TELESCOPIC SPOUT OPERATION - FSD SHIP LOADER

1 INTRODUCTION

CWA Engineers Inc. (CWA), acting on behalf of Fraser Surrey Docks LP (FSD), contracted THOR Global (THOR) to perform a pre-engineering study for a ship loader spout intended to be used on the ship loader for the Direct Transfer Coal Facility (DTCF) at FSD in Surrey, BC, Canada.

The purpose of this study was to determine the best fit ship loading equipment while considering the ship loader design, weights (e.g. wheel loads etc.), commodity loads and to optimize the ship loading process.

The main objective of the engineering study was to provide the Best Available Technology Not Entailing Excessive Costs (BATNEC), specifically for loading coal into a Panamax class vessel. The study also considered all sensitive design aspects and capacity constraints that would directly relate or impact potential dust creation and effective mitigation of fugitive dust.

2 BACKGROUND

2.1 DESIGN CONCEPT

The ship loader, spout and spoon design for the FSD DTCF has been based on a THOR concept layout Type Tower Ship Loader TS 244x72x4000M with a 244’ long main truss conveyor equipped with an under-slung shuttle conveyor at the front part of the main truss. The ship loader has a 27.4m outreach and a height of 36.2m.

A telescopic spout of approximately 10.0m (33’) at a fully extended length supports the feed of the individual vessel hatches. The figure below shows the TYPICAL design of the Ship loader. For more details (e.g. overall dimensions, heights and elevations etc.) please refer to the latest revision of the General Arrangement drawing No. 14-267 (TS244x72) of the TELESCOPIC TOWER SHIP LOADER.

![Figure 1: THOR Telescopic Tower Ship loader / Concept (Typ.) – Operation](image)

The spout consists of multiple segments and thus can be retracted to a minimum length of approximately 2.5m (8.2’) to clear vessels when the main truss is luffed to a maximum 15° position. The telescopic spout will be equipped with a full revolving loading spoon to optimize the loading, particularly to fill the holds under the hatch rims.
2.2 Available SHIP LOADING Spout SYSTEMS
Thor considered the numerous spout and spoon designs available to meet the specific ship loading needs of the DTCF Project. A telescopic spout was chosen for the DTCF as it represents the BATNEC in modern ship loader operations, particularly for wet coal. Below is an overview of the spout and spoon designs options that were considered.

‘No-spout’ approach
At one end of the scale is the ‘no-spout’ approach. In this case, the material is discharged off the end of the conveyor belt directly into the ship or barge. In many cases, a curved hood may be used to collect the discharged material and direct it vertically downward into the hold, but sometimes the trajectory of the discharged material is used to gain additional outreach. This ‘no-spout’ option is the most economic, most reliable solution, and should be chosen whenever conditions permit.

The biggest advantages of this option are: zero maintenance, zero risk, and zero ‘plugged chute’ load. However the downfall of this option is the minimal amount of dust control. This option would be considered the least effective in terms of dust mitigation and was not considered for the DTCF Project.

Loading spouts
For free flowing commodities such as coal, completely enclosed vessel loading systems, such as loading spouts are the preferred technology. These spouts are usually cascade chutes terminating with a telescopic dust skirt that gently transfers the material down the center of the spout with very little turbulence, and hence dust propagation. This ship loading option is considered the most effective technology in terms of dust mitigation. However the biggest draw-back of this kind of system is twofold.

- These spouts, due to the inherent design of the cascading components, exert a tremendous load in the form of a moment arm on the ship loader and therefore berth and/or decking/piling. This is particularly the case with wet materials, such as coal induced with wet dust surfactants and water which is the case for the DTCF project.

- The cascading process limits the speed of the product during the descent, which does not provide an effective use of a spoon at the end of the spout. A spout without a spoon would only be considered if the reach of the ship loader is sufficient to reach as much of the vessel hatch(es) as possible.

Considerations for a Spout Selection
The design of the spout clearly needs to take into consideration all the conditions of the DTCF project at FSD. These parameters include:

- Characteristics of coal to be handled
  - Dust
  - Product Degradation
  - Dynamic flow properties
  - Density (post surfactant application)
  - Abrasiveness

- Loading rate (4,000 mtph)

- Trimming requirements (IMO regulations)

- Panamax vessel characteristics (air draft light and loaded, beam, hold dimensions, ship’s gear, log stanchions, type of hatch covers, etc.)

