



Operational & Control Philosophy: Coal & Fertilizer Handling

DRY BULK TERMINAL AT TUNA, NEAR KANDLA

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1. GENERAL DESCRIPTION:

Adani Kandla Bulk Terminal Pvt. Ltd (AKBTPL) at Tuna near Kandla, Gujarat, India, is planned with ship unloading facility for coal & fertilizer with total four berths. Berth-1 is planned for unloading coal & fertilizer while Berth-3 is planned for unloading coal. Further unloaded material will be transferred to stockpile and from stockpile to truck and wagon manually. Fig. 01 Shows plant layout of the site. Basic Material characteristics of coal & fertilizer are as follows.

| 1 | Material Handled | Coal | Fertilizer |
|---|--------------------|--|--|
| 2 | Bulk Density | 0.8 T/m ³ (min.) 1.2 T/m ³ (max.) | 0.6 T/m ³ (min.) 0.9 T/m ³ (max.) |
| 3 | Moisture Content | 40 to 45% | 0% |
| 4 | Angle of Repose | 37° | - |
| 5 | Angle of surcharge | 20° | - |
| 6 | Lump Size (Max) | (-) 150 mm | (-) 10 mm |

2. MASTER PLAN:

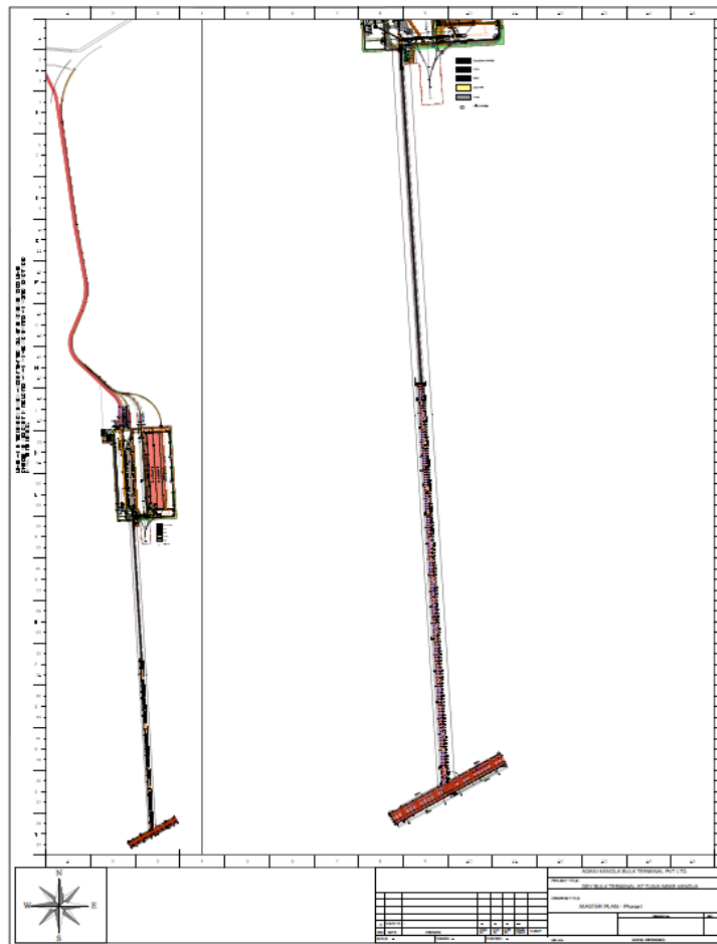


Figure 1: Master Plan for Tuna Project

Coal/Fertilizer will be imported in ship as a carrier. Coal/Fertilizer handling process starts, as the ship will be located at jetty face. Coal/Fertilizer handling system consists of various material handling equipment with prime movers, sensing and control accessories as listed in flow sheet of the bulk material handling system. Fig. 02 shows flow diagram of the coal handling plant.

3. FLOW DIAGRAM:

As the flow sheet indicates, the plant will be utilized for unloading of Coal/Fertilizer from ship using mobile cranes installed on jetty. Mobile crane will grab material from the ship and unload it onto Mobile hoppers located on the same track in-line with mobile cranes. Mobile hopper will feed the receiving conveyor through Belt feeder & Boom conveyor.

The coal material will be delivered to coal stock yard through either of following mentioned chain of receiving conveyors:

- A. KC-1C→KC-2C→KC-3B→KC-4AA→COAL STOCK
- B. KC-1A→KC-2A→KC-3B→KC-4AA→COAL STOCK

The fertilizer material will be delivered to closed go-down/truck loading station through following mentioned chain of receiving conveyors:

