**WORK INSTRUCTIONS FOR** **PIG CASTING MACHINE OPERATION**

**Responsibility: PCM in charge**

**Identified Hazards:**

1. Contact with hot metal
2. Fire & Explosion
3. Contact with hot metal due to ladle warping
4. Hot metal Ladle falling
5. Mech Impact Back hoe damage the overhead cable tray
6. Contact with steam
7. Entanglement/trapping
8. Fall of Pig
9. Contact with metal spark while cleaning the spout while pouring was on
10. Contact with metal spark, while dumping PCM consumable
11. Impact by PCM tools
12. Fall of a person
13. Impact of wheel loader to the PCM platform
14. Contact with hot ladle shell
15. Eye contact with lime powder
16. Impact or run over by moving machinery
17. Impact due to both hot metal crane collision.
18. Unwanted movement of equipment like tilter, hot metal crane etc.
19. Non use of PPE & WI
20. Improper house keeping
21. Inadequate local lighting
22. Throwing PCM dam jam without looking person all around
23. Puncture of ladle when it is full of hot metal.
24. Impact with moving machinery
25. heat
26. Vision impairment due to glare of metal
27. Dust inhalation causing lung diseases
28. sing cold powda during the scooping of dam
29. Burning due to contact of metal
30. Improper Securing Chain
31. Dis engagement of DS ladle transfer car wire rope before wheel loader moves in the area.
32. Non-working of limit switches of ladle transfer cars
33. Slip of person on walkways.
34. Contact with hot water
35. Contact with flying metal chips at PCM discharge end
37. Ladle puncture
38. Misjudging while lifting the pig
39. Overloading of crane
40. Overloading of Pig carrying truck
41. Metal Eruption during SSG
42. Fall of ladle

Significant Aspect:

1. Water consumption
2. Fire & Explosion
3. Emission of graphite
4. Emission of lime dust
5. Vehicle Emission
6. Water vapor Generation
7. Compressed Air consumption

**HOT METAL HANDLING**

1. Unauthorized operation or repair of any equipment is a punishable offence
2. PCM in charge should ensure that PCM operator wears all PPE namely safety overcoat, safety shoes, woolen Patti, leg guards, hand gloves & helmet with screen. Crane operator should wear safety helmet, safety shoes, safety spectacle & black goggle while pouring.
3. Unauthorized operation or repair of any equipment is a punishable offence.
4. PCM operator should ensure proper dam height for better siphoning and to prevent slag entry into the runner.
5. Operator should make pouring spout after each pouring or depending on condition of spout, during spout preparation PCM to be locked by LOTO lock.
6. Before pouring could be started, the operator should ensure ladle spout is clean so that metal flow into runner is not splashing.
7. Crane operator should ensure no personnel is working on PCM / PCM runner spout which will include discharge as well as the tail end of PCM before commencing of hot metal pouring
8. Crane operator should first start PCM by inching before commencing pouring to avoid metal spillage if PCM doesn’t start.
9. PCM in charge should ensure no person should pass under or by the side of the ladle when it is in hoisted position. Area should be cordoned and barricaded with chain.
10. No personnel should cross the runner when pouring is in progress.
11. PCM Engineer should ensure that water spray on the pig mould is sufficient enough & at the same time it should be ensured that there is no overflow of water on to the return moulds. Do not open/adjust water sprays on moulds by standing on the walkway of PCM since heated sprays could spray jets of hot water on the moulds resulting in splashing of hot metal and hot water.
12. Water for pigs cooling at PCM discharge end should be uniformly sprayed on hot pigs by controlling the flow through valve adjustment.
13. No person should be allowed to stand near PCM discharge end nor allowed to walk in the direction of steam, when cooling of pigs is in process.
14. Before lifting the jam with the help of monorail crane (3T), PCM in charge should ensure jam is loosened from both sides so that crane does not get overloaded.
15. Link chain (10mm) to be used for lifting the jam.
16. While removing runner jam of PCM 2 normal procedure as mentioned in serial no. 11 to be followed, but while lowering the runner jam the same should be done from the monorail PB control, which is placed near the PCM 2 staircase for better visibility.
17. PCM Incharge should ensure that Crane bay is barricaded with link chains all the time.
18. If it is required to remove barricades for any reason same should be conveyed to the crane operator of both the furnaces and area should be barricaded immediately after the job is over.
19. While pouring on cold PCM, Operator should ensure that lime powder is in stop position, start the pouring and fill the mould till discharge end wait for 2min. do not leave water, repeat this for first round, then continue normal pouring, to be done in presence of PCM in charge in coordination with bag house staff who will monitor the activity with safety/quality perspective in mind. At discharge end care to be taken to avoid splashing of molten metal. Precautions to be taken and area to be cordon off at discharge end to prevent unauthorized entry.
20. Do not park crane above D/S unit during D/S process to avoid damage of crane cables.
21. Do not stand or walk below moving crane.
22. During SG production(or addition in ladle process) no individual should come in vicinity of ladle till it is lifted by the crane after metal is transferred in the ladle & also during the pouring of hot metal

