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Selection of Risk Assessment Criteria: Minimising Risk for Offloading Area and Port Tanjung Pelepas Channel

Mohd Redza Bin Mahmud,

ABSTRACT: These journal contain communication data, as well as other reference review especially navigating the high-risk operation area within Sungai Pulai and Port Tanjung Pelepas. The purpose of this guideline is to provide guidance to the Master and officers on board the ship with respect to the steps to be taken when an incident has occurred or is likely to occur. With restriction due to current, tide, wind direction, and traffic flow from inbound or outbound the Outer Port Limit (OPL) of Port Tanjung Pelepas, this plan will assist thae Master of vessel to coordinate and address any immediate emergency according to the law and regulation comply. Recognizing that there are a variety of options to improve efficiency including speed optimization, weather routing and hull maintenance, for example – and that the best package of measures for a ship to improve efficiency differs to a great extent depending upon ship type, cargoes, routes and other factors, the specific measures for the ship to improve energy efficiency will be identified. These measures will be listed as a package of measures to be implemented, thus providing the overview of the actions to be taken for that ship. Particularly, the topic discuss will evaluate the best approach for Risk Assessment Model and contribute the lowest factor of incidents or is likely to occur.

Keywords: Navigating, Incidents, Speed, Weather, Energy Efficiency, Risk Assessment Model

I. INTRODUCTION

Planning is the most crucial stage of the vessel efficiency and optimization, in that it primarily determines both the current status of vessel energy usage and the expected improvement of ship energy efficiency. Therefore, it is encouraged to devote sufficient time to planning so that the most appropriate, effective and implementable plan can be developed. It is required to understand, both, design and operational aspects of the vessel characteristic to determine a credible baseline. This can be collated from vessel and equipment design documentation. This review identifies energy-saving measures that have been undertaken, and determines how effective these measures are in terms of improving energy efficiency, thus this measure will reduce the risk operating and impact to the manoeuvring course. The International Maritime Organization (IMO) has distribute varies guideline for the requirement of vessel operating within high risk areas which expose to the incidents and hazards. One of the guideline written in accordance with the requirements of Regulation 37 of Annex 1 of the International Convention for the Prevention of Pollution from Ships, 1973, are called Shipboard Oil Pollution Emergency Plan, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) and as further revised in accordance with the amendments in the IMO Resolution MEPC 54 (32), as amended by Resolution MEPC 86(44) as shown below. Guidance on best practices for operation of vessel are related to the efficiency across the entire transport chain takes responsibility beyond what can be delivered by the owner / operator alone. A list of all the possible stakeholders in the efficiency of a single voyage is long; obvious parties are designers, shipyards and engine manufacturers for the characteristics of the ship, and charterers, ports and vessel traffic management services, etc., for the specific voyage. All involved parties should consider the inclusion of efficiency measures in their operations both individually and collectively. The varies are included in below salient point:

1.1 Fuel-Efficient Operations: Improved voyage planning by calculate the shortest distance or optimum route. The efficiency can be achieved through the careful planning and execution of voyages. Thorough voyage planning needs time, but a number of different software tools are available for planning purposes.

1.2 Weather routeing: Weather routeing has a high potential for efficiency savings on specific routes. It is commercially available for all types of ship and for many trade areas. Significant savings can be achieved, but conversely weather routeing may also increase fuel consumption for a given voyage.

1.3 Just-in-time: Good early communication with the next port should be an aim in order to give maximum notice of berth availability and facilitate the use of optimum speed where port operational procedures support this approach. Optimized port operation could involve a change in procedures involving different handling arrangements in ports. Port authorities should be encouraged to maximize efficiency and minimize delay.

1.4 Speed optimization: Speed optimization can produce significant a safe manoeuvring from departure to arrival. However, optimum speed means the speed at which the fuel used per tonne mile is at a minimum level for that voyage. It does not mean minimum speed; in fact sailing at less than optimum speed will consume more fuel rather than less. Reference should be made to the engine manufacturer's power / consumption curve and the ship's propeller curve. Possible adverse consequences of slow speed operation may include increased vibration and problems with soot deposits in combustion chambers and exhaust systems. These possible consequences should be taken into account. As part of the speed optimization process, due account may need to be taken of the need to coordinate arrival times with the availability of loading/discharge berths, etc. The number of ships engaged in a particular trade route may need to be taken into account when considering speed optimization. A gradual increase in speed when leaving a port or estuary whilst keeping the engine load within certain limits may help to reduce fuel consumption.