- C. KC-1A→KC-2A→KC-9→GODOWN/TRUCK LOADING

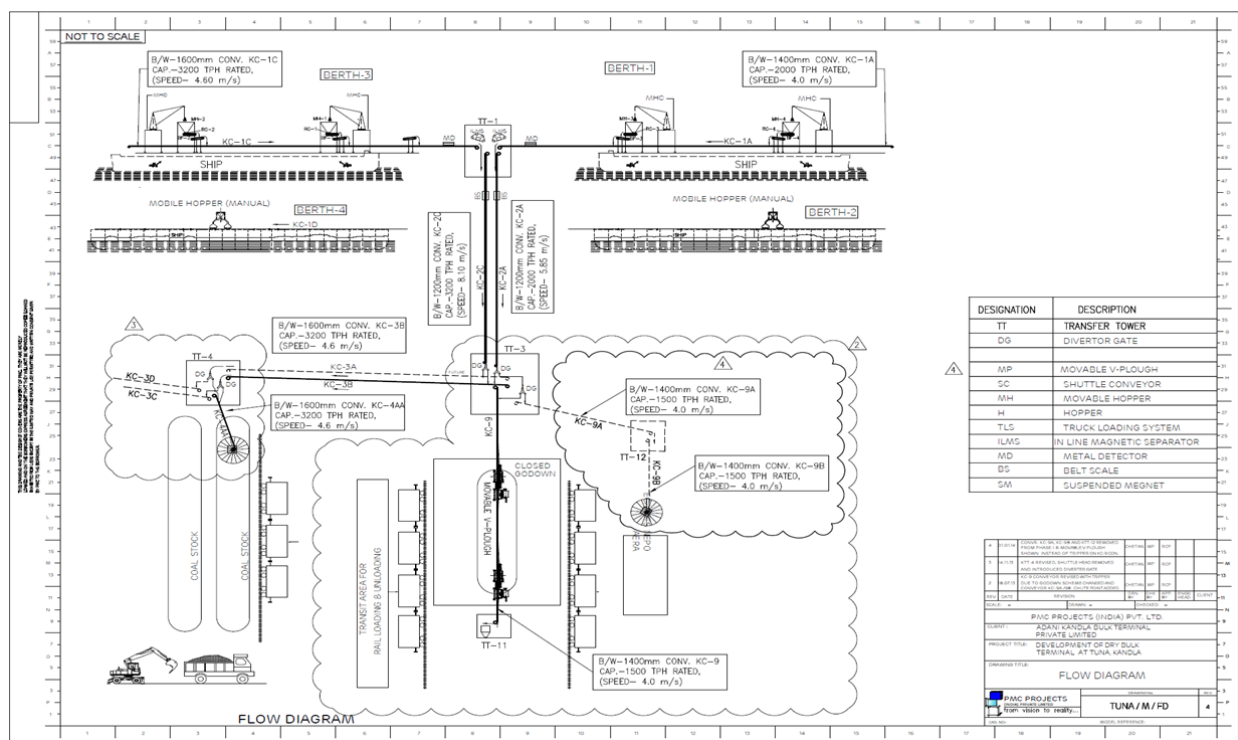


Figure 2 : Flow Diagram

As mentioned,

- Conveyors KC-1A & KC-2A will be common for both coal and fertilizer application while KC-1C & KC-2C will only be used for coal application.
- Conveyors KC-3A, KC-9A, & KC-9B will be part of future development.

Conveyor KC-9 also has option of Movable- V-plough arrangement. When movable V- plough will be in operation, fertilizer material will be stacked on both side and along the length of conveyor KC-9. And during bypass operation of Movable V-plough, the material will be directly discharged in to hopper of 20T capacity inside tower KTT-11 for truck loading.

4. OPERATING PRINCIPLES

4.1 Starting and stopping of conveyors

Before starting conveyor system, it is necessary to start first receiving conveyor and then start feeding conveyor i.e. operating logic is from downstream to upstream. For stopping of conveyor system, the operation will be opposite i.e. from upstream to downstream. So it is necessary if any conveyor is stopped in the system all the upstream conveyors should stop automatically.

Important:

Oil level and lubrication check must be done before system starts.

Regularly inspection & maintenance of scrapper shall be done.

Hooters shall provide the alert of conveyor start.

4.2 Drive operations of conveyors

The conveyor drive module consists of two or more equipment like electric motor (DOL/Freq. drive), fluid coupling (scoop type variable speed or fixed filled), thruster brake (drum/disk), Reducer (multistage Reduction) all with connecting couplings. Flywheel is also provided in conveyors 3B & 4AA. First of all, In case of scoop coupling, start the electric motor and let it come to full speed with no load condition. After arriving at full speed of electric motor, the scoop type fluid coupling shall be started. While starting and getting full speed of fluid coupling the process of injecting of oil takes place and then it starts to rotate the reducer shafts and hence takes the conveyor load. This whole process will take few seconds. In case of simple fluid coupling, the same procedure has to be followed, except fluid coupling starts automatically when oil inertia reaches the required level. All the conveyors are having different starting and stopping times. Please refer Table: 1 for conveyor drive system power schedule and starting / stopping time. Thruster brake requirement is decided on stopping time difference of feeding and receiving conveyors, transfer chute space and inclination of conveyor (Layout/Elevation). Sometime, during the operations thermal conditions / components temperature shall be scanned for better performance / oil replacement / maintenance schedules.

4.3 Control Modes

Automatic mode is the normal operating mode of the conveyor. In this mode, the complete system is operated from the central operator control room. Only fully interlocked automatic equipment starts and stops are available in this mode.

Manual mode provides the ability to run each conveyor and major component independently for maintenance purpose. All internal equipment interlocks are maintained in this mode. However, most external interlocks are disabled. In particular, interlocks to prevent material from lading onto the belt remain in place so that the belt always operates empty in manual mode.

Creep mode allows the conveyor to be operated at low speed (10%) in forward or reverse direction. This function is provided for maintenance purpose and is otherwise similar to the manual mode. This function can only be entered if the conveyor is stopped and is only available when the conveyor is empty. The feeders are disabled whenever the conveyor is operated in this mode.

Maintenance modes provide manual control of various equipment for maintenance purpose (pumps, fans, motors, and brake systems). When in maintenance mode, the equipment is operated from push buttons located at the equipment panels. All external and internal interlocks are disabled in this mode. Maintenance modes can only be entered when the corresponding conveyor is stopped. Conveyor starts are prevented as long as the mode is active.

4.4 Metal Detector Operation

Metal Detector is provided in conveyor KC-1A & KC-1C to detect the metal parts in conveying material bed, it generates audible/visible indication on panel and drop sand bag/chain marker on detected area, so one can interrupt the system and remove the metal parts manually.

4.5 Belt Scale Operations

Belt scale is used to measure material weight in dynamic condition. It consists of weighing system and tachometer to gather the weight details with conveying speed. All these details are continuously processed in a microcontroller and shows capacity (TPH) of conveying material and total material transfer. The signal from local unit is transferred to the master module to collect the data and processed for logical operations.

4.6 Diverter Gate Operations

This gate is also known as prism gate. It is used to divert material on either of the conveyor to receive the material.

