Incident Title	**Blast Furnace Explosion**	
Incident Type	Explosion and Fire	
Date	8th November 2001	
Country	UK (Wales)	
Location	Port Talbot	
Fatalities	**Injuries**	**Cost**
3	12	Unknown

Incident Description

Credit: UK Health & Safety Executive

No. 5 blast furnace produced pig iron from iron ore, coke and limestone. Raw materials were charged via a gas-tight distribution system into the top section of the furnace ("stack") which was supported by a circumferential lintel mounted on 8 large steel columns (each attached by 8 large bolts). The raw materials undergo a series of complex and intensely exothermic chemical reactions as they descend through the refractory-lined furnace over a period of 6 – 8 hours in counter current contact with "blast" air injected at 1100 ºC (2012 ºF) through a series of nozzles ("tuyères") in the lower "bosh" section just above the "hearth". The furnace had a sliding and overlapping joint ("lap joint") at the interface between the stack and hearth to allow for expansion of the furnace shell and its refractory lining. The shell and lining had numerous cooling elements supplied from an open-circuit cooling water system.

On the afternoon of 08-Nov-01, No. 5 blast furnace exploded. The furnace superstructure and its contents weighing around 5000 tonnes (11 million lbs) parted at the lap joint and the top section lifted upwards approx. 0.75 m (30"). As the internal pressure dissipated, the top section fell back down onto the lower lap joint plate but offset from its starting position and mounting bolts. During this time, around 200 tonnes (441,000 lbs) of hot liquid, solid and semi-solid materials were forcibly ejected onto the cast house floor via the annular gap created by the upward movement. Gaseous material and dust rose into the cast house and exited to atmosphere where most of it ignited.

Incident Analysis

Basic cause of the furnace explosion was significant internal over-pressure due to interaction of water and molten materials within the lower section.

Critical factors included: 1) Failure of 2 out of 3 of the available safety-critical cooling water pumps some 20 hours before the explosion, 2) Late detection and correction of significant water ingress to the furnace via several cooling elements (burnt out after partial loss of cooling water flow), 3) The furnace was operating in transient ("chilled hearth recovery") mode, 4) The support column head/lintel bolts on 7 of the 8 columns had fractured months earlier.

Root causes included: 1) Inadequate hazard awareness (water/molten material explosion, cooling water system unreliability), 2) Inadequate risk assessment (increased cooling water demand vs fixed supply capacity), 3) Inadequate management of change (furnace campaign life extension), 4) Inadequate maintenance (column head/lintel bolts, cooling water pumps, pipes and valves), 5) Inadequate operator training (abnormal situation response), 6) Inadequate instrumentation (for prompt water leak detection).

Lessons Learned

1) Blast furnaces are subject to Control of Major Accident Hazard (COMAH) regulations which mandate use of appropriate hazard identification and risk assessment techniques, 2) Blast furnace cooling water systems are safety-critical (reliability goals should be set by risk assessment not production requirements), 3) Closed-circuit cooling water systems are preferred for blast furnaces as they are less susceptible to fouling and leak detection is easier.

More Information

1) "The explosion of No. 5 Blast Furnace, Corus UK Ltd, Port Talbot", Health & Safety Executive, WEB34 09/08 (2008): Investigation Report (UK HSE).
2) "Blast Furnace No. 5 Incident, Corus, Port Talbot, 8th November 2001", J. Hodges and S. Curry, IChemE Loss Prevention Bulletin 219 (2011): https://www.icheme.org/media/2521/lpb_219_pp3-7.pdf.

Industry Sector	Process Type	Incident Type
Oil & Gas	Iron & Steel Manufacturing	Explosion & Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Heaters and Boilers	Blast Furnace

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