## Appendix C

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## **Shutdown Manual**

### #1 Can and store brick, hooks and brick count

### #2 List of Pre-fab work for shutdown

### #3 Work required on boilers

#4 Inspect per-heater for required repairs

#5 Pre-shufdown survey for elevations and marking

#6 Inspect flat cars

### #7 Inspect reverb Lighting and Plugs

Whom Smelter Electricians Time: 4 to 6 weeks prior to shut down

List:

- 1) check all general lighting around the reverb and specify around the furnace
- 2) check all 120 volt receptacles in the reverb
- 3) check all 575 volt plug in the furnace area
- ) assist in compiling a list of temporary lights needed for the shutdown and determining where they should be fed from
- 5) assist in determining the 575 volt needs (Grantomatic Welder, Bricksaws, etc) and where they could be fed from
- 6) make extension cords, 575 and 120 volt as well as welding leads prior to shutdown

### #8 Identify area clean up required

#9 Draw up doghouse

### #10 Make up feed blend for furnace shutdown

### #11 Burn furnace bottom and uptakes for furnace shutdown

Furnace Bottom:

Take bottom measurement one month prior to shutdown.

- Review measurements and establish where areas need burning down.
  - Set up a program of adding cast to areas that need burning down.
    - As burning is carried out, keep an eye on the slag. If slag starts to get heavy, add ferre silicate at the slag launder.

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Continue to take bottom measurements once per week and establish where burning the bottom is required.

otakes:

- Inspect the uptakes through the ash chamber doors; up take doors and bricks removed from Y of uptake.
- Identify areas in uptakes that require burning. Choose the uptake that requires the most Immediate attention.
- Using the uptake burner, burn down any high spots in uptakes.
- Review burning requirements each day.
- Once one uptake is burned out, start burning in the other uptake. When complete switch back to the first uptake for final burn out.

### <u>#12 Prepare large matte hole for final matte taps</u>

- With in one month of shutdown, a block requiring replacement would be left in place. Matte will be tapped on the other hole until shutdown.
- This large hole should be tapped for a few matte very near shutdown to ensure that it can be opened when needed.
- When tapping the last matte from the furnace, switch to the larger hole for the final matte tapped.
- #13 Prepare storage area for last matte

### <u>#14 Converter pit track in and cleaned</u>

### <u>#15 Prepare #2 dope car for lifting hopper covers</u>

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<u>#16 Clean entire feed belt line</u>

### #17 Area in front of furnace cleaned or all dope and sand

### #18 Blow off Reverb Baghouse, Baghouse Hopper and Beams

Three days prior to shutdown, the arch blower is to start blowing off the very top of the reverb bag-house. The first day, the entire bag-house, bag-house landing and piping is to be blown off to get rid of the majority of the built up dust. The next shift the bag-house, all support steel, piping, and landings is to be blown off as much as possible. Extra care must be taken to ensure that everything around the bag-house is blown off, as this will be the final cleaning of the bag-house area before the furnace is shut down.

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### #19 Remove air hoses and horns etc.

On the last 12-hour shift prior to shutdown all air horns, hoses, blowpipes are to be removed from the \_\_\_\_\_\_ch, uptakes, and walls. Hoses to be rolled up and brought down off the arch/uptakes. Horns also to be removed and stored for future use. Any horns found not working to be marked and sent out for repair

### #20 Remove tie up low pressure air pipes and flex hoses

### # 21 Clean and prepare calcine floor

Have calcine floor clean and clear of all garbage, hoses, brick, and bars etc. ready for shutdown

### # 22 Area in front of furnace cleaned of all dope and sand

### #23 Converter ladles with shells prepared for start up

#24 Clean debris from arch

#25 Service brick rollers

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<u>'26 Service scaffold stands</u>

### <u>#27Procure fire hoses and nozzles</u>

### #28 Cut feed and fettling to furnace

### Run out roster feed hoppers and roasters

### #2 & #3 Tap out all slag and Matte

At the determined time for the fire to be turned off of the reverb furnace notify the reverb boilers that the fire to the reverb furnace is going to be turned off.

Using the D.C.S. control system turn the oil valve controls on the reverb furnace to 0% valve opening by

- 1) Select the burner to be turned down.
- 2) Select the oil control screen "C"
- 3) Turn the control of valve to manual by pressing ALT. M if the valve is in the automatic mode.
- 4) Activate the control of the valve by pushing ALT. O.
- 5) Using the number keypad enter 0% and hit enter. The valve will now close.
- 6) As soon as the automatic oil valve has closed attach the steam line in the maxon room to the burner to be steamed out.
- 7) Open the value in between the steam line and the burner line and then open the steam value that feeds the steam hose.
- 8) Allow the steam to flow through the burner for about five minutes.
- 9) Turn off the steam valve and the oil line valve.
- 10) The burner is now steamed clean and is ready for the removal procedure.
- 11) Continue this procedure with the rest of the burners.

### Elevate reverb firing rate

Once the slag has been tapped off and after checking the condition of the arch/bullnose, the fire can be elevated. You do not want to put too much fire on all at once, since it will still take some time to tape the furnace down. The rate of raising the fire will depend on how long it will take to empty the furnace, condition of arch, walls and bullnose. Make sure the water is not turned off wall blocks to early as they will smelt fast. Make sure that the powerhouse is kept informed of all increases.

#5 Turn water off to the blocks

#### #6 Remove job burner and up take burner

- A) Remove uptake burner:
- 1. Phone powerhouse at 2598 or 2408 and let them know that you are shutting down the burner
- 2. Go to burner #1 on computer screen (F1 or A)
- 3. On screen will snow boxes CDE letters in red (oil flow). Press "C" on keypad which will put you in box C which should be outlined in white after "C" is pressed.
- Check bottom of white boxed area to see if showing either Auto or Manual. If in auto press
  ALT S which will show TRGT set. Make sure you hold down ALT button while pressing the letter "O".
  - 5 Press number 0 button than enter, which should drop your numerical value to 0 and shut oil off to burner.
- After oil has been shut off on computer go to the sough east corner of the oil room. Two valves are situated on the horizontal line running south, (#1 oil line). The steam should be up on the valve directly on the line, rotate the valve until the steam lowers to the valve. Attach the steam line (flexible metal hose) to the oil line through the opening on the valve line, which is facing

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east. Make sure the screw clamps are tightened firmly with a pipe wrench before applying steam. Open the steam line valve fully (the one located on the oil line). The steam should be fully moved up. Now open the steam line valve, which is located on the other end of the flexible metal line (south middle of the five valves). Open the valve until steam is up. You should now have steam going through the line and burner.

- Go to the uptake burner (a length of tube with two valves pointing directly into the furnace) which is located at the north East End of the furnace. Turn the air off the burner, (the larger of the two lines going into the burner). Pull the burner out of the furnace; (make sure the nozzle is pointed in a safe direction). Check to see if steam is coming out of the nozzle end. If the steam is present, partially close the steam line nozzle end, (smaller of the two lines going into the burner back into the furnace. Secure the burner and turn the air back on. After putting the burner back into the furnace, go back to the oil room and shut off the steam. Make sure you turn the steam valve line off before shutting off the steam line going into the oil line. After shutting off the steam line in the oil room go back to the uptake burner and turn the air off on uptake burner. Pull the burner out of the furnace, (pointing the nozzle of the burner in a safe direction); open the steam line on the burner to drain all the steam. Trace the airline (flexible rubber hose) to its source and shut off that valve. Go back to the burner (make sure the nozzle is pointed in a safe direction) open the airline on the burner to drain airline. Using a crescent wrench remove both hoses from the burner and store the burner in a safe location.
- Note: (Before doing any of the work above, make sure you are wearing all required Personnel protective equipment.)

