» COMMISSIONING STEAM GENERATOR

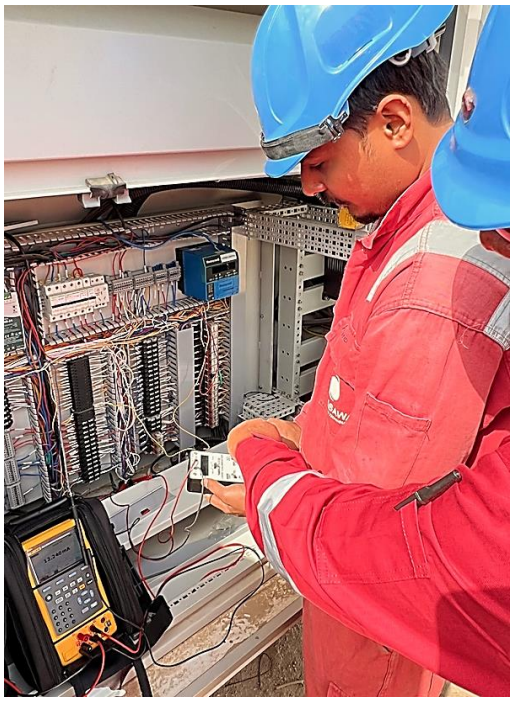
HOW TO ENSURE A SUCCESSFUL COMMISSIONING IN THE START-UP OF STEAM GENERATION EQUIPMENT? » LESS DAMAGE - INCREASE SUCCESS»

By: Jesus Rodriguez;
E & P Director Nakasawa

Commissioning is crucial in the start-up of a steam generator as it ensures its proper functioning, safety, and performance. During this process, comprehensive tests are conducted to verify the correct operation of all components and systems. Adjustments and optimizations are made to maximize efficiency, and safety tests are performed to ensure compliance with standards. Additionally, commissioning provides training to personnel and generates important documentation for future reference and maintenance. In summary, commissioning in the start-up of a steam generator is essential to ensure its long-term successful and reliable operation, while significantly reducing risks for both the equipment and the personnel operating it.

Key stages:

Operator requirements and preparation before initial commissioning operations:



1. **Thorough Training:** Every operator must be comprehensively trained on the equipment, their designs, purposes, limitations, and relationships to other components. This includes studying the instructions, drawings, and thoroughly inspecting the equipment.

2. **Familiarity with Distributed Control Systems (DCS):** Operators should understand how DCS integrates individual process controllers into a coordinated, interactive system. This enables them to manage the whole system and control the interrelationship of various subsystems.

3. **Simulator Training:** Modern DCS can provide operating personnel with advanced simulations of equipment behavior. Simulator training, typically conducted in real-time, ensures operators gain a working understanding of the various systems, including the reaction time and rate of the equipment.

4. **Avoiding Inexperience:** Preliminary operation should not be entrusted to inexperienced personnel. Improper preparation of equipment or its misuse during preliminary checkout can result in considerable equipment damage and potential safety events.

5. **On-going Learning during Initial Operating Period:** Operator training is particularly important during the initial operating period when adjustments and tests are being made. Experienced operators are valuable during this period.

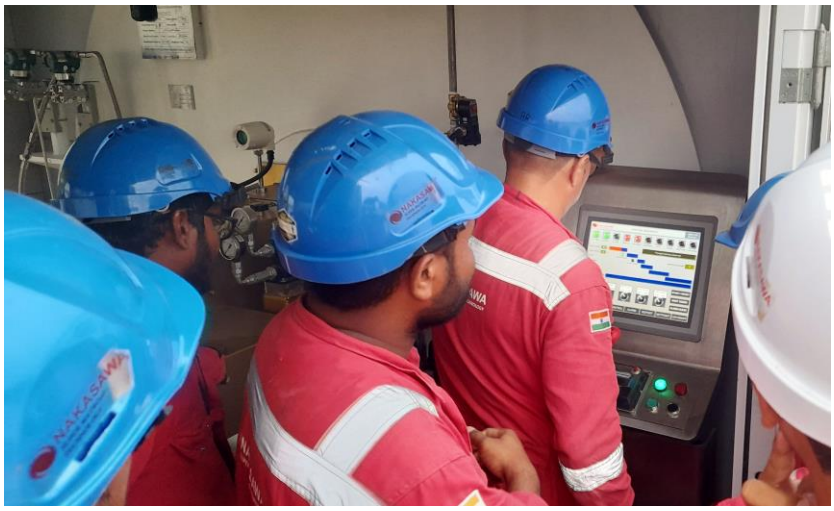
Preparation for startup:

1. **Inspection:** Inspection of the boiler and auxiliary equipment is essential. This helps familiarize the operator with the equipment and verifies the condition of the equipment. The provision for expansion should not be overlooked during the inspection.

2. **Cleaning:** It is necessary to remove debris and foreign material that accumulate during shipment, storage, erection, or repairs. Particular attention should be paid to fuel lines, with steam cleaning recommended for all oil and gas lines.

3. **Hydrostatic Testing:** Hydrostatic testing is performed after the pressure parts are assembled but before the refractory and casing are installed. A hydrostatic test at 1.5 times the boiler design pressure is applied to all new boilers and maintained for a sufficient time to detect any leaks.

In addition to these points, it is also necessary to undertake pre-calibration of instruments and controls, auxiliary equipment preparation, refractory conditioning, chemical cleaning, steam line cleaning (blowing), safety valve testing and settings, and initial operations for adjustments and testing.