4.7 Inline Magnetic Separator Operations

Inline magnetic separator is used to remove the ferrous particles from the conveying material. These are electrically charged magnets, located above the discharge pulley. The ferrous particles are attracted by the magnet from the material bed to bottom face of the equipment and these ferrous particles are carried out with the help of ILMS.

5. SAFETY SWITCHES

5.1 Plug Switch Operation

The Plug chute condition is also a major criterion in operation and control for material handling with conveyors and other feeding equipment. The plug chute switch is used for this and it shall be located before skirt board area (in chute) of receiving conveyor. If material is plugged or it touches the switch, switch will generate a signal for plug chute indication. This signal shall be utilized for interrupting the sequence of feeding by stopping upstream chain of conveyors systems with auxiliary equipment. All the receiving conveyors are equipped with the plug chute switch before skirt board area (in chute). When the signal is received, the upstream chain of feeding route shall be stopped.

5.2 Pull Cord Switch Operation

All conveyors are equipped with pull cord arrangement throughout the length of conveyor. Pull cord switch shall be provided at regular interval of 30 m. This switch can be operated by pulling the cord attached to it and it has been laid along the manual reachable position all the way. As the pull cord operation is manually done in any emergency circumstances, the signal from pull cord switch shall be utilized to stop the conveyor chain from upstream to the conveyor where this situation is occurred. As conveying chain is interrupted, all the route mounted auxiliary equipment shall be stopped with the relative conveyors.

5.3 Belt sway switch

Belt sway switch is provided to avoid belt swaying.

5.4 Belt Rip Detector

High speed conveyors duly installed with belt rip detector shall have proper interlocking with conveyor system.

5.5 Zero Speed Switch Operation

All the belt conveyors including Belt feeders & boom conveyors are equipped with Zero speed sensors. As the speed of conveyor goes down below 80% during the operation due to some reasons, the signal from this switch shall be utilized to stop that conveyor up to upstream chain of that route. Feeding conveyor shall be started

after receiving conveyors speed reaches 80% of the full speed. As conveying chain is interrupted, all the route mounted auxiliary equipment shall be stopped with the relative conveyors.

5.6 Emergency Stop Operation

All the power panels are having Emergency Stop push type/lever type button on it. This operation will be performed manually when emergency stoppage of system required. When emergency stop switch is pushed, the local control shall be stopped up to upstream chain. As conveying chain is interrupted, all the route mounted auxiliary equipment shall be stopped with the relative conveyors.

5.7 Linear fire detection system

Fire detection wire is provided along the length of each conveyor to detect fire as safety provision.

5.8 Take-up limit switches

Take-up travel limit switches shall be provided to avoid over travel.

5.9 Interlocking with Stockpile height

Conveyors shall have interlock with the stock pile height to avoid accidental damage.

5.10 Interlocking with hopper top level

Conveyors shall have interlock with the top level of hopper (inside KTT-11) to avoid hopper over-flow.

Note: Please refer separate document for Operation & control philosophy of following:

- i) Operating and control philosophy of conveyor KC-2A & KC-2C
- ii) Operation & Control philosophy of Mobile hopper with belt feeder & boom conveyor
- ii) Operation & Control philosophy of Movable V-Plough.
- iii) Operation & control philosophy for Motorized winch for counter weight lifting.

6. OPERATIONAL SEQUENCES/ROUTES

Following are the possible operational sequences/routes during the process of unloading, stocking, truck loading.

I. Unloading of fertilizer from ship (BERTH-1) to closed go down or to hopper inside transfer tower KTT-11 (Figure-3)

II. Unloading of coal from ship (BERTH-1) to coal stock. (Figure-4)

- a. MH-4+Belt Feeder-4 & MH-3+Belt Feeder-3 feed onto KC-1A
- b. MH-4+Belt Feeder-4, MH-3+Belt Feeder-3 & MH-1+Belt Feeder-1 feeding onto KC-1A

III. Unloading of coal from ship (BERTH-3) to coal stock. (Figure-5)

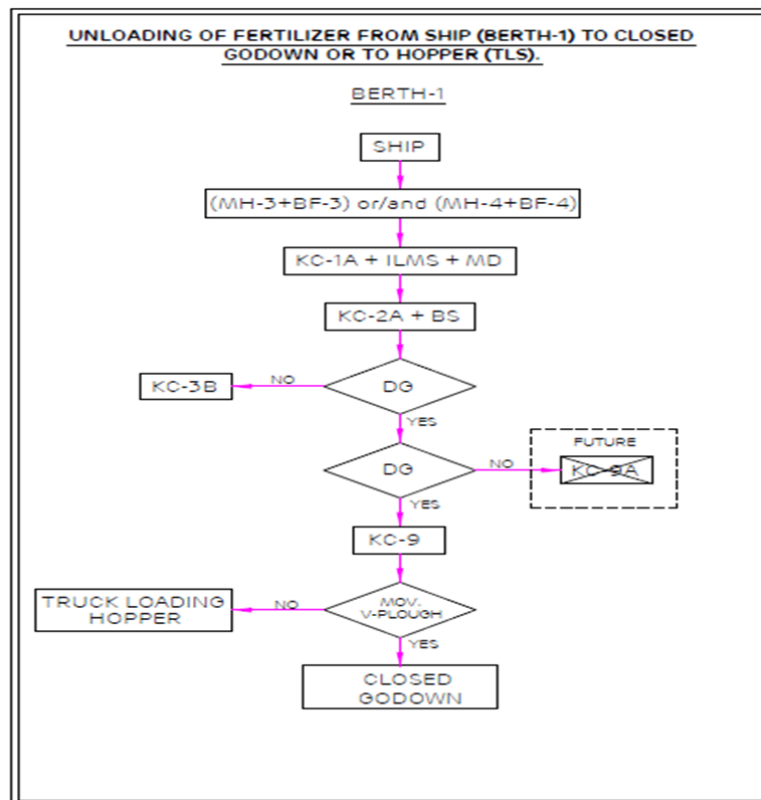


Figure 3: Unloading of fertilizer from ship (BERTH-1) to go-down or to hopper inside tower KTT-11

