Ref: WI/MAINT/10

1. **Work instructions BFG blower impeller cleaning**

Objective Old BFG blower impeller cleaning

Responsibility Mechanical Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism,Violation system

Chemical hazards CO gas poisoning

PRECHECKS

Take/ensure the work permit.

Ensure both suction & discharge ‘U’ seal is filled from operation department and drain valves is locked as per isolation procedure (LOTOV).

Ensure CO level near gland and at vent is zero by checking with portable CO monitor.

Take electrical shut down of the blower.

LOTO Box should be locked by each person with Isolation Keys inside LOTO box.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

**LTI - On 06/02/2022 at 12:00 PM 3 Anish Scaffolding workmen Mr. Manu Nag, Mr. Kunjay Naik, Mr. Lambodhar Naik, Mr. Sri ram (supervisor) who were engaged in scaffold erection as a part of boiler 1 tube replacement job became victim of gas leak. While, Mr. Manu Nag and Mr. Kunjay Naik resumed duty post observation at dispensary. Mr. Lambodhar Naik was referred to GMC Bambolim for further medical care where he was kept under observation for 24 Hrs and he joined duties next day**

PROCEDURE

Ensure proper electrical shutdown of the blower by personally visiting the Panel room & checking the breaker rack out condition. Also try attempting to start the blower by using local strt-stop push button to doubly ensure that the blower is under shutdown. After getting all clearance from operation department start to open inspection door.

Remove, clean and flush entire drain pipe.

Remove the IGV to air line and cylinder connection by C&I department.

Fix the lifting equipment like chain block, slings properly for removing IGV, Cone and ~~bellow~~ Distance piece.

Remove IGV, cone and distance piece.

Ensure that the BFG gas is isolated from suction & discharge side by 02 way isolation method in series i.e. Water-seal & valve or water-seal & dummy plate.

Start the cleaning of impeller and IGV with scrapper and buffing wheel using PPE nose mask, safety goggle.

After cleaning impeller by scrapper apply water wash on impeller.

Close inspection door and fix cone, IGV & distance piece.

Fix all the drain lines with proper tightening.

Gland packing tightening to be done.

Apply silicon sealant at the flange joint Wait for 30 minutes for curing of sealant.

Carry out air leak test with using compressed air, at 2 times the normal BFG working pressure at the suction/discharge of the blower.

Remove all tools and clean the equipment surrounding areas by removal of wastages.

Clean the Bearing housing and check the oil level if found low top up the same.

Check the coupling spring for any wear & tear, coupling bolt, nut, apply grease and proper guard arrangement.

Check the all foundation bolt of fan bearing housing and motor.

Check the cooling water circulation pump and line. Drop the water-seal. Mechanical Engineer In-charge to give the clearance to control room engineer by clearing the work permit, for taking trial.

After satisfactorily trial run handover the equipment to user department. In case any BFG leakage, high vibrations (> 10 mm/s) are observed then immediately stop the Blower & commence purging.

1. **Work instructions Servicing/Overhauling of BFG Blower**

Objective Servicing/Overhauling of BFG Blower

Responsibility Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism, Violation system

Chemical hazards CO gas poisoning

PRECHECKS

Take/ensure the work permit.

Ensure both suction & discharge ‘U’ seal is filled from operation department and isolated by LOTOV.

Ensure CO level near gland and at vent is zero from operation department.

Take electrical shut down of the blower.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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PROCEDURE

After getting all clearance from operation department start to open manhole.

Remove, clean and flush entire drain pipe.

Remove the Vibration probe, RTD and IGV connection by C&I department.

Fix the lifting equipment like chain block, slings properly for removing IGV, Cone and bellow.

Remove IGV, cone and suction bellow with the help of lifting equipment.

Before removal of impeller, loose the gland cover plate and remove gland packing, gland cooling line etc.,

Remove the impeller lock nut and impeller with the help of puller, hydraulic jack and start the impeller cleaning.

Remove the coupling guard and decouple the same.

Remove the fan bearing housing foundation bolt, lube oil connection line, oil level indicator and drain the complete oil.

Shift the bearing housing towards backward direction and remove from the casing with proper holding arrangement.

Remove the coupling with the help of puller, hydraulic jack, cutting set and hammer.

Before using cutting set safety precaution must be follow as instructed

During removal of coupling use all the necessary safety precaution.

After removal of coupling weight for few hours for cooling.

Remove bearing housing cover plate, bearing locking circlip and oil seal from the cover plate from both the bearing.