Remove job burner:

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1. Bring up burner #4 on the computer screen (F4 or D buttons)

- 2. On screen will snow boxes CDE letters in red (oil flow). Press "C" on keypad which will put you in box C which should be outlined in white after "C" is pressed.
- Check bottom of white boxed area to see if showing either Auto or Manual. If in auto press ALT S, which will show TRGT, set. Make sure you hold down ALT button while pressing the letter "O".
- 4. Press number 0 button than enter, which should drop your numerical value to 0 and shut oil off to burner.
- 5. After oil has been shut off on the computer go to the south wall of the oil room and shut off valves
- On top line that runs east west or #4 burner oil line. Put steam line on valve that is far right of the 5 valves where steam line (metal flexible hose) runs off of. Open far right valve located on #4 oil line. Open steam line valve that is located behind the valve you just opened on the oil line. Now open main steam line than follow procedures 5 & 6 for uptake burner. Burner is located middle of north side of furnace at jog.

Note: After steaming out lines and guns put them in the reverb office upstairs for storage.

### #7 Shut down O2 and remove lances and cap them

### #8 Shut down pre-heater

Turn to stop position, purge the gun out, pull gun, and pull breaker

### #9 Shutting down Fire

At the determined time for the fire to be turned off of the reverb furnace notify the reverb boilers that the fire to the reverb furnace is going to be turned off.

Using the D.C.S. control system turn the oil valve controls on the reverb furnace to 0% valve opening by Select the burner to be turned down.

- 3. Turn the control of valve to manual by pressing ALT. M if the valve is in the automatic mode.
- 4. Activate the control of the valve by pushing ALT. O.
- 5. Using the number keypad enter 0% and hit enter. The valve will now close.
- 6. As soon as the automatic oil valve has closed attach the steam line in the maxon room to the burner to be steamed out.
- 7. Open the valve in between the steam line and the burner line and then open the steam valve that feeds the steam hose.
- 8. Allow the steam to flow through the burner for about five minutes.
- 9. Turn off the steam valve and the oil line valve.
- 10. The burner is now steamed clean and is ready for the removal procedure.
- 11. Continue this procedure with the rest of the burners.

### #10 Steam out all oil lines

### #11 Raise dampers & hoist

#### #12 Shut down cooling air

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Make sure both north and south low-pressure air fans are shut down prior to the furnace going down. The sooner we can shut them down the better; this will allow us to smelt whatever we can off the  $\mu$ valls.

#### Tear down Furnace

- #1 Remove arch fans
- #2 Remove feed gate actuators
- <u>#3 Remove calcine vent fan pipes</u>

#### #4 Remove feed hopper covers and floor plates

- Using #2 dope car, attach strong arm and chain block to lift covers
- Attach hopper cover lifter to chain block and remove covers. Store covers on floor north side of battery room.
- Using the bob cat, attach chains to I bolts on floor plates and remove. Store with hopper covers.
- <u>#5 Remove converter slag launder</u>
- <u>#6 Remove slag drill</u>
- <u>#7 Remove slag launders</u>
- <u>#8</u> Clean out boilers and haul boiler ash
- <u>#9 Knock cooling holes in furnace walls</u>
- <u>#10 Wash down furnace</u>

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- Four fire hoses are used to wash down furnace. Attach 2 hoses to hydrant at front of furnace located on the north West Side of landing. Attach 2 hoses to hydrant located on the east wall of the slag tapping area.
- Using 2 fire hoses start at the West End and wash calcine floor from west to the middle. Using 2 fire hoses start at East End and wash calcine floor from west to middle. After floor is washed down, start at west and East End of furnace and wash down uptakes, beams and arch brick.
- <u>#11 Remove mud qun</u>
- #12 Disconnect all piping, water, oil, and steam
- <u>#13 Disassemble reverb burners and remove</u>
- <u>#14 Remove matte launders</u>

#### #15 Tear down arch & uptakes

- Using bar hooks, knock in arch brick by lifting brick hooks off pipe hangers and drop into furnace. Start at West End of furnace on flat part of arch between feed hoppers. Ensure that all hooks are removed from pipe hangers.
- Using bar hooks, starting at the West End of the furnace, knock in slopes of arch on both north and south side of furnace working from feed floor.
- After the arch is down, remove brick and hooks from pipe hangers on the north and south uptakes. Start at the damper level and work down.

#### #16 Remove front walkway

#### #17 Tear down walls

- Starting at the West End of the furnace, knock in north and south walls of furnace using machine. Remove wall from the top down. Check brick width and stop knocking wall down when 24' of wall-brick is measured.
- Using the machine, bush water blocks into furnace on east wall. After all blocks are down, remove blocks from furnace and dump them in the Converter Pit. Arrange to have blocks removed from front of furnace and store in Pit area for copper recovery.
- Using the large forklift, attach a sling to burner blocks at West End of furnace and pull out into the Converter Pit area. Arrange to have blocks removed from front of furnace and store in Pit area for copper recovery.
- Using the machine remove south wall in the matte area. Ensure that all straps have been removed on water blocks. Knock in brick wall and blocks will fall into furnace. Remove blocks from furnace and dump them in the Converter Pit. Arrange to have blocks removed from front of furnace and store in Pit area for copper recovery.

#### <u>#18 Remove matte jackets and inspect</u>

#### <u>#19 Clean brick from inside furnace</u>

## <u>#20 Cut down, save and store all feed pipes, fettling pipes, dust pipes, drop pipes</u>

During the demolition of the arch and walls smex will be cutting and dropping feed pipes, fettling pipes, dust pipes and drop pipes into the furnace which will become mixed in with the debris. Before and during the removal of brick, all feed

pipes, fettling pipes, dust pipes and drop pipes must be pulled out and saved. They will be set aside outside on pallets and will be picked up and taken away for repair. These pipes will be brought back and re-hung, when the furnace is being put back together.

#### #21 Remove and repair feed gates

Same as #20.

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#### #22 Demolish bull nose, vertical wall and 2 uptake bull nose #23 Remove uptake build up and walls

#24 Remove 6" water line over the slag holes

#25 Clean per-heater

### #2 Assemble north and south walls

### #3 Install furnace center line and repair bent nut

#4 Install boiler bulkheads

### **#5** \_\_\_\_REVERB FURNACE BULLNOSE INSTALLATION PROCEDURE

#### Procedure Revision Record

- Draft revision: S.D. Graham, May 1, 2000
- Revision A: issued to Smelter Dept. for review/comment; S.D. Graham, May 5, 2000
- Revision 0: issued to Smelter Dept. for construction; S.D. Graham, May 31, 2000

#### **Definitions**

The following definitions reference M.H. Detrick Co. drawing P-29941 rev. 4 (HBMS Plant Engineering foreign file JJ-256)

- fastener refers to a 5/8" [] x 3" long hex head bolt c/w hex nut and flat.washer
- hangar refers to casting no. OHC15 (this identification number is normally on the casting, typical)
- boat keel refers to casting no. FEOH31LP
- paddle refers to casting no. OHLP
- clip refers to casting no. BT10C
- expansion spacer material (there will be no identification marks on these). This material will replace the corrugated iron roofing expansion plates shown on the drawing.

### Ordering Checklist

6 months prior to the shutdown:

- determine the useable castings from the previous shutdowns (the castings may have to be cleaned)
- determine the useable brick from the previous shutdowns
- place orders for the required castings (the castings have a long delivery time)
- place orders for the required brick including the H18 and H15 brick
- determine the type of expansion spacer material (for the 2000 Shutdown, this material is <sup>1</sup>/<sub>4</sub>" thick plywood or particle board)
  - order the expansion spacer material.