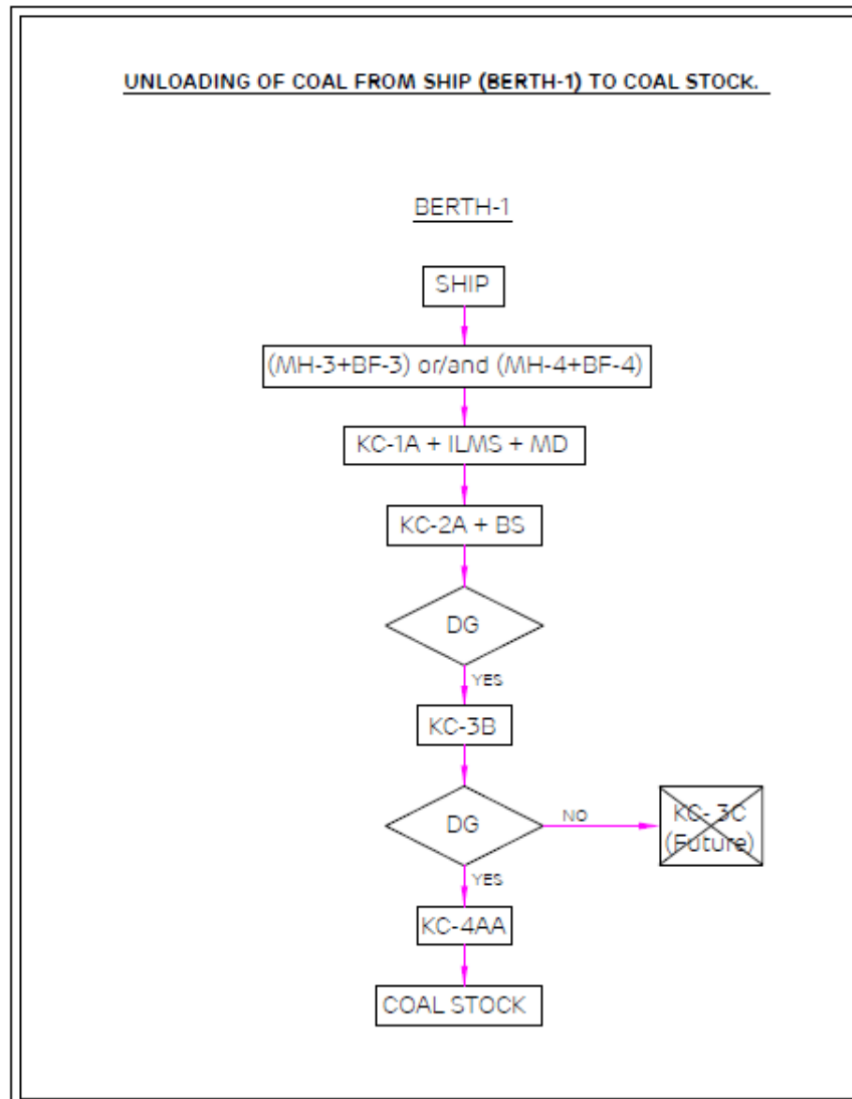


Figure 4: Unloading of coal from ship (BERTH-1) to coal stock

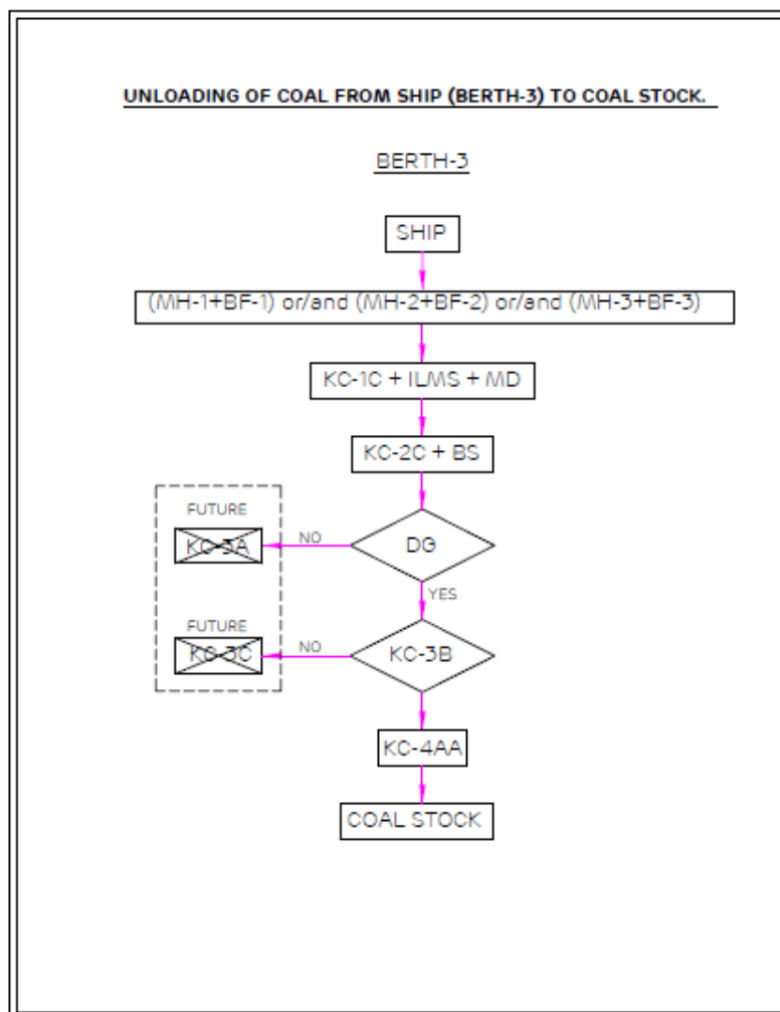


Figure 5: Unloading of coal from ship (BERTH-3) to coal stock.

