

**A CASE STUDY ON SHIP
UNLOADER
AT
MSTPP/BIFPCL
(Bangladesh)**

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Bangladesh-India Friendship Power Company (Pvt.) Limited is a private company limited by shares duly incorporated in Bangladesh under the Companies Act 1994 and was registered with the Office of the Registrar of Joint Stock Companies and Firms (RJSC), Dhaka, Bangladesh on 31 October 2012 vide the Certificate of Incorporation with Registration No. C-105370/12.

Project Name: Maitree Super Thermal Power Project (2 X 660 MW)

11.01.2010: MoU signed between Govt of India & Govt of Bangladesh, to enhance traditional ties of friendship between the two countries through development of economic cooperation.

30.08.2010: MoU signed between NTPC Limited & BPDB to form a JV Company (JVC) through 50:50 equity participation for setting up a 2 X 660 MW coal based power project at Khulna in Bangladesh.

29.01.2012: JV Agreement signed between NTPC Limited & BPDB.

31.10.2012: Joint Venture Company Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL) incorporated. Located at Rampal (Division: Khulna; District: Bagerhat, Bangladesh) is a coal-based project with 100 % power to Bangladesh Power Development Board (BPDB).

Coal source country: Indonesia/ Australia/ South Africa.

Coal is transported by **OGV** from source country to transshipment point within Bangladesh. Coal from mother vessels shall be shifted to lighterage vessel at Mongla Port / Chittagong. These lighterage vessel will transport coal through Pussur river to BIFPCL Jetty.

Unit 1: Synchronization: 15th August 2022 / **COD:** 23/12/2022.

Unit 2 : Synchronization: 19th October 2023 / **Full Load:** 24/10/2023.



Purpose



Failure can be a powerful teacher. By sharing our failures with others, we not only acknowledge our mistakes but also create opportunities for learning and growth. Others can learn from our experiences and potentially avoid making similar mistakes themselves.

Hiccups in unloading process

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Nature

1) Silting effect: Mother vessel could not come to BIFPCL Jetty.

Around 1-1.5m draft loss in every 6 months.

2) Tidal effects: Low Tide restricts barge movement

3) Fog during winter season: 4-8 hours unloading hampers due to low visibility

Skill Manpower

Available SUL operators are accustomed to run manual type of grab, our PLC operated machines are new to them.

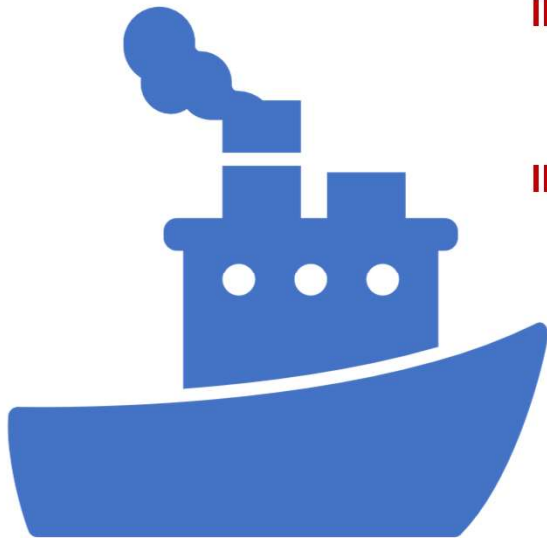
Teething troubles

- 1) Frequent stoppage of gantry movement..
- 2) Frequent failure of Travel trolley & grab synchronization.
- 3) Sheeve jamming.
- 4) Restricted movement of shuttle conveyor.
- 5) PCRD problem

Major Break down

- 1) Failure of Hold drum.
- 2) Failure of wire rope sockets.
- 3) Power circuit problem in SUL.

Nature



➤ **Silting effect:** Mother vessel could not come to BIFPCL Jetty:

I. From Nov-March :

Fairbuoy (Mongla Port): 69 Nautical Miles: Capacity 55000 MT: 25000 MT unloaded & moved to Herbaria. Travel time to jetty 18 hours

Harbaria: 25000 MT: 30 nautical-miles from Jetty. Travel time 6 hours.

II. April-Oct (Rough Sea):

At **Chittagong Port** : 205 Nautical-Miles. 25000 MT unloaded & moved to Herbaria. Travel time to Jetty 48 hours.

III. Maximum capacity barge that can ply in our route : **4200 MT.**

a. Small barge size, restrict semi automatic mode of operation. Cycle time increase from 53 sec to 2 minutes.

✓ With 02 Sul in operation: Generally, 02nd SUL is kept for continuous sweeping, so unloading restricts to **800-900 MT/hr.**

❖ Running Hours: 20

❖ Belt utilization factor: Quantity in MT / (Time in hour * Belt capacity): **23.52 %.**

b. Small barges means increase in number of positioning.

c. Small barges means higher sweeping time.

➤ **Tidal effects:** Low Tide restricts barge movement. During low tide condition (Tidal effect) barges has to wait for 3-4 hours for positioning below SUL

➤ **Fog** during winter season: 4-8 hours unloading hampers due to low visibility during peak Winter.

Mitigation Plan



Silting effect:

- Available draft between Herbaria to jetty during low tide: 3-3.5m.
- To reduce silting effect at jetty area regular dredging operation is being performed.
- Draft of 8 m (w.r.t mean sea level) maintained along the length of Jetty (Approximate 1300 m length) up to a width of 30 m.
- Contract for removal of 200000 m³ of silt / year is already existing.

Barge Size:

- 7500 MT flat barge is under construction. Expected by month end (February 2024).
- With flat barge we can try for semi automatic mode of operation, so we can reduce cycle time & sweeping time considerably.

Skill Level:

In Bangladesh SUL operators are called as crane operators & considered as low-profile job, so education level is maximum SSC. However, our machines are PLC controlled. Operator should have the capability to read HMI monitor & have little diagnostic ability apart from operating skills. We are conducting regular classroom & on-site training for such operators.

Parallely, we are developing fresh Diploma engineers.

Mitigation Plan



Teething troubles:

- PM plan prepared & being followed meticulously by all departments.
- Maintaining centralized lubrication system is on top priority.
- Regular tightness checking of clamps, rope greasing etc.
- Replacement plan made for wire rope & its sockets.
- SOP prepared & training imparted.

Major failures attended:

- Hold Grab Drum failure: Explained in detail.
- Rope re-socketing & rope changing.

Most Important of all is self believe & can-do attitude.

