

# **CIRCULATION FAILURE IN A BOILER**

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What it is presented here might be a happening in your boiler too! It has been more than 11 years the problem was not solved by the well known Boiler Company based at Pune. The Client was hesitant in referring the mystery to me. The client explained that the water level keep vanishing from the boiler very often. The problem was solved in a single visit. The problem & the solution are presented below.

## ***THE PROBLEM***

There are two 8 TPH boilers in this Plant. The boiler no 1 is a three pass shell type oil cum biogas fired boiler, supplied by a Baroda based company. When the plant capacity was increased, the client installed another 8 TPH oil cum gas fired boiler from Pune based company. The new boiler is a three-pass shell tube boiler with a separate steam drum. The boiler is illustrated in figure no1. There are six downcomers feeding the water from the steam drum. The steam generated enters the steam drum via three risers. The boiler Operating pressure is 14 kg/cm<sup>2</sup>g.

The plant steam load is steady and the two boilers share the load. The burners were provided with modulation arrangements initially. Presently the firing rate is set manually by the operator. However, the high-pressure trips are in action. The boiler will restart automatically on low fire. At times the high pressure tripping and restarting were proper. At times, when the boiler trips on high pressure there will be low water level occurrence too. The water in the gauge glass vanishes. It has happened more than 15 times in day. The boiler would not restart immediately, as the low water level interlock does not permit the restarting. The steam pressure in the plant header would come down to 5 kg/cm<sup>2</sup>g. Once the water level is restored in boiler no2, the firing would commence and the header steam pressure comes back to normal. The plant has been suffering due to low steam pressure for many years.

The water level vanishing from gauge glass was something unusual. This was not happening in boiler no1, which is a shell type boiler. The Client had experienced the problem only year later after the boiler was installed. After which the client had taken up with the supplier, who had struggled nearly for a year and the problem remained.

## ***THE SOLUTION***

First I suspected the NRV of boiler no 2. Client explained they had removed the NRV flap and seen. I checked the pump capacity. If it were very much oversized, the downcomers would not be getting sub-cooled water for circulation (due to long idle time of pump). Further, the load was more than 5 TPH per boiler. The water level vanishing problem started after a year since the boiler was installed. The change was that the load had gone up. Then I doubted the adequacy of the downcomers and risers. The circulation calculation proved that the boiler should work even at full load.

During the visit the boiler was in shut down condition and hence I requested the client to open the steam drum manhole of the boiler no 2. There was no proper internal arrangement for effective circulation. There is no arrangement to separate downcomers and risers sections. The risers and downcomers were located very close. The steam mixture exiting from the riser would enter the downcomers. Thus there will not be any circulation. The water in Bottom shell and in steam drum would together swell and produce the steam. Due to restriction for cold water to enter the bottom shell, the steam ratio in the boiler water would be high. The apparent water level would be very high under normal condition. When the boiler trips on high water level, the heat input is stopped. Hence the boiler water would shrink and cause low water level.

I suggested the modifications as in figure 3. Three separate riser boxes were added so that the rising steam- water mixture would pass through the box. This helps in reducing the resistance faced earlier. The feedwater distributor is added so that the downcomers gets sub-cooled water. The client carried out the modifications and then reported the problem is solved.

### ***CONCLUSION***

Boilers without proper circulation can lead to tube failures on starvation. This was a case the starvation was not there, as it was a shell type boiler with a float switch tripping the boiler on low water level. Clients who have the same type of boiler installed should be experiencing the problem.