**Plate /roller jam Removal**

**Responsibility: PCM in charge**

**Identified Hazards:**

**1.** Fall of jam

2. Fall of person

3. Entangling with wire rope

4. Impact or run over by moving machineries (Wheel loader, truck & backhoe)

5. Contact with hot metal & hot sand

6. Imbalance while removing jam

7. Improper house keeping

1. PCM in charge should ensure people working on plate jam should wear safety goggles along with other PPE viz safety helmet, safety shoes, hand gloves and protective cloth clothing.
2. Unauthorized operation or repair of any equipment is a punishable offence.
3. PCM LAUNDER CRANE should be operated by trained operators only
4. Plate jams removal to be done only after stopping the pouring.
5. For roller and sprocket jams PCM is to be locked by lotto locks before removal of jams
6. Ensure that the men pulling the jam should always stand on the side of the jam plate and use proper hooks.
7. Ensure that sufficient amount of sand / granulated slag is put on the plate after removing the jam.
8. Maintain good housekeeping around the area.
9. Removed jam should not be piled up near PCM and should be shifted to skull stacking area in the magnet crane bay.
10. It should be ensured that removed jam from PCM3 are not touching transfer car rail, cable or limit switches
11. PCM in charge should ensure that that lotto locks are removed after the completion of the activity
12. Cracked moulds should be changed regularly to avoid any stickers, explosion & metal spillage.
13. While cleaning debris at PCM tail end manually due to space constraint use proper sized crow bar.

**Guidelines for hot metal crane operators**

**Identified Hazards:**

1. Ladle falling
2. Impact of ladle & contact with hot ladle
3. Glare of hot metal
4. Impact of 10 t crane to the people working in the cast house
5. Impact of crane to metal launder
6. Fall of material from top
7. Contact with hot metal
8. Fire & Explosion
9. Impact of crane to HMC columns, PCM runner platforms, ladle tilter structures.

**GUIDELINES:**

1. People involved in the activity should wear all PPE viz safety helmet, safety shoes, safety goggle.

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Unauthorized operation or repair of any equipment is a punishable offence.

1. All equipment and cranes to be operated by trained operators only.
2. Before starting first pouring of the shift operator should thoroughly check the crane Limit switch operation, wire rope, and any other abnormality. Any abnormality should be immediately brought to the notice of the in charge and the activity to be started after necessary clearances.
3. During use of PCM 3 ensure that ladle car is not parked in crane bay as metal sparks could damage the car.
4. Hot metal pouring to be started only after cleaning the ladle spouts and cleaning of PCM.
5. Overflow of metal to be restricted only to one mould to ensure clean pigs
6. Crane operator should ensure that the 10 t hook is hoisted to its max. While placing the ladle below the spout and also while removing it from there so that it should not cause any accident to the personnel working in the metal dam area.
7. Ladle should be taken out to the bag house only after third pouring, so that metal wastage is minimized.
8. After emptying of all the metal from ladle operator should check for 60T hook engagement. Ladle LT movement should also be restricted to avoid 60T hook disengagement when 10T hoist is engage. 10T hoist should be lowered fully so that the ladle is in full vertical position before cross travel of the ladle is initiated.

## Check the functioning of the emergency switch once in a shift, after emptying the ladle

1. Do not carry the ladle in horizontal position after pouring and tilting.
2. Do not carry the ladle over the other ladle.
3. Lower the 60T & 10T hooks to the minimum level before tilting the ladle, to reduce the pollution
4. All the cast house and PCM engineers should interact with the crane operators while placing and removing the ladle from the spout.
5. Stop the emergency switch at the crane control room, in case of any abnormal operation in any of the PCM related activity of the cranes and inform the concerned engineer.
6. Crane operator should not go out of the crane control room in case of power failure during night hours.
7. Ensure clear visibility of the ladle while transferring the hot metal from one ladle to other also ensure ladle should not touch the other ladle during the process. This activity should be done in the presence of the area in charge
8. Before starting the pouring PCM in charge should ensure that the PCM entrance from the main road towards coke shed is barricaded with chain at all entry points.
9. PCM control room glasses to be cleaned by dilute HCl acid solution once in general shift
10. If crane bay area is not barricaded same should be informed to PCM Incharge and crane operation should be done ensuring that crane bay is clear of wheel loader or worker movement.
11. If electrical or mechanical wants to work on crane during running furnace they have to carry remote and key. CO-Detector is required if crane is parked close to the furnace