Working principal of Grab Type Ship Unloader

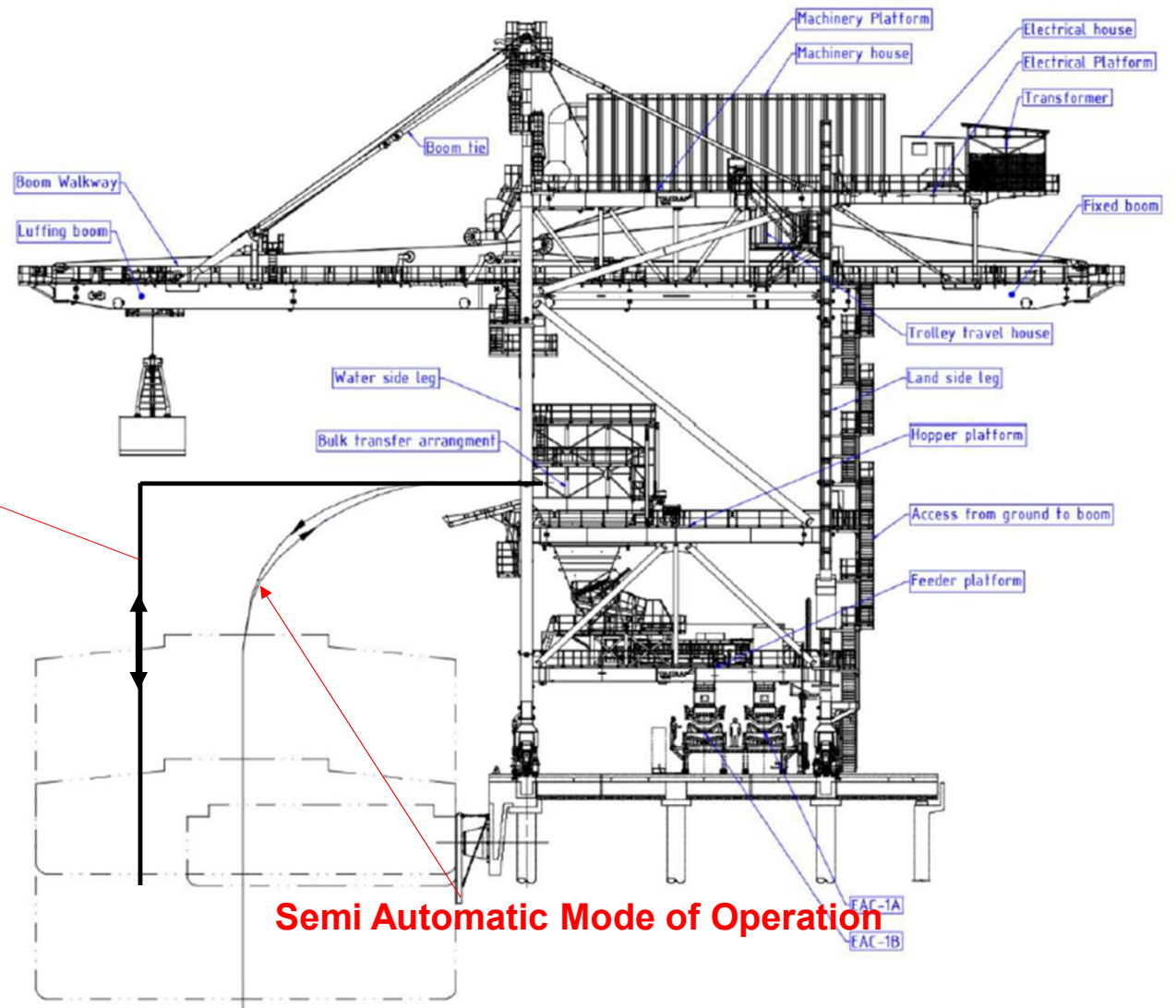
Manual Mode of Operation

The three rail-mounted Grab Type Ship Unloaders are provided to transfer coal / lime stone from Ships/Barges to jetty conveyors 1A/B.

Two Unloaders, SUL-1 & SUL-2 (Type 1) are suitable for unloading Coal and feeding to either of two Jetty Conveyors. The third Unloader, SUL-3 (Type-2) is suitable for unloading Coal and Limestone and feeding to any one of three Jetty Conveyors.

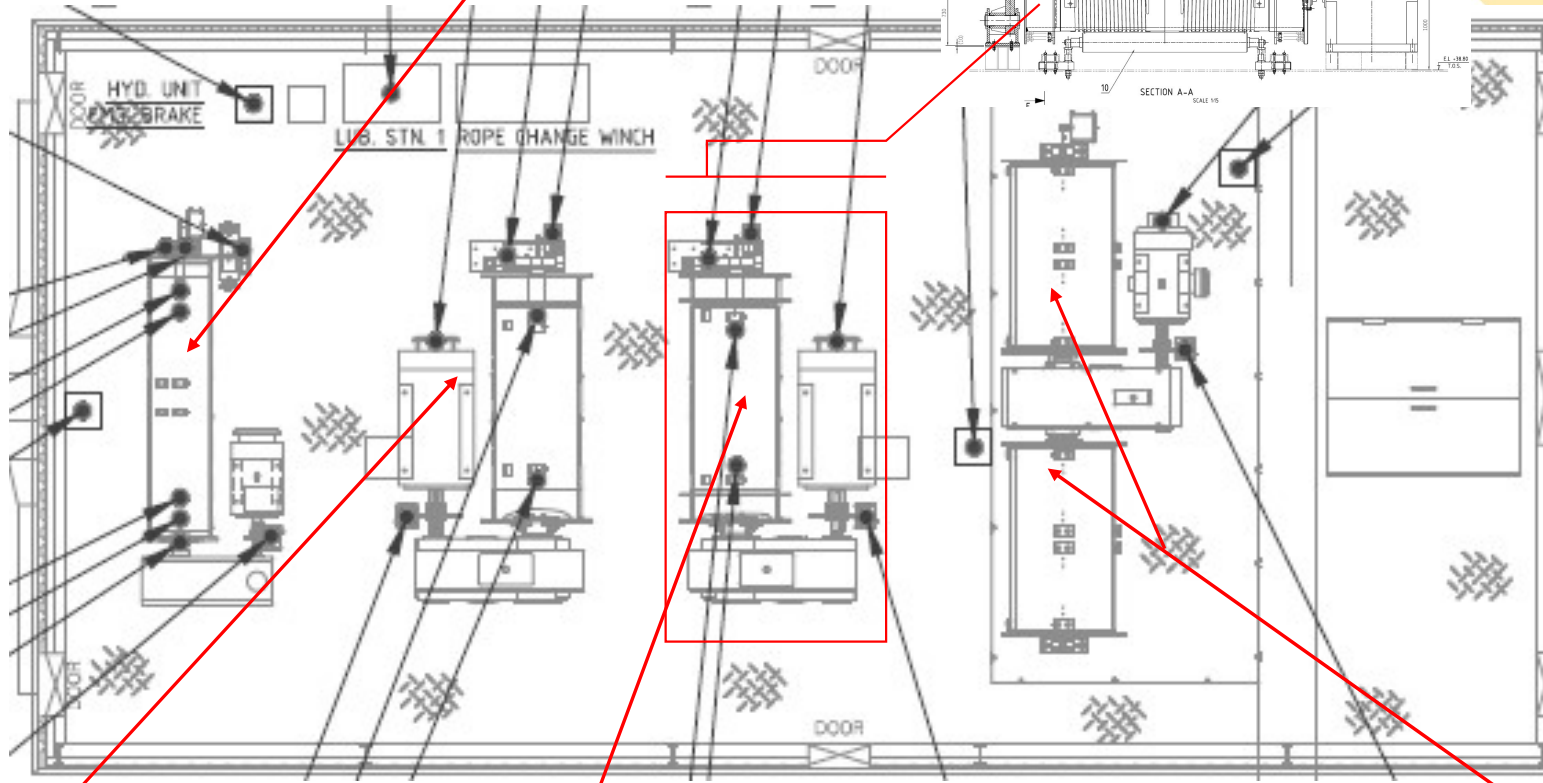
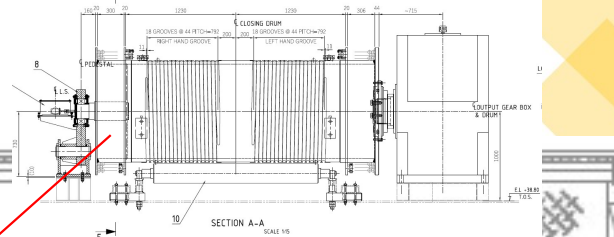
Capacity of unloaders:

- 1) All 3 Unloaders are designed for a guaranteed free digging capacity of **1,700 TPH** with Coal Grab.
- 2) **1000 TPH** with Limestone Grab for Ship Unloader-3.



