A Quarterly Loss Prevention Digest

Fourth Edition

Nov 2011

IN-SIGHT

Asia Insurance Industry Awards
"Risk Manager of the year" – 2011
Bharti AXA General Insurance Co. Ltd

bharti AXA
redefining / general insurance

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Dr. Amarnath Ananthanarayanan

CEO & MD

Bharti AXA General Insurance Company Limited.

Message from CEO & MD:

I am very happy to inform you that, we have been awarded the "Risk Manager of the Year" award at the prestigious "Asia Insurance Industry Awards" held at Singapore on the 31st of October 2011. We are the only Indian company in the Life & General Insurance category to have been nominated for this year's awards, which we did eventually win. We at Bharti AXA General Insurance are very proud to be honored with this award.

We are striving to become the Preferred General Insurance Organization in India and our risk engineering offer adds to the innovative bouquet of risk management solutions that we can offer to our customers besides insurance. I would like to congratulate the entire Bharti AXA General Insurance team for being a part of this journey to winning this award and would like to encourage them to keep putting in their best.

Dr. Amarnath Ananthanarayanan

Subrahmanyam B

VP & Head, Health and Commercial Lines

Bharti AXA General Insurance Company Limited.

From the Editor's Desk:

It is indeed a great pleasure for me to take over the editorship of 'In-Sight' - our quarterly risk engineering newsletter on safety and loss prevention. The lead article for this issue focuses on hazards and mitigation measures associated with metal casting operations. Foundries or metal casting operations have inherent fire, injury and health hazards associated with them due to the hazardous nature of the processes that are carried out. These involve high temperatures, generation of fumes during melting of metals/ alloys and generation of dusts associated with mould making and fettling operations. A careful understanding of these hazards and the control measures required to mitigate them is necessary to ensure the safety and well being of employees who carry out these operations as well as to effectively manage fire safety. The issue does contain a safety quiz that helps to check your safety quotient and the special feature this time is a fire loss incident in a metal casting industry.

Subrahmanyam B

Winner of the "Risk Manager of the year 2011" at Asia Insurance Industry Awards

The 15th Annual Asia Insurance Industry Awards 2011 is intensely contested amongst leading insurers, reinsurers and risk managers across Asia, with over 500 entries from leading players across 15 categories of awards. The jury comprises of 29 distinguished panelists from across Asia both from the regulatory and professional community.

We are the only Indian insurance company in the Life & General Insurance segment to have been nominated for this year's awards, which we did eventually win.

We have an in-house risk engineering team, which offers a wide range of risk management services that includes specialized consultancy studies like General Safety Audit, Fire Safety Audit, Electrical Safety Audit, Marine Loss Control Study, Post Loss Surveys, etc. One of our major strengths is the wide experience of our Risk Engineers who have carried out more than 5000 different assignments for all types of industries over a period of nearly 3 decades. This helps us to provide flexible and cost effective risk management solutions especially to the SME segment to manage their risks effectively.

We are amongst the few companies who implement an Enterprise Wide Risk Management framework through systems and processes to assess risks, design and implement mitigation measures, create employee awareness and train the Control Operators. These systems and procedures provide the necessary internal controls that help in managing Insurance Risks, Financial Risks and Operational Risks including Information Security, Business Continuity and Disaster Recovery and Fraud Risk Management.

This award definitely puts us one step forward in our journey to become the preferred insurer.

Bharti AXA General Insurance

The India-based insurer impressed the judges with its trailblazing role in risk management by having an in-house team that provides a wide range of risk management consultancy services to the insured for free.

Within only two years upon its launch, Bharti AXA's risk management team has redefined the scope and services of a risk engineering team by going beyond the traditional tasks of doing pre-acceptance surveys and providing risk control recommendations to clients.

The company prides itself on being the first insurer in Asia to have an in-house risk management team that provides a wide range of risk management consultancy services to the insured for free. These services have not only gained clients' appreciation, but have also helped the company acquire business through higher co-shares and new clients. Beyond India, its risk engineers have participated in select overseas surveys in Indonesia.

It scored another first when it became the first insurer to start a free quarterly technical newsletter for safety officers and risk managers, commercial establishments and the general insurance community in India and abroad.

Considering the level of risk management practices possible at SME industries in India, Bharti AXA General Insurance developed a risk-rating system for this segment as opposed to large risks – facilitating the acceptance and pricing decisions by rating and ranking of risks. It also developed a questionnaire for auto rating of preferred SME segments, which evaluates inherent fire hazards and facilitates higher discounts when risks are significantly lower.