### **Tools Required**

- 12" crescent wrenches
- 8" to 9" side wire cutter pliers
- utility knives
- tape measures
- marking chalk
- flashlights
- 1<sup>1</sup>/<sub>2</sub>" x 3/16" x 12" long flat iron sharpened to a chisel point at one end.

### Preparation

Expedite the castings, brick and expansion spacer material orders to assure arrival 2 months before shutdown

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- inspect and count the castings, brick and expansion spacer material on delivery to assure the correct and count and integrity
- store the castings, brick and expansion spacers under weatherproof cover. The brick must stay dry.
- All the bullnose brick is to be stored together in the same location. Label the brick pallets that they are for the furnace bullnose
- obtain 74 18" uncanned brick (H18) and store with the bullnose brick
- obtain 24 units (cans) 15" canned brick (H15) c/w 6" hooks (i.e.: 24 15 x 6) and store with the bullnose brick
- obtain 50 fasteners
- obtain at least 4 prints of the above noted drawing (2 for the dayshift crew and 2 for the nightshift crew). Get the appropriate sections of the prints plasticized
- all the bullnose installation supervisors are to meet to review the drawing and the procedure prior to shutdown. Also view the castings and brick for familiarity
- trial fit the paddles onto the boat keels to confirm the paddles fit correctly, they lock into place and the east flat face of each paddle hangs vertically. Burrs may have to be removed to allow this.

### Bullnose Rebuild - Castings Installation

- Keep the work area clean of debris, empty pallets, tripping hazards, etc.
- depending on the height of the bullnose above the furnace bottom, arrange for a scaffold to be built to access the bullnose
- deliver all the castings to the furnace slag end between the slag bays leaving room for the brick pallets and expansion spacer material (to be delivered later)
- remove the old hangars from the old boat keels
- remove the old paddles from the old boat keels
- inspect the old boat keels and remove any which show any damage or severe corrosion paying particular attention to the various attachment points. Indicate the location on the drawing which castings are removed
- inspect the old clips and note/mark those requiring replacement
- remove the old castings from inside the furnace
- using the sharpened chisel point flat iron, clean the lower flange (both sides, top and bottom) of the steel bullnose support beam in the immediate vicinity (about 1 inch on either side) of the removed boat keels and the remaining boat keels. This is to provide rough setting locations for the new boat keels and allows repositioning of the existing castings
- clean the flange and the paddle areas of the old boat keels remaining on the bullnose beam
- hang the new boat keels in the gaps on the bullnose beam

- remove/replace all the fasteners (nut and washer to be on the bottom) and the defective clips one boat

- keel at a time. The boat keels hang loose when not bolted and could fall; the headroom in this area is usually restricted. A washer may have to be inserted between the boat keel and the clip. Tighten the fasteners finger tight only. Collect all the used fasteners for disposal
- rough set the boat keels parallel to each other
- install a paddle onto each boat keel so it locks into place. Make sure the east face of each paddle hangs vertically. Burrs may have to be removed to allow this. The boat keel may have to be replaced if a proper fit with the paddle can not be obtained. The paddle may have to be held in place until the brick is installed against it
- dispose of the used fasteners.

### Bullnose Rebuild - Brick Installation

- Keep the work area clean of debris, empty pallets, tripping hazards, etc.
- establish the centerline of the furnace by referring to the horizontal east-west steel beam overhead at the
- bottom of the uptake vee
  - the brick can now be hung north and south from the furnace centerline
- deliver all the bullnose, the uncanned H18 and the H15 canned brick to the furnace slag end between the slag bays and lay out the pallets one pallet high with access room between them

have the pipe installation crew inspect the 4 short east-west pipes and their support rods under the furnace centreline and repair/replace them as required

- hang the 24 – 15 x 6 (H15) canned brick under the furnace centreline on the 4 short east-west pipes (2 pipes on each side of the centreline): 3 cans east-west by 4 cans north-south (on each side of the centreline)

- with the westerly most surface of the west brick row flush with the west surface of the to be installed H18L and H18R bullnose brick. The brick should be installed one row east-west at a time. Each brick can is to hang vertical and be flush and in full contact with the adjoining brick can. See the drawing Sections "B-B" and "E-E"
- the brick can now be hung on the boat keels
- build the bullnose one complete row of brick across at a time to maintain the centreline
- for each boat keel, select one H18L brick, one H18R brick and one hangar
- starting on each side of the centreline, slip the hangar onto the flange of the boat keel and slide it down
- install the appropriate brick onto the hangar with the cutout in the brick facing the paddle
- slide the brick and the hangar into position against the paddle
- support the installed brick to prevent it from falling and hang its mate onto the hangar
- view the two bricks from all directions and balance/straighten them. Each brick is to be flush and in full contact with the adjoining brick except where an expansion spacer is to be installed
- starting after the sixth 18" (H18L and H18R) brick from the 15 x 6 (H15) canned brick on each side of the furnace centreline, and every 6 brick thereafter, install a vertical 18" x 9" expansion spacer parallel to the furnace centreline with the west edge flush with the west surface of the 18" brick
- when hanging these H18L and H18R brick near the furnace side walls, trim the slag/buildup as required to fit in a pair of brick
- repeat the above steps to install a row of H18 brick
- repeat the above steps to install a row of DH5 brick
- as the DH5 brick is being installed, slip in a 15" x 18" expansion spacer between the H18 and the DH5 bricks. The expansion spacer should be hidden by the brick
- measure the distance between the back to back (west side) of the boat keels and reposition the front (east side) of same to these measurements as required
- tighten all the boat keel to clip fasteners
- for the installation of the 4 brick (2 boat keels) on either side (north and south) of the 15 x 6 canned brick, see the drawing Section "B-B", Detail "A" (Section "C-C" is not used for the HBMS furnace bullnose) and the tile legend
- for the installation of all the other DH5 brick on the remaining boat keels, see the drawing Sections "A-A", "B-B" and the tile legend
- following the above steps, complete the installation of the bullnose remembering to install the expansion
  - the bullnose brick installation stops at the top of the boat keels
  - the furnace bullnose installation is now complete
  - sort the old castings, keep the re-useable ones and dispose of the damaged ones
  - remove all the castings (re-useable old and unused), the unused brick and expansion spacers to a weatherproof secure storage location for use in future shutdowns
  - count the number of castings, brick and expansion spacers and document these and their storage location
  - deliver the remaining unused fasteners to the Smelter mechanics shop bins
  - return the unmarked prints to the shutdown coordinator for use in future shutdowns
  - return the marked-up print(s) to the shutdown coordinator for use in compiling the shutdown report.