Semi Automatic Mode of Operation

Construction of Drum

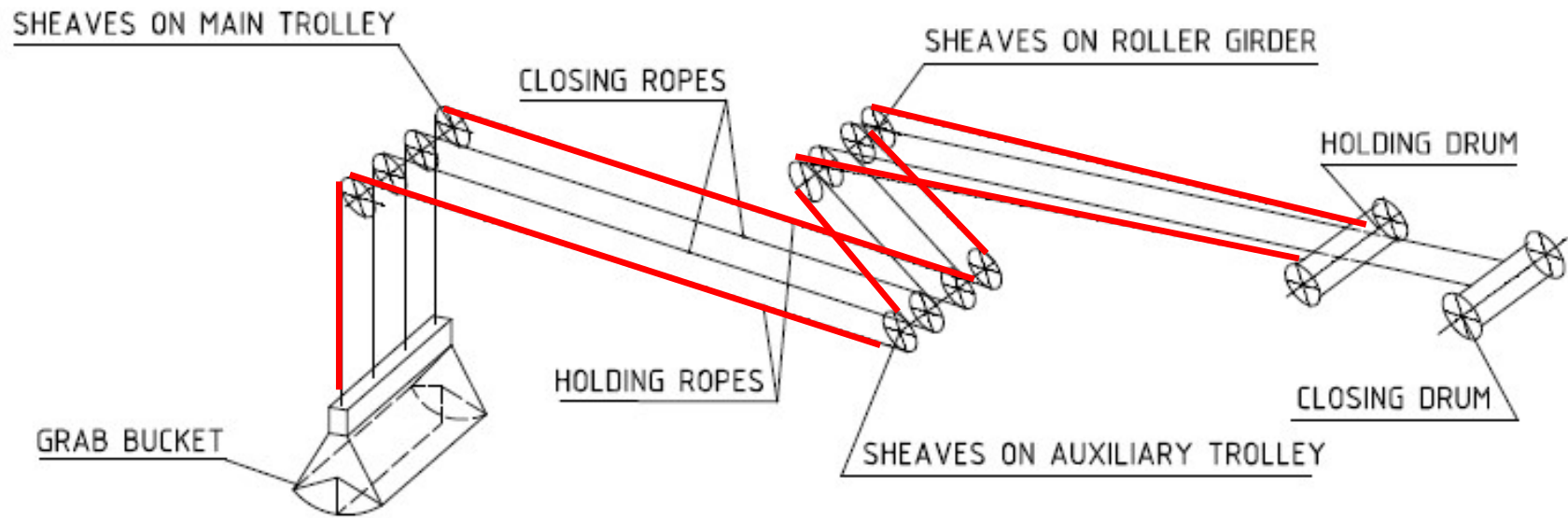


Hoist Drum

Grab open Drum

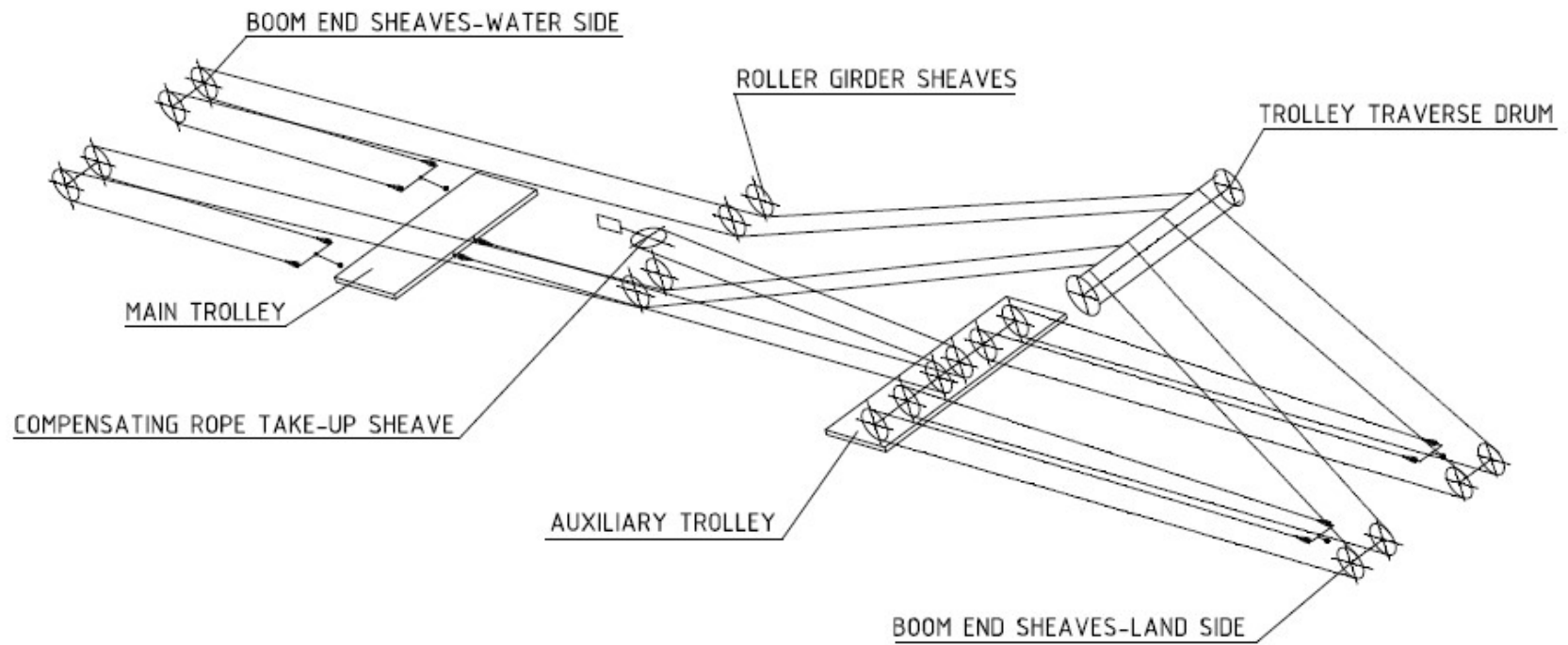
Grab close Drum

Travel Trolley Drum (Two drums driven by same gear box). Gear box output shaft extended both sides.

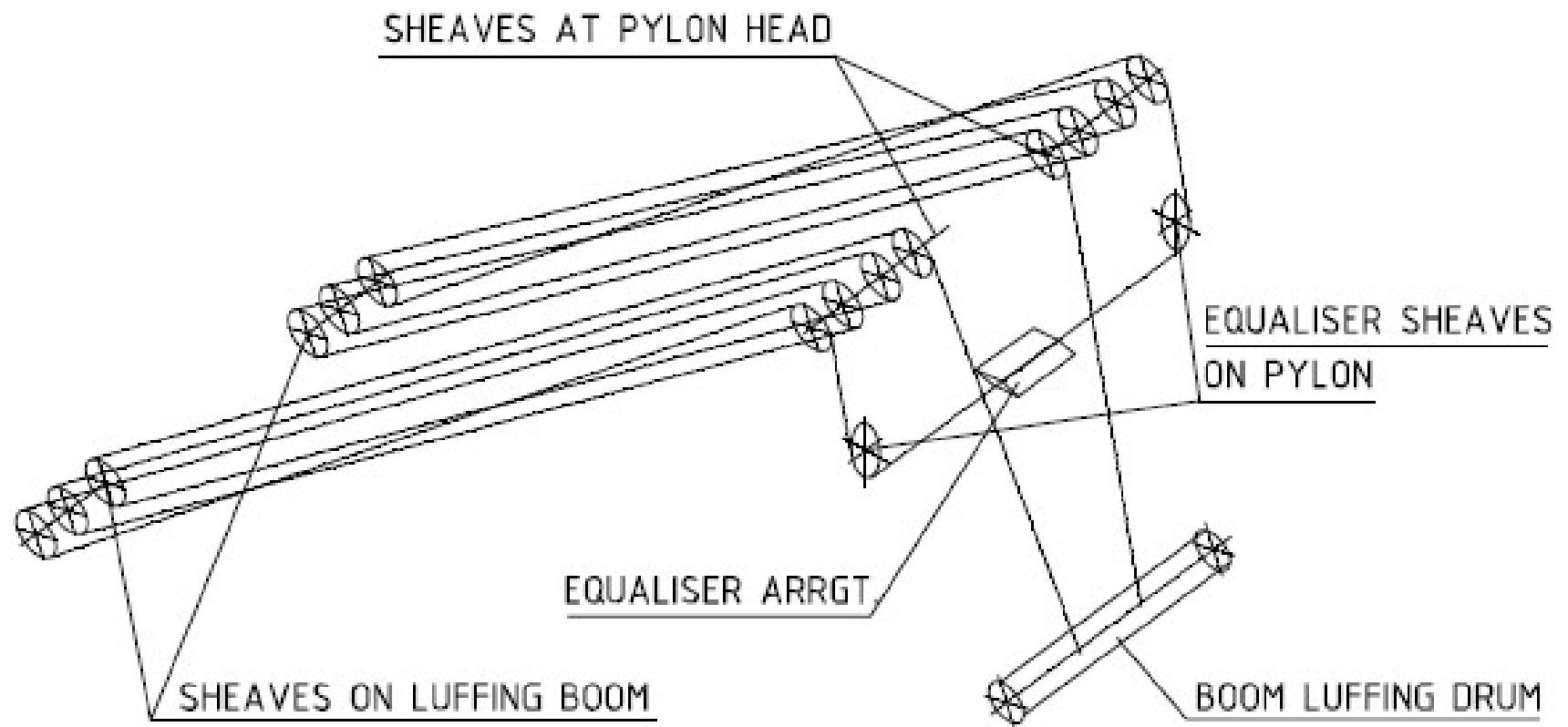


Grab Hold & close Drum (BIFPCL Arrangement)





Trolley Travel wire rope arrangement (BIFPCL Arrangement)