Note:

- Manual truck loading can be done with the help of crane & tyre mounted mobile hoppers on Berth 2 & 4.
- Mobile crane can also travel Berth-3 & Berth-4 for unloading of material.

7. EXPLORING AND UNDERSTANDING OF A ROUTE

7.1 Unloading of fertilizer from ship (BERTH-1) to closed godown or to hopper.

One of the given possible sequences/routes considering all the in-line equipments and system working with all the possible integrated interfaces and interlocks. Fig. 6 shows the route of material handling from berth to loading conveyors (KC-2A & KC-2C) with auxiliary equipment. However there may be chances of operation of

- Both mobile hoppers and belt feeders on each berth. (i.e MH-3+BF-3 & MH-4+BF-4 on berth-1)
- One mobile hopper and belt feeder on each berth. (i.e Either MH-3+BF-3 or MH-4+BF-4 on berth-1).

For Mobile Hopper Operational Instruction, please refer "Operational and control philosophy of Mobile Hopper with Belt Feeder".

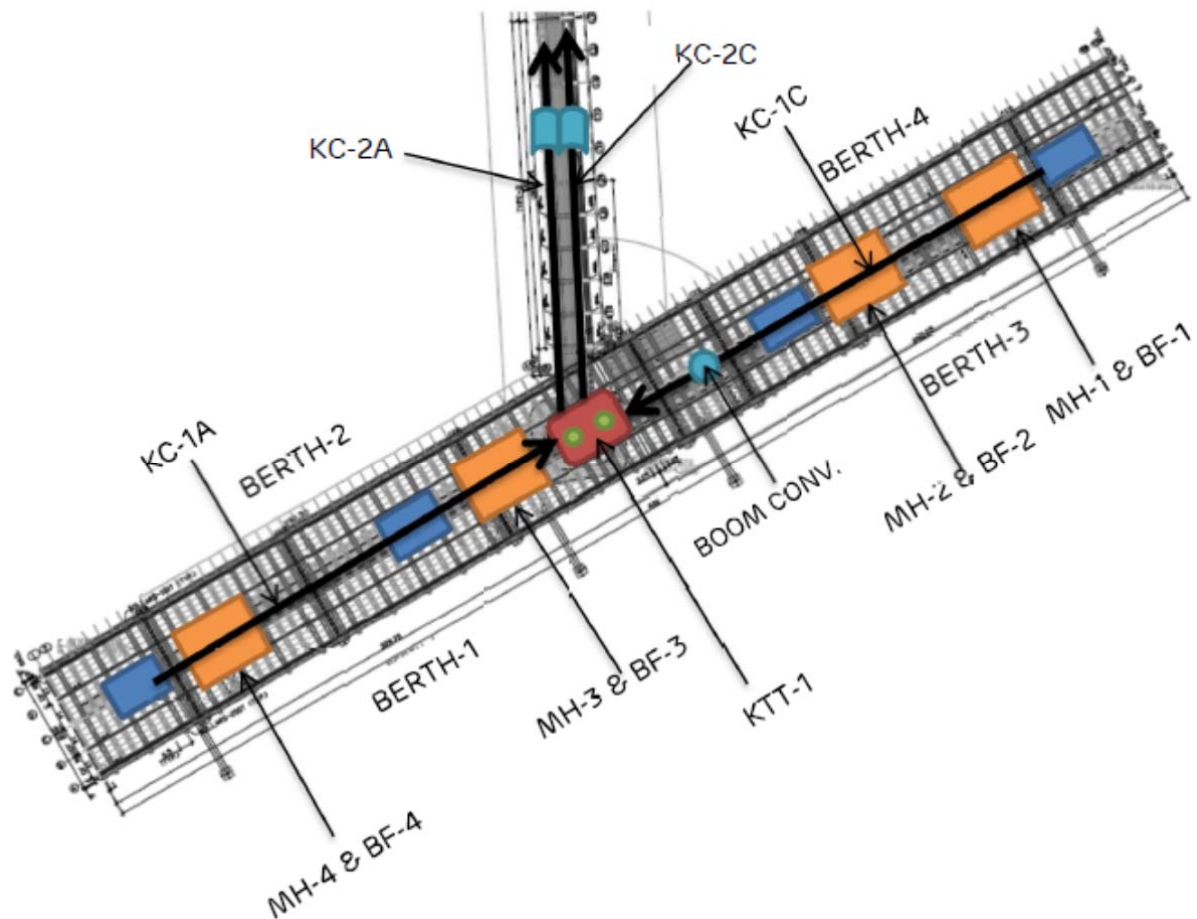








Figure 6: Route of unloading coal/fertilizer from ship to unloading conveyors

| | | | |
|---|---------------|---|--------------------------------|
|  | Mobile crane |  | Transfer Tower |
|  | Mobile Hopper |  | ILMS |
|  | Belt scale |  | Boom Conveyor with resting pad |