### 6 Install vertical wall

#7 Sand reverb bottom

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### #8 Straighten and replace arch hanging pipes

### #9 Install boiler bull noses

### #10 Clean bull nose cooling pipe

# #11 Assemble Slag, Matte and Burner wall install expansion joints, follow drawings

### PROCEDURE FOR EAST WALL BLOCK ASSEMBLY

- I- USING JCD-0030 SECTION C-C, MEASURE DOWN FROM ESTABLISHED PIN MARKS THE BRICKLAYERS WOULD MARK THE NEW BASE ELEVATION AND REPAIR THE BASE FOR THE BLOCKS. THE NEW ELEVATION FOR THE BASE IS FOUND IN THE BOTTOM RIGHT HAND CORNER OF THE DRAWING.
- 2- FIND THE MARK FOR THE CENTER POINT OF THE FURNACE WALL.
- 3- USING DRAWING JCD-0030 ASSEMBLE THE EAST WALL OF THE FURNACE.
- A- USING A TOWMOTOR WITH THE EXTENDED BOOM AND A TWO TON ELECTRIC HOIST MOVE THE J-1497L AND RS AND THE J-1497AL AND AR FAR ENOUGH INTO THE FURNACE THAT THEY WILL NOT INTERFERE WITH THE WALL ASSEMBLY.
- 3- POSITION ONE J-1497C AND J-1497BL AS FAR TO THE NORTH AS YOU CAN AND ONE J-1497C AND J-1497BR AS FAR TO THE SOUTH AS YOU CAN REACH.
  - C- INSTALL THE TWO J-1497BLS AND THE TWO J-1497BRS ON EACH SIDE OF THE CENTERLINE AS PER DRAWING.HAVE SMEX WELD THEM TOGETHER WITH CLIPS. THEY MUST BE WELDED TO THE INSIDE FACE OF THE WALL.2 INCH SPLITS MUST BE INSERTED ON THE CENTER LINE BETWEEN J1497BL AND J-1497BR.

D- INSTALL J-1497CS TO THE NORTH AND SOUTH OF THE FOUR BLOCKS IN POSITION. 2- TWO-INCH SPLITS MUST BE INSERTED ON BOTH SIDES OF THE SOUTH TAPPING BLOCK.3-TWO INCH SPLITS MUST BE INSERTED ON THE SOUTH SIDE OF THE NORTH SLAG TAPPING BLOCK AND 2-TWO INCH SPLITS MUST BE INSERTED ON THE NORTH SIDE. DO NOT CLIP THESE BLOCKS, AS THEY WILL HAVE TO BE REPLACED DURING THE FURNACE CAMPAIGN.

- E- INSTALL J-1497BR AND BL.
- F- INSERT A ROW OF ONE- INCH SPLITS ACROSS THE TOP OF THE BASE ROW OF BLOCKS. THE SPLITS SHOULD BE PUT IN JUST AHEAD OF EACH BLOCK AS THE BLOCK IS INSTALLED.
- G- START INSTALLING THE BLOCKS AS PER DRAWING STARTING AT THE CENTER POINT AND WORKING OUT TO BOTH ENDS. NO FURTHER USE OF SPLITS IS REQUIRED WELD CLIPS TO THE ADJACENT BLOCK AND THE BLOCK BELOW TO HOLD THE WALL TOGETHER
- H- THESE BLOCKS WILL BE RIGGED INTO PLACE WITH AN AIR TUGGER. NOTE THE BLOCK PIPE PATTERN IS INSTALLED AS PER DRAWING.

I- INSTALL THE TOP ROW OF BLOCKS FOLLOWING THE PATTERN SHOWN ON THE DRAWING. 5. WELD CLIPS TO THE BLOCK BELOW AND THE BLOCK ADJACENT.

TURN OVER TO THE BRICKLAYERS TO BRICK IN BEHIND.

### PROCEEDURE FOR ASSEMBLING SOUTH REVERB WALL BLOCKS

USING DRAWINGJCD-0030-C, SECTION B-B ESTABLISHES THE ELEVATIONS FOR THE BOTTOMS OF THE CAST BLOCKS AND THE WALL TILE BLOCKS. THE DESIRED ELEVATIONS ARE LISTED IN THE TABLE AT THE BOTTOM RIGHT CORNER OF THE DRAWING

- 1- . THE ELEVATION FOR THE BOTTOM OF THE CAST BLOCKS IS ESTABLISHED BY MEASURING DOWN FROM THE ELEVATION PINS ON THE VERTICAL BUCKSTAYS ON EACH SIDE OF EACH MATTE CHUTE SUBTRACT THE DESIRED ELEVATION, FROM THE PIN ELEVATION TO GET THE DISTANCE TO MEASURE DOWN. RUN A STRING FROM THE MARK ON THE BUCKSTAY ON THE LEFT SIDE OF THE CHUTE TO THE MARK ON THE BUCKSTAY ON THE RIGHT SIDE OF THE CHUTE. THIS WILL ESTABLISH THE HORIZONTAL LINE FOR THE INSTALLATION OF THE CAST BLOCK.
- 2- THE CAST BLOCK MUST BE PLUMMED VERTICALLY ON IT'S END AND IT'S FACE. SHIMS MAY BE WELDED BETWEEN THE BLOCK AND THE BUCKSTAY TO HOLD THE BLOCK IN A PLUM POSITION.
- THE WEST EDGE OF THE BUCKSTAY ON THE West Side OF THE MATTE CHUTE IS USED TO ESTABLISH THE VERTICAL LINE EAST-WEST FOR THE CAST BLOCK. BECAUSE THE BUCKSTAYS ARE WARPED A PLUM LINE WILL BE REQUIRED TO LINE UP THE CAST
   BLOCK VERTICALLY NORTH AND SOUTH. A SUPPORT BEAM IS INTALLED HORIZONTALLY NORTH-SOUTH FROM BUCKSTAY TO BUCKSTAY A VERTICAL BEAM IS MOUNTED ALONG THE EASTSIDE OF THE BLOCK FROM THE HORIZONTAL BEAM DOWNTO SUPPORT THE BLOCK PLUM. THE HORIZONTAL AND VERTICAL BEAMS TO BE INSTALLED ARE SHOWN ON DRAWING J-1836.
- 4- BOTH CAST BLOCKS CAN BE INSTALLED FOLLOWING THE SAME STEPS.
- 5- THE BRICKLAYERS WILL THEN BRICK IN AROUND AND BEHIND THE CAST BLOCKS. THEY WILL BUILD UP THE WALLS TO THE ELEVATION OF THE BOTTOM OF THE WALL TILE AND THE WATERCOOLED COPPER BLOCKS.THIS ELEVATION CAN BE ESTABLISHED BY MEASURING UP FROM THE PIN ELEVATIONS FOUND ON THE THREE MATTE BUCKSTAYS TO THE DESIRED ELEVATION FOUND ON TABLE 1 IN THE BOTTOM RIGHT HAND CORNER OF THE DRAWING.
- 6- TO INSTALL THE WATER-COOLED COPPER BLOCKS USE DRAWING JCD-0030 SECTION B-B.TAKE BLOCK J-1836L. MEASURING FROM THE WEST EDGE, MAKE A VERTICAL LINE 14.5 INCHESFROM THE WEST EDGE.LINE UP THE MARK ON THE BLOCK UP WITH THE LEFT EDGE OF THE WEST MATTE BUCKSTAY. WELD THIS BLOCK INTO POSITION. FROM THIS POINT YOU CAN INSTALL THE OTHER 9 BLOCKS FOLLOWING THE DRAWING.

### → ROCEDURE FOR REVERB WEST WALL BLOCK ASSEMBLY

1- ÚSING DRAWING JCD-0030 SECTION A-A BRICKLAYERS WILL FIND THE MARKS ÉSTABLISHED PRIOR TO SHUTDOWN ON BUCKSTAYS, AND ESTABLISH MARKS FOR THE BLOCK BASE. THE BRICKLAYERS WOULD REPAIR THE BASE FOR THE BLOCKS.

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-TO ESTABLISH NORTH/ SOUTH LINE FOR BLOCKS, RUN A LINE FROM THE NORTH MOST BEAM TO THE SOUTH MOST BEAM, USING THE INSIDE EDGE OF BOTH BEAMS TO RUN THE LINE. THIS WILL BE YOUR WORKING LINE TO KEEP THE BLOCKS RUNNING STRAIGHT.

3-USING DRAWING JCD-0030, SECTION A-A, ASSEMBLE THE WEST WALL OF THE FURNACE.

