

## Boiler Furnace Explosions

### What happened?

Recent incidents on Floating Production, Storage and Offloading (FPSO) facilities in Australian waters have highlighted the dangers of unignited fuel accumulating in boiler furnaces. In two cases there were explosions in boiler furnaces resulting in structural damage to the boiler. Fortunately no one was injured.

A furnace explosion is a rapid uncontrolled combustion of fuel in the combustion chamber or exhaust uptake of a boiler resulting in high overpressure. The basic cause of this is the ignition of an accumulation of unburned fuel at some point in the system.

One incident involved a number of failed attempts to light a boiler on diesel oil and a further attempt to light the burner on fuel gas. A furnace explosion occurred which caused structural damage to the membrane walls of the furnace. In another case, whilst two boilers were being brought on line, there was a furnace explosion in one boiler shortly after the third successive light up of the burner on oil fuel. This caused extensive damage to the furnace casing and uptakes.

Whilst the boilers are of different types and makes, the two incidents highlight the hazardous conditions that can arise during routine light up operations. A furnace flashback or sudden release of the boiler contents due to structural damage may have serious consequences for personnel in the area.



*Furnace casing damage*

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*Damaged boiler exhaust uptake*

### What could go wrong?

- Several unsuccessful attempts to relight a burner result in an accumulation of unburned fuel in the boiler furnace. Ineffective purging of the furnace and gas passages with air will result in pockets of combustible mixture remaining in the system.
- Poor combustion and/or defective burners can result in deposits of unburned fuel in the furnace.
- Unstable fuel control systems can cause fuel pressure spikes, flow surges and poor combustion with the attendant risks of explosive ignition in the furnace.
- Incorrect fuel gas flow control valve settings can introduce quantities of fuel gas into the combustion chamber, well in excess of the minimum amount required for light up.
- Leaking fuel shut down valves and pipe connections can result in an accumulation of unburned fuel in the furnace.

### Key Lessons

- Even small amounts of accumulated combustible mixture in a boiler furnace can, on ignition, cause explosions with serious consequences.
- Operators should ensure that automatic combustion control systems are not degraded. Properly functioning and maintained automatic burner fuel control systems should not normally require manual intervention.

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- Procedures should be in place for the start up and safe operation of boilers on oil and gas fuel. These procedures should include mitigating measures to be taken by operators should flame failure occur.
- Always identify the cause of persistent flame failures before attempting to relight a burner. Ensure an extended purge cycle after repeated failed attempts to light up a burner so that unburned fuel vapour is dispersed from the furnace and gas passages.
- Burners should be lit with oil/gas fuel at the minimum design flow rate that is necessary for stable flame establishment.
- A system for periodic checks of burners, fuel shut down valves, safeguarding devices and instruments should be in place.

### **Who is responsible?**

Under provisions of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006*, operators of facilities have a duty of care to ensure that plant and equipment at the facility are safe and without risk to health. Manufacturers and suppliers of plant also have a duty to ensure that plant, when properly used, is safe and without risk to health.

### **Contact**

For further information email [alerts@nopsa.gov.au](mailto:alerts@nopsa.gov.au) and quote Alert 37.