1.5 Optimized shaft power: Operation at constant shaft RPM can be more efficient than continuously adjusting speed through engine power (see paragraph 5.7). The use of automated engine management systems to control speed rather than relying on human intervention may be beneficial.

1.6 Optimum trim: Most vessel are designed to carry a designated amount of cargo at a certain speed for certain fuel consumption. This implies the specification of set trim conditions. Loaded or unloaded, trim has a significant influence on the resistance of the ship through the water and optimizing trim can deliver significant fuel savings. For any given draft there is a trim condition that gives minimum resistance. In some ships, it is possible to assess optimum trim conditions for fuel efficiency continuously throughout the voyage. Design or safety factors may preclude full use of trim optimization.

1.7 Optimum ballast: Ballast should be adjusted taking into consideration the requirements to meet optimum trim and steering conditions and optimum ballast conditions achieved through good cargo planning. When determining the optimum ballast conditions, the limits, conditions and ballast management arrangements set out in the ship's Ballast Water Management Plan are to be observed for that ship. Ballast conditions have a significant impact on steering conditions and autopilot settings and it needs to be noted that less ballast water does not necessarily mean the highest efficiency.

1.8 Optimum propeller and propeller inflow considerations: Selection of the propeller is normally determined at the design and construction stage of a ship's life but new developments in propeller design have made it possible for retrofitting of later designs to deliver greater fuel economy. Whilst it is certainly for consideration, the propeller is but one part of the propulsion train and a change of propeller in isolation may have no effect on efficiency and may even increase fuel consumption. Improvements to the water inflow to the propeller using arrangements such as fins and / or nozzles could increase propulsive efficiency power and hence reduce fuel consumption.

1.9 Optimum use of rudder and heading control systems (autopilots): There have been large improvements in automated heading and steering control systems technology. Whilst originally developed to make the bridge team more effective, modern autopilots can achieve much more. An integrated Navigation and Command System can achieve significant fuel savings by simply reducing the distance sailed "off track". The principle is simple; better course control through less frequent and smaller corrections will minimize losses due to rudder resistance. Retrofitting of a more efficient autopilot to existing ships could be considered. During approaches to ports and pilot stations the autopilot cannot always be used efficiently as the rudder has to respond quickly to given commands. Furthermore at certain stage of the voyage it may have to be deactivated or very carefully adjusted, i.e. heavy weather and approaches to ports. Consideration may be given to the retrofitting of improved rudder blade design (e.g., 'twist - flow' rudder).

II. METHODOLOGY & SCOPE OF STUDY

This chapter will be further analyse and measure the data input from few methods and next to structure the Risk Assessment Model. The model shall be applicable to achieve the optimization route selection. At the early stage, the model are dedicate for Sungai Pulai as a main focal where Port Tanjung Pelepas channel also using the same passage for marine offloading routeing. However, researcher believe that these models can be apply to other channel and river which link in between industrial and development. A systematic method will be deliver application considering three (3) main issue as follow:

a) Density of traffic and route selection containment of volume cargo transit from loading to offloading facility. This necessary need to counter travel time and involved with level of service traffic strength at Port Tanjung Pelepas channel. Alternative routes proposal can be adhere by draw the potential for dredging operation in order to reduce the time travel and significantly to reduce the hazard routeing.

b) Weather and environment factor such wind direction, tide clearance and current effect on scope of area. This is including adjacent dredging area for sensitivity of ecosystems, which significantly affect the accident and incident rates potential. Determination of hazards framework are consider from risk level and efficiency of emergency access.

c) Vessel design and utilisation also will encounter contribution of risk level where it cost of distance, travel time, operating cost and mariners training background which whom experience and not experience. All this consequence will ensure the vessel safety design and regulatory maintenance can be operate at optimum condition against the risk level framework.

Developing a simulation area model of the proposed navigation route by carry out 2D ship-handling simulation to test the proposed navigation route is the best approach to find out the most vessel optimization results of simulation and risk assessment. The data input from weather factor, cargo weighting, ballast condition, machinery equipment, etc will identify potential areas of concern and propose appropriate mitigation measures, if necessary;

