

## **CHECK LIST FOR BOILER SPECIFICATION**

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## **INTRODUCTION**

The productivity & profitability is undoubtedly related to the proper selection of utility equipment. Boiler is one such item where care is to be taken while procurement. In this paper, a checklist for boiler specification is brought out for the use of Boiler buyers.

## **IMPORTANCE OF BOILER SPECIFICATION**

The boiler specification shall be in the written form so that there is no communication gap between the buyer and the seller. One can take the Boiler enquiry sheet from the vendor in order to communicate the requirement clearly to the Designers who engineer the boiler for you. Often it so happens that the requirement is not clearly transmitted to the Designers due to failure on the procurement process.

The following checklist would help anyone planning to buy a boiler for any purpose. The paper is, general in nature as it is addressed to both small and medium size boiler buyers.

## **CHECK LIST FOR BOILER SELECTION**

### **1. 0 Specify why you need the Boiler.**

#### 1.1 For plant expansion!

- Specify the present plant capacity and the proposed capacity. This helps to prevent under-sizing of the boiler.

#### 1.2 For the new plant!

- Specify the plant capacity. This will enable the boilermaker to offer a right capacity boiler. Over sizing / under sizing of the boiler can thus be avoided.

#### 1.3 To reduce the operational cost!

- To switch over to alternate low cost fuels. One could highlight the reason why the same could not be done in the existing boiler.
- To switch over to less polluting fuels.

#### 1.4 To replace the existing boiler!

- To improve the boiler availability. It is worth mentioning the reason for the poor availability of the existing boiler.
- To remove the manual operation in fuel feeding / ash removal / boiler control.
- For faster response of the boiler to meet plant need.
- The existing boiler is undersized.
- The existing boiler is of right capacity, but not generating the rated steam. This needs to be analyzed as the new boiler could also land into the same problem for several reasons such as boiler water quality, Undersized chimney affecting boiler draft conditions, leakages in airheater, worn out fan impellers, poor fan assembly, poor fuel quality, etc.

#### 1.5 To have a stand by!

- To ensure the continuous availability of steam in the event of boiler break down / maintenance. This calls for incorporating suitable preservation system

for the boilers. In addition, most of the existing facilities such as feed water tank, feed pump station, chimney could be made use of. In addition the layout implications will have to be taken care of. The change over methodology needs to be thought of.

#### 1.6 To burn the process waste!

- Specify the process waste & give a fuel sample. As received fuel sample is important for selection of fuel handling system, fuel preparation system. At times the choice of combustion system will be decided by the fuel nature.
- Specify the availability of the process waste such as rate of generation, rate at which it is to be consumed, or the time duration within which the same is to be consumed.
- Specify the generation process, the conveying mode available to the proposed boiler. Thought should be given to eliminate unnecessary material handling.
- In case fuel gross calorific value & ultimate analysis values are available, the same could be given to vendors.

#### 1.7 For Cogeneration or captive power generation!

- Give the complete process diagram, heat –mass balance diagram. This helps the boiler designer the plan for auxiliary steam consumption such as deaerator steam, soot blower steam at low pressure after turbine extraction conditions. This maximizes the efficiency of the plant.
- Specify the upset conditions. In Cogeneration system, sometimes the process steam demand may be nil, but power demand would be there. The boiler needs to be designed with suitable turn down facility for this.
- Specify all possible plant operating conditions.
- Discuss start up power availability and mode of change over to TG power. You may opt for two sets of boiler auxiliaries such as fans. One set of fans could be connected to EB / DG supply and the other set to TG.
- Specify HT voltage as available so that HT motors can be selected for high HP motors.

### **2.0 Are the boiler parameters and steam conditions clearly spelt out?**

#### 2.1 Boiler capacity

- Boiler capacity to include or exclude auxiliary steam consumption. The auxiliary steam may be required for deaerator, steam turbine drives, soot blower, Oil preheating steam.
- Always specify from & at 100 deg C or nett steam. Enclosed chart gives the actual steam produced for various feed water temperature conditions. Specify the feed water temperature in the case of net steam requirement.
- In the case superheated steam boiler, specify saturated steam requirement, if any, to be directly taken from steam drum.

#### 2.2 Boiler pressure

- Specify normal operating pressure instead of boiler design pressure. Boiler design pressure implies the safety valve set pressure.
- Specify the pressure required at consumption end too. Long distance between the plant and boiler house calls for higher boiler operating pressure.

- In case of connection to existing steam lines and feed water lines, the approved design pressure needs to be spelt out.

### 2.3 Boiler Outlet steam temperature

- Specify the steam temperature conditions at MCR conditions. Consider the temperature drop due to distance between the consumption point and the boiler.