A-USING THE SKY TRACK FORKLIFT SITUATED IN THE CONVERTER PIT, LIFT J-1495AL AND J-1495AR UP AND RIG THEM INTO THE FURNACE OUT OF THE WAY AT ABOUT THE MID POINT OF THE WALL MAKE SURE THAT THEY ARE FAR ENOUGH INTO THE FURNACE THAT THEY WILL NOT INTERFERE WITH THE ASSEMBLY OF THE REST OF THE WALL

B- LIFT AND RIG IN THE TWO J-1835 BLOCKS. ONE SHOULD BE MOUNTED ON EACH SIDE OF THE ESTABLISHED CENTER POINT . WHEN THEY ARE IN POSITION HAVE THE SMEX CLIP THEM TOGETHER SO THEY WONT MOVE .

C-LIFT AND INSTALL THE J-1774S ON THE NORTH AND SOUTH SIDES OF THE J-1835S. WELD CLIPS TO HOLD THEM IN PLACE.

- D-LIFT AND INSTALL J-1834L AND R. PUT 1 INCH SPLITS BETWEEN THE J-1834S AND THE J-1774S. WELD CLIPS ON TO HOLD THEM IN PLACE.

E- LIFT J-1799 BM4 AND BM2 TO THE NORTH END OF THE WALL, AND RIG THEM INTO PLACE ON THE FURNACE. LIFT J-1799 BM3 AND BM1 TO THE SOUTH END OF THE FURNACE AND RIG THEM INTO PLACE ON THE FURNACE.

F-RIG J-1495AL AND AR INTO PLACE AND INSTALL CLIPS.

. . . . . . .

G- TURN OVER TO WELDERS AND BRICKLAYERS TO WELD CLIPS ON BLOCKS, AND BRICK IN BESIDE AND BEHIND BLOCKS.

### #12 Install arch & thermocouples

- Hang bull nose first
- Install vertical wall
- Hang arch from bull nose to the east wall.
- Hang arch from bull nose to the west. Follow arch drawings for brick size. Install thermocouples as per metallurgist instructions.

### #13 Install feed pipes, fettling pipes, dr-mechanics pipes, and measuring hole

#14 Install arch hanging scaffolding

### <u>5 Install scaffolding for walls</u>

#16 Bebuild buck stays on matte side. Follow drawings

#17 Install front walkway

#18 Install burner assemblies

#19 Remove and install calcine tracks

#20 Install uptake arch

#21 Install wall braces

### #22 Jackhammer trenches in bottom of furnace

#23 Plycast walls

### "24 Seal obvious break out points along the walls

Once the walls of the furnace have been build, check along the base of the wall, check for areas where pockets of matte may bu9ild up between the base of the new wall and old floor Bottom. These crevasses should be filled with brick and magnesite to fill the holes. This will reduce the chances of breakouts. Note: Most breakouts after a shutdown start where the new brick begins.

### #25 Remove and save arch scaffold

### # 26 Install wall tile:

 Hoist wall tile to the feed floor-using forklift. Using the dolly, transport to the location to be installed. Using chain block, hoist wall tile into place.

### #27 Clean brick & debris out of the furnace

7 #28 Align burners

### Procedure for Sighting-In Reverb Furnace Burners

Objective:

The ultimate objective of this procedure is to align the reverb burners so that the flames from each burner have room to develop properly and to minimise damage to the arch and sidewalls. This is achieved by aiming the burners parallel to each other and slightly downwards so that the flames are centred north/south between the

3s and impinge on the top of the slag bath at just beyond the jogs.

#### Personnel:

Two people are required for this procedure – a "sighter" and a mechanic.

### Equipment:

Sighter - You will need the following:

- A set of legs with metal feet and a level from plant engineering.
- A straight, 16' long 4" X 6" wooden beam from the carpenters.
- Wood blocking, shims and, if the furnace bottom is low, two scaffold stands.
- A 50' tape measure.
- A 4' carpenter's level (the bricklayers should have one).
- A Duralite flashlight and a spare set of batteries.
- A pen or pencil to mark the beam.

Mechanic - You will need the following:

- Two 1.5 ton come-alongs.
- A ¼" impact wrench c/w 1 ¼" & 1 ½" sockets.
- A sighting pipe this pipe is about 8' long and has a peephole at one end.
- Some flatiron and a welding unit.

#### ···rocedure:

Sighter:

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- 1) Centre the wooden beam (longitudinally in a north-south orientation) inside the furnace at the narrow point of the jog and, by eye, level the top of the beam at the height of the bottom of the burner keyholes. Use the metal scaffold stands for blocking bases (if possible) as the sand may still be hot enough to ignite wood.
- 2) From the inside of the reverb, survey the elevation bottom of the burner keyholes with the metal feet and level. If the keyholes are at different elevations, obtain an average value. Adjust the position of the 4" X 6" wooden beam to this height and level with the carpenter's level. Repeat the survey to confirm the beam is now properly positioned. Once the beam is correctly placed, make sure the blocking is secure and take care not to disturb the beam.
- 3) Measure the north-south distance across the furnace from the inside of the wall tiles at the jogs and find the centre. Mark this point on your beam. This point should line up closely with the furnace centreline. This can be checked by looking up at the arch, locating the expansion spacer running east-west down the centreline of the arch, and comparing the relative positions.
- 4) Measure the distances between the centres of # 2 & # 3 and # 1 & # 4 burners. From the inside of the furnace, this can be done by measuring the distances between the edges of the keyholes (either north edge to north edge or south to south). Alternatively, this measurement can be taken outside the furnace. On the west side of each burner elbow is a pipe sleeve for the burner assembly. These can be used as references.
- 5) Divide the distance between # 2 and # 3 burners in half. Mark the beam at this distance on either side of the centreline mark. These points will be where you set the flashlight for sighting in the two inside burners.

- 6) Divide the distance between # 1 and # 4 burners in half. Mark the beam at this distance on either side of the centreline mark. These points will be where you set the flashlight for sighting in the two outside burners.
- 7) When sighting in each burner, make sure the flashlight is focused as tightly as possible, is on the appropriate mark and is aimed directly at the centre of the burner. The flashlight may have to be shimmed to achieve this.

#### Mechanic:

- 1) Put sighting pipe in burner sleeve and sight in through peep hole on flashlight.
- 2) Move pipe to brightest part of beam and note orientation of the pipe. You will now have to use the come-alongs to change the position of the burner cone so that the burner sleeve lines up with the sighting pipe.
- 3) Do the elevation first. Move the cone position up or down as required until the peep hole is lined up with the flashlight beam elevation. Remember, the sighting pipe must be resting in the burner sleeve.
- 4) Lock the nuts on the bottoms of the J-hooks to fix the burner cone in the correct vertical position.
- 5) For left/right orientation, again use the come-alongs to pull the cone into the desired position. Instead of tightening bolts, weld a piece of flat iron to the burner block and butt it against the burner cone on the opposite side of the come-alongs to prevent it from twisting back.
- 6) Re-check the elevation of the sighting pipe and adjust as necessary. When the sighting pipe is resting in the secured burner cone sleeve and the peep hole is aimed directly at the flashlight, you are finished and ready to move on to the next burner.