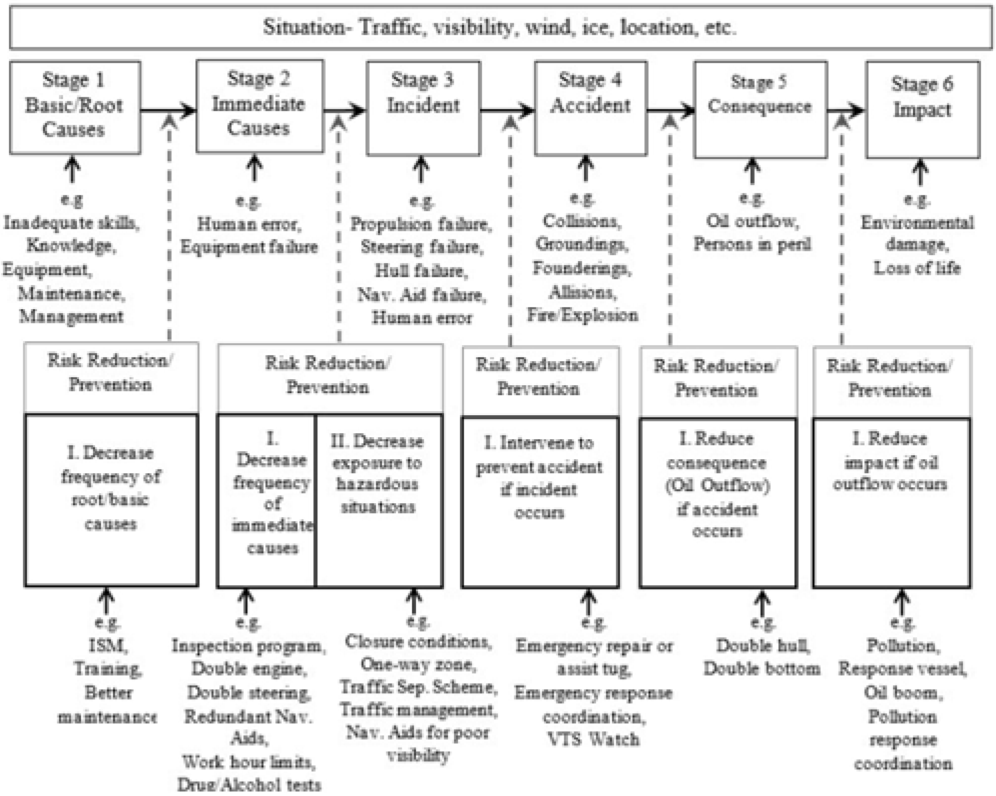

Figure 1 : The configuration of vessel efficiency and optimization prior departure of port.

2.1 HAZID METHODOLOGY

The HAZID study is based on the Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO Rule-Making Process - MSC-MEPC.2/Circ.12 dated 8th July 2013. Formal Safety Assessment is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis.

A three step Formal Safety Assessment (FSA) was conducted:

a) Step 1 - Hazard Identification: Identification of the hazards and their causal / contributing factors

b) Step 2 - Risk Assessment: Assessment of the severity (severity index) of each hazard and the likelihood (frequency index) of the occurrence of the hazard based on the causal / contributing factors

c) Step 3 - Risk Control Options: Discussion on potential risk control options, if considered necessary, to mitigate the likelihood (reduce the frequency index) of each contributing factor

The Risk assessment was carried out based on an established index adopted by the International Maritime Organization (IMO) for maritime related incidents:

Severity Index				
S.I	Severity	Effects on Human Safety	Effect on Ship	S (Equivalent to Fatalities)
1	Minor	Single or minor injuries	Local equipment damage	0.01
2	Significant	Multiple or severe injuries	Non severe ship damage	0.1
3	Severe	Single fatality or multiple severe injuries	Severe damage	1
4	Catastrophic	Multiple fatalities	Total loss	10

Table 1 : Severity Index (S.I)

Frequency Index			
F.I	Severity	Definition	F (Per ship year)
7	Frequent	Likely to occur once per month on one ship.	10
5	Reasonably probable	Likely to occur once per year in a fleet of 10 ships, i.e. likely to occur a few times during the ship's life.	0.1
3	Remote	Likely to occur once per year in a fleet of 1,000 ships, i.e. likely to occur in the total life of several similar ships.	10^{-3}
1	Extremely remote	Likely to occur once in the lifetime (20 years) of a world fleet of 5,000 ships.	10^{-5}

Table 2: Frequency Index

Risk Index					
F.I	Frequency	Severity Index			
		1	2	3	4
		Minor	Significant	Severe	Catastrophic
7	Frequent	8	9	10	11
6		7	8	9	10
5	Reasonably probable	6	7	8	9
4		5	6	7	8
3	Remote	4	5	6	7
2		3	4	5	6
1	Extremely remote	2	3	4	5
(red)	Intolerable				
(yellow)	ALARP				
(green)	Negligible				