Boom luffing arrangement (BIFPCL Arrangement)



Repairing of Ship Unloader Drums

FAILURE ANALYSIS

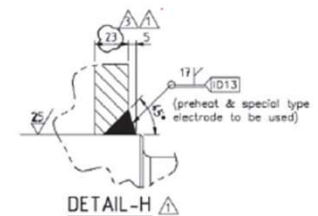
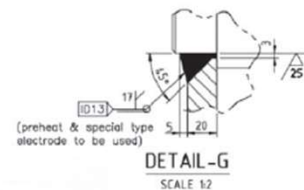
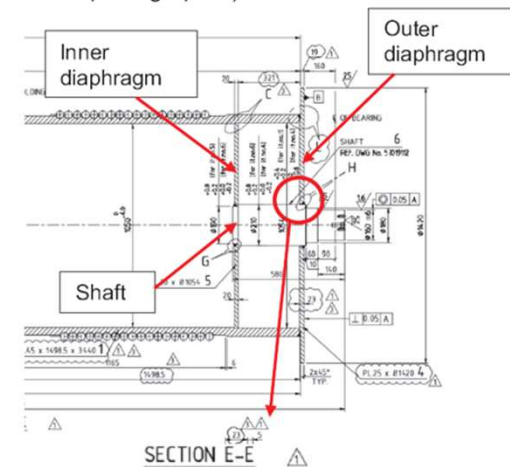
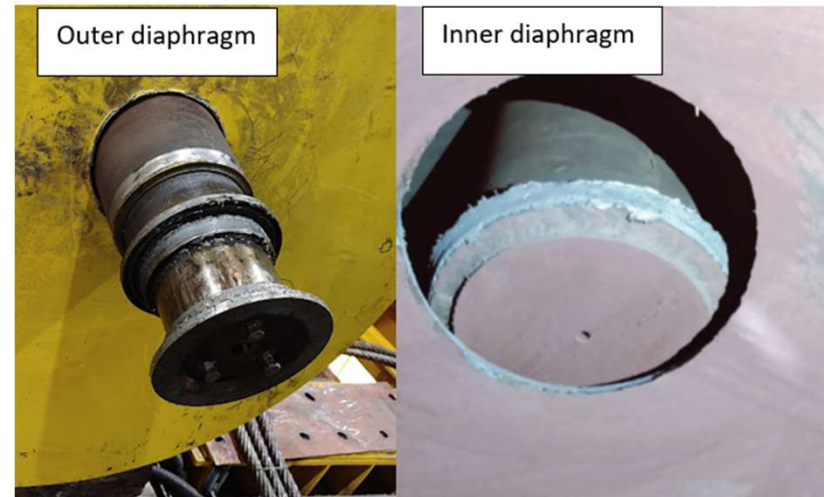
HOLD DRUM

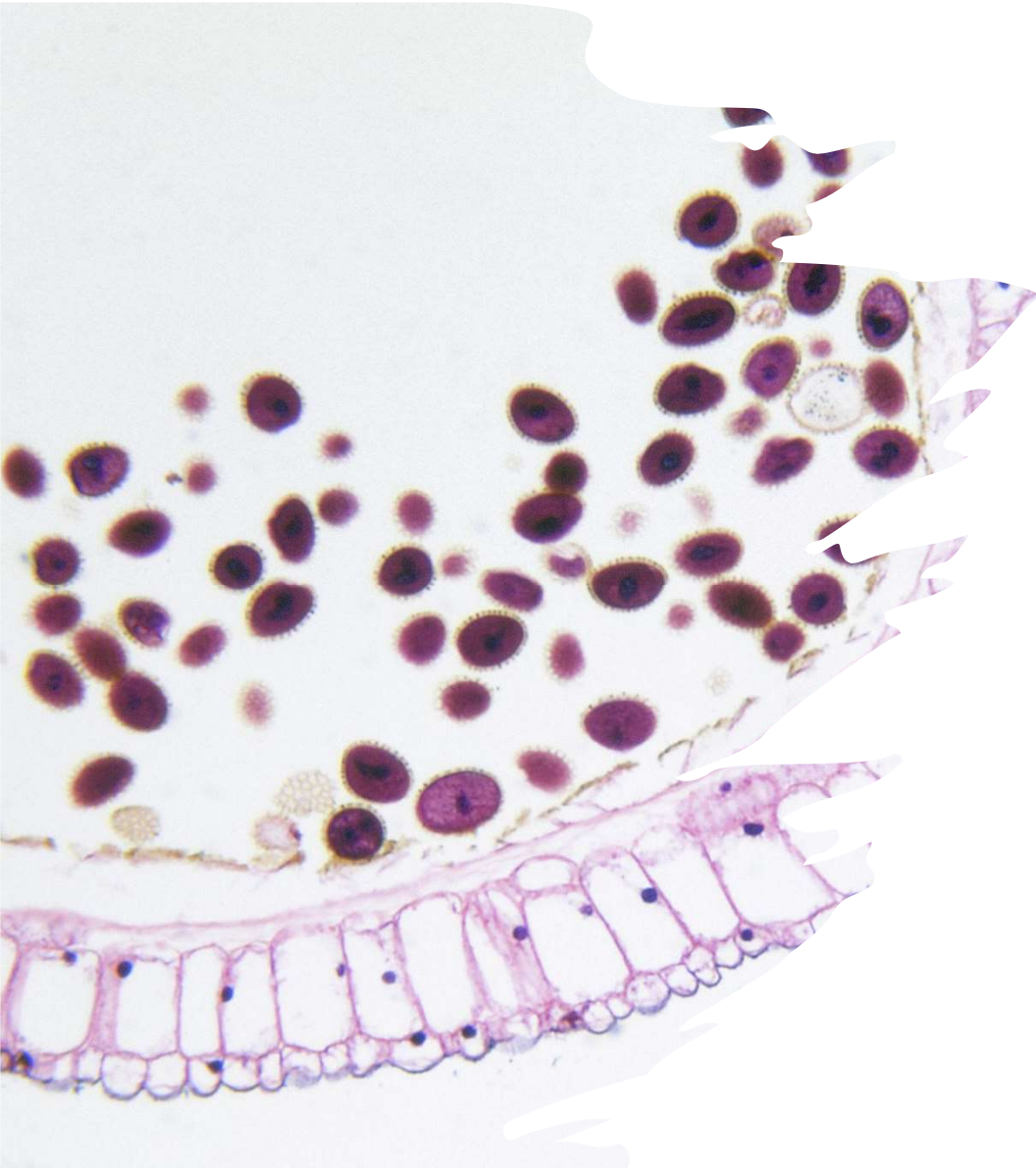
Failure analysis

On 10.11.2022, SUL-3 was stopped on hearing abnormal sound from its hold drum. It was observed that NDE shaft of holding drum (1420 Dia. X 3380 Long) got detached from drum body.

Size of the holding drum: 1420 mm Dia. X 3380 mm Long.


Cause of Failure: NDE (Floating side) shaft got detached from Drum.





Analysis of results and observations:

- Surface cracks were observed at some area of the plates. This was secondary in nature and presumed to be developed after welding failure.
- Major failures were observed in welding area, and these are transverse in nature. This showed that the crack was initiated first on welds between shaft and drum.
- Crack in shaft welding and detachment of shaft and drum were noticed at various places in welding area.
- The weld area thickness was found considerably low i.e., 6 to 7 mm, while plate itself is having thickness of 23mm.
- The thickness at various places of weld area was also not very uniform and at many places undercuts were also observed.
- Upon preliminary investigation excessive machining of weld area which reduces weld depth to 6-7 mm, whereas as per manufacturing drawing it is supposed to 17 mm.
- The reduction of weld thickness has been further analyzed with vendor and it came to notice that the manufacturing of these items has been taken during COVID period and regular manpower has not been employed. Further, inspection was also not performed physically rather it has been done through camera. There is inadequacy of record of manufacturing also noticed.
- Hardness of weld is found to be in satisfactory range.
- Due to reduction of weld area, welded portion became the weakest part & weld got sheared due to frequent reversal of stress (Clockwise & anti clockwise movement of drum).
- OEM was asked to recheck adequacy of welding thickness of 17mm due to nature of forces acting on drum particularly impact loading. OEM confirms that the thickness of welding was found to be safe, and enough margin is available for safe operation.