### #29 Make up start up feed bin

### #30 Install calcine hopper covers and floor plates

### <u>#31 Install matte chutes & re-brick launders</u>

### #32 Install slag bays and launders

### <u>#33 Install mud gun</u>

### <u>#34 Install arch fans</u>

### #35 Hook up all low pressure flex pipes

### #36 Install calcine vent pipes

#37 Install slag drill

### #38 Install feed gate actuators

#39 Remove, repair, and install slag tracks

### #40 Remove temporary lighting

#41 Install converter pit slag launder

## #42 Add cast and fettling in furnace

- 43 Re-install, inspect and repair reverb baghouse
- #44 Re-install false wall behind slag blocks
- #45 Install water, steam, oil and O2
- #46 Misc. lighting, clean up

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#2 Start ID fans

#3 Raise wall tile for wood fire

#4 Low wood fire – What is the firing plan

- #5 Start oil fire primary air fans
- <u>#6 Start pre-heater</u>

### PREHEATER START UP

1) When the pre-heater has been down for an extended period of time all major systems should be checked for proper operation. See major systems.

2) If all the major systems are on line the start up sequence on the control panel can be initiated. Turn the "status-alarm" switch to alarm and confirm there are no alarms. If there is an alarm refer to the alarm section of this manual. If there are no alarms turn the switch back to status.

3) When there are no alarms place the "run – stop" control in the run position. If the display reads non-recycle purge then the control system has not cleared itself for start up. If this occurs see non-recycle purge. The display should show system ready.

4) When system ready is displayed push the "start button". If there is a problem with the pre-heater an alarm will sound immediately, switch the "status-alarm" switch to alarm to determine what the problem is and refer to the alarm section of this manual. If the display reads pre-ignition purge the system is going through the first stages of start up. This stage of start up is where the control system checks all sub-systems for proper position and operation. This will take about 3-5 minutes.

5) The system will automatically switch to pilot light start cycle when the pre-ignition purge cycle is complete. When the display reads Pilot light start the system is checking all pilot light control systems. When all systems are checked then the control system will switch to the pilot light trial cycle.

6) When pilot light trial is displayed, switch the "auto-hold" switch to hold position (it does not matter what position this switch was in until now). Open the viewing port on the front of the pre-heater firebox and visually check to see if the propane pilot light is lit. Take care, as a large amount of air will be blowing out of the viewing port. If it isn't lit see pilot light. If the pilot light is lit turn the "auto-hold" switch back to auto. The control system will switch to the main flame start cycle.

7) As soon as main flame start display comes up turn the "auto-hold" switch to hold. When the start up process has reached this point the automatic oil valve will open to allow the main flame to be lit. If the pre-heater has been down for an extended period of time in the winter see cold weather start up. CARE MUST BE TAKEN NOT TO ALLOW THE OIL TO FLOW INTO THE PREHEATER FOR TOO LONG, IF YOU ARE UNABLE TO LIGHT THE FIRE AS YOU WILL BE FILLING THE COMBUSTION CHAMBER

WITH OIL. Now that the oil valves are open some of the oil in the lines may be to cold to flow fast enough to allow the flame to ignite. 1 - 3 pails of cold oil may have to be drained off to get to the hot oil. If this is the case see cold weather start up. WHEN DRAINING OFF OIL AT THE BURNER THE HAND

EAM VALVE AT THE BURNER HAS TO BE CLOSED OR STEAM WILL BLOW OUT THE OIL TRAIN VALVE. Once the oil is hot then ensure both the steam and oil control valves are wide open with the purge valve is in the run position and the main flame should ignite. If the main flame does not ignite use a flashlight and look through the viewing port to ensure both that the pilot light is still lit and that oil is flowing through the burner nozzle. ONCE AGAIN CARE SHOULD BE TAKEN FOR THE AIR AND GASES BLOWING OUT OF THE VIEWING PORT.

8) Once the main flame has ignited and is burning fairly smoothly turn the "auto-hold" switch back to auto. The control system will switch to main flame trial and then normal fire cycle.

9) When the pre-heater is on normal fire cycle then the burner control should be set to manual with the valve opening set around 20% to allow the pre-heater to warm up. If the control is set to automatic the control will turn the fire up to 100% and may kick out when the fire box temperature gets to high before the proper air temperature is reach and the control begins to turn the fire down. If this happens the display will read HGTI or HGTO.

10) After a period of about 1- hour then the control can be set to automatic and adjusted to the desired temperature.

#### MAJOR SYSTEMS

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 $\checkmark$  The pre-heater has 8 major systems that have to be operating properly for the pre-heater to run. These systems are

- 1) Primary air fans 2) Circulating fan
- 3) Combustion air fan
- 4) Lungstrom drum
- 5) Bumer oil
- 6) Burner steam
- 7) Bypass dampers
- 8) Control systems

1) Primary air fans; There are two primary air fans that supply all of the combustion air for the reverb furnace. Of these two fans only one fan is ever run at a time. The primary air fans are located on the second floor of the pre-heater building at the West End. There is one main damper for each fan located in the ducting just east of the fans. These dampers are used to isolate the fan that is not running, the spare fan. When the handle for the damper is at 90 degrees to the duct then the damper is closed and that fan is isolated from the pre-heater. If both fans are down and you are unsure as to which fan was running the fan that was running will have the isolation damper in the open position, parallel with the ducting. These fans are monitored on the D.C.S. system on screens f6 & f7 as #1 and#2 fans. The start stop buttons for the primary air fans are on the north wall directly across from the fans.

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3) Combustion air fan; The combustion air fan is located above the pre-heater firebox on a landing half way between the first and second floors. This landing is accessed by way of the steel ladder on the East de of the pre-heater firebox. The start stop switch is located on the bottom of the breaker box that is is is located on the north side of the west pre-heater control panel. This breaker is also the breaker for the combustion air fan and the pre-heater control system.

4) Lungstrom drum; The lungstrom drum is the pre-heater's rotating heat exchanger. The hot air from the firebox is moved through the bottom half of the ducts for the lungstrom drum heating the fins in the drum. As the drum rotates the heated fins move into the ducting for the primary air to the reverb furnace. As the air passes through the lungstrom drum the heat is transferred to the reverb primary air. The lungstrom drum is rotated by a speed reducer and motor located on the north side of the pre-heater ducting on the second floor of the pre-heater building. The start stop button is located on the north wall directly across from the speed reducer. There is also a second start stop button located on the west wall of the main floor of the pre-heater building by the west control panel.

5) Burner oil; The pre-heater burner oil is controlled by the control that is located on the west pre-heater control panel. This control is set at either a predetermined temperature or the amount the oil control valve is open. When the control is in manual mode the % the valve is open is being regulated and when the control is in automatic then the temperature of the primary air to the reverb fumace is being regulated. When the pre-heater is going through its start up cycle this valve is locked at a predetermined set point and cannot be changed. There are two gauges to the left of the burner when facing south. The right gauge is the oil pressure at the gun. This pressure can also be controlled with the hand valve at the burner. The hand valve should be in the wide-open position for normal start up and operation.

There is a second oil valve that is also controlled be the pre-heater control system. This valve is the main shut off valve for the pre-heater oil supply. When the pre-heater is in the start up cycles this valve ill remain closed until the cycle reaches (main flame trial) At this point the valve opens to allow the fire \_\_\_\_\_\_\_ be started. The valve will only remain open as long as the cycle is in main flame trial or the fire eye reads a flame once the cycle goes to (main flame start) or (normal fire cycle). The oil is fed to the pre-heater from the reverb oil supply room on the calcine floor.

The pre-heater oil is steam traced to ensure the oil is hot enough to flow properly. If the oil is shut off and the steam trace is not working then the oil will become to cold to flow and you will be unable to start the pre-heater. The steam trace can be checked at the pre-heater burner.

6) Burner steam; The burner steam allows the oil to be atomised and then burned. If there is no steam to the burner then the oil will not burn. The left-hand gauge at the burner is the steam pressure gauge. The steam pressure should be at 80 when the hand valve is wide open. The hand valve for the steam should be wide open for normal operation and start up.