Its promotion of risk management culture and practice among its clients does not end with consultancy studies and reports. It also conducts follow-up surveys and if required, provides support in implementing recommendations. Its follow-up survey at Kothari Industrial Corporation, Chennai after Cyclone Laila struck in May 2010 averted a potential loss of INR250,000-500,000 (US$5,100 to $10,200) when Cyclone Jal hit in November of the same year.

Within the organisation, it conducts workshops on marine loss control and specialised risk inspection training programmes for SME champions. Members undergo rigorous classroom sessions, followed by written tests, onsite risk inspections and report writing.

Bharti AXA General Insurance is one of the few companies in India to implement an ERM framework with a dedicated risk management team that has systems and procedures to assess risk, design and implement mitigation measures, create employee awareness and train control operators.

To achieve process excellence in pre-acceptance surveys and reporting, it uses tools such as mapping of coordinates with GPS instruments, satellite images and Munich Re's Global Hazard mapping software. It continues to upgrade professional standards in risk management by sharing risk information and best practices with other AXA Group entities and through access to AXA Corporate Solutions' global expertise.

Its multi-disciplinary team of graduate engineers are qualified in insurance, risk management and industrial safety. They are experienced in various manufacturing industries as well as in loss prevention and risk management consultancy firms. Most of them have nearly three decades of experience and have delivered more than 5,000 assignments.

The company hopes that its effort to promote risk management knowledge and practice will set a good example in the region and will help propagate the importance and practice of risk management within and outside the industry.

1.0 Lead Article: Loss Prevention in Metal Casting Operations

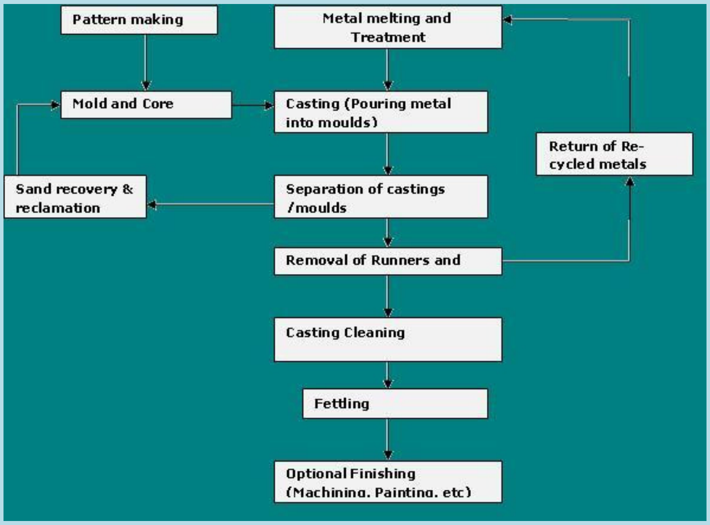
1.0 Introduction

Metal casting industry (foundries) plays a very important role in the manufacturing segment. Besides producing castings for special applications this industry also happens to be an important raw material supplier for a wide variety of industries which include - automobiles, aerospace, railways, cement, sugar, textiles, iron and steel, sanitary pipes and fittings, as well as industries engaged in the manufacture of compressors, motors, generators, turbines, diesel engines, pumps, industrial valves, etc.

Castings are made of both ferrous and non ferrous metals which include cast iron, steel, aluminium and its alloys, bronze, magnesium, copper, tin, and zinc based on which metal casting industries get classified as – Ferrous and Non-Ferrous foundries. Though the working temperatures of non-ferrous foundries are generally lower than ferrous foundries the process in both the cases are common in that it involves the pouring of molten metal into a shape called mould which determines the configuration of the metal being cast. Both the external as well as the internal shape of the metal being cast is achieved through the physical shape of the mould.

2.0 General Process

Processes involved in foundry operations are - Pattern making, Core making, Metal melting, Casting, Shakeout, Surface cleaning and Fettling and their inter-relationship is as illustrated in the flow chart below.



3.0 Hazards in Foundry Operations

Hazards in foundry operations are mainly due to the hazardous nature of the processes that are carried out in the work place. These give rise to risks such as property damage resulting from fires and explosions, accidents that cause injuries and death, as well as short term and long term injuries to health including cancer. A preview of each of these hazards is dealt with in the sections that follow.

4.0 Fire and Explosion hazards

Furnace explosion is the most hazardous event that can take place in a foundry. The consequences of such an event besides fire following explosion include run off of molten metal, impact damages, and structural collapse. Furnace explosions can take place on account of wet charges, charging of sealed containers, introduction of easily fragmenting charge or cold tools into the furnace, and due to bridging.

