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Light-Off Problems Lead to Three Different Boiler Explosions

Safety Note

The following describes incidents that happened immediately prior to three fire-side explosions of industrial plant boilers. The cause of these incidents and the lessons learned apply to all types of fuel-fired equipment.

Three separate industrial water tube boilers experienced fire-side explosions with boilers with a capacity of 20,000 to 40,000 pph and operated at 90 to 100 psig pressure. The explosions destroyed one boiler and damaged three others, fortunately no injuries were reported. The incidents came after the three boilers experienced trouble lighting-up, had fuel/air ratio, or burner capacity problems.

Lessons to Learn

Recognize obvious danger signs and take actions to avoid explosions before they occur. Three important takeaways from this article are your ability to recognize danger signs that may sound like this:

a. We aren't getting the steam capacity or the temperature we expected.

b. The equipment is hard to start. We had to try and light-up several times.

c. There's smoke and soot coming out of the stack. When the burner ramps up to high fire the flame turns orange or yellow.

These situations can mean trouble. Calling a contractor is not the end of the story. It is important that the contractor coming to the site has the right skill set and experience. In two of the three explosion cases described above, a contractor service person was at the scene working on the equipment. In one case, the contractor's service person was at the site the day before.

Light-Up Basics

All three incidents occurred on the equipment's light-up. It is important that you understand light-up basics to avoid dangerous conditions. The light-up process for boilers and process equipment involves four important elements, these are:

1. The Pre-purge

Process equipment requires at least four air changes of the fire box before an ignition source can be introduced. Multiple burner boilers have a number of issues that must be considered to calculate the proper purge time. Multiple burner boilers must have purge times that are a minimum of five minutes.

Other boiler air change requirements for purging can be from four to eight air changes depending on a number of factors. In one of the explosions, the purge time was found to be only about half of what it should have been.

2. The Pilot Trial for Ignition Period

Pilot systems are allowed 10 seconds to try and light for natural gas and 15 seconds for heavy fuel oil. It should never really take this long. If you're not getting a pilot lit in three or four seconds your system needs to be more closely evaluated.

3. Low Fire Positioning

Most systems of any size, (i.e. usually 5 million BTU's per hour input and up), require the main fuel valve to be at a low fire position prior to light off. This usually means somewhere between 15 to 25% of high fire capacity. You'll have to check with the burner manufacturer to find the correct minimum firing rate for your particular equipment. Only then can a qualified technician make the necessary adjustments. In one of the explosions, the burner was set to light-off at 50% of high fire or about 15,000,000 BTUH. This was a major factor in the boiler's explosion.

4. Main Flame Trial for Ignition Period

Once a pilot is lit and the main gas firing rate control valve is at a minimum position, then the main automatic safety shut-off valves open for a specific amount of time (i.e. the main flame trial for ignition period). This is 10 seconds for gas and 15 seconds for heavy fuel oil.

Once again, as in the case of the pilot trial for ignition period, it should never take 10 or 15 seconds. If you're not getting a main flame lit in three or four seconds your system needs to be more closely evaluated.

Beside these factors, one should know about pilot systems and how they work.

Basic Types of Pilot Systems

A. Standing Pilots

Standing pilots are lit all the time just like home hot water heaters. These are usually used in very small and very old equipment.

B. Intermittent Pilots

Intermittent pilots are on for the entire call for heat (i.e. the entire burner firing cycle).

Because of this, a signal from the igniter system could fool the burner management system into thinking that a stable pilot is lit even when it isn't. This could cause the main fuel valves to open or remain open when they shouldn't be.

C. Interruptible Pilots

Interruptible pilots allow for the pilot igniter to be open for only five of the 10 or 15 second trial for ignition period. If a pilot flame signal is seen after the 10 or 15 second period then it has to be from a legitimate and proper pilot. These types of pilots are required for most process equipment and larger boilers.

There are a number of other issues that are important in understanding pilots and light-ups, including early spark termination systems, pilot spark pick-up tests, hot surface igniters, and self-piloted burners.

Avoiding Catastrophes

Mark and Maintain Fuel Shut-off Valves

The incidents described did not escalate into major catastrophes in part because the operators were able to quickly get the fuel shut off. Make sure that your manual fuel shut-off valves are operable, marked, and maintained. Our firm offers the sealants and equipment to properly maintain valves, including instructional videos about service techniques.

External Position Indication

Purchase and install fuel valves that have an external position indication. This can help safe light up monitoring.

Verify after Start-up Process

When manual or automatic fuel valves are changed out, make sure that the start-up process includes dry firing with fuel "off" to safely verify that fuel valves are set and operating properly.

Qualified Contractors

Verify that contractors are qualified to perform the required services. Ask about specific experience and training. Make sure that qualifications, and not just price, are included in the decision for who to hire for critical interlock and safety testing functions and/or combustion equipment service.

ABOUT US

Honeywell Combustion Safety is a part of Honeywell Thermal Solutions, an industry leader in commercial and industrial combustion solutions. Honeywell Combustion Safety, formerly known as CEC Combustion Safety, has been in business since 1984. With engineers and staff members that sit on Code committees such as NFPA 56, NFPA 85, NFPA 86, and NFPA 87, our inside expertise is integrated within all of our practices, and our global reach ensures that customers around the world are kept safe. Honeywell offers testing and inspections, engineering & upgrades/retrofits, gas hazards management, training, and field services for all industrial facilities and different types of fuel fired equipment. By assisting organizations and their personnel with the safe maintenance and operation of their combustion equipment, Honeywell aims to save lives and prevent explosions while increasing efficiency and reliability of combustion equipment.

For more information

Learn more about Honeywell Combustion Safety, contact info@combustionsafety.com, visit www.combustionsafety.com or contact your Honeywell Sales Engineer.

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