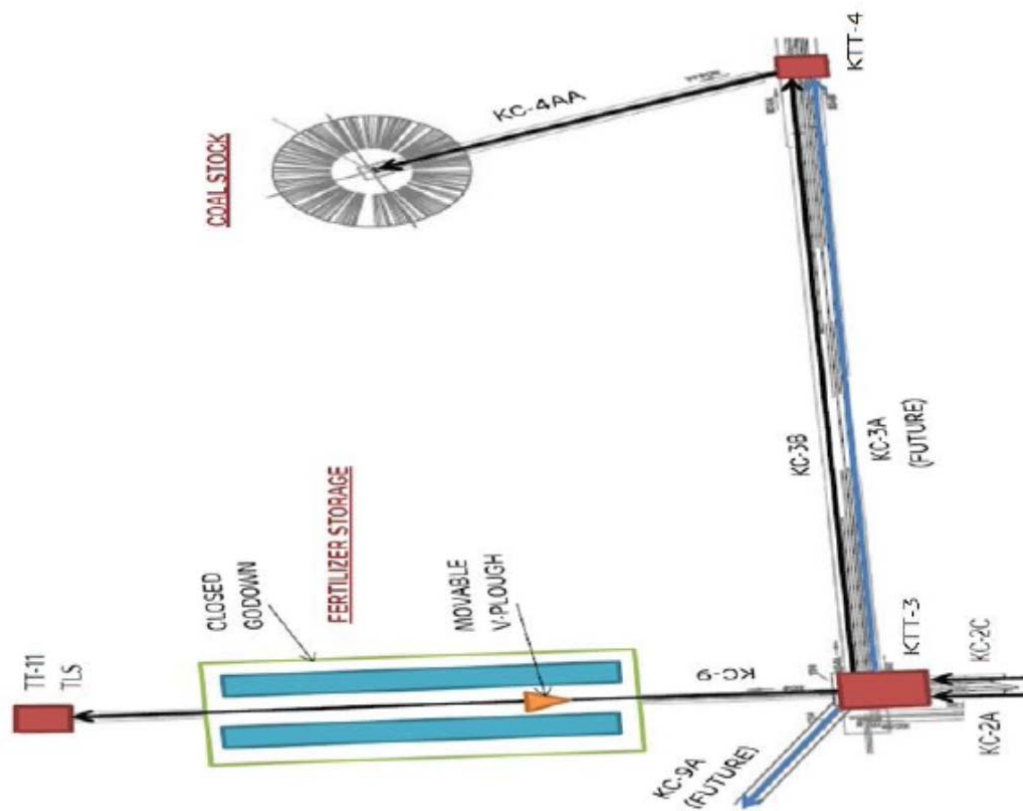
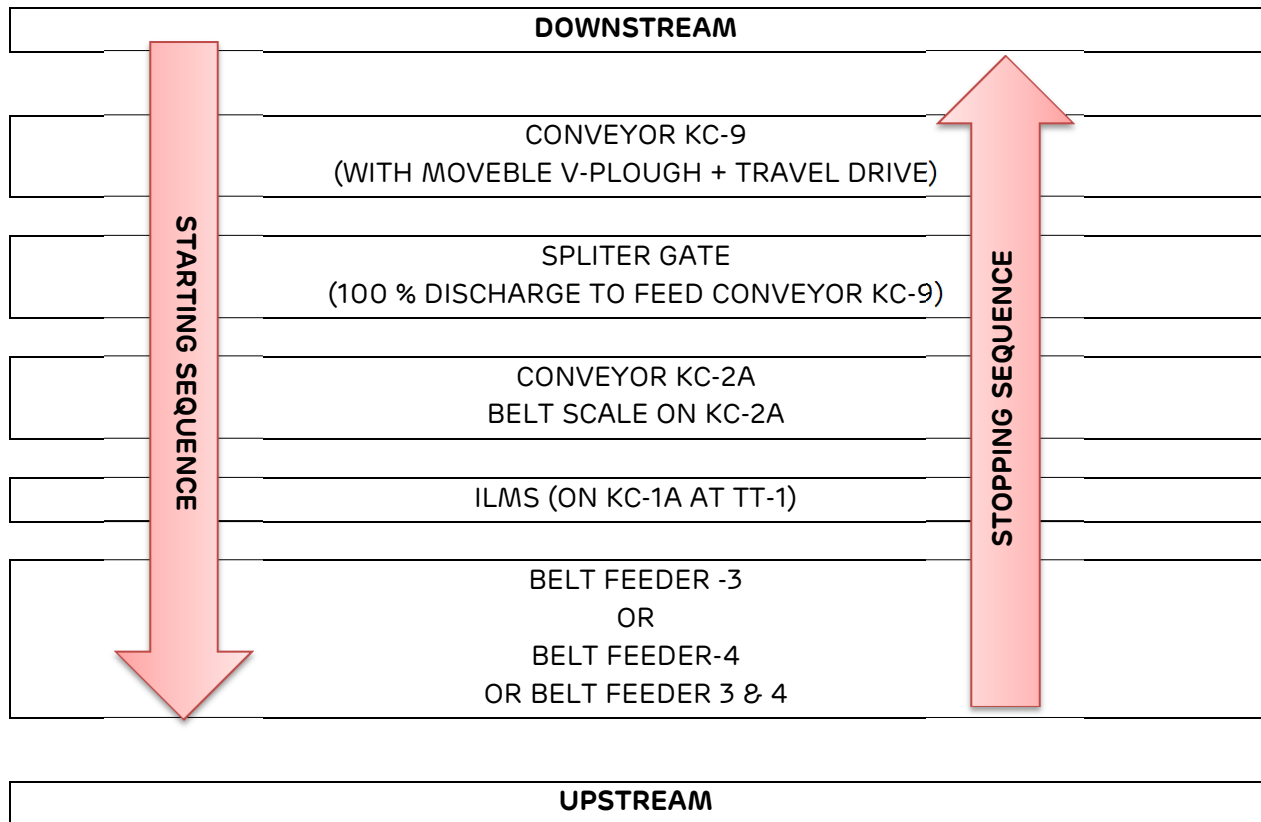


Figure 7: Route of unloading conveyors to loading area

Operation sequence-1 (Unloading of fertilizer from ship (Berth-1) to closed go-down or Hopper-TLS) is shown in figure 5 & 6. This route starts from unloading the material from the ship (Berth-1) to KC-1A with the help of mobile hopper and belt feeder. Further the material will be transferred to conveyor KC-9 via TT-1, KC-2A, TT-3 and Splitter gate respectively. During this operation splitter gate will divert 100% fertilizer material from KC-2A to KC-9. Conveyor KC-9 transfers material to Truck Loading Station (TT-11) while Movable V-plough is not in operating condition. Trucks are loaded with the help of sliding gate arrangement provided at the bottom of hopper. While Movable V-plough is in operation the fertilizer material will be stacked in along the length on both side of conveyor KC-9 in closed Go-down. Further material is loaded into wagon with the help of rail loading system. For Operational and Control Philosophy of Movable V-Plough refer Doc: KDL-011-03-GE-CP-001

This route includes following sequence of conveying and auxiliary equipment. Its starts with starting sequence from downstream to upstream and ending with stopping sequence from upstream to downstream. Starting and stopping sequence of the route and equipment are shown in below. Bounded equipment shall be started with combination of corresponding conveyor. For particular bounded equipment, all auxiliary equipment shall be started before the corresponding

conveyor has to be started. The same shall be stopped only after the corresponding conveyor has stopped.