7) Bypass dampers; The bypass dampers on the pre-heater are used to allow the combustion air, primary air, for the reverb furnace to bypass the pre-heater so maintenance can be done on the pre-heater without shutting the reverb furnace down. There are four damper for bypassing the pre-heater. These dampers are located on top of the main ducting for the pre-heater on the second floor of the pre-heater building. The steel ladder on the north side of the pre-heater 2nd floor accesses these dampers. Three of the damper levers are in plain view when you are on top of the pre-heater; the fourth damper -lever is on the West Side of the west duct rising out of the top of the pre-heater. You have to go around to the West Side of this duct in order to find this damper lever.

These levers are marked as to whether they open or closed. For the pre-heater to operate the large ever on the floor and the north west lever must be open and the other two levers should be closed. In this position the reverb primary air passes through the pre-heater. If the west lever and the south lever are open and the other two levers are closed the pre-heater is bypassed.

8) Control systems; the two control panels located at the north end of the pre-heater building on the main 4, fldor control the pre-heater. These panels house the control systems for the pre-heater. The north panel, #1, has the control switches for the start up and stop control of the pre-heater. The use of these controls

as explained in the start up section of the manual All switches on this panel are also labelled. The west and has two control displays mounted on it, the north display, #2, measures the fire box temperature of the pre-heater. The south display, #3, is where the fire level of the pre-heater is controlled.

#2 display; This display contains the high firebox temperature kick out for the pre-heater. If the temperature of the pre-heater reaches then this control will shut down the pre-heater. Before the pre-heater can be restarted then the reset key on this control must be pushed to reset the high temperature kick out. This control does not control anything else.

#3 display; When the pre-heater is in the normal fire cycle mode then either the oil valve opening or the reverb air temperature can be set from #3. The three controls on this display are the auto-manual control, shown as A\M. The raise and lower control which is indicated by an up and down arrow and the scroll control marked as "set\ent".

There is also three separate displays mounted on this control. The top display marked as PV, indicates the temperature of the preheated primary air that is going to the reverb furnace in degrees Celsius. The bottom left display indicates if the temperature set point or the valve opening of the oil control valve on the pre-heater is being displayed. If this display reads SP then the temperature set point is being displayed. If the display reads oVe then the valve opening is being displayed.

When #3 is in manual mode, which is indicated by the man. Light being lit up, and then push the scroll button until oVe is displayed in the bottom left display. The number in the bottom right display is the percentage the oil control value is open. 45.7 would indicate the value is open 45.7% Pushing the up or down arrow opens or closes the value by whatever percentage is displayed.

#1 Display; The display on the north control panel indicates whatever mode the pre-heater's main control system is in. The different screens on the display indicate this. These screens progressively read.

1) BURNER SYSTEM INACTIVE

2) BURNER SYSTEM READY

- 3) PRE-IGNITION START
- 4) PRE-IGNITION PURGE
- -5) PILOT IGNITION START
  - 6) PILOT IGNITION TRIAL
  - 7) MAIN FLAME START
  - 8) MAIN FLAME TRIAL
  - 9) NORM. FIRE CYCLE
  - 10) NON-RECYCLE SHUTDOWN
  - 11) NON-RECYCLE PURGE
  - 12) RECYCLE SHUTDOWN HCI
  - 13) RECYCLE PURGE HCI

1) BURNER SYSTEM INACTIVE; the "run\stop" switch is in the stop position and the control system is inactive.

> 2) BURNER SYSTEM READY; the "run\stop" switch is in the run position, the control system reads no alarms but the start up cycle has not been started.

3) PRE-IGNITION START; The control system has just begun the start up cycle.

4) PRE-IGNITION PURGE; The control system is checking itself and the pre-heater over to see is any 5, sensors or alarms are being read correctly.

5) PILOT IGNITION START; The control system is checking the pilot light systems for faults.

5) PILOT LIGHT TRIAL; The control system has found no alarms and has opened the propane value to allow the pilot light to be lit. The automatic igniter for the pilot light should also be active. The fire eye is now active and requires a flame is the control system is to proceed past this point in the start up cycle.

7) MAIN FLAME START; The fire eye is reading a heat signature from the pilot light and the control system opens the automatic oil shutoff valve to allow the main flame to be lit. The variable oil control valve is locked at a pre-set point and can not be raised or lowered.

8) MAIN FLAME TRIAL; The control system closes the propane valve and the pilot light shuts off. The fire eye must continue to read a heat signature, now from the main flame. The variable oil control valve is still locked at a pre-set point and can not be raised or lowered.

9) NORM FIRE CYCLE; The control system reads all systems are normal and releases the oil control valve. The pre-heater is now in normal operation.

10)

#### COLD WEATHER START UP

When the pre-heater has been down for an extended period of time in the winter. One half our or more, then the oil that is burnt in the pre-heater will thicken to the point it will not move in any place that is not heated. The oil line to the pre-heater is steam traced but has a few sections that cannot be steam traced. These sections are 1) right at the burner, the last few feet of oil line to the burner is not heated 2) the main automatic oil shut off valve located behind the west wall control panel.

If the weather is cold enough, 20 below or more then the oil control valve will have to be heated before attempting to start the pre-heater. If this valve is not heated then when the control system tries to open the valve the valve may be damaged.

When trying to start the pre-heater once the start up cycle has reached main flame trial then the oil ine at the burner can be checked for temperature.

Close the hand steam valve at the burner to prevent steam from blowing out the oil drain valve. Place a bucket under the oil drain valve, the bucket can be hung on the elbow below the oil drain valve. Slowly open the oil drain valve located below the burner. If the oil is hot it will start to flow like water immediately. If the oil is cool it will drain slowly, like molasses. In this case you can either drain off two or three pails of oil until the oil is hot or you can heat the oil line until the oil is hot. If the oil does not flow at all the while leaving the oil drain valve open crack the steam valve. Steam should blow out the oil drain valve. If no steam comes out of the oil drain valve then the line between the burner and the oil drain line is plugged and will have to be heated until it is cleared. If steam does come out the oil drain valve then close the steam valve. This shows the oil to the burner is either shut off somewhere before the burner, check the automatic oil valve and the oil supply, or the oil to the burner is to cold to flow.

If the oil is to cold to flow check the oil line steam trace. This is the 3/8 copper line that runs along the oil piping. The steam trace should be very hot to the touch. If the oil steam trace is working then the last few feet of oil line to the burner will have to be heated.

There is a steam hose located on the west wall between the firebox and the wall. With the oil drain valve in the open position and a bucket under the drain, then use the steam to heat the oil lines at the burner. As you heat the oil lines keep a close eye on the drain valve as once the oil starts to flow it can flow very fast possibly over filling the bucket or splashing all over. When the oil is flowing freely then the - pre-heater is ready to be started. Close the oil drain valve and continue the start up cycle.

#### ALARMS

- 1) HCI High circulating air temperature switch
- 2) HGTI High flue gas temperature, lungstrom inlet
- 3) HGTO High flue gas temperature, lungstrom outlet

- 4) IAP Lo instrument air pressure
- 5) HFGS High flue gas flow
- 6) 1FSI Draft fan fault 2FSI Draft fan fault
- CSI Circulating fan fault
- 9) CPS Low circulating air pressure
- 10) RSS Rotor speed fault
- 11) LOT Low oil temperature
- 12) HOT High oil temperature
- 13) LOP Low oil pressure
- 14) ADP Steam \ oil differential pressure
- 15) ASP Low atomising steam pressure
- 16) CSFI Combustion fan motor fault
- 17) AS Low Combustion air pressure
- 18) OVS Downstream oil valve switch fault
- 19) PAFS Purge air flow fault
- 20) PLS Purge limit fault
- 21) LFS Low fire start fault
- 22) SPS Start position fault
- 23) FSM Flame scanner fault

1) HCI High circulating air temperature switch

In the case of this alarm check the circulating fan to ensure there are no problems such as drive belts vissing etc.