Remove the both end of bearing with the help of fabricated bracket, hydraulic jack and gas cutting set.

Clean the entire bearing housing, coupling and shaft with emery sheet, LDO thoroughly and start the assembly.

Fix the one end of bearing with the help of induction heater, heat the bearing up to required temperature and put the bearing circlip for locking.

Then lift the shaft with the help of chain block insert in to the bearing housing properly with checking clearance.

After matching the shaft in to bearing housing then slowly kept rest in to ground and then lift the same assembly in to reverse direction with proper supporting.

Fix the other end of bearing with the help of induction heater, heat the bearing up to required temperature and put the bearing circlip for locking.

While fixing both end of bearing put the bearing cover plate with proper gasket, oil seal, sealant and bolts.

Fix the coupling with the help of induction heater/ gas cutting set.

Put the gland seal follower on bearing housing shaft.

Fix the fan bearing housing assembly in to fan casing and put the foundation bolt with proper tightening.

Once the bearing housing fix into the position start the assembly of blower from suction side raise the cone and start the cone alignment with the impeller maintain the clearance on all corners up to 5mm.

After completion of cone alignment start assembly of bellow, IGV and all drains with proper tightening, proper gaskets and apply the silicon sealant for all joints.

Start the alignment work while maintaining air gap between couplings, providing the shim at the bottom of motor and maintain the alignment reading of both radial and axial below 0.05mm.

After completion of alignment work, tight the foundation bolt properly and start the couple with the help of coupling spring, cover with proper gasket and coupling guard.

Put the gland packing with proper tightening.

Fix the bearing housing oil level indicator, fill the lube oil up to middle level indicator and connect lube oil cooling system.

Take the air fill test for checking leakages if satisfy then give the clearance for trail run,

If trail run found satisfactorily then cancel the work permit by concerned engineer.

1. **Work instructions Gas cutting & welding work in the BF Gas system**

Objective Gas cutting & welding work in the BF Gas system

Responsibility Mechanical Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism,Violation system

Chemical hazards CO gas poisoning

PRECHECKS

Take/ensure the work permit and electrical shut down of the blower.

Ensure both ‘U’ seal at PID and of BF3 Gas line DG set and Boiler-2 U-seal is filled from operation department and isolated with LOTOV.

Ensure multi isolation in BFG system along with U-seal.

Complete BFG gas line isolation and complete air purging through boiler ID fan.

Vent should be open of before and after PID Shut Off Valve and BF3 Shut Off Valve near DG set of PP1.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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PROCEDURE.

Take clearance from production department for working on the Gas system.

Cutting/welding operation can be carried out on Gas system only during complete BFG shutdown and after complete purging through Boiler ID fan and after purging blower inspection doors should be kept open.

Workmen and engineer concern should ensure the Co level at the work place and proper circulation of fresh air at the work place.

Carry out the cutting/welding operation as per work procedure SP 44K, WI/MAINT/07,WI/MAINT/09.

After completion of job close all manholes, take trials and give clearance to the production department.

1. **Work instructions air leak test in the BF Gas system**

Objective : Procedure to carry out air leak off test

Scope : Air leak test.

Responsibility: Mechanical Engineer In charge

PPEs to be used : Helmet, Safety shoes, safety hand gloves, safety belt, CO monitor

**Aspect impact**

Dust generation Air Pollution

Compressed Air Wastage Resource Depletion

**Hazards identified**

Mechanical Hazard - Falling

Physical hazard – Air pressure

Chemical Hazard – BF Gas

Human Behavior--- improper housekeeping, Non PPEs, Alcoholism, system Violation.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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**Procedure**

* Ensure complete BFG isolation in blower system.
* After completion of box up commence to air fill test.
* Close all vent, drain line valve which was provided in system.
* Charge entire line by slowly filling of air and hold the line pressure 500 mmwc
* Check the any leakage in each joint by putting soap solution.
* Attend the leakage portion and ~~try the~~ repeats the same exercise.

1. **Work instructions for bfg U seal drain valve replacement and drip pot cleaning**

Objective U seal drain valve replacement and drip pot cleaning

Responsibility Mechanical Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism,Violation system

Chemical hazards CO gas poisoning

PRECHECKS

Take/ensure the work permit and electrical shut down of the blower.

Complete BFG gas line isolation has to be isolated by using U-seal and Valves.

Ensure U-seal prior to whose drain valve (i.e. At PID-1) has to be replaced is filled and drain valve of that U-seal is locked with LOTO.

BFG gas line PCV valve at PID-1 has to be isolated.

