement Contract Obligation** to get the desired results & trouble free operation. A knowledgeable & attentive customer will create the path of safe, productive & reliable operation of plant.

INFORMATION REQUIRED FOR FAILURE ANALYSIS:

1. **Fluid Flow & Process Parameters, Any abnormality, if already exist**
2. **Photographs before repair & after repair**
3. **Plant's team view on current failure & history, if any**
4. **Protocol, Report of Commissioning & Operation**
5. **Mark failed tube / pipe / parts identification in field and on related drawing / documents**
6. **Test failed sample at best reliable Lab, If required**
7. **Keep Sample preserved for future reference and analysis**
8. **Make a comparison with design data v/s operation data**
9. **Establish a Root cause analysis by plant's team**
10. **Compare the Plant's team outcome with OEM outcome**

Unite Energy Corporation LLP, Ghaziabad, UP is assuring customers that this article shall help them to get best results from Slop fired boiler. **Our mission of "ENERGY CONSERVATION & TROUBLE FREE WORK ENVIRONMENT" with an idea to reduce plant's cost & maintenance.**

Unite Energy Corporation LLP is keen to provide best support to you to mitigate the irregularities in the plant, best technical services to mitigate breakdown, minimize downtime, improvise design and system performance, operational recommendations, genuine analysis, construction & commissioning services, repair & retrofit services, training and skill enhancement etc, to improve the overall plant's health and performance.

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