To avoid repeatability of issue following actions were taken:

- Following checks were performed on all balance drums of SULs (14 Drums):
 - Analysis of type of crack i.e., transverse, or radial.
 - Analysis thickness at various places of weld area.
 - Adequacy of weld thickness for the intended job including impact loading in situation like lifting, striking, reversal movement, jerking action etc.
- Following investigation tools have been employed:
 - DP has been done to find out surface cracks to ascertain parent material failure.
 - Ultrasonography has been done to find out thickness, homogeneity of welding and internal cracks.
 - Checks for general looseness of assembly has been done for checking any undue vibration.
 - Elaborate checking has been done to find out correctness of assembly with respect to assembly drawing and nature of forces.
 - The results of analysis have been further analyzed.

For balance 14 drums (05 in each SUL) following action plan finalized

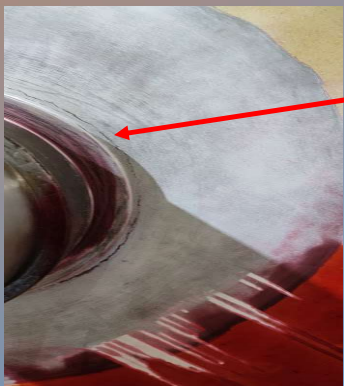
- DP test to detect any surface crack.
- UT to determine welding thickness.

Following are the summary of failures:

Category 1: Failed SUL 3 hold drum.

Category 2: Surface defect noticed during DP test: Repairing of the crack & then reinforcement plate to be fixed.

Category 3: No surface defects observed during DP: Only reinforcement.

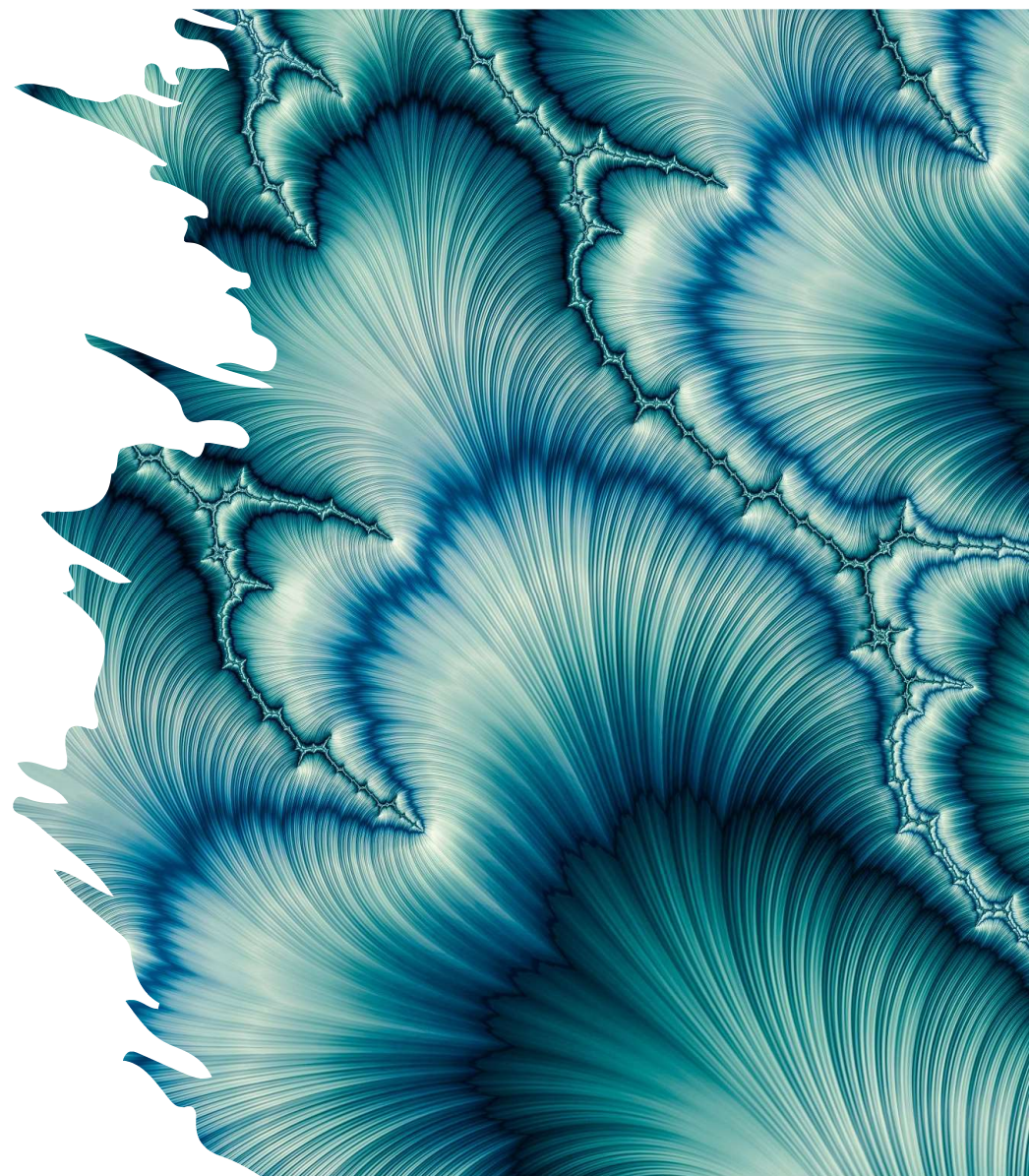


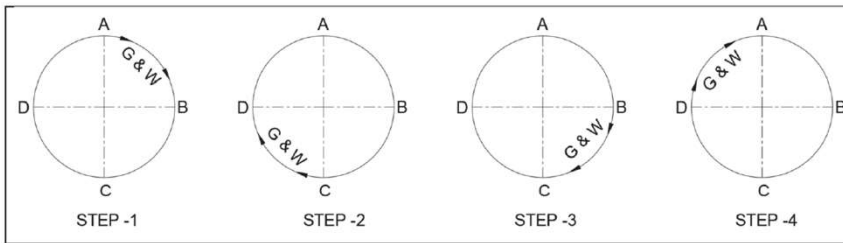
Toe Crack

| Sr. No. | Drum Description | Welding Thickness (Min.) | Welding Thickness (Max.) | Crack Found (Y/N/Failed) | Category |
|-------------------------|-------------------|--------------------------|--------------------------|--------------------------|----------|
| Ship Unloader-01 | | | | | |
| 01 | Garb Hold Drum | 10.3 | 17.6 | N | 3 |
| 02 | Boom Hoist Drum | 11.2 | 21.2 | N | 3 |
| 03 | Grab Open/Close | 8.7 | 11.1 | N | 3 |
| 04 | Trolley Travel-D1 | 15.4 | 17 | N | 3 |
| 05 | Trolley Travel-D2 | 13.5 | 16.8 | N | 3 |
| Ship Unloader-02 | | | | | |
| 06 | Garb Hold Drum | 7 | 7 | Y | 2 |
| 07 | Boom Hoist Drum | 7.3 | 16.6 | N | 3 |
| 08 | Grab Open/Close | 8.2 | 9.3 | Y | 2 |
| 09 | Trolley Travel-D1 | 12.2 | 14.7 | N | 3 |
| 10 | Trolley Travel-D2 | 12.8 | 17.5 | N | 3 |
| Ship Unloader-03 | | | | | |
| 11 | Garb Hold Drum | 3 | 4.3 | Failed | 1 |
| 12 | Boom Hoist Drum | 7.1 | 9.3 | N | 3 |
| 13 | Grab Open/Close | 6 | 13.5 | N | 3 |
| 14 | Trolley Travel-D1 | 4.1 | 6.7 | Y | 2 |
| 15 | Trolley Travel-D2 | 3.7 | 7.5 | N | 3 |

Inspection report of drums

RECTIFICATION





Welding pattern to avoid thermal stress

WELDING PROCEDURE

- Remove the paints all over the weld area circumferentially and clean the surface.
- Qualified welders to be used for welding.
- For shaft and outer diaphragm plate welding E7018 electrode to be used.
- Defective welding is to be removed in drum with cracks by grinding. Grooving & welding to be done as per following sketch

Weld metal shall be deposited in layers up to 90 degrees. Welding to be done in opposite side of drum by rotating the drum.

Total weld metal deposit 17+5 mm leg size. Each weld run to be DP tested.

Welding to be done in one stretch.