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If the fan is good then the pre-heater bypass dampers should be checked to ensure the primary air for the reverb is passing through the pre-heater.

If both the fan and the bypass dampers are good then there may be a blockage in the circulating duct or the sensor may be giving a false reading.

2) HGTI High flue gas temperature, lungstrom inlet

In the case of this alarm check the reverb primary air fans to ensure proper operation.

If the fan that is running is good then the lungstrom drum itself may not be allowing enough airflow through. This can be checked by comparing reverb air temperature to pre-heater firebox temperature to see if they are in a reasonable relation to each other.

Next check the sensor.

3) HGTO High flue gas temperature, lungstrom outlet

4) IAP Low instrument air pressure

Check the control air pressure to the pre-heater.

) HFGS High flue gas flow

Check the re-circulating air damper between the pre-heater exhaust stack and the circulating ducting. If the damper appears to be in the correct position check the sensor.

#### 6) 1FSI Draft fan fault

Both primary air fans are down. Check and restart the proper fan. If the proper fan is running check  $\sim$ ne sensor.

7) 2FSI Draft fan fault

Both primary air fans are down. Check and restart the proper fan. If the proper fan is running check the sensor.

8) CSI Circulating fan fault

Check the circulating fan to ensure proper operation. If the fan is running check the sensor.

9) CPS Low circulating air pressure

10) RSS Rotor speed fault

Check the lungstrom drum to ensure proper operation. If the drum is turning check the sensor.

11) LOT Low oil temperature

12) HOT High oil temperature

Check the oil temperature to ensure it is below. The oil temperature frequently exceeds maximum when the oil flow to the reverb is lowered as the oil heating system takes time to an oil flow fluctuation. If this occurs the temperature will correct itself in a short period of time. If the oil temperature is below check the sensor.

13) LOP Low oil pressure

Check oil pressure to ensure it is above. If the pressure is adequate check the sensor.

14) ADP Steam \ oil differential pressure

15) ASP Low atomising steam pressure

Check the atomising steam supply pressure. This pressure can not be checked at the burner when the pre-heater is down as the pressure is regulated to oil pressure.

16) CSFI Combustion fan motor fault

The combustion air fan is down or the sensor is at fault.

(17) AS Low combustion air pressure

Check the combustion air fan for proper operation.

18) OVS Downstream oil valve switch fault

The automatic valve that controls the oil shut off to the pre-heater burner is malfunctioning. If the preater will not enter the start up cycle the valve is being indicated to the control system as open and the control system will not start until the signal from the valve indicates the valve is closed. If you are unable to get oil to the pre-heater burner in the (main flame trial) phase of start up this valve may be stuck closed. Electrical assistance is needed to check the position of this valve.

19) PAFS Purge air flow fault

This alarm will indicate that there is a problem with the reading of

20) PLS Purge limit fault

21) LFS Low fire start fault

22) SPS Start position fault

This alarm indicates that one of the controls for the air, oil or steam is out of it's proper start up position. Electrical assistance will be needed to determine which of these controls is out of position.

23) FSM Flame scanner fault

This alarm is the alarm that will shut off the oil to the firebox should the fire go out for some reason. The flame scanner measures the light signature from the firebox to determine if the heat signature is correct for that step of the operation the pre-heater is in. There are several methods of allowing the start up of the pre-heater when this alarm is stopping the start up cycle.

A) If the pre-heater fire has only been down for a short time, 1 hour or less, then when the start cycle begins the fire eye will read a heat signature off of the hot bricks in the fire box. If it reads a heat signature off of the firebox at the beginning of the start cycle then the fire eye will not allow the start cycle to continue and it will shut down as soon as the start button is pushed. The status display will read non-recycle shutdown or non-recycle purge. The alarm display will read flame scanner fault.

In this case remove the fire eye from the pre-heater and let it hang outside it's mount. Reset the control system and push start again. The pre-heater will begin the start up cycle if all alarms are clear. The control system will cycle through pre-ignition start, pre-ignition purge, pilot ignition start and then to pilot ignition trial. When the cycle reaches pilot ignition trial place the auto-hold switch in the hold position and ensure the pilot light is lit. If the pilot light is not lit see pilot light in this manual. If the pilot light is lit then replace the fire eye in it's mount and turn the auto-hold in the auto position and continue at step 6 in the start up procedure.

B) If the control system is shutting the start up cycle down at the start of the main flame trial step in the cycle then the fire eye is not picking up a strong enough signature off of the pilot light. This is a problem with the fire eye but can be bypassed to allow the start up of the pre-heater.

When the start up cycle reaches pilot light trial place the auto-hold switch in the hold position. Have an authorised person bypass the fire eye in the west control panel by hooking a jumper from post #2 to post 4119. This will eliminate the fire eye from the control loop. Continue you the start up cycle from step 6.

When the main flame is burning then the fire eye bypass jumper can be removed. This will only work if the fire eye is weak or is not aligned properly. Either of these problems should be corrected as soon as possible. THE PREHEATER CANNOT BE RUN WITH OUT SOMEONE PRESENT WHILE THE FIRE EYE IS BYPASSED. IF THE FIRE WERE TO GO OUT WITH FIRE EYE BYPASSED AND NO ONE **9**, WAS TO SHUT THE PREHEATER DOWN THEN OIL WOULD CONTINUE TO FLOW INTO THE FIRE BOX CREATING THE DANGER OF AN EXPLOSION.

### <u>47 Start arch fans</u>

### <u>#8 Turn on O2</u>

When the oxygen is ready to be turned on to the reverb furnace these are the steps to be followed;

- 1) Check all manual ball valves located to the south of the slag launder to ensure they are closed.
- 2) Check the D.C.S. to ensure the automatic control valves are in the manual position and that they are closed.
- 3) Check the position of the main line oxygen control valve on the D.C.S.
- If the Main line valve is closed then the valve will have to be opened. In order to open the valve;
  - a) The pressure on both sides of the valve has to be equal so the oxygen pressure on the reverb will have to be bled off. The powerhouse will then have to bleed off the pressure on their side of the valve to equalize the line pressure.
  - b) Once the pressure is equalized then press "X" on the D.C.S. display to open and high light the oxygen control valve screen.
  - c) With the screen highlighted press "ALT. E" to move the valve control cursor to the open position. Pressing "ALT. Q" will move the valve control cursor from the open position to the closed position.
  - d) Once the valve control cursor is in the open position the valve position cursor should move into the open position within 10 seconds.
  - e) If the valve position cursor doesn't move into the open position, the valve control sensors have not been satisfied that the pressure on either side of the valve is equal and the valve will not open. When this occurs check the press on the furnace control screen to ensure the pressure is at "0". Then check with the powerhouse to check the oxygen line pressure on the oxygen plant side of the valve, that pressure should also be "0".
  - f) If these two pressures are both "0" and the valve will still not open then phone instrumentation as there is a problem with the valve.
  - g) Once the main line oxygen value is open then insert the oxygen lance into the burner ports on the reverb furnace and fasten the lance in place with the safety chain.
  - h) With the lances fastened into the burner port open the ball type isolation valve.
  - i) Using the D.C.S. controls put the automatic valve in automatic operation.
  - j) Set the automatic valve to the proper flow value.
  - k) Follow the steps "g" through "j" for the other oxygen line.

#### <u>#9 Start feed belts</u>

### #10 Lance open slag and matte holes

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