4.1. Wet Charges

Charges fed into furnaces for melting consist of commercially pure forms of metal, scrap generated from internal operations, bought out external scrap, and various alloying elements that bring about the desired metallurgical properties. When any of the charge material is wet a serious explosion hazard arises. Water or even moisture that is present in the charge instantaneously turns into steam on contact with hot molten metal. This results in a sudden volume expansion (for water expansion is 1,600 times) causing a violent explosion which spews out molten metal and high temperature solids from the furnace. Since these incidents occur instantaneously and without any warning they cause injuries to people in the vicinity besides possible damage to furnace and nearby plant and equipment.

Explosions occurring in induction furnaces have a higher degree of hazard than those occurring in other furnace types. This is because of the fact that secondary explosions can take place in an induction furnace when liquid from the ruptured cooling system damaged by the primary explosion comes into contact with the molten metal in the bath. It is not necessary that molten metal needs to be present in a furnace for an explosion to occur. The high temperature of a hot furnace is sufficient enough to cause an explosion when material with water or traces of moisture are charged into an empty but hot furnace. In such cases the explosion spews out the newly charged material, and this is likely to damage the refractory lining of the furnace.

Measures that reduce exposure to this hazard are:

1. Storing scrap under a covered shed for at least a day before it is charged into the furnace as also carefully inspecting the bales and containers for presence of any residual moisture.
2. Use of remote charging mechanisms enhance operator safety in that this permits the operator to stand safely back from the furnace or behind protective screens during charging.
3. Deploying Dryers and pre-heaters which maximize the removal of water and moisture before scrap is fed into the bath.
4. In manual charging operations placing the scrap near the furnace prior to it being charged helps in eliminating moisture due to radiant heat from the furnace.

4.2 Sealed Containers

Charging scrap that contains sealed containers or sections of tubing or piping that are sheared/ closed at both ends is another factor that can give rise to furnace explosions. Hazards due to feeding of such type of charges into the furnace arise from the following factors:

- They could hold combustible liquids or fumes which will explode even before the scrap melts.
- They could hold trapped air which will rapidly expand due to the intense heat in the furnace. The resulting pressure build-up could be sufficient enough to breach the container wall or escape through a sheared/ closed end of a pipe or tube resulting in a forceful expulsion of gas that can propel hot scrap out of the furnace or smash it into the furnace lining causing damage.

Preheating material holding trapped air or combustible liquids or fumes will not mitigate this hazard. On the contrary it will increase the risk of explosion as sealed containers could explode during such preheating operations. The only available control measure for mitigation of this hazard is operator vigilance and it needs to be ensured that such material is not fed into the furnace or pre-heater.

4.3 Cold or easily fragmenting charge and tools

Cold charge or tools and materials that easily fragment do also pose a special hazard for induction furnaces and their operators. This is because of the fact that they may contain a thin layer of surface or absorbed moisture which on contact with the bath will turn into steam, resulting in spitting or splashing. While appropriate protective equipment and face and eye protection will protect the operator from risk, preheating the charge and tool helps in preventing such incidents.

In ferrous metal foundries this hazard is greatest towards the end of the melt when ferroalloys or tools get introduced into the melt. While Ferro -alloy materials can absorb moisture from their surroundings, sampling spoons and slag rakes can also collect a thin film of moisture due to condensation. In a nonferrous foundry, spitting or splashing can accompany the introduction of ingots into the melt because of moisture that condenses on the ingot surface coming into contact with molten metal.

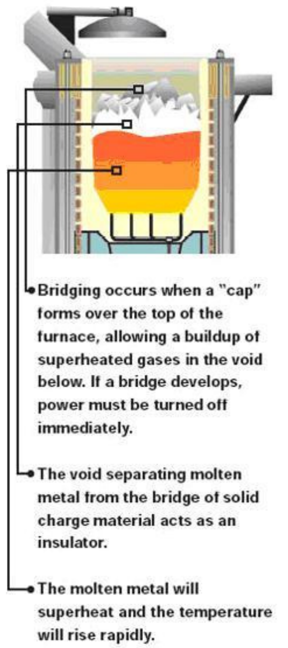
Recommended risk minimization measures are:

- Strictly following manufacturers' instructions regarding storing of alloying materials
- Preheating of tools
- In Non ferrous factories, ingots to be placed only in empty furnaces or on top of solid foundry returns.
- Ingots added to a molten pool should be preheated and introduced using a remote charging system.