- Baking of electrode has to be carried out at minimum 250°C for minimum one hour or as per manufacturer's recommendation. Subsequently the electrodes have to be kept in holding oven at min. 120°C till used.

- Weld area shaft and plate preheating to be done up to 180° C to 200° C.

- Preheat the entire plate up to 70° C.

- Proper earthing to be done on the shaft before welding.

- After welding slow cooling to be allowed by covering weldment by glass wool / blankets etc.

- After cooling the weld is to be cleaned and inspected for surface defects.

- After the welding completed at the job in a room temperature. The start and end welding's shall grind smoothly to ensure notch parts are not there.

- DP test to be done for the entire welding and make sure any defects / cracks, etc.

- DPT after 3 days of welding.



CATEGORY:1: Failed SUL 3 hold drum.

Sending the drum to India & get it repaired will lead to a huge delay, so necessary repair work was done at the BIFPCL site.

SUL-3 -Grab Hoist drum had removed from the machine for the welding rectification & after resting it on rollers necessary rectification work done at site.



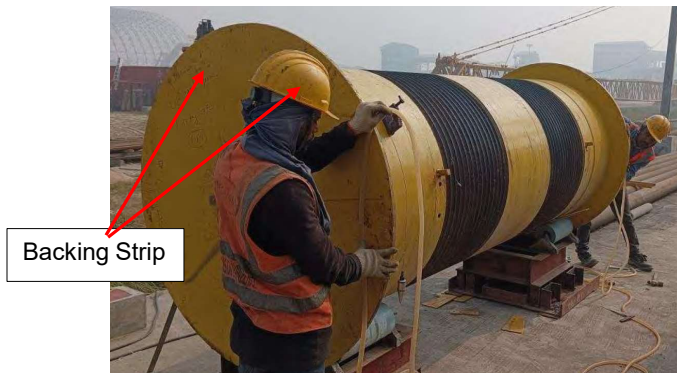


1. Center line was marked on the drive side with reference to rectangular hole.



2. Verification of central line through plumb.

3. All four corners & centerline was transferred to NDS flange with help of water level .





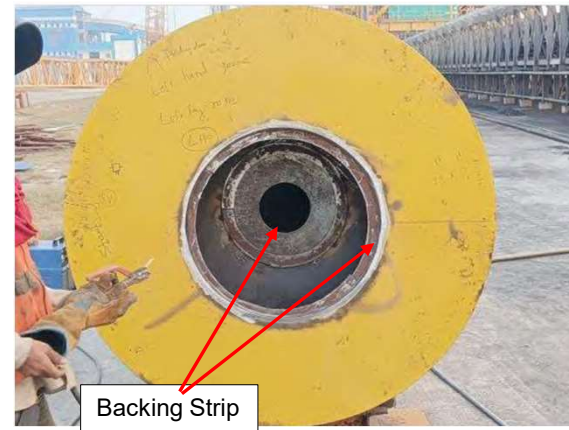
4. Centre marking on NDS outer flange.



Cutting of NDS outer diaphragm for Fixing of Plate 1A



5. Similarly center marking & cutting of inner diaphragm was done to fit plate 2A.



6. Backing strip provided for plate 1A & 2A.



7. Inner diaphragm reinforcement plate 2A was positioned along with shaft (Loosely fitted).



8. Outer diaphragm reinforcement plate 1A was positioned along with shaft & alignment of shaft in progress.

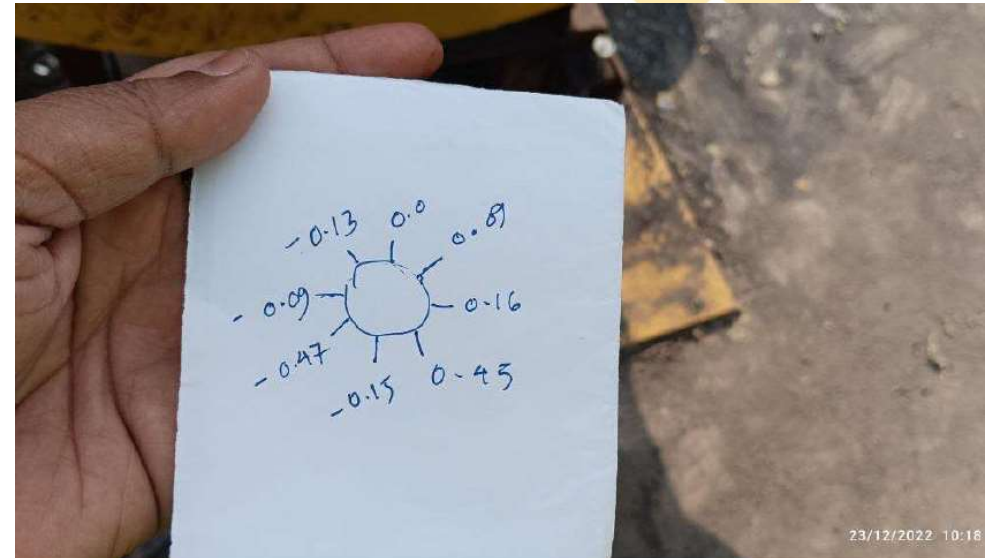
Jacking bolts were used for precise positioning of the shaft with help of dial gauge indicators.

9. V Groove preparation along the periphery of Plate 1A





8. Dial gauge used for checking of alignment of shaft Centre with hole center.



9. Final reading of dial gauge after complete welding from inside & outside.



10. Stiffeners used for final fixing of outer plate



Wool packing for slow weld cooling.

11. Slow cooling done by glass wool packing.



INSIDE WELDING



OUTSIDE WELDING

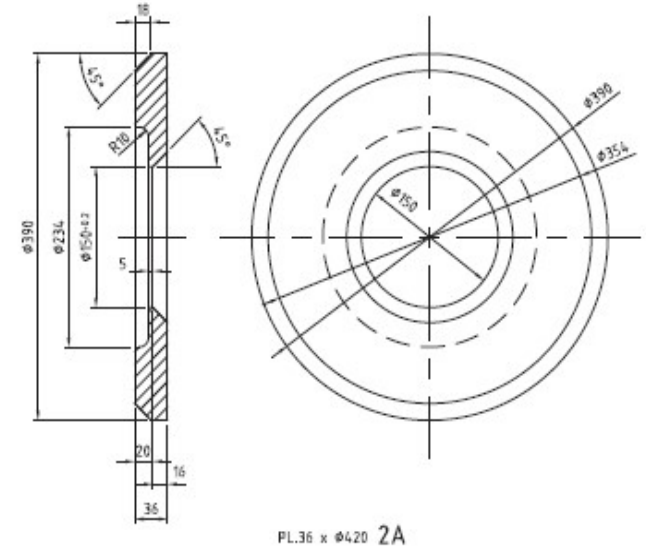
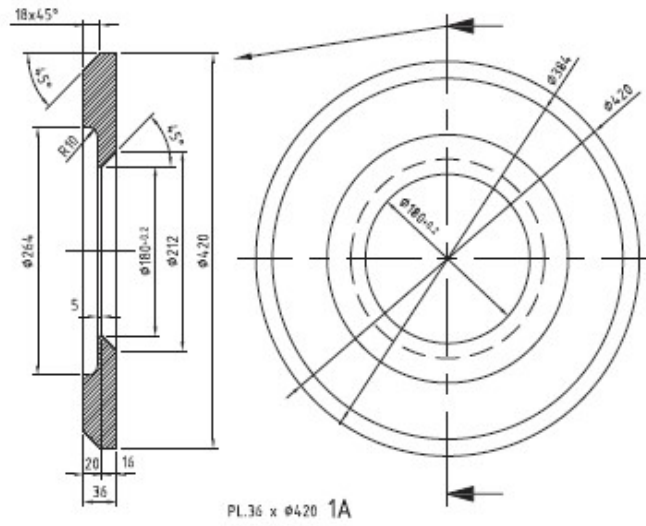


ULTRASOUNFG TESTING



DP was done during various stages of welding. DPT after 3 days of welding also found normal. After completion of entire welding work ultrasound testing was done to detect any welding defect.

During ultrasound, no peak touches DAC (Distance amplitude curve) line.