Ensure U-seal at other end (i.e. from BF-3 End is also filled and drain valve is locked with LOTO.

Complete air purging by using boiler ID fan.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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PROCEDURE;

Drip Pot cleaning:

After getting all clearance from operation department start the drip pot filling valve opening.

Check the line got chocked, if chocked try to hit pipe line manually by gun hammer.

If chock got not cleared close the close the drip pot filling line.

Start remove the drip pot bottom dummy and clean the entire wet dust or hard mud particle.

Flush the line completely by 10 to 15 min by opening water filling line.

After entire line flushing again put the dummy on drip pot bottom flange.

Fill the drip pots and overflow the same and give clearance to operation department.

Drain Valve Replacement:

For replacement of drain valve, ensure that U-seal is completely drained and purged by using ID fan and may be by compressed air. Check for presence of CO by opening U-seal vent valve.

After CO is found zero, drain valve can be removed by using spanners. If bolts are not getting opened, same can be cut by gas cutting and valve can be taken out.

Clean the U-seal by flushing with U-seal filling valve and may be by poking with rod.

Replace new Valve with new gasket and hardware. Fill U-seal with water and check for leakage. If no leakages found, normalize the Isolation.

Clear the work permit and give clearance to operation.

1. Work Instruction for Maintenance of Blowers and Fans

Objective Servicing of Blower and Fans

Responsibility Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism, Violation system

Chemical hazards CO gas poisoning in Area near Equipment

PRECHECKS

Take/ensure the work permit.

Ensure both suction & discharge valves are closed from operation department.

Ensure CO level in gas prone area is zero.

Take electrical Isolation of the Equipment.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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PROCEDURE

After getting all clearance from operation department start to open inspection door.

Inspect Impeller for any damage or crack.

Inspect coupling guard, its hardware. Remove the coupling guard and inspect the coupling for any abnormality.

Check for alignment and note the readings.

In case of resilient type coupling, check coupling spring. For any type of damage replace the same.

Replace old grease with new grease in coupling. Couple the equipment. Put back coupling guard with hardwares.

For Fan directly mounted on shaft, no coupling and its guard will exist.

For Pulley mounted Fan, Inspect bell and pulley condition. In case of belt looseness on pulley adjust the same.

For damaged belt replace with new one.

Inspect Fan and Motor Base bolts for tightness. In case of looseness, tighten the same.

Open top cover of Plummer Block check for tightness of lock nut.

Replace old grease with new grease. In case of oil lubricated, Check oil level, Drain 10% of oil and top up the same.

Refit the top cover of Plummer Block.

Check operation of IGV and Discharge Valve for freeness.

Check casing seal of shaft for any leakage or if damage gland packing, replace the same.

Normalize the Equipment.

Clear Electrical and Work Permit for Trial.

Note vibration during trial. Vibration should be less than 4 mm per sec.

1. **Work instructions Servicing/Overhauling of Fan and Blower**

Objective Servicing of Blower and Fans

Responsibility Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism, Violation system

Chemical hazards CO gas poisoning in Area near Equipment

PRECHECKS

Take/ensure the work permit.

Ensure both suction & discharge valves are closed from operation department.

Ensure CO level in gas prone area is zero.

Take electrical Isolation of the Equipment.

**Physical isolation/blanking to be provided to carry any activity on BFG gas line system by isolating complete BF gas sources from Pig iron Plant.**

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PROCEDURE

After getting all clearance from operation department start to open inspection door.

Inspect Impeller for any damage or crack.

Inspect coupling guard, its hardware. Remove the coupling guard and inspect the coupling for any abnormality.

Decouple the Fan from motor. Push back motor, such that sufficient space is available to remove coupling.

Remove Coupling with Puller, Hydraulic Jack. If Coupling is coming jammed, Heat with cutting set uniformly.

After coupling gets removed. Loosen the top cover of Plummer block of DE, Remove the base bolt of Housing at DE.

Loosen the locknut of bearing in housing.

Remove Bearing of Drive End with Puller or Chisel and Hammer.

Similarly remove Plummer Block and Bearing of NDE of Fan.

Install new bearing with grease in shaft and housing at NDE. Similarly install new bearing with grease in Plummer block housing and shaft of DE.

Fix both housing with base bolt at Pedestal. Tighten the bearing in Plummer Block with Locknut.

Before Tightening, Ensure side clearance of bearing and bearing should not be more than 0.05 mm.

Put Back Top Cover of Plummer block.

Install the Coupling into shaft of Fan if required by uniform heating the coupling.