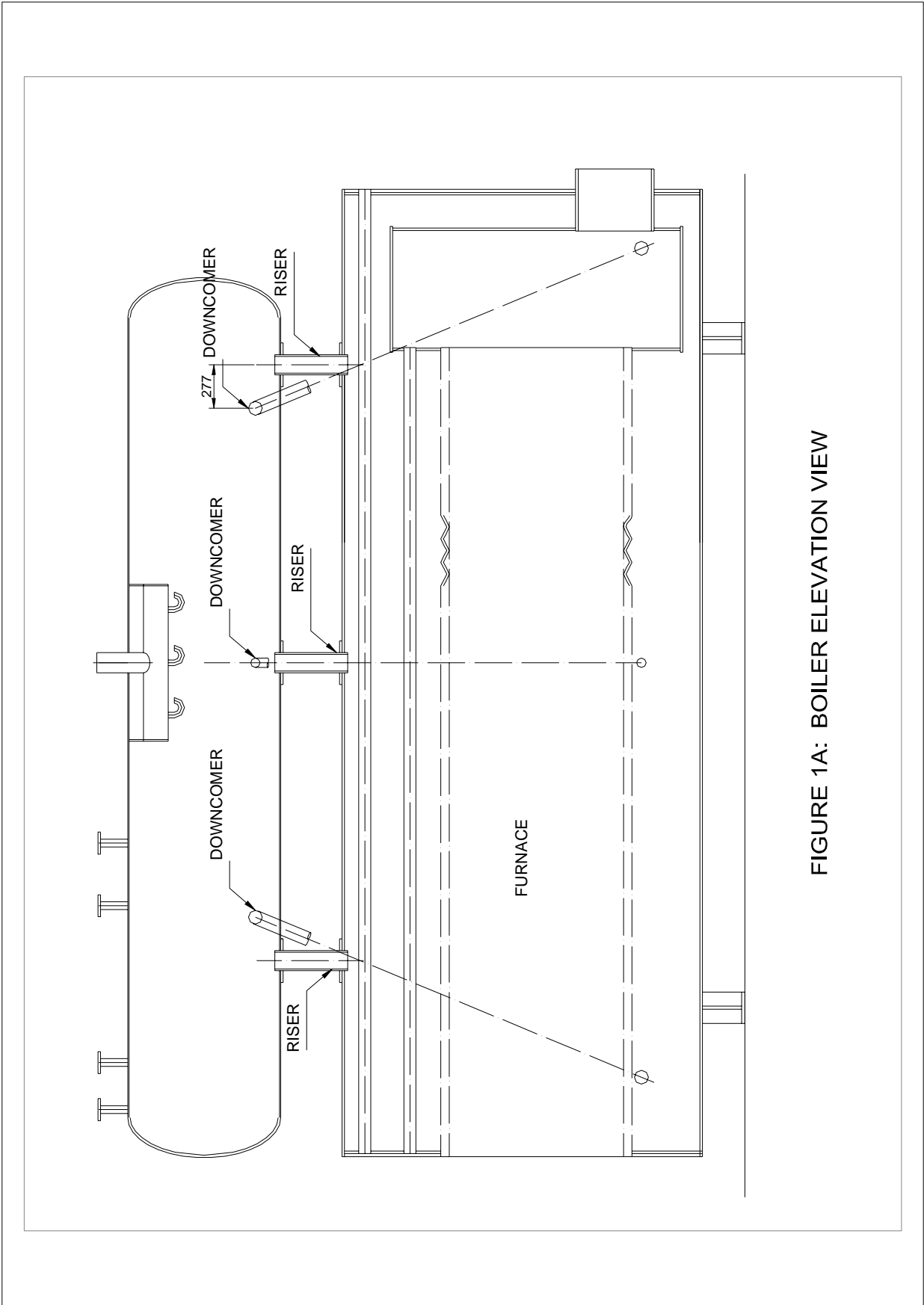


FIGURE 1A: BOILER ELEVATION VIEW

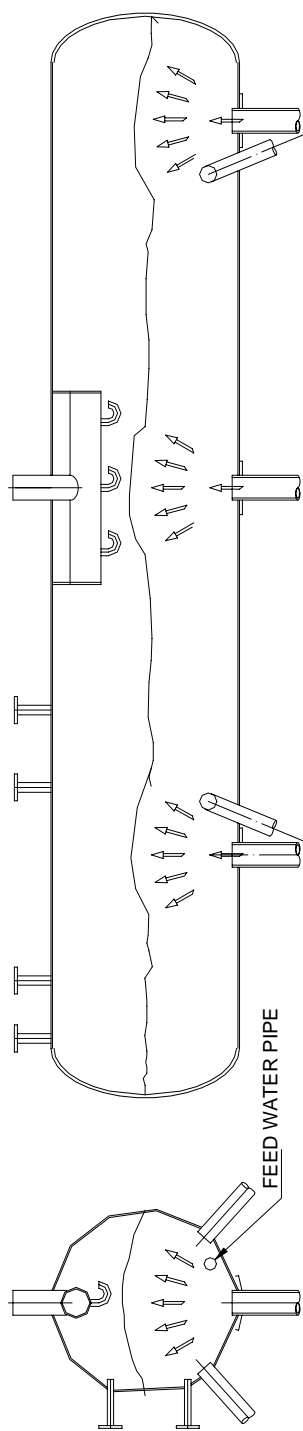


FIGURE 2 : EXISTING DRUM INTERNAL ARRANGEMENT

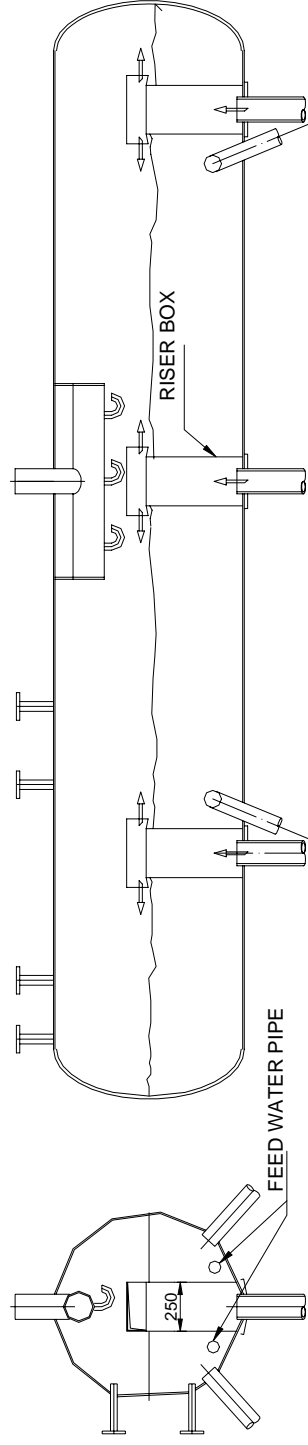


FIGURE 3 : MODIFIED DRUM INTERNAL ARRANGEMENT