Table 3 : Risk Index

2.2 MAIN RESULTS

The HAZID result has been analyzed and identified by the wya of possible hazards associated with the proposed transit of the self-propelled barges including its causal / contributing factors:

No.	Hazard	Causal / Contributing Factors
1	Collision with passing commercial vessels (container ships, tankers & barges)	• Miscommunication between self-propelled barge and commercial vessel • Equipment failure on commercial vessel • Equipment failure on self-propelled barge • Error in navigation • Adverse weather (eg. Sumatra squall)
2	Collision with small boats	• Equipment failure on commercial vessel • Equipment failure on self-propelled barge • Error in navigation • Adverse weather (eg. Sumatra squall)
3	Grounding of self-propelled barge	• Equipment failure on self-propelled barge • Error in navigation • Adverse weather (eg. Sumatra squall)

Table 4 : Potential hazard and its potential risk

The results of the HAZID risk assessment are presented in the HAZID Worksheet below, showing the frequency index (FI), severity index (SI) and risk index (RI) of each fault event and contributing / causal factor pair:

No.	Fault Event	Contributing / Causal Factor	F.I	S.I	R.I
1	Collision with passing Commercial vessels (containerships, tankers & barges)	Miscommunication between self-propelled barge and commercial vessel	5	4	9 Intolerable
		Equipment failure on commercial vessel	1		5 ALARP
		Equipment failure on self-propelled barge	2		6 ALARP
		Error in navigation	1		5 ALARP
		Adverse weather (eg. Sumatra squall)	1		5 ALARP
2	Collision with small boats	Error in navigation (Fishing Season)	5	2	7 Intolerable
		Error in navigation (Off-Season)	2		4 Negligible
		Equipment failure on self-propelled barge	2		4 Negligible
		Equipment failure on commercial vessel	2		4 Negligible
		Adverse weather (eg. Sumatra squall)	1		3 Negligible
3	Grounding of self-propelled barge	Equipment failure on self-propelled barge	5	1	6 ALARP
		Error in navigation	2		3 Negligible
		Adverse weather (eg. Sumatra squall)	1		2 Negligible

Table 5: Sample Hazard Identification Worksheet

2.3 SHIP HANDLING SIMULATION

In many ways that this method can be use as simulation where the result appear in coordination with list risk of assessment. Based on the above specification, ship odel was selected based on nature of limited draft and compatible cargo space up to 1300 Gross Tonnage which suitable for the routeing in marine offloading and loading facility.
The dimensions of the self-propelled barge are as follows:

a) Deadweight : 1,200t
b) Length Overall, LOA : 80.0 m
c) Breadth : 18.0m
d) Depth : 4.0m
e) Summer Design Draught : 2.2m
f) Speed during Loaded Conditions :10 knots

Runs were rated PASS, MARGINAL or FAIL, according to the criteria shown in below.

PASS	☐ The ship remains under full control at all times ☐ The ship stays within the navigable part of the channel with acceptable clearances or closest point of approach (CPA) from shallow areas, other objects, facilities or obstacles.
MARGINA L	☐ The master considers the ship is at the limit of control. ☐ The ship stays within the navigable part of the channel and swing area, but with unacceptable clearances from shallow areas, other objects, facilities or obstacles
FAIL	☐ The master loses control of the ship. ☐ The ship strays outside the navigable part of the channel and / or grounds.

Table 6 : Run assessment criteria

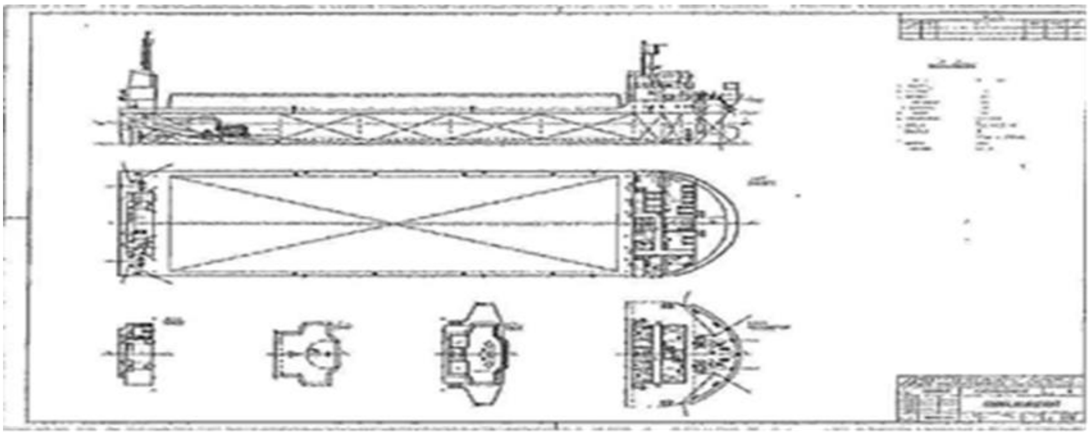

Figure 2 : General arrangement of the design self-propelled barge (Source: 1,500 ton deck cargo ship)