- Tidal range

- Ship loader characteristics

- Berth 2 and transfer point loading capacities (1,000 psf)
The criteria used for evaluating and determining the BATNEC for the spout considered the following points:

- Reliability in terms of operation
- Reliability in terms of minimal dust propagation and the mitigation of such dust
- Ease, duration and cost of maintenance
- Potential for damage due to:
  - Spout hitting hatch coaming
  - Ship surging
  - Spout plugging.
- Degradation
- Trimming versus peak loading rates

2.3 Proposed TELESCOPIC Spout OPERATION and Design for DTCF

Telescopic spouts represent the BATNEC in modern ship loader operations, particularly for wet coal. A telescopic spout (with a revolving and adjustable spoon) was specified to provide a smooth and soft loading process. The results of the study and the preliminary design of the spout estimates that the majority if not all of the dust will be captured within the spout.

**Deflector Hood**

Another key design feature that was added to reduce dust during loading was to carefully control the transfer point at the discharge so that the material flows in a laminar fashion, as opposed to turbulent transfer.

A clamshell type, doubly curved deflector hood will collect the material as it is discharged from the belt. These hoods generally change the direction of material flow by 90°, essentially from horizontal to vertical. By gently concentrating and diverting the flow maintains much of the kinetic energy and minimize air entrainment.

For practical reasons, the hood will be at a fixed angle relative to the boom. This means that when the boom luffs up or down the head box must make the final correction to ensure that the material moves vertically down into the chute inlet cone irrespective of boom angle.

![Figures 2 & 3: Typical Head Chute at Ship loader / Similar Deflector Hood Design](image-url)
Telescopic Spout
The main part of the telescopic spout will consist of telescopic-type pipe segments. The lifting and lowering of the telescopic segments is winch operated and fully remote controlled. Pending final engineering, the segments will be either made of stainless steel or lined accordingly.

The total extended length of the spout is approximately 10.0m. It is important to note that the design (i.e. cascading versus non-cascading, diameter, etc) and length of the spout was determined through a “plugged chute” scenario in conjunction with the capacity of the ship loader and ultimately the berth deck.

In this case it was determined that the type of spout was primarily a factor of the loading capacity of the berth deck and transfer point, which is 1,000 psf and hence limited to 10.0m. This length will be more than adequate to maintain a less than 1.0m drop height (negating the spoon) from the bottom of spout to the top of the product in the vessel hatch. This is based on the maximum tidal change (approximately 3.0m) and the elevation of the vessel in respect to the berth/ship loader.

The minimum extended length of the spout (not including the spoon) is approximately 3.5m. Thor is of the opinion that these operational ranges will have a significant advantage of mitigating against potential fugitive dust.

Figures 4 & 5: Typical Telescopic Chute at Ship loader / Similar Installation

Soft Loading Spoon
Again due to the loading capacities of the berth deck and tail transfer point, the length of the ship loader was maximized at 75.0 m (244’). However to ensure an effective vessel loading operation was achieved (with minimal vessel warping), it was determined that a spoon would need to be attached to the bottom of the spout. This design provides further reach to the loading operation without significantly stressing the moment arm of the main ship loader truss.

To further mitigate dust, a 360° rotatable and luffing soft loading spoon will be installed. A soft spoon provides minimal separation of the material stream at the bottom outlet of the telescopic section, which again minimizes against the potential for dust to be created. The spoon will be designed to smoothly collect and guide the material in order to provide homogeneous and consistent trajectory with the least amount of turbulence. To further augment dust mitigation, it is Thor’s understanding that a wet suppressant halo will be attached to the bottom of the spout to spray the coal exiting the spout and spoon into the hatch of the vessel (not shown in the drawing as this is outside of Thor’s scope of work).
2.4 THOR GLOBAL’s DTCF TELESCOPIC CHUTE SUMMARY

The THOR GLOBAL Telescopic spout and soft spoon design will offer the most advanced technological features for a modern method of ship loader operation within the conditions and parameters given by FSD and CWA.

The telescopic spout system will be equipped with both an adjustable deflector and a retractable loading spout. The entire spout system will be designed for optimized material flow control to minimize any dust creation through product degradation, augmented with highly effective dust mitigation. In respect to all considered Thor strongly believes the suggested spout and ship loader design is the Best Available Technology Not Entailing Excessive Cost.

With Kind Regards

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P. Eng. / Thor Global.
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