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CONCESSIONAIRE : <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; font-weight: bold; font-size: 1.2em;">ADANI KANDLA BULK TERMINAL PVT. LTD.</div> </div>			
CONSULTANT : <div style="text-align: center; font-weight: bold; font-size: 1.2em;">MATERIAL HANDLING SYSTEM FOR DEVELOPMENT OF DRY BULK TERMINAL AT TUNA, NEAR KANDLA</div>			
<div style="text-align: center;"> PMC PROJECTS (INDIA) PRIVATE LIMITED <i>from vision to reality...</i> </div>			
CONSULTANT : <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center;"> L&T Construction <i>Metallurgical & Material Handling</i> <i>BMH EDRC Chennai</i> </div> </div>		REV. 0 SCALE : -	
PROJECT : <div style="text-align: center; font-weight: bold; font-size: 1.2em;">MATERIAL HANDLING SYSTEM FOR DEVELOPMENT OF DRY BULK TERMINAL AT TUNA, NEAR KANDLA</div>		DSGN	BRD
		04.03.2014	
TITLE : <div style="text-align: center; font-weight: bold; font-size: 1.2em;">CONTROL WRITE-UP FOR MOBILE HOPPER</div>		DRWN	DATE
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		O13074-M-BM-EQ-DC-4113 Rev. 0
Project :	Development of Dry Bulk Terminal Off Tekra Near Tuna, Kandla	
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TITLE :	Control write-up for Mobile Hopper	

1. GENERAL DESCRIPTION

Orientation:

Four (4) nos. of Mobile Hopper machines are mounted on railway track for feeding coal into Berth conveyor no. KC-1A/1C (2 machines to each conveyor). These Mobile Hopper machines are intended to receive material from grab mounted mobile harbour cranes and to discharge the material to either to the Berth conveyors or directly to the trucks through the chute & hydraulically operated sector gate.

The machines have a long travel distance of 115m (for the Mobile Hopper #1 & #4) & 155m (for the Mobile Hopper #2 & #3). The electrical power and control supply to the machines is via a machine mounted composite power and control cable reel. The trailing cable is routed through the cable trench over seaside jetty.

Description:

All machines can operate simultaneously. In normal operating condition, mobile hopper is stationary while receiving material from a grab crane. At the same time it either discharges the material to the downstream conveyor KC-1A/1C through Belt Feeder, Boom conveyor and impact nest or discharges directly to the truck through hydraulically operated sector gate & chute.


The machine will only travel to move from one position to the other by its own Long Travel Drive to suit crane location. During normal operation when Mobile hopper is discharging material to the jetty conveyor, Boom conveyor will be pinned with main structure on its own position. During the movement of Mobile Hopper #2 & #3 from one Berth to another Berth without interfering the jetty building KTT-1, Boom conveyor structure will be detached from the main machine and placed on the castor wheel assembly.

2. PLANT PHILOSOPHY

The control & sequence of operation of drives and equipments of mobile hopper shall be done by using PLC cum control desk located in Operator cabin. The machine operations are possible from the control desk of operators' cabin in local & maintenance modes.

Under normal operating conditions, the mobile hopper shall be stationary and shall be clamped to the rails by hydraulic rail clamp. The rail clamps shall be released so as to make the machine travel. Rail clamp engaged and released conditions are sensed by limit switches mounted inside the rail clamp housing.

The boom structure will be attached to the main machine during normal operation. The boom structure along with all electrical and utility lines has to be detached from the main machine and placed on the castor wheel before travelling of main machine from one berth to another berth.

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Two nos. of Proximity Sensors will be placed to sense whether the boom is in attached or detached condition.

If the wind speed increases above the maximum permissible operating speed (22.4m/s), the anemometer controller located in operator cabin gives indication signal, so that machine can be brought to parking position.

Plain water dust suppression system (**in client's scope**) on the hopper top and chute discharge point area shall be manual by operating local push button located in belt feeder platform.