4.4 Bridging

Bridging is a condition which occurs when charge material lying at the top of the furnace is not in direct physical contact with the molten metal at the bottom. This causes the furnace to superheat.

Charge in a furnace plays a very vital role of moderating the bath temperature during the melting cycle. However when bridging occurs the air gap between the molten metal and the charge at the top acts as an insulator and prevents the charge material from moderating the bath temperature. This causes superheating of the molten metal at the furnace bottom since a small quantity of metal is subjected to the full heating power of the furnace. This high heat also causes stirring of molten metal below the bridge.



Superheating which occurs very rapidly in an induction furnace can result in refractory failure due to two main reasons:

- Temperature of molten bath rising above the maximum rated temperature of the refractory
- Excessive stirring of molten metal combined with high temperatures causing rapid erosion or failure of refractory lining

Failure of refractory will lead to a metal run-out that can lead to the following scenarios.

- If run out occurs from the bottom of the furnace it can lead to a fire under the furnace in the pit area resulting in a loss of hydraulics, control power, and water cooling. Recommended control measures are to keep the furnace pit area clean and dry and not to allow water or hydraulic fluid to accumulate in the pit. The pit is designed to hold molten metal in an emergency and hence must be kept clean and dry at all times.
- If run-out occurs through the side of the furnace, the coil may be damaged and if cooling water comes into contact with the molten metal, the water instantaneously turns into steam. If the water becomes trapped by the molten metal, this instantaneous expansion can produce an explosion which could cause injury or death and extensive damage to equipment.

Bridging can occur in any induction furnace and all furnace operators must learn to recognize this hazard and understand the dangers involved.

Measures that mitigate this hazard are:

- Using proper charge material and ensuring that different sizes of charge material are correctly added.
- When a bridge is noticed power should be immediately switched off and the melt deck and surrounding areas immediately evacuated giving sufficient time for the molten metal to solidify before operations are resumed.

5.0 Dust explosion

Metal dusts besides presenting problems related to hygiene and personal health do also pose a risk of explosion when they involve combustible dusts like aluminium. A recent study conducted by OSHA estimated that around 30,000 U.S facilities are at a risk of explosion due to operations involving combustible dusts. Proper design of facility, provision of local exhaust ventilation systems, and housekeeping programs that prevent accumulation of dust as well as elimination of ignition sources like hot surfaces and use of dust light electrical fittings are control measures that mitigate this hazard.

6.0 Special Hazards

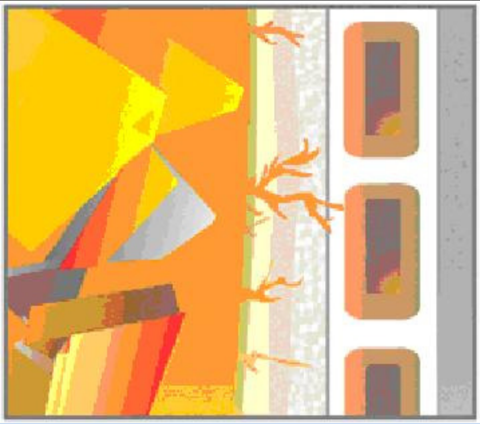
6.1 Metal run-out

Metal run out happens to be one of the most severe accidents that usually occur in a foundry. This can take place either during melting or holding operations. Run outs occur when molten metal breaks through the refractory lining. If this occurs in a furnace; cooling, electrical, and hydraulic or control lines can get damaged giving rise to a danger of fire or water/molten metal explosion. Maintaining the integrity of refractory lining is the key to preventing a run-out. Failure of refractory lining can take place due to:

- Installation of wrong refractory material for a particular application
- Inadequate or improper installation of refractory material.
- Improper sintering of refractory material.
- Failure to monitor normal lining wear and allowing the lining to become too thin.
- Sudden or cumulative effects of physical shocks or mechanical stress.
- Sudden or cumulative effects of excessive temperatures or thermal shocks.
- Slag or dross build-up.

Choosing the right refractory lining material for a specific melting or holding application is crucial. The best way to do this is through close consultation with the refractory supplier, who has the most current information on specifications and performance characteristics.

Proper installation of lining is as important as selection of right material. If the material is inadequately compacted during installation, voids or areas of low density may form, creating a weak spot easily attacked by molten metal. If the crucible is created with a lining form that is improperly centred, or one that has been somehow distorted during storage or shipment, lining thickness will be uneven as a result of which it may fail before the end of its predicted service life.