FOR PLATE 1A (Outer Diaphragm)

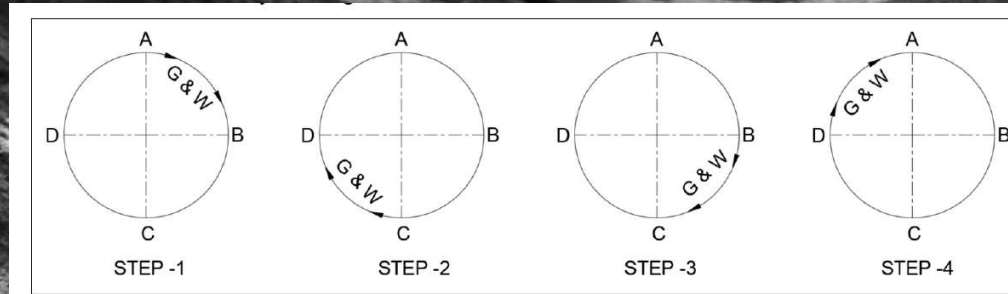
FOR PLATE 2A (Inner Diaphragm)

12. Addition stiffeners / reinforcement are provided.



Category 2: Surface defect noticed during DP & UT :

Repairing of the crack to be done as per welding procedure



Weld metal shall be deposited in layers up to 90degree. Welding to be done opposite sides of shaft by rotating the drum.

Total weld metal deposited up to 17+ 5 mm leg size.

Welding to be done in one stretch

Category 3: No surface defects observed during DP & UT.

Only reinforcement plate to be fixed.

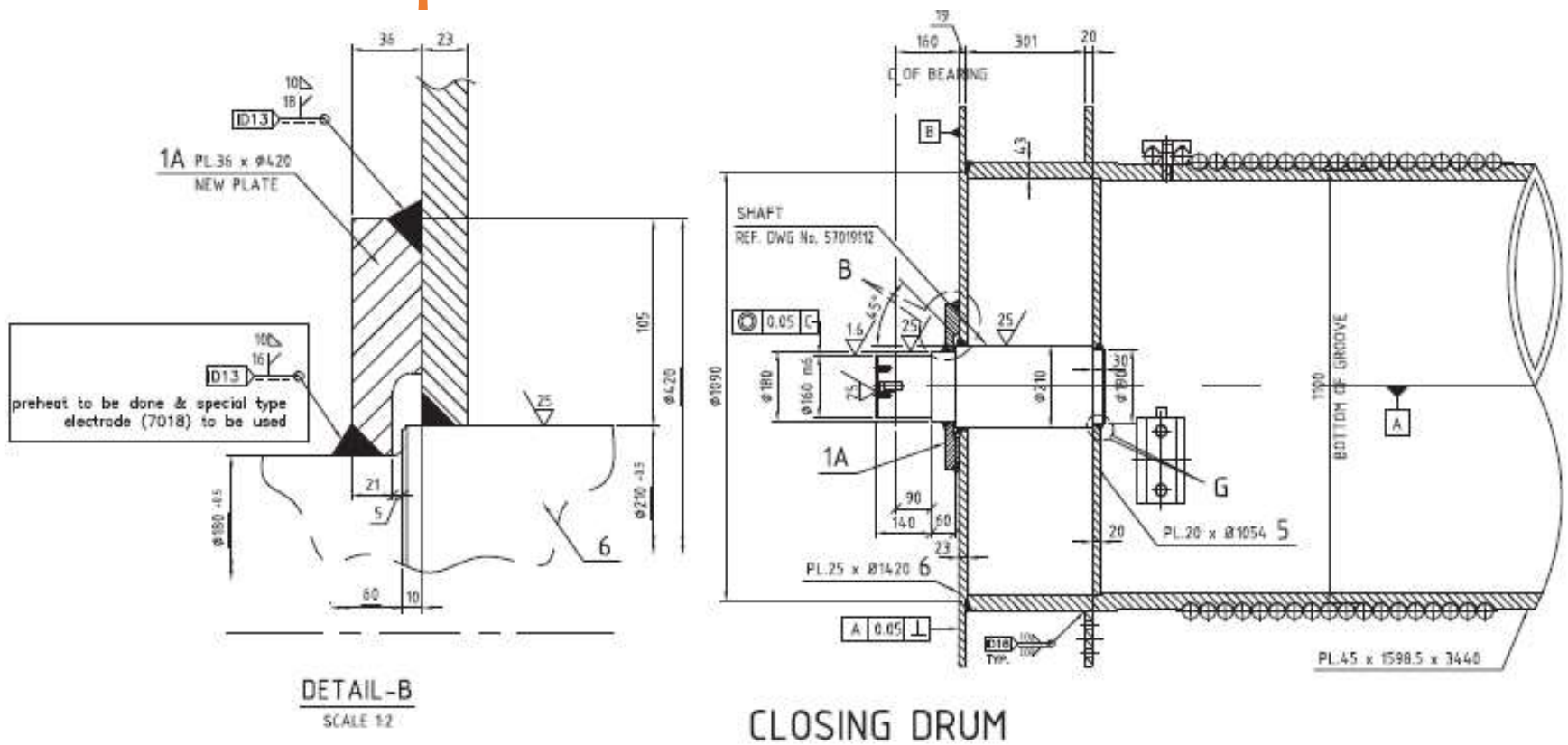


Procedure for fitting of reinforcement plate.

To be done after completion of repairing in all 3 categories.

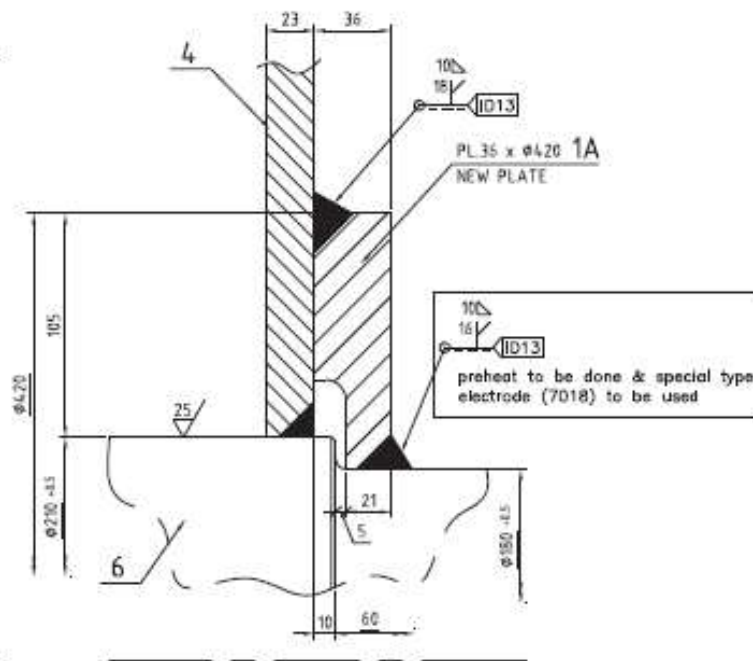
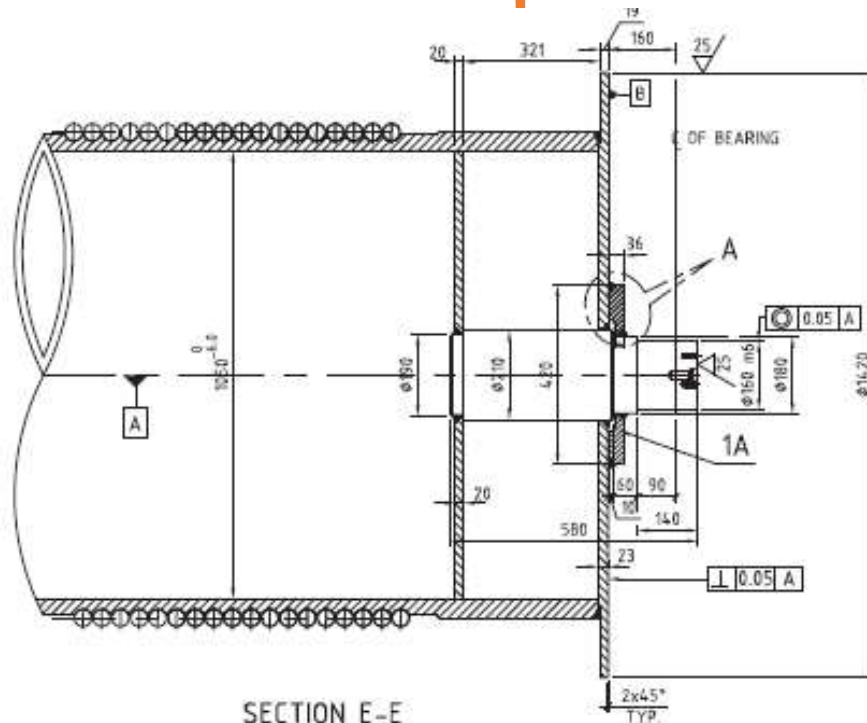
Closing Drum

All welding procedure to be followed including DP test after 03 days.