CONTROL SYSTEM ARCHITECTURE

Belt feeder speed is variable from 0 to 0.5 m/sec. and is achieved by VVVF drive located inside the electric house. The electric house also accommodates the Starter panel, VVVF drive panel for long travel, UPS with battery and Lighting DB. The operator control desk is located in the operator's cabin where from both local and maintenance operations of individual drives are achieved through their respective push buttons or through HMI.

3. MODES OF CONTROL

LOCAL MODE

In local mode, individual drives can be run except **Long Travel Drive** of Mobile Hopper from the operator's cabin when respective sequential and safety interlocks are satisfied.

MAINTENANCE MODE

This mode is generally used for maintenance of machine. No load operations are recommended in this mode of operation. Each drive is controlled individually from the respective local control stations without sequential but only minimum safety interlocks (i.e.) pull cord and belt sway switch is not operated. The above modes can be selected by the selector switch provided in the operator's cabin.

4. START-UP LOGIC FOR INDIVIDUAL DRIVES

HYDRAULIC RAIL CLAMPS

The opening / closing of the twin rail clamps are activated by hydraulic cylinder/ co-axial springs in the following manner:

- The clamps are normally held on the rails by force of co-axial springs (in extended pos.) through link mechanism.



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- The rail clamp shall be opened automatically when long travel forward ON / reverse ON command is given. Once the rail clamp released feedback is received, the speed reference will be given to Long travel VFD/Belt feeder VFD and the machine operation starts.

As the oil pressure rises, the oil flows to the rail clamp cylinder through the 2-position direction control valve. As the piston moves, the clamp 'hold-on' co-axial spring is compressed and the link mechanism releases the clamp from the rail.

Limit switches LS/SLL/R and LS/SLR/R are provided on rail clamp assembly on left and right respectively. As the respective clamps are released, the above limit switches are actuated and when both the clamps are released, both switches get actuated, the pump motor is cut-off and at the same time, pump open at power pack is energized through the solenoid Hold contact thereby holding the clamp in open position.

- The rail clamp will be engaged, after a time delay from the moment long travel forward ON/ reverse ON command is withdrawn. It is done by de-energising the solenoid valve after certain time delay.

As the solenoid is de-energised the cylinder inlet lines are connected to sump through the direction control valve and return line throttle valve.

As the oil pressure in the cylinders are released the co-axial springs extends and put the clamps back on the rail and simultaneously retracts the piston back in the cylinder. Oil from the cylinder now flows back to sump and the speed of the clamp movement can be adjusted by the return line throttle valve.

Similarly for supply failure the rail clamp shall be engaged in similar fashion.

MANUAL STORM LOCK

Two additional manual storm lock pins are also mounted with the main structure to ensure positive securing with the jetty foundation, when the machine is parked at parking position. Also two manual storm lock pins are mounted with the boom structure leg to ensure locking with jetty foundation when the boom structure will be supported on castor wheel assembly at parking position. After getting the storm information the machine has to be always taken to the parking position and all the locking arrangement like hydraulic rail clamp & manual storm lock pins has to be applied. For commencing operation of the machine, manual storm locks have to be unlocked first, in order to prevent any damage to hydraulic rail clamp assembly as well as to rail. However the interlocks are provided in such a way so that unless the manual storm lock pins are taken up & hydraulic rail clamps are disengaged, the machine cannot travel.

The manual storm lock pin has got a collar ring which acts as a target for a proximity switch. This proximity switch prevents long travel when the locking pin is put down inside the land mounted locking brackets.



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BELT FEEDER

This is a reversible feeder which when running in forward direction receives material from the hopper and feeds the Berth conveyor no. KC-1A/1C via boom conveyor, when runs in reverse direction, it delivers material to the trucks.

It can be started in forward or reverse direction by push buttons on control desk in local mode, if following checks are O.K.