Bad refractory can lead to fins of molten metal coming into contact with the coil and damaging the furnace

There are instruments available that can be used for condition monitoring of refractory lining/ furnace. The first is a magnetic contact thermometer attached to the steel shell of a channel furnace which indicates lining wear through revealing of the position of a hot spot. The other is an Infrared thermometer (a hand-held instrument) that helps in remote temperature measurement of the object on which it is focussed. State of art automatic lining-wear detection systems that display the lining condition graphically are also available. Regardless of the instrument a foundry uses to monitor lining wear, it is essential to develop and adhere to a standard procedure. Accurate data recording and plotting will assure maximum furnace utilization between relines as also minimize the risk of using a furnace with a dangerously thin lining.

6.2 Electric Cables

Exposed electric cables near the furnace and in areas where it is likely to come into contact with hot liquid metal poses a serious fire hazard. The high temperature of molten metal is capable of igniting the PVC insulation provided on the cables resulting in a fire which can spread to other areas through cable routings. Fire can also be caused due to the cable insulation getting damaged on contact with hot metal and resulting in a short circuit that can start a fire. While the best solution would be to route cables away from such fire prone areas the alternatives would be to encase them in concrete or metallic enclosures insulated with glass wool cladding. The extent of length that needs to be protected is important as encasement is likely to impact the current rating of the cable. However covering or encasing cables for a length of 2 to 5 metres is less likely to impact their rating. Generally such requirements would arise in areas where cables are laid near to furnaces at or below 2.0 metres of finished floor level.

6.3 Power Supply

Reliability of power supply is a very important factor for foundry operations. If there is a failure of grid supply and the back-up emergency supply available is not capable of meeting the requirements of running the furnaces, then the melt inside the furnaces will freeze and adversely impact productivity. It is hence necessary to ensure that adequate back up emergency supply is available for running all the critical loads in a foundry.

6.4 Furnace cooling

Failure of furnace cooling systems can result in furnace damage and the best available safeguard against this risk is the provision of an overhead tank that can supply cooling water for furnace cooling during an emergency. Care needs to be taken to ensure that the height of the overhead tank and pipe sizing is sufficient enough to cater to the minimum pressure/ flow requirements.

6.5 Location of Furnace transformers

Location of transformers (Induction/ Arc Furnace transformers) that supply power for melting plays an important role in increasing or decreasing the fire hazard. This is primarily because of the combustible nature of the huge amount of insulating oil that they hold. It is recommended that these transformers be located at least 6 metres away from all surrounding buildings. Where this is not feasible all door and window openings of buildings within 6 metres of transformer shall be protected by single fire door and 6mm thick wired glasses in steel framework respectively.

6.6 Gas/ oil Fired Furnace

Hazards associated with gas/ oil fired furnaces are quite different from hazards present in electric furnaces. This is mainly due to the usage of a fuel which is combustible in nature. Hence certain special precautionary measures are required for control of hazards associated with these types of furnaces. A safety checklist for such types of furnaces is given below:

Safety check list for gas/ oil fired furnaces

- Analysis for the presence of carbon monoxide and combustible gas
- Checking for adequacy of combustion air
- Inspection of heat exchangers for possible cracks or other defects
- Cleaning of main burners, heat exchanger, blower and pilot assembly
- Inspection of flue piping
- Inspection of all electrical wiring and switches
- Inspection of cooling coil for proper drainage
- Periodic verification of safety interlocks including operation of thermostat
- Maintaining a log book detailing all safety or efficiency related issues

7.0 Health and Injury hazards

7.1 Health Hazards

High temperatures and direct infrared (IR) radiation are two common hazards in foundries. While high temperatures cause fatigue and dehydration, exposure of direct IR radiation to the eye can cause loss or damage to sight. Foundry processes do generate a substantial amount of metal fumes and dust that are injurious to health. Lead used in gun metal and other alloys are highly dangerous and silica used in mould and core making operations can cause silicosis. Other chemicals used in mould making operations like sodium silicate, isocyanates, furans and phenolics are also injurious to health. Respiratory and lung related diseases including lung cancer are thus the major health hazards associated with foundry operations. Appropriate control measures for these hazards include reducing and controlling the generation of fumes and dusts at the operational level, provision of adequately rated local exhaust ventilation systems where appropriate and use of appropriate respirators as PPE by persons working in such hazardous areas. Another hazard in foundries is exposure to gamma rays and related exposure to ionizing radiation. Other possible health hazards in foundry operations are noise induced hearing loss and hand arm vibration syndrome resulting from use of vibratory tools in fettling operations.