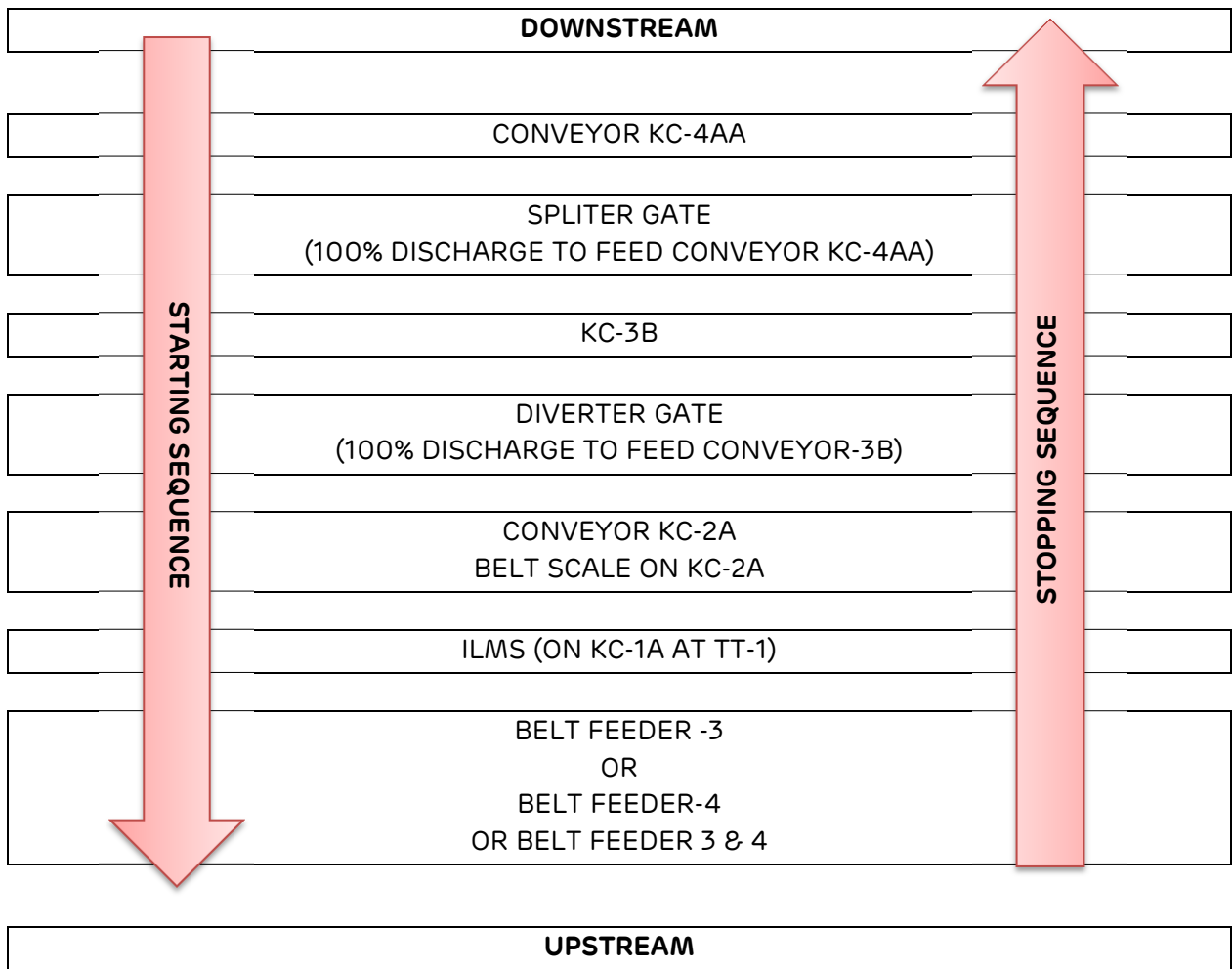


Among all the given routes and details, the basic operating principle of conveyor system/stream shall be interlocked with running time. Hence, starting and stopping sequence of conveyors stream with inline equipment shall be considered very carefully.

7.2 Unloading of coal from ship (BERTH-1) to coal stock.

In this operation sequence, coal is transferred to coal stock area from the ship (Berth-1) via KC-1A, TT-1, KC-2A, Spliter gate, KC-3B & KC-4AA.