For maintenance mode of operation, forward /reverse along with speed increase / decrease, emergency stop and a meter for belt feeder conveyor speed indication in push button station shall be provided near belt feeder motor

- a) Belt feeder common checks
 - i. Belt feeder stop push button on control desk not pressed.]
 - ii. Emergency PB on control desk not pressed]
 - iii. VVVF drive healthy] For local &
 - iv. Pull cord wire not tripped.] Maintenance modes
 - v. Belt not misaligned]
 - vi. Emergency PB in LPBS not pressed]
 - vii. Chute block switch-1/2 not activated] for maintenance mode
- b) Belt feeder forward checks
 - i. Boom conveyor is ON feedback] For local mode
 - ii. Berth conveyor no. KC-1A/1C is ON feedback] For local mode
 - iii. CBS-1 towards conv. KC-1A/KC-1C not activated] For local mode
- c) Belt feeder reverse checks
 - i. Boom conveyor is OFF feedback] For local mode
 - ii. hydraulic sector gate in Open condition] For local mode
 - iii. CBS-2 on truck loading side not activated] For local mode

If any of these conditions fails, it will trip the Belt Feeder.

LONG TRAVEL DRIVE

In normal operating condition Long travel drive arrangement of Mobile Hopper can only be activated after ensuring that the boom structure are connected with the machines to move from one position to another position. Also ensure that boom is in disengaged condition before travelling of mobile hopper from one berth to another berth.

The long travel of the machine is achieved via 6 nos. Squirrel cage induction motors.

The brakes within the drive arrangement are designed as 'holding brakes', and are used to 'hold' the machine at standstill.

Each brake is fitted with a "brake lifted" limit switch to confirm correct operation prior to long travel motion.



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- a) Long travel common checks – For Normal operation
 - i. Ensure that Boom structure connected with Machine]
 - ii. Manual Clutch coupling engaged condition (Visual check)]
 - iii. Emergency stop PB on control desk not pressed]
 - iv. Emergency stop PB in LCS not pressed]
 - v. Hydraulic rail clamp & manual storm lock raised (Both LHS &RHS)]
 - vi. CRD healthy (from CRD feeder)]
 - vii. Travel drive brakes disengaged]For local
 - viii. Electrical and Utility Lines connected for Boom (Visual check)] mode
 - ix. Anti-collision switch not activated]
 - x. Long travel forward/reverse end limit switches are not activated. (Both normal travel and over travel)]

- b) Long travel common checks – For One Berth to another Berth
 - i. Ensure that Boom structure NOT connected with Machine]
 - ii. Manual Clutch coupling engaged condition (Visual check)]
 - iii. Emergency stop PB on control desk not pressed]
 - iv. Emergency stop PB in LCS not pressed]
 - v. Hydraulic rail clamp & manual storm lock raised (Both LHS &RHS)]
 - vi. CRD healthy (from CRD feeder)] Maintenance
 - vii. Travel drive disengaged] mode
 - viii. Electrical and Utility Lines NOT connected for Boom (Visual check)]
 - ix. Anti-collision switch not activated]
 - x. Long travel forward/reverse end limit switches are not activated. (Both normal travel and over travel)]

CABLE REELING DRUM DRIVE


The composite CRD drive motor is rated for continuous operation with machine stationary and the motor shall remain energised always.

The reeling drum when energised maintains the cables at the correct tension and thus they are laid correctly or picked up as the machine travels.

Provided that the checks are satisfied reeling drums are energised when machine travel starts Long Travel drives gives a command to reel or unreel the cable.

- a) CRD checks
 - i. Reeling drum cable not over tensioned
 - ii. Reeling drum cables not under tensioned

Above check shall be done using the inputs received from the geared cam limit switches and pendulum limit switches.

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HYDRAULIC SECTOR GATE

Hydraulic sector gate open and close are achieved by a hydraulic cylinder and power pack. These actions(open & close) are done by 2 nos. push button on the control desk .Closed and open positions are sensed by 2 nos. Limit switches with min. IP 65 Degree of protection.