7.2 Injury Hazards

There are various sources which can give rise to injury hazards in a foundry. Severe burn injuries could arise from splashing of hot metal due to explosions, as well as from accidental spillages during handling or transfer. Badly maintained hoisting appliances may fail and cause injuries due to falling objects or dropped loads. Lifting and moving heavy loads at elevated heights using hydraulic platforms and cranes besides giving rise to injury hazards can also cause impact damages. Sprains and strains may result from overexertion in lifting and carrying. Bursting or breaking of abrasive wheels can also give rise to serious injuries which at times can be fatal. Crush injuries to fingers or forearm could result if they get caught in the gaps between the grinding wheel and the guard. Unprotected eyes are at risk at all stages. Electric shock may result from badly maintained or unearthed (ungrounded) electrical equipment, especially portable tools. Slips and falls, especially when carrying heavy loads, may be caused by badly maintained or obstructed floors. Such injuries can also result from bad housekeeping where materials are left cluttered on the work floor.

Risk control measures given below help in such injury prevention:

- Design and layout of facility contributes a lot towards injury prevention. A well laid out facility would ensure:
  - That there is no crossover of different activities or process flow
  - Operational area for fixed handling equipment (e.g. cranes, elevated platforms) does not cross above worker and pre-assembly areas
  - Material and product handling is carried out in restricted zones
  - Machine-tools are located at safe distances away from walkways and other work areas.
  - Individual, enclosed workplaces are provided for fettling and grinding activities
  - Aisle ways are always maintained free of any type of storages
  - No work or storage is carried out in close proximity of electrical cables / equipment

- For control of burn injuries
  - Shield surfaces where close contact with hot equipment or splashing from hot materials is expected (e.g. in cupola furnaces, EAF, induction melting ladles, and casting)
  - Do not use a crucible that has been damaged or dropped since these can easily fail.

- For control of injuries arising out of material handling equipment
  - Implement specific load handling and lifting procedures, including: Description of load to be lifted (dimensions, weight, position of centre of gravity) and use of appropriate sling scheme for lifting of loads
  - Carry out regular maintenance and repair of all lifting, transport, and material handling equipment including periodic testing.
  - Provision of clear signage's in all transport corridors and working areas especially where overhead cranes are used to carry crucibles of molten metal or heavy castings.
  - Training of staff in handling of lifting equipment and driving of mechanical transport devices.

- Other risk control measures for injury prevention are:
  - Providing adequate guarding and automatic lockout for all dangerous parts of machinery including abrasive wheels.
  - Conducting regular inspection and repair of portable machine-tools as well as protective shields and safety devices / equipment
  - Training of staff in proper use of portable machine tools
  - Use of appropriate Personal Protective Equipment (PPE) / safety gear like leather shoes, leather apron, leather foundry hat, gloves, wire mesh face shield, and safety glasses

Our ten loss prevention commandments for metal casting operations are given in the page that follows

N.Sivaraj
Regional Manager – Risk Engineering
Bharti AXA General Insurance Company Limited,
Chennai

Ten Loss Prevention Commandments for Foundry Operations

1. **Wet Charges:** Materials charged into the furnace should be devoid of any moisture to prevent furnace explosions. Storing scrap under a covered shed for at least a day before it is charged into the furnace, careful inspection of bales for presence of moisture, deploying dryers and pre-heaters for moisture removal and placing scrap near the furnace prior to it being charged are techniques that help in preventing entry of moisture into the furnace.

2. **Sealed containers:** Charging scrap that contains sealed containers or sections of tubing or piping that are sheared/ closed at both ends can give rise to furnace explosions. Operator vigilance is required to ensure that such material is not fed into the furnace or pre-heater.

3. **Cold charge or tools and materials that easily fragment:** A thin layer of surface or absorbed moisture which ferroalloys or tools easily absorb from their surroundings can result in spitting or splashing of metal. While appropriate protective equipment and face and eye protection will protect the operator from risk, preheating the charge and tool helps in preventing such incidents.

4. **Bridging:** This condition which occurs when charge at the top of the furnace is not in direct physical contact with the molten metal at the bottom causes the furnace to superheat and damage its refractory lining leading to a run out of the metal. Using proper charge material and ensuring that different sizes of charge material are correctly added will help in mitigating this hazard. If a bridge is noticed power should be immediately switched off and the melt deck and surrounding areas immediately evacuated giving sufficient time for the molten metal to solidify before operations are resumed

5. **Metal run out:** Run outs occur when molten metal breaks through the refractory lining either during melting or holding operations. If this occurs in a furnace; cooling, electrical, and hydraulic or control lines can get damaged giving rise to a danger of fire or water/molten metal explosion. Maintaining the integrity of refractory lining is the key to preventing a run-out.