Tilter Operation

Before putting ladle on tilter, PCM in charge should ensure that ladle spout pouring side is clean. Metal in the ladle should not be more than 33 T.

Operator should ensure that after placing ladle on tilter ladle trunion is locked with chain

Slowly lift ladle with help of gear operation

Pouring to be done only with gear operation

During emergency or excess metal flow fast operation can be used

Ensure that the debris chute is cleaned of all debris before pouring is started.

Ensure 3 times pouring to clear all metal from ladle

Before removing ladle from tilter ensure that trunion lock chain is removed..

No body including moving equipment/machinery should be close to the Tilter while it is in operation. All entry points should be cordoned off.

**REMOTE OPERATION**

1. Unauthorized operation or repair of any equipment is a punishable offence.
2. Before starting the activity remote with strap to be worn around the neck
3. Select the mode of operation i.e., Radio remote or cabin desk to be selected by selector switch provided on control desk in the cabin. Each crane operator should ensure that he is using the appropriate radio remote for the crane which he has been assigned to operate
4. All activities other than pouring (like transfer of hot metal from one ladle into the other ladle, placement of ladle below desulphurization unit & below metal spouts , long travels, specifically when pouring is taking place on tilter, movement of ladle transfer car,)should be carried out by remote operation, standing at a safe & visible distance..
5. Radio remote to be switched off while not in use also emergency button to be kept pressed in off position.
6. Remote to be handed over to the reliever or to be returned to the furnace control room after completion of shift duties.
7. In the event of radio remote malfunctioning and not responding.
8. The crane Operator can stop the crane by operating the “OFF” push button present on the Emergency radio remote. Emergency radio remote has been provided in addition to main remote so that the main power to the EOT crane is stopped and crane operation is thereby stopped.
9. The functioning of Emergency radio remote to be checked by operator in every shift
10. Additional radio remote has been mounted along with the main remote .Both the remote shall be to be maintained together all the time.



“OFF” button of Emergency radio remote

**Instructions for handling lime powder**

**Responsibility: PCM in charge**

**Identified Hazards:**

1. Contact with lime powder
2. Impact by moving machinery

**Significant Aspect:**

1. Generation of lime dust
2. Vehicle Emission

Procedure

1. People working on lime powder should wear dust protection goggles along with other PPE viz hand gloves, helmets, dust mask, safety shoes and long sleeves cotton shirt
2. Unauthorized operation or repair of any equipment is a punishable offence. .
3. In case burnt lime is to be added in PCM lime tank ensure that the people are aware of the change and fill the tank with the help of funnel having 12mm mesh. Before starting the activity people should smear coconut oil in their hands, legs and face.
4. Area at the pouring platform, lime powder tank discharge end and walkways should be kept clean & free from obstacles.
5. Damaged bags should not be taken out of stores
6. Proper care should be taken to avoid damage of lime bags during handling / unloading.
7. Wheel loader bucket should not be loaded with more than 60 bags of 30Kg capacity and operator should also ensure that his visibility is not blocked. On the lime tank only 30 bags of filled lime should be stacked at a time in proper manner.
8. Lime tank platform has to be barricaded after unloading the lime bags.
9. Lime solution specific gravity to be maintained from 1.15-1.20 units max.
10. PCM in charge should ensure that while taking lime solution sample for checking specific gravity, Lime stirrers of the respective PCM should be stopped and restarted after sampling is over.
11. Ensure that the lime stirrer & other moving equipment are covered with guard.
12. Ensure that the personnel working near the lime tank area are not wearing loose clothes towels, mufflers.
13. Used lime bags are to be stacked separately and to be sent to MCD for burning in the oven or to be sent to the stores as rubbish for disposal.
14. Loose bags or filled bags/ram coke fines to be used by using 10mm screen only to avoid chocking of lime spray.