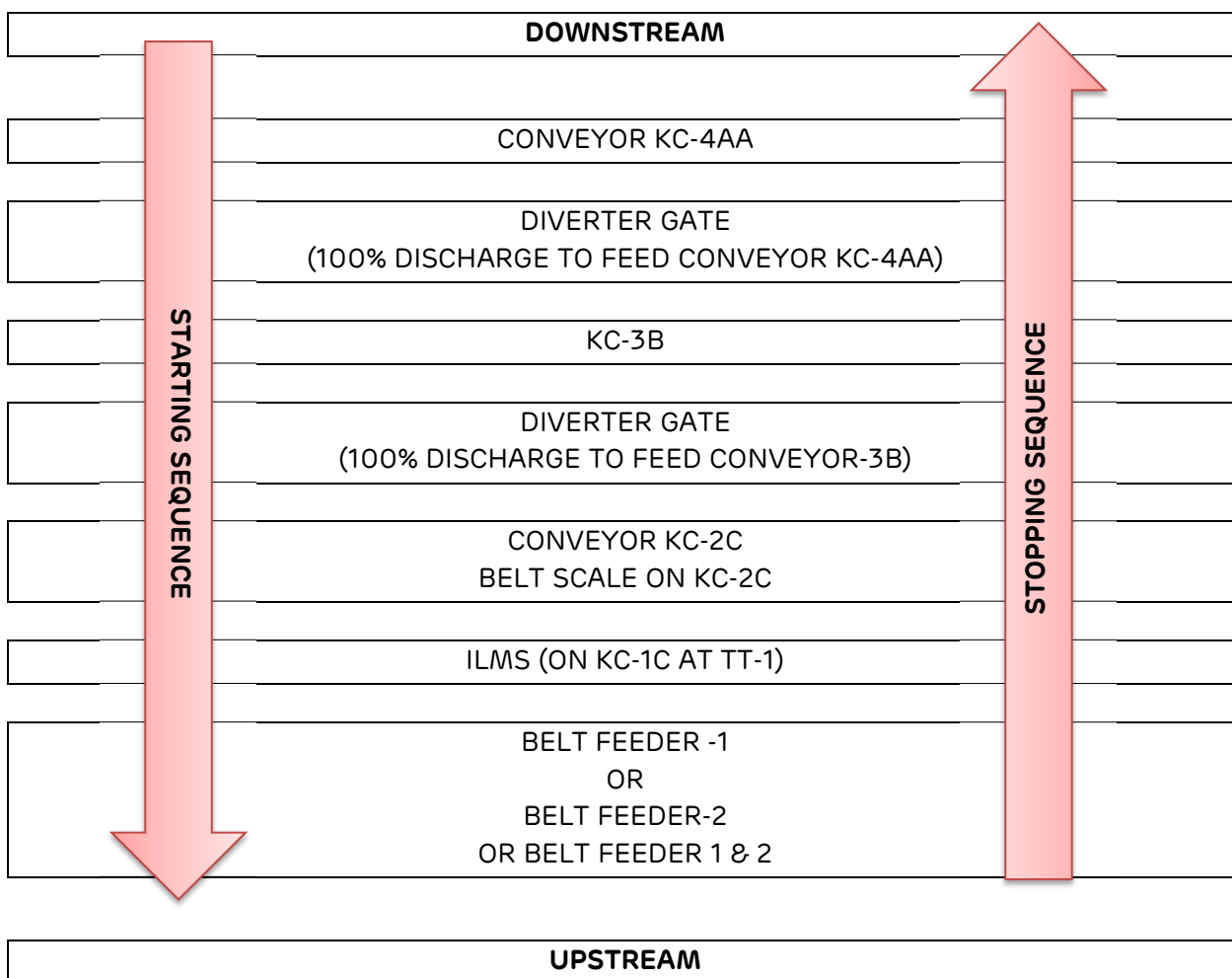
Starting and stopping sequence of the route and equipment are as shown in below.



7.3 Unloading of coal from ship (BERTH-3) to coal stock.

In this operation sequence, coal is transferred to coal stock from the ship (Berth-3) via KC-1C, TT-1, KC-2A, Splitter gate, KC-3B, KC-4AA.

Starting and stopping sequence of the route and equipment are as shown in below.



7.4 Other operational possibilities:

- Coal can be unloaded on conveyor KC-1C (Berth-3) with the help of all three Mobile cranes & Mobile hoppers (MH-2+BF-2, MH-1+BF-1 & MH-3+BF-3). During this operation Boom conveyor of Mobile hopper No:3 (on Berth:1) will be dismantled, only mobile hopper with belt feeder will travel to Berth No:3 and will be engaged to boom conveyor already kept at resting pad at Berth No:3 for operation of 3 cranes & 3 Mobile hoppers at a time.
- Coal can be unloaded simultaneously with all equipment and interlocks, from both Berth 1 & 3 by following mentioned routes with controlled feed rate and appropriate Splitter gate discharge proportion. In this case material feed to conveyor KB-3B shall be such that its rated capacity shall not exceed 3200TPH.
 - KC-1A→KC-2A→KC-3B→COAL STOCK
 - KC-1C→KC-2C→KC-3B→COAL STOCK
- Fertilizer from Berth: 1 and coal from berth: 3 can be unloaded at the same time.

8. DISPATCH STREAM

➤ For coal

Manual loading of coal to rail rack will be done at coal stock area.

➤ For fertilizer

Bagging and rack loading as per the policy decided by operational group.

9. DUST SUPPRESSION SYSTEM

Dry fog type dust suppression system is to be used at discharge end and at skirt board (loading point).

Important:

DSS system will only be used during unloading of coal. During unloading of fertilizer DSS shall not be operated.

10. CONVEYOR OPERATIONAL TIME CHART

Table 1 : Conveyor Starting and Stopping Time

| Conv. Name | Operational Timings (Sec.) | | Stop Control |
|------------|----------------------------|--------------|--------------------------------|
| | ~ START TIME | ~ STOP TIME | |
| | Fully Loaded | Fully Loaded | |
| KC-1A | 43** | 4.5** | Natural Stopping |
| KC-1C | 45** | 14.5** | Natural Stopping |
| KC-2A | 180 | 19 | VFD+ Emergency brake |
| KC-2C | 220 | 28 | VFD+ Emergency brake |
| KC-3B | 110** | 32** | Natural stopping with flywheel |
| KC-4AA | 115** | 28** | Natural stopping with flywheel |

** To be confirmed by L&T.

Note:

This document does not cover OCP of mobile crane. Please refer separate document for OCP of mobile crane.