6. **Process automation:** The use of automated equipment, such as remote charging, preheating/drying, computerized melt monitoring and control, increase the operator's safety by distancing the operator from the furnace. The use of advanced automated furnace tending systems that use industrial robots for temperature measurement, metal sampling, slagging, etc., do enhance the safety and prevent accidental losses.

7. **Electricals:** Exposed electric cables near the furnace and in areas where it is likely to come into contact with hot liquid metal poses a serious fire hazard. While the best solution would be to route cables away from such fire prone areas the alternatives would be to encase them in concrete or in metallic enclosures insulated with glass wool cladding in areas where cables

are laid near to furnaces at or below 2.0 metres of finished floor level. Further Induction/ Arc Furnace transformers that supply power for melting should be located at least 6 metres away from all surrounding buildings. Where this is not feasible all door and window openings of buildings within 6 metres of transformer shall be protected by single fire door and 6mm thick wired glasses in steel framework respectively. No work or storage should be carried out in close proximity of electrical cables / equipment. A reliable back up power supply that would be able to supply power to all the critical loads in a foundry and an overhead water tank that would be able to supply emergency cooling water for the furnace are positive features.

8. **Layout:** Design and layout of facility contributes a lot towards injury prevention. A well laid out facility would ensure that there is no crossover of different activities or process flow, material and product handling is carried out in restricted zones, machine-tools are located at safe distances away from walkways and other work areas, individual, enclosed workplaces are provided for fettling and grinding activities and Aisle ways are always maintained free of any type of storages.

9. **Safety Management:** Essential features of good safety management are having an emergency plan which addresses issues of molten metal splash, dust explosion, furnace explosion etc. and training and retraining of system operators carrying out melting, holding, transfer and pouring of metal in Safe Operating Procedures (SOP) which helps to ensure a safe working environment. Since the process involves generation of dust and fumes which seriously impact employees' health and activities which can give rise to injuries use of appropriate Personal Protective Equipment (PPE) / safety gear like leather shoes, leather apron, leather foundry hat, gloves, wire mesh face shield, and safety glasses would need to be enforced depending on the type of exposure.

10. **Fire Protection:** Protect the premises by a hydrant system installed in line with TAC regulations where stipulations for light hazard occupancy such as a foundry are provision of hydrant posts for every 60 m of external wall measurement provided at distances between 2 m and 15 m of from the face of the building. Additional considerations regarding hydrants for tank farms, storages in open, and hydrants for upper floors would however need to be additionally provided for.

2.0 Safety Quiz

1. **Water is extensively used in fighting fires because:**

a. It is good a solvent and so dissolves and washes many products of combustion such as ash which enables the fire fighter to access the seat of the fire.
b. It has high latent heat (~ 540 calories per gram) and can hence absorb tremendous amount of heat when converting from boiling liquid to steam.
c. It is cheap and abundantly available.
d. All of the Above

The technique used in extinguishing fires by removal of fuel either by cutting of the fuel supply or by physical removal of fuel is called?

a. Cooling
b. Smothering
c. Starvation
d. None of these

Which class of fire is fuelled by combustible metals and is usually extinguished with special chemical powders or foam?

a. Class B
b. Class C
c. Class D
d. None of the above

Main hazards associated with metal casting industries are:

a. Furnace explosions due to wet charges, charging of sealed containers, introduction of cold tools or materials that easily fragment, due to bridging entry of moisture contained in charge materials, into the Explosion in metal or slag due to water insertion.
b. Burns due to spillage of molten metal resulting from furnace explosions or operations such as tapping, pouring, tilting, or falling of ladle/ metal run out etc.
c. Respiratory and lung related diseases including lung cancer are major health hazards associated with foundry as substantial amounts of metal fumes and dusts are generated in various processes
d. All of the above

The accumulation of static electricity is less in high humidity situations and hence its effects are felt more during winter than in summer.

a. True
b. False

6. Effect of fire on human beings in form of burns are categorised as ‘first degree’, ‘second degree’ and ‘third degree’ burns. The value of heat radiation just sufficient enough to cause injury is

a. 4.7 kW/m2
b. 6.9 kW/m2
c. 10.5 kW/m2
d. 12.5 kW/m2

7. Failure of refractory lining before its predicted life takes place because of:

a. Installing a wrong refractory material for a particular application
b. Inadequate or improper installation of refractory material
c. Improper sintering of refractory material.
d. All of the above.