### 2.4 Steam purity conditions.

- Specify the steam purity limit as ppm of solids as required due to process limitations. In case the existing feed water treatment plant is to be made use of specify the treated water analysis.

## **3.0 Are the load conditions and the importance of pressure / temperature explained?**

- Specify the variable loads, minimum loads, sudden loads expected from process side.
- Specify the minimum load at which the rated steam temperature is required.
- Specify the temperature tolerance range at MCR conditions.
- Specify the minimum temperature at which the steam will be required at the plant charging / turbine rolling conditions.

## **4.0 Specify the fuels for Boiler design.**

- While specifying many fuels, inform the yearlong / seasonal availability.
- In case the alternate fuels are not available for meeting 100% steam generation, Specify the quantity of fuels to be fired on hourly basis along with a base fuel.
- Be specific in mentioning fuels. Low GCV fuels & high moisture fuels will result in over-sizing the boiler.
- Specify the fuel size as received so that the fuel handling / preparation / feeding system could be optimally chosen. As received fuel samples could be given to vendors to enable them to take note of fuel size and moisture content.
- Specify if you desire the vendor to make use of the existing fuel handling system.
- Specify the mode by which the fuels will be brought to the fuel yard.
- Specify all the fuel firing combinations based on the feasibility.
- Restricting fuels to process wastes / agro wastes could get you excise duty concessions.

## **5.0 Efficiency factor**

- Instead of demanding efficiency, specify desired boiler outlet gas temperature, excess air, unburnt carbon level. At times unburnt carbon in ash could be a factor for utilization of ash for other purpose.

## **6.0 Choice of combustion technology**

- Opt for the right technology based on overall operating cost. The operating cost could be more in addition to the cost of technology. This is particularly true for fluidised bed combustion boiler for small capacity application.

- Pollution control could be a major factor for the plant location or the product of the Industry. Choice of combustion technology should match this.

## **7.0 Choice of Boiler configuration**

- Specify if you would desire water tube / shell tube depending on the maintenance factors. Shell type boilers are not suitable beyond 21 kg/cm<sup>2</sup> for safety reasons. Also capacity puts limitation on the use of shell type boiler due to abnormal size.
- Specify the reasons for your wish so that the vendor could remove your misconceptions.
- Give your feedback to vendors regarding your experience on product failure.
- It has been experienced that certain agro waste fuels having ash slagging characteristics demand water tube configurations so that soot blowers could be used.
- Share your views to improve the features of the boiler from maintenance point of view. Some boiler configurations do make the maintenance very simple but at an additional cost.

## **8.0 Choice of pollution control equipment**

- State local pollution control norms to enable selection of the right type of pollution control equipment. Specify the location where the plant is coming up.
- Understand maintenance aspects associated with type of pollution control equipment.
- In case sound pollution is not acceptable due to adjacent residential houses, specify silencers for air vents / safety valve.

## **9.0 Personnel safety, boiler safety and automation**

- Boiler water level is the first factor, which plays havoc. The redundancy in the level switches, additional remote level indicator should be considered.
- Furnace pressurization is second important factor. For balanced draft furnaces, ID fan interlock system and furnace pressure trip switches are worth.
- Spell out the control requirements such as Boiler drum level control, furnace draft control, superheater temperature control, combustion control, and deaerator pressure control, deaerator level control.
- Use of variable speed drive could give you advantage in power saving particularly on varying load conditions.
- Choice of Data acquisition & control system would be a wiser choice, as troubleshooting is easiest. Past history can be easily obtained eliminating long man-hours required for data collection & analysis. Erroneous conclusions based on opinions can be eliminated.
- Specify redundancy required in automation too.

## **10.0 When the Boiler is required to be operational?**

- Specify the plant commissioning date. Allow pre commissioning period for boiler.
- Specify the magnitude of the loss to you in case the boiler would not be commissioned on the time required by you.

## **11.0 Have you stated your future plans?**

- Specify if boiler house layout should be designed for sharing common systems such as fuel, ash, electrical, feed water, and blow down systems.

- Specify additional steam requirement in the future. Sometimes a marginal cost could save time, effort, and money later.

### **12.0 Existing Plant & Boiler house layout**

- Boiler room layout has to be matching the existing access road conditions. Fuel bunker & fuel preparation systems have to match the existing locations.
- Ash discharge points in the boiler have to be planned matching the ash storage area.
- The fuel & ash conveying systems have to be decided keeping the future plan in mind. The capacities of equipment have to be adequately sized to avoid future investment.
- Steam outlet point / main steam line has to match the location of existing steam header / steam consumption points
- MCC location and cabling layout shall be suitable to save cost.
- Consider future expansion in sizing of boiler house.
- Specify north / east direction and firing direction as per vastu sastra. This would give better working environment for the boiler operators.
- Specify space limitations if any. In existing boiler house, the available space for moving equipment could also be a limitation. In such a case the boiler needs to be designed with site assembly work with less shop preassembly.
- Furnish layout of other related equipment coming in the boiler house to avoid congestion & to ensure necessary operating space.