Do the alignment of Fan with motor. Please note the readings.

Alignment reading should be +- 0.005mm. Max. Difference of 0.01 mm.

Couple the Equipment. Put back the guard.

Normalize the areas disturbed in Equipment.

Clear electrical isolation and take trial to ensure rotor in balance position.

During trail if rotor found unbalance that case balancing of same to be initiated by coordinating with operation and electrical department.

User must be write note on electrical permit before start the balancing and inform the operation department.

Permit requestor ensure in any work in blower area during balancing LOTO with individual isolation (one man one lock) available at site only.

Balancing each trail will be carried out under close coordination of site supervisor, DCS engineer and electrician.

After completion of blower balancing again electrical isolation ensure and start the blower box up.

In case of impeller replacement or leakage from casing flange, dismantle the casing.

Remove by using chain block. Check for gasket damage, if required replace the same.

Remove the impeller by dismantling casing suction cone. Remove the impeller put back the same with new impeller.

Take Trial and check Vibration reading. Same should be less than 3.0mm per sec.

1. **Dynamic Balancing of BFG Blowers and Fans**

Objective Balancing of BFG Blower

Responsibility Engineer in charge

PPEs to be used Helmet, Safety shoes, safety hand gloves, ear plugs and nose

mask

Aspect-Impact

Oil Spillage Land contamination, RESOURCE DEPLETION

Oil traced waste generation Land contamination & Resource Depletion

Generation of waste oil Generation of hazardous waste, resource depletion

Dust generation Air Pollution

Waste water Resource Depletion

Hazards Identified

Mechanical Hazard Slip, fall and trap

Physical hazard Noise,

Human behavior improper housekeeping, Non PPEs, Alcoholism, Violation system

Chemical hazards CO gas poisoning in Area near Equipment

PRECHECKS

Take/ensure the work permit.

In case of BFG Blower, Ensure suction and Discharge U-seal are filled and LOTO is applied from both operation and maintenance.

In case of FD Fans, Ensure Boiler Individual U-seal are filled and LOTO is applied. Also both IGV & discharge valves are closed from operation department and LOTO is applied.

Ensure CO level in gas prone area is zero.

Take electrical Isolation of the Equipment.

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PROCEDURE

User must be write note on electrical permit before start the balancing and inform the operation department.

Permit requestor has to ensure in any work in Fan and blower area during balancing, LOTO with individual isolation (one man one lock) available at site only.

Balancing each trail will be carried out under close coordination of site supervisor, DCS engineer and electrician.

In this case either the shaft should have been isolated, secured and at zero energy or the machine guard should have been in place.

Permits should not be issued before the relevant authority has physically verified isolation and zero energy at the site.

After getting all clearance from operation department and ensuring LOTO, start to open inspection door.

Inspect Impeller for any damage or crack or dust deposition.

If deposition of dust is found on impeller, clean the impeller thoroughly

Rotate the impeller to check the point of static unbalance and consequently identify the location for welding of trial mass. Trial mass is selected based on diameter and weight of impeller. Put reflecting sticker on impeller shaft for measuring the phase angle.

Balancing and similar activities to be done through non-driving end  or by making arrangement of small opening/slot in the guard itself, such that guard cannot be removed.

Close the inspection door, put dummy in both suction and Discharge duct.

Clear the electrical isolation after removing all the locks on LOTO box and panel.

Co-ordinate with control room Engineer for starting BFG Blower. Control room Engineer should consequently take clearance from shift electrical person (Technician/Engineer). Before starting Blower, Maintenance Engineer should ensure no-man is in line of fire. No loose material should be near equipment.

Take first set of trial reading. Note down the vibration and phase reading.

Stop the Blower/Fan and isolate the equipment. Bring LOTO Box back to site, ensure personal LOTO of each person working on balancing job.

Open the inspection door, weld the suitable size trial mass on identified location as suggested by CBM/Balancing Expert.

Close the inspection door. Clear the electrical isolation after communication with control room Engineer. Start the BFG blower along with co-ordination of both Desk Engineer and Shift electrical.

Take second set of reading which is based on trial weight.

Based on trial weight, vibration and phase reading is utilized for identification of correction weight.

Similarly repeat the process by welding correction weights at calculated phase angle recommended by balancing/CBM expert.

Process is repeated until the vibration reading is reduced below 3 mm/sec.

If Vibration is not reducing below 3 mm/sec, clean the impeller again, Attend any other recommendation suggested by CBM/Balancing expert.

After completion of blower/Fan balancing again electrically isolate the blower and start the blower box up.