8. The Indian Electricity Rule requires that all electrical installations except low voltage ones below 5 KW should have ELCBs (Earth Leakage Circuit Breakers) installed

a. True
b. False

9. Substances that can be detonated and burst into flames when agitated, vibrated, struck or dropped are known as

a. Spontaneously combustible materials
b. Shock-sensitive materials
c. Reactive materials
d. All of the above

10. Non destructive testing is mainly used for detecting cracks and or determining the thickness or quality of weld or metal parts. Which one of the following test is an NDT?

a. Radiography

b. Magnetic particle

c. Dye penetrant

d. All of the above

Answers:

1	2	3	4	5	6	7	8	9	10
d	c	c	d	a	a	d	a	b	d

Wasim Khan
Senior Specialist – Risk Engineering
Bharti AXA General Insurance Company Limited, Mumbai

3.0 Loss Lessons – Fire in a Ferro Chrome manufacturing unit at Andhra Pradesh

Date & Time of Loss: August 23, 1993 - 20:30hrs

Occupancy: Manufacturing of High Carbon Ferro Chrome

Reported Loss: INR 60.0 Lakh

Premises:

The company is situated in Andhra Pradesh and is engaged in the manufacture of High Carbon Ferro Chrome used in steel industry. The unit has different blocks such as administrative block, Briquette plant, Briquette yard, Chrome storage yard, stores, Slag Storage yard, Coal Storage yard, 132KV and 11KV substations and a Laboratory. All these blocks are well separated from each other.

Process:

Chrome Ore is mixed with binder and then converted into briquettes. Chrome briquettes along with other raw materials are charged into an electric arc furnace. In the furnace, high temperature is generated using electrical energy and the chrome ore gets reduced to Ferro Chrome. Hot Ferro Chrome is tapped from the furnace and is cast as ingots.

Incident:

There was a failure of the oil circulation pump of the furnace transformer. Workmen engaged in replacing this oil circulation pump noticed a flash fire in the ACB on operating a push button control of this circuit breaker. Fire was simultaneously noticed in the cable trench near the 132/11 KV sub-station as also the oozing of oil from furnace transformer. One of the workmen immediately operated the emergency siren and alerted others regarding the outbreak of the fire. Flames were also noticed in the power transformer at the sub-station. First aid fire fighting with portable fire extinguishers was attempted but fire fighters were unable to go anywhere near the fire affected equipment. The public fire brigade was informed about the outbreak of fire. Besides the fire affected equipment related accessories like battery charger, SF6 circuit breakers, bus bars and cables were also severely damaged due to this fire incident.

Probable Causes of Loss:

Consequent to the failure of the oil circulation pump, the furnace transformer would have overheated and damaged its insulation. Damage to insulation can result in the occurrence of an internal fault (inter-turn or short circuit) in the transformer causing a very high fault current to flow through the circuit upstream of the fault till the faulty circuit is isolated from the power source through circuit breakers. Since the circuit breakers - the Air Circuit Breaker (ACB) and the Bulk Oil Circuit Breaker (BOCB) on the HT side did not operate in time either because of failure or faulty settings of the relays/ circuit breakers the fault current persisted for a longer than acceptable duration resulting in a fire that affected the equipment through which the fault current did flow, namely - the furnace transformer, the power transformer, the circuit breakers, bus bars and cables which had resulted in fires at ACB, bus bars, cable trench near 132/ 11 kV Sub-station, power transformer.

Loss Prevention Recommendations

1. All furnace transformers are to be provided with oil and winding temperature indicators/ alarm/ trip as well as bucholz relay and these are to be well maintained to ensure that high temperature alarms and trips are actuated at pre-determined temperature settings and bucholz relay is actuated for any incipient fault in the transformer.
2. Circuit Breakers and Protective Relays are to be periodically serviced and tested to ensure that they function without fail during an emergency.
3. Battery bank that provides power supply for the operation of protective relays is to be regularly checked and maintained to ensure the safe operation of relays and breakers during an emergency.
4. Provision of fire stops at every 50 meter length of outdoor cable trenches will prevent spread of fire through cables.
5. Inspection and maintenance of transformer to be carried out as per IS 10028 – (Part 3).

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Response Invite:

We invite your feedback on the contents and coverage we provide in our e-newsletter as also articles of interest on safety and loss prevention including fire loss case histories with loss lessons for publication over here. Your feedback and articles may please be sent to Risk.Engineering@bharti-axagi.co.in

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