Real-time shiphandling simulation was perform using the NTPRO 5000 software to confirm the suitability of the proposed navigation route from proposed loading / unloading facility at Sungai Tiram Duku to proposed loading / unloading facility at Forest City Island 1 through Sungai Pulai and Port Tanjung Pelepas fairway.

2.3.1 Simulation Result Based on Proposed Navigation Route 1 and 2

Twelve (12) simulation runs was perform in various scenarios. Run 2 was rated Fail as the self-propelled barge grounded after exiting the Port Tanjung Pelepas Channel due to a combination of dynamic wave motion and squat effect. The summary of the simulation results are as follows:

Run No.	Scenario	Result
Proposed Navigation Route Option 1		
1	Proceeding from CGPV IBS site to Forest City Island 1 in baseline **(LAT)**	PASS
2	Proceeding from CGPV IBS site to Forest City Island 1 in ebb current **(LAT)**	FAIL
3	Proceeding from PBG 1 to PBG 2A in flood current **(LAT)**	PASS
4	Proceeding from PBG 1 to PBG 2A in ebb current **(LAT)**	PASS
5	Proceeding from PBG 2A to PBG 1 in flood current **(LAT)**	PASS
6	Proceeding from PBG 2A to PBG in ebb current **(LAT)**	PASS
7	Proceeding from PBG 2A to Forest City Island 1 in flood current **(tide level of 0.55m)**	PASS
8	Proceeding from Forest City Island 1 to PBG 2A in ebb current **(tide level of 0.55m)**	PASS
Proposed Navigation Route Option 2		
9	Proceeding from PBG 1 to PBG 2B in ebb current **(LAT)**	PASS
10	Proceeding from PBG 2B to PBG 1 in flood current **(LAT)**	PASS
11	Proceeding from PBG 2B to Forest City Island 1 in flood current **(LAT)**	PASS
12	Proceeding from Forest City Island 1 to PBG 2B in ebb current **(LAT)**	PASS

Table 7 : Result summary of shiphandling simulation runs

2.3.2 Lay Out Proposed Navigation Route Option 1

The proposed navigation route Option 1 is not navigable at LAT tide level, because of dynamic wave motion and squat effect. Dynamic wave motion was measured during simulation to affect the self-propelled barges under keel clearance (UKC) by 0.4m whereas squat effect was measured to be 0.2m when the self-propelled barge was moving at 8 knots.

It was therefore determined that the minimum depth required for safe navigation is 3m, a combination of vessel draft (2.2m), dynamic wave motion allowance (0.4m), squat effect (0.2m) and under keel clearance (UKC) allowance (0.2m), which requires a rise in tide of at least 0.6m (shallowest point along the route after exiting the Port Tanjung Pelepas Channel is 2.4m).