- a) Sector Gate checks for open action
 - i. Belt Feeder not running in reverse mode] For local mode
 - ii. Long travel motor not running] &
 - iii. Hydraulic cylinder & system not over loaded] maintenance
 - iv. Emergency stop PB on control desk not pressed] mode
 - v. Sector gate pump stop PB in LCS not pressed]
 - vi. Truck is properly positioned below gate (Visual check)]
- b) Sector Gate checks for close action
 - i. Hydraulic cylinder & system not over loaded] For local & maintenance
This shall be checked from following field inputs:
 - 1. Filter clogging switch not activated.
 - 2. Oil temperature ok
 - 3. Oil level ok
 - 4. System pressure healthy.
 - ii. Emergency PB on control desk not pressed] mode

5. INTERFACE BETWEEN LAND PLC AND MACHINE

The following data is required to pass between the Land PLC and the machine PLC for correct and safe operation of mobile hopper and the same is achieved through the composite cable reeling drum.

- a) From machine PLC to Land PLC
 - i. Conveyor KC-1A/KC-1C run permissive/trip command from mobile hopper.
 - ii. Mobile hopper trip/fault feedback.
- b) From Land PLC to machine PLC
 - i. Conveyor KC-1A /KC- 1C running
 - ii. Emergency stop from CCR not operated.
 - iii. Harbour crane forward/reverse running feedback.

Also, all the process inputs for monitoring shall be sent to the land PLC through the wireless radio telemetry system. A radio trans-receiver set shall be mounted one on each machine and the same shall be communicating with the radio trans-receiver set mounted on the CCR directly or via a repeater set located on the transfer tower KTT-1.

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WIND VELOCITY

Anemometer controller (located in operator's cabin) shall continuously measure the wind velocity through a sensor mounted on the top of machine and indicate the wind speed in m/sec. Wind speed can be set in anemometer panel for alarm and trip. When the wind speed exceeds beyond the set value (alarm value), an alarm indication shall be given to the PLC and when it exceeds beyond the trip value (i.e., 22.4 m/sec), the Anemometer controller gives an trip Indication signal to the PLC and a command will be sent to the hydraulic rail clamps to engage and the machine will be set in parked position.

6. INDICATION AND DISPLAYS

Various indication & displays are provided on control cabin for the ease of operation.

The following indications will be provided:-

- Hydraulic Rail clamp engaged. (Red)
- Manual storm lock Released (Green)
- Conveyor KC-1A/KC-1C on /system ready to start (Blue)
- LT incomer on indication lamp (Red)
- Harbour crane running (Red)

Also an HMI (human machine interface) screen of 10.4" shall be provided on the control desk, from where the operator can be able to monitor the status of each process/alarms/and healthy ness of all the drives of mobile hopper. Also the process related quantities like belt feeder current/speed, long travel speed, etc. can also be indicated in the HMI.


Beacon light is provided at the top of mobile hopper whenever the belt feeder trip or Wind speed high above the set value indication lamp will be glow.

7. DUST SUPPRESSION (Client's scope)

Machine mounted DS system has been considered for Mobile Hoppers based on mobile hopper general arrangement drawing. Each Mobile Hopper shall be provided with a fabricated MS storage tank (14m³ storage capacity) , one centrifugal pump with drive motor, piping, valves, solenoid valve, spray header, spray nozzle, flexible hose etc. The DS spray headers are considered at the hopper top and Discharge portion of chute at truck loading area. Each DS header (or group of DS header) shall be provided with solenoid valves for automatic operation of DS system. The hopper solenoid valve located in solenoid box with bypass arrangement and the same shall be operated through manual push button (press to start & stop).

Pump shall be interlocked with the 'low level' of level switch of water tank to avoid the dry run of pump in case of low water level in the tank.

Pressure transmitter/switch is introduced in the common header to monitor the pressure. If pressure increases than permissible limits, centrifugal pump motor will be stopped. One working & one standby pumps are provided on mobile hopper. Selector switch is provided on control

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desk to select the working pump. Annunciation is provided on control desk to indicate the status of pumps. If one of the pumps fails, operator can select the standby pump and proceed for operation.

8. AIR BLASTING SYSTEM

Rotary/Screw type air compressor shall be installed in Mobile hoppers. The flow control unit can be operated in auto/manual mode through selecting a selector switch at flow control unit. In manual mode the systems run by actuating respective push button ONE AFTER ONE. In auto mode the system starts by operating a reset push button & a pre-programmed sequential timer, actuating the solenoid valve as per set time.