(Point no.13 to be done in the general shift- Responsibility: Engr.Gen.Shift)

**REMOVAL OF PCM STICKERS.**

**RESPONSIBILITY- PCM IN CHARGE**

1. People working should wear safety plain glass goggle along with other PPE viz hand gloves, safety shoes, dust masks, helmet and ear plugs..
2. While removing the stickers ensure that there is no loading of pigs below discharge end.
3. Stickers are to be removed after every pouring.
4. Lime tray cleaning should not be done during sticker removal.
5. Stickers should not be removed while the PCM is in motion.

**CLEANING BELOW PCM**

**RESPONSIBILITY- PCM IN CHARGE**

1. People working near PCM should wear safety plain glass goggle along with other PPE viz hand gloves, helmets, safety shoes and long sleeves cotton shirt.
2. Unauthorized operation or repair of any equipment is a punishable offence.
3. Ensure that the PCM is stopped by LOTO locks before starting the activity
4. Pigs below the PCM collection chute, to be removed after every completion of pouring with the help of hook which is circled at the non-use end & loaded in the wheel loader. Care has to be taken to ensure safe distance from the other persons involved in the activity so as to avoid hurting / hitting the other person with the hook. Minimum distance to be ensured between shifters involved in removing pigs,
5. After every pouring pigs below the PCM should be collected in the respective cast.
6. Ensure no person goes below the pig collection chute opening for removal of pigs & chips during running of PCM.
7. PCM walkway and the area below are to be cleaned of lime, pigs & chips.
8. PCM in charge should ensure that that lotto locks are removed after the completion of the activity
9. While cleaning at PCM tail end, PCM in charge should ensure that cast is closed and no ladle to ladle metal transfer activity is done during tail end cleaning. Also put the sign board at this place.

THE FOLLOWING PREVENTIVE ACTIONS ARE REQUIRED TO BE FOLLOWED TO REDUCE SKULL GENERATION

**PREVENTIVE ACTION:**

1. If there is any breakdown in crane or maintenance. (Mech. /Elect.) persons are not able

to locate the problem, the furnace will be taken under shutdown to avoid taking the hot metal in emergency launder.

**Responsibility: Shift-in-charge**

1. Ensure proper alignment of moulds in PCM (Pig Casting Machine) to avoid spillage and production of undersize pigs.
2. Ensure PCM is tighten on regular basis to avoid metal spillages from gap.
3. Proper roller adjustment at pouring spout and changing of worn out rollers on regular basis.

**Responsibility: Mech. Maintenance**

1. Ladle has to be emptied completely by lowering the ladle in vertical position 2-3

Times (second and third pouring)

**Responsibility: PCM-in-charge**

Ensure Availability of moulds and replacement of cracked moulds.

**Responsibility: Mech. Maintenance/ PCM in-charge**

* **If pouring is simultaneously taking place on PCM1 & PCM2 (Tilter), operator should use the emergency walk way for exit which is provided near PCM2.**
* **While cleaning the PCM roof,** PCM Incharge should **ensure that the water does not fall on the moulds and should be covered properly with Silpaulin. This is required to prevent unnecessary cooling of moulds which may lead to stickers later.**

**PCM STRUCTURE, ROLLERS, WALKWAY, DEFLECTOR PLATE, PIG COLLECTING CHUTE CLEANING:**

**Identified Hazards:**

1.Contact with lime powder

2. Contact with metal chips

3. Impact by moving machine

4. Fall of person

**Significant Aspect:**

1. Generation of lime dust
2. Depletion of natural resources

**Procedure**

1. People working near PCM should wear safety plain glass goggle along with other PPE viz hand gloves, helmets, safety shoes and dust mask.
2. PCM in charge should hand over PCM which will be not in operation to PCM cleaning gang.
3. Lock the PCM by LOTO lock and key to be with PCM cleaning gang supervisor.
4. Deflector plate chippings to be removed with the help of small powda and lime powder to be cleaned with the help of water hose provided on PCM walkway, this is to be done twice in a day for each PCM.
5. Rollers, structure, walkway to be cleaned with the help of scrapers and then with the help of air hose pipe provided on PCM walkway.
6. Pig collecting chutes to be cleaned with the help of long crow bar.
7. After completion of cleaning activity, LOTO lock to be removed.

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| **Prepared By:**  Head – Production PID I | **Reviewed & Issued By:**  Management Representative | **Approved By:**  Head – Pig Iron Division |
| **Signature:** | **Signature:** | **Signature:** |
| **Date: 10.07.2023** | **Date: 10.07.2023** | **Date: 10.07.2023** |

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