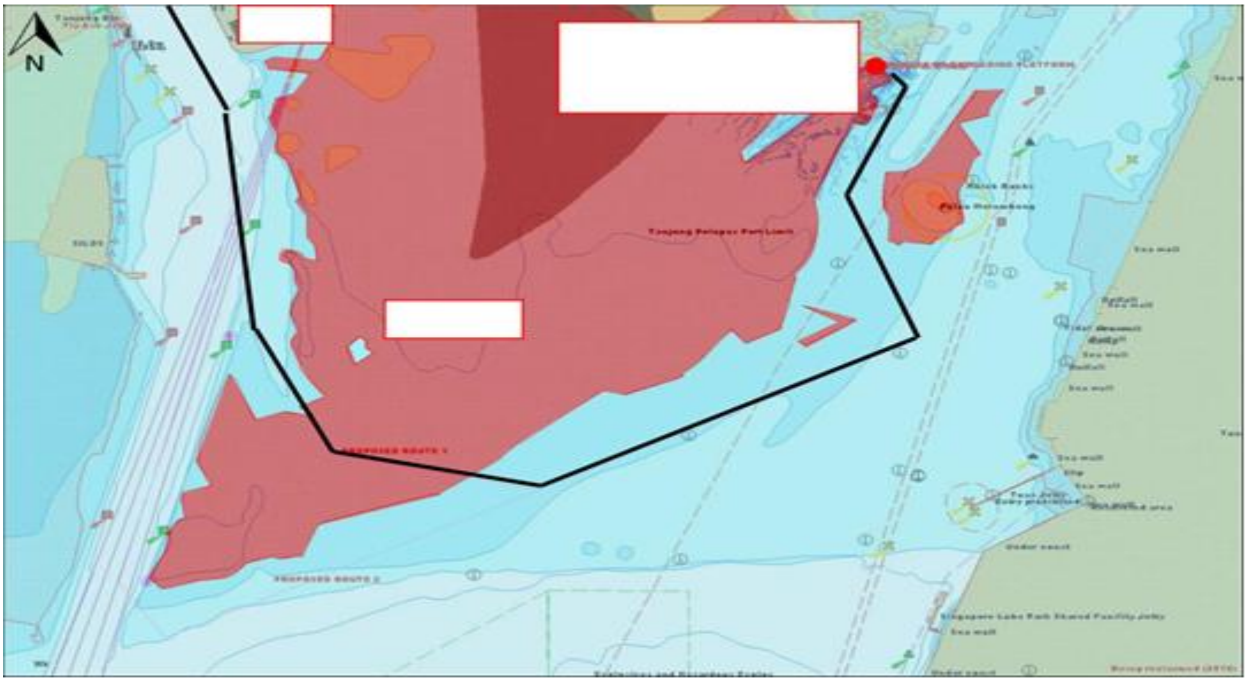

Figure 3 : Proposed Navigation Route Option 1 (black dashed line) shown to be passing through an area with depths of less than 3m (shaded in red)

III. CONCLUSION

The recommendations / risk control options were derived from the HAZID worksheet above are based on the preliminary and excessive test conducted on ship handling simulation. The communication between vessels and PTP Port Control is considered critical for the safe navigation of the self-propelled barges while passing PTP. It is vital that the barge crew be conversant in either English or Malay so as to be able to communicate with PTP Port Control. VHF radios on board the self-propelled barges must be tuned to Channel 83 while transiting within the port limit. The self-propelled barges must wait for clearance before transiting pass PTP. The crew of the self-propelled barges must adhere completely to the instructions provided by PTP Port Control. Pilotage is compulsory within PTP port limit for vessels larger than 15m LOA. Pilot boarding grounds must be identified and marked for the picking up and disembarking of pilots. The proposed locations of the pilot boarding grounds located at Pilot Boarding Ground 1 (PBG1) - Located north of PTP will be positioned close to the yellow buoy, SP1, and Pilot Boarding Ground 2 (PBG2) - Located south of PTP will be positioned. The route taken by the self-propelled barges between the PTP Channel and Forest City Island 1 be identified by the creation of waypoints so as to mitigate the risk of grounding on transit to / from the Forest City site. A briefing and familiarization training course must be conducted for the crew of the self-propelled barges prior to operations. The training will focus on the Standard Operation Procedure of Marine Controller Port Tanjung Pelepas as well as the operational limits and berthing / unberthing protocols of port control. A small chaser boat (less than 15m LOA) be used to warn and clear the way for the self-propelled barges.

THE WAY FORWARD

Generally, the risk analysis methods for maritime transportation have received a growing interest in recent years, even to the extent that international organizations have provided recommendations on the use of specific risk analysis and management tools. In parallel, there is a recent focus on foundational issues in scientific environments concerned with risk analysis, with calls for intensifying research on issues such as applied terminology, principles and perspectives for analysing and managing risk. In recent data collection or reading material with regard to risk analysis application for maritime transportation along Sungai Pulai, Johor, there is little research done for this particularly area especially at Port Tanjung Pelepas and offloading facility at Forest City.

With few similar research which done for other ports which engaged with marine offloading and loading activity for specific development project, researcher wish that these thesis will contribute data and input for contribution the application of Risk Assessment Model into the various ports and waterway.

To apply the specific risk definitions into this research, the element of mitigation and breakdown the potential risk are the main tools for risk reduction or prevention. The risk analysis could not endeavour without proper data and input from many elements, i.e. human error, equipment failure, environmental damage, loss of life, poor of maintenance, etc. However, with using Risk Assessment Model, the risk will reduce significantly in order to achieve the successful reduction of risk measurement.

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