Flow Control Unit for blasting of Air Blaster is sequentially programmed in the sequential timer. Air blaster works on the principle of compressed air being fed through a 2/3 solenoid valve & quick exhaust valve into piston assembly located at the top end of air vessel. Air is blend from the storage vessel. When the pressure equalizes the flow stops.

To fire the air blaster a signal is fed to the solenoid valve, this than changes over closing the inlet and opening the exhaust port. The piston is depressurized and the air pressure inside the vessel exerts pressure on the piston face exposed. Since there is no pressure at the upstream of piston, the stored pressure pushed the piston back exposing large area. The air then flows through delivery pipe. The air on reaching atmosphere expands rapidly, thus destroying any material build up within the structure. The time taken to discharge is fraction of second.

The air blaster will recharge quickly from the external supply and will be ready for use within a short time dependent on the capacity of air supply.

LIST OF SAFETY SWITCHES / FIELD DEVICES PROVIDED ON THE MACHINE

IDENTITY	DESCRIPTION
1. LS/LT/BLL/R/1	LONG TRAVEL BRAKE-1 RELEASED (LHS)
2. LS/LT/BLL/R/2	LONG TRAVEL BRAKE-2 RELEASED (LHS)
3. LS/LT/BLL/R/3	LONG TRAVEL BRAKE-3 RELEASED (LHS)
4. LS/LT/BLR/R/1	LONG TRAVEL BRAKE-2 RELEASED (RHS)
5. LS/LT/BLR/R/2	LONG TRAVEL BRAKE-2 RELEASED (RHS)
6. LS/LT/BLR/R/3	LONG TRAVEL BRAKE-2 RELEASED (RHS)
7. LS/SLL/R	LEFT STORMLOCK RELEASED
8. LS/SLR/R	RIGHT STORMLOCK RELEASED
9. LS/CC/MA	BELT FEEDER BELT MISALIGNED
10. LS/CC/PC	BELT FEEDER PULL CORD SWITCH
11. LS/CRD/P1-P3	CRD PENDULUM SWITCH 1-3
12. LS/CRD/G1-G2	CRD GEAR CAM LIMIT SWITCH 1-2



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|-----------------|---|
| 13. LS/TC/EXT | HYDRAULIC SECTOR GATE OPEN |
| 14. LS/TC/RTC | HYDRAULIC SECTOR GATE CLOSED |
| 15. LS/LT/ACT | MACHINE TO MACHINE ANTI-COLLISSION |
| 16. LS/BC/A | BOOM SENSOR/LIMIT SWITCH-ATTACHED |
| 17. LS/BC/D | BOOM SENSOR/LIMIT SWITCH-DETACHED |
| 18. LS/LT/FNT | LONG TRAVEL FORWARD NORMAL TRAVEL |
| 19. LS/LT/FOT | LONG TRAVEL FORWARD OVER TRAVEL |
| 20. LS/LT/RNT | LONG TRAVEL REVERSE NORMAL TRAVEL |
| 21. LS/LT/ROT | LONG TRAVEL REVERSE OVER TRAVEL |
| 22. LS/MRLL/D | LEFT MANUAL RAIL CLAMP DISENGAGED |
| 23. LS/MRLR/D | RIGHT MANUAL RAIL CLAMP DISENGAGED |
| 24. CBS-1 | CHUTE BLOCK SWITCH OPERATED AT BELT FEEDER
DISCHARGE END TO CONV. KC-1A/KC-1C. |
| 25. CBS-2 | CHUTE BLOCK SWITCH OPERATED AT BELT FEEDER
DISCHARGE END TO TRUCK LOADING. |
| 26. ZSS | ZERO SPEED SWITCH OPERATED FOR GANTRY CONVEYOR |
| 27. LS/CC/MA/GC | GANTRY CONVEYOR BELT MISALIGNED |
| 28. LS/CC/PC/GC | GANTRY CONVEYOR PULL CORD SWITCH OPERATED. |