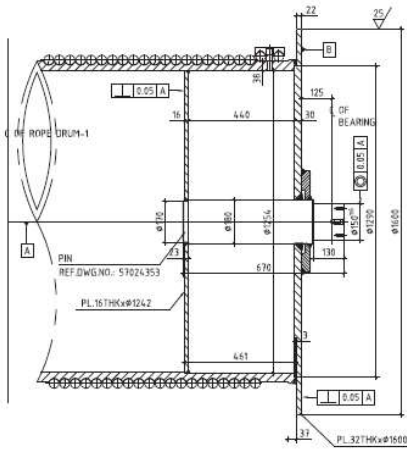
Holding Drum (Drive Side)

All welding procedure to be followed including DP test after 03 days.

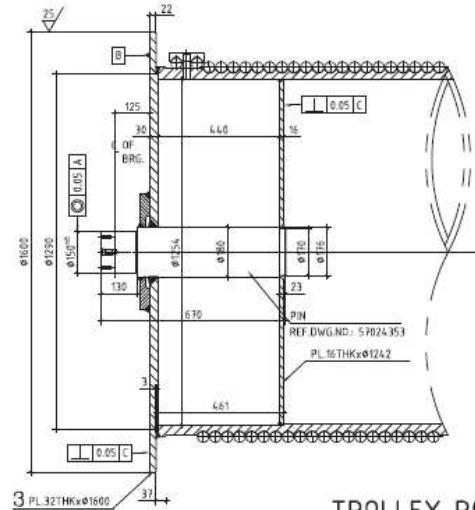
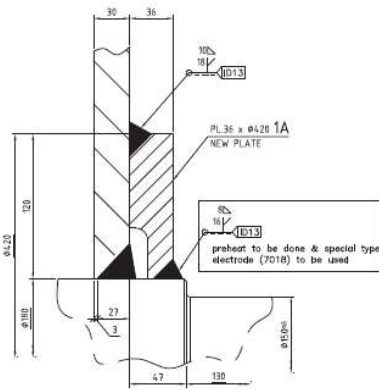


Trolley Drum

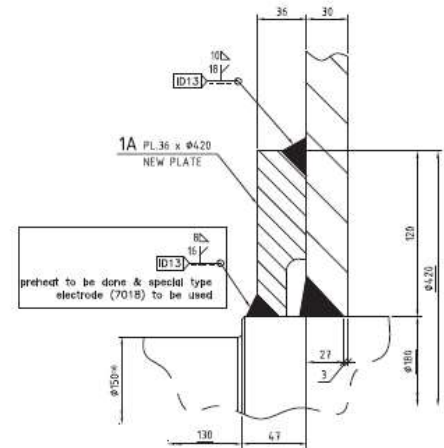
All welding procedure to be followed including DP test after 03 days.



TROLLEY ROPE DRUM-1

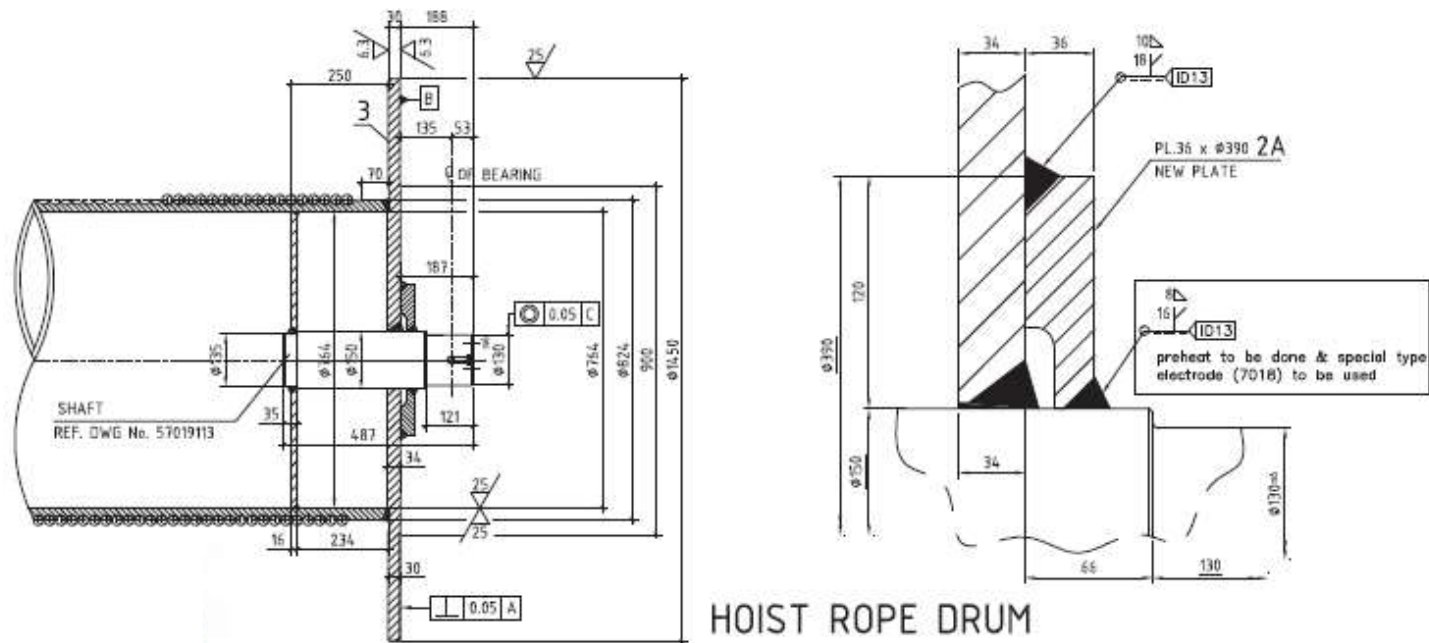


TROLLEY ROPE DRUM-2



Hoist Drum

All welding procedure to be followed including DP test after 03 days.



HOIST ROPE DRUM



CONCLUSION:

SUL-03 Drums were restored in first phase, resulting in uninterrupted unloading of barges.

Decision to check all drums & repairing / strengthening ultimately pays in long run. Thus, repeatability of the failure was eliminated.

All 03 SULs are running successfully as on date.

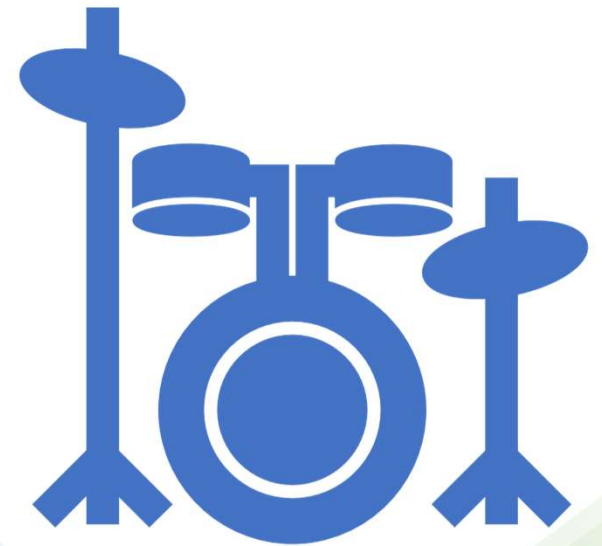
"Most importantly, it increases our self-belief and can-do attitude."

ACKNOWLEDGEMENTS

We are thankful”

- To OEM for their support in restoration of rope drums. OEM design team revisited the design aspects after getting data from site & provide necessary drawings for reinforcement, without which it might be very difficult to restore drums which are subjected to multiple forces during operation.
- To the quality assurance team of our Principal engineer for their support during the entire process.
- We are also thankful
 - a. Then CTO BIFPCL Mr.Ravindra Kumar.
 - b. Mr. Deabasis Saha, GM/FM BIFPCL.
 - c. Mr. Santanu Mishra, Project Director/
BIFPCL

for their guidance & support during the entire process



Any
suggestions
/questions,
please?