1. **Temporary Valving**: This is required to control the flow rates during the blowing period. Boiler pressure and temperature can be maintained during the blowing period by continuous firing.

2. **Safety Valves:** Safety valves are crucial for the safe operation of any pressure vessel. They provide relief of excess pressure during abnormal operating conditions. Testing of safety valves requires caution to avoid damage to the valve seats and to ensure correct operation.

3. **Startup Operating Procedures:** Startup procedures should aim at four main objectives - protection of pressure parts against corrosion, overheating and thermal stresses; prevention of furnace explosions; production of steam at the desired temperature, pressure, and purity; and compliance with environmental regulations.

4. **Filling the Boiler:** High-quality water should be used to minimize water-side corrosion and deposits. The temperature of the water should be regulated to match the temperature of the boiler metal to prevent thermal stresses. Vents should be used to displace all air with water, reducing oxygen corrosion and ensuring all boiler tubes are filled with water. Correct water level must be established before firing begins.

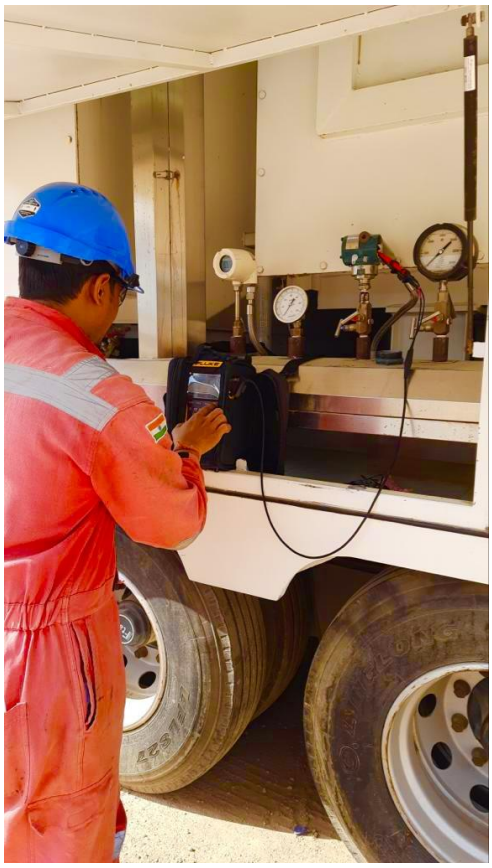
5. **Circulation:** Overheating of boiler tubes is prevented by the flow of fluid through the tubes. In a natural circulation-type boiler, this flow is produced by gravity acting on fluids of different densities. The flow increases as the firing rate is increased.

6. **Purging:** This is done to prevent furnace explosions, especially on units burning fuel in suspension. The unit must be thoroughly purged before lighting the burners, following the procedures outlined by regulatory bodies like the National Fire Protection Association (NFPA).

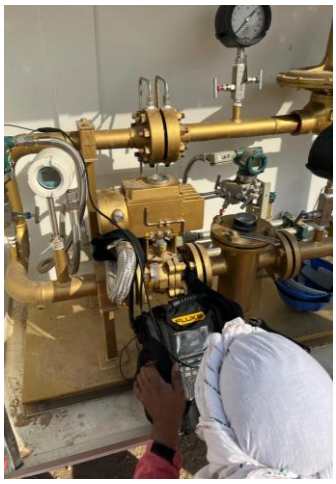
7. **Protection of Economizer:** During the pressure raising period, there's typically very little or no feedwater flow through the economizer. However, some economizers generate steam during this period. To avoid water hammer and control steam drum water level, the steam can be vented or boiler water recirculated through the economizer until feedwater is being fed continuously through it.

By following these steps and precautions, it ensures the safe and efficient operation of the boiler system. Regular maintenance and inspection are also crucial to ensure the longevity of the system and avoid any potential issues or hazards.

1. **Protection of Superheaters:** Superheaters must maintain sufficient steam flow to prevent overheating. During startup and when steam flow is not fully established, the temperature of combustion gases entering the superheater must be controlled. Various means can be used to control gas temperatures, including firing rate, excess air, gas recirculation, and burner selection. Steam flow prerequisites include the removal of all water from each superheater tube and a total steam flow at or above 10% of the rated steam flow.



2. **Protection of Drums and Headers:** The time required to start a boiler and protect the superheater against overheating often determines the startup and shutdown times. However, limiting thermal stresses in drums and headers can also determine this timing, particularly in systems that need to cycle on and off for load demand. Three sets of rules, based on thermal stress analysis and operating experience, guide these operations: one for drums and headers with rolled tube joints, another for headers with welded tube joints, and the last one for steam drums with welded tube joints.



3. Drums and Headers with Rolled Tube Joints: In these components, tubes contract and expand faster than thicker drum or header walls due to their relatively thin nature, which could lead to tube seat leaks. Therefore, the heating and cooling rates should be controlled to limit these leaks.

4. Headers with Welded Tube Connections: Here, the concern is mainly about temperature differentials through the header wall, leading to potential cracking if excessive thermal stresses occur.

5. Steam Drums with Welded Tube Connections: These drums are not subject to tube seat leaks, but temperature differences between the top and the bottom parts can pose a problem due to the presence of water at the bottom and steam at the top. **Babcock & Wilcox 2015**

To minimize the potential for damage and maintain safe and efficient operations, temperature differentials during startup and shutdown periods need to be continuously monitored. This is often accomplished through the use of thermocouples. These monitoring devices are important tools in preventing excessive thermal stress in boiler components. They help to ensure that temperature changes during startup, operation, and shutdown remain within safe limits.