### **13.0 Specify the facilities as available to be made use of for the new boiler**

- Specify if you desire if some of the existing boiler auxiliary systems to be made use of.
- Specify the type of water treatment plant in use. Further the water quality and regeneration frequent and duration are important in taking a decision for a new water treatment plant.
- Specify the Chimney top diameter, height and boiler capacities, which would share the chimney at the same time.
- Specify if HT supply is available for use in high HP drives.

### **14.0 The plant location**

- Specify the plant location, as it would be a critical factor in terms of mode of transport of the boiler. At times there are even limitations in taking heavy equipment to the boiler site.

### **15.0 Climatic conditions at site**

- Wind direction to be taken care of designing ash discharge points in the boilers. This will avoid spending money later on wind shielding to avoid dust nuisance.
- Specify wind velocities to be considered for design. Dust collection systems, chimney, bunker that are installed in open environment need this input for design.
- Dust generating equipment such as coal crusher and screen may have to be strategically located to avoid dust nuisance to the process industry.
- Fuel storage yard & ash storage silo may have to be located to avoid nuisance due to wind.
- Extent of rain would affect the design of fuel storage yard. Closed sheds have to be planned in the case of agro waste and pre-crushed coal storage yard.

- Maximum & minimum ambient temperatures have to be specified for taking care in selection of electrical equipment.

#### **16.0 Plant topography, soil conditions & flood level**

- Boiler house, fuel, ash-handling layout could be favourably used to reduce the cost of civil work.
- Specify present soil level with respect to mean sea level. Further specify the flood level based on past records. Select finished floor level accordingly. Specify the limitations for underground hoppers based on the above.
- Specify the water table level during rainy season and the limit for underground hoppers for fuel handling system.
- Plant altitude has a major effect in sizing draft equipment.

#### **17.0 Water availability & quality has major effect on the type of boiler**

- Specify raw water quality and seek boilermaker's recommendation for the right choice of treatment method.
- Give the raw water samples taken from the available resources under the worst seasonal conditions during which the water will be impure.
- Very high TDS influences the design of boiler to a very great extent. At times the water might have to be bought from a totally a different source. The disposal of high TDS effluent could be a bigger problem.

#### **18.0 Have you spelt out the guarantees & warranty?**

- Boiler parameters and thermal efficiency are the first set of parameters.
- Steam temperature at minimum load condition.
- Steam quality is critical for condensing turbine application. Type of drum internals affects the steam quality.
- Specify the period of warranty.

#### **19.0 Documentation requirement**

- Specify no of copies of Operation & maintenance manuals for Boiler & accessories.
- Specify the list and no of copies of reference drawings for boiler & critical non-pressure parts.
- Mention if you would need specifications of sub vendor items for future use.

#### **20.0 Specify scope of supply for sub systems**

- Specify sampling system, HP /LP chemical dosing system, feed water preheater system, Deaerator, Blow down tank system, Dust collection system, Cabling & earthing, Instrument air system, etc

#### **21.0 Specify design standards**

- Specify the requirement of boiler conformance to Indian boiler regulations or any other codes.
- Specify the electrical & Instrumentation standards as applicable to the plant standard. Explosion proof, intrinsic safety requirements shall be spelt out.

## **22.0 Specify statutory requirement**

- Specify the statutory formalities to be covered by the vendor.

## **23.0 Specify inspection requirement**

- Specify inspection stages for the boiler & accessories that are must before despatching the items to site for installations.
- Specify if you wish to witness any test / trial run of equipment at vendors works. It is customary to test boiler auxiliaries, which are designed for the first time.

## **24.0 Specify the make of bought out items**

- Specify the make of bought out items. One should think of plant level standardization. Factors to be considered are minimum inventory, Quick service availability, reliability, and plant personnel experience, past performance history.

## **25.0 Commercial terms**

- It is needless to say that commercial terms are important.

## **CONCLUSION**

The above checklist will be useful for specifying the boiler before purchase. The same could be used for technical discussions with boiler vendors so that the boiler would be the one that meets all your present and future requirements and brings the satisfaction to you. However it is also important to obtain detailed specifications of boiler pressure parts, non pressure parts, Boiler auxiliaries, scope of supply, velocity profile, pressure profile, temperature profile, draft profile, etc from the vendors. A critical evaluation of the product offered by the vendor is necessary based on the above. It is hoped that this article would contribute for better selection of boiler in future.