AN OBSERVATION ON THE ACCIDENT OF NON-CONVENTION VESSELS CARRYING PASSENGER SANK IN INDONESIAN WATERS

T Sastrodiwongso and **Aleik Nurwahyudy,** National Transportation Safety Committee, Indonesia

SUMMARY

A number of marine accidents involving high loss of life were investigated by The Indonesia National Transportation Safety Committee (NTSC). Three cases of ship accidents based on NTSC reports of respective vessels are observed on the aspects of ship design focusing on the hull construction and ship stability. A new decree by Indonesian Minister of Transportation "KM. 65 Tahun 2009" was issued and enforced dated on 17 September 2009. The decree has established the standard of Indonesian flag non-convention vessels for securing the safety of sea voyage. The objectives of the observation are to obtain the facts related with ship design and construction which significantly contribute to the accident.

A number of safety recommendations following identified contributing safety factors involved in the accident were issued to prevent recurrence.

Key words: *vessel, non-convention, standard, safety*

1. INTRODUCTION

Since established in 1999, National Transportation Safety Committee (NTSC) as the Marine safety investigation Authority in Indonesia have investigated a number of ship accidents categorized as marine casualties defined by IMO's Casualty Investigation Code, Resolution MSC.255(84) adopted on 16 May 2008.

The investigated ship accidents among others were domestic passenger carrying non-convention vessels sank in Indonesian waters with causality of quite high loss of life. Non-convention vessel means that the vessel does not comply with SOLAS and other safety related IMO's International Convention.

For securing the safety of sea voyage of non-convention vessels, a decree regulating the standard of non-convention vessels flying Indonesian flag, "KM. 65 Tahun 2009" has been issued by Indonesian Minister of Transportation. The decree was enforced on 17 September 2009.

Based on NTSC reports, three cases of passenger carrying non-convention vessel accidents will be observed on the aspects of ship design focusing on the hull construction and ship stability related to KM. 65 Tahun 2009 decree, in particular Chapter II Section 3: Hull Construction and Stability and Chapter VI Section 9: Calculation and assignment of Freeboards.

Representing of various materials used for the hull construction of most domestic vessels, those three selected vessels are respectively a Fibre Reinforced Plastic (FRP) vessel *KM. Dumai Express 10*, a wooden vessel *KM. Acita-03* and a steel vessel *KM. Teratai Prima*. The vessels were built by local shipyards and were owned and operated by local ship operators.

2. THE OBSERVED SHIP ACCIDENTS

2.1. SUNK OF KM. DUMAI EXPRESS-10

The *KM. Dumai Express 10* was a fibre reinforced polymer high speed passenger vessels built in 1999. The ship was owned and operated by the PT. Lestari Indoma Bahari, Dumai, and not under any of Ship Classification Society. The approved route for the ship was local water way from Dumai to Batam.

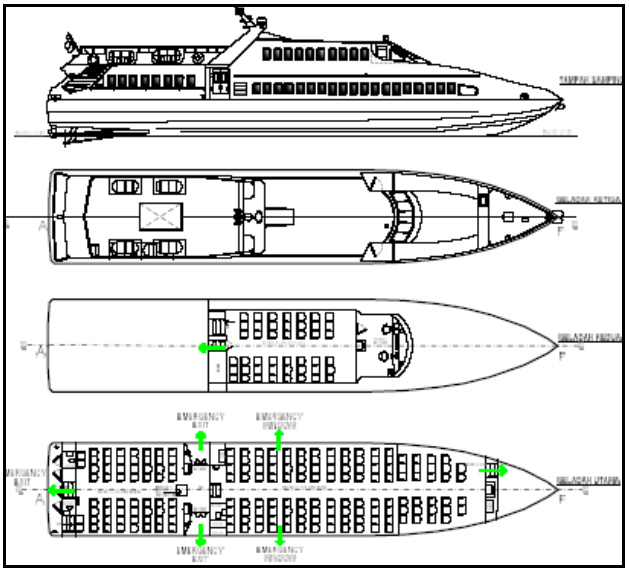

Figure 1: The general arrangement of *KM. Dumai Express 10*.

The ship has overall length of 31.45 m, a beam of 5.45 m, a depth of 2.27 m and 147 gross tonnages.

The ship propulsion was provided by three (3) units of MAN B&W single acting direct reversing, four stroke motor Diesel, each of it developing 735 kW at 2100 rpm. The propulsion system would provide the ship's speed of 30 knots at its maximum.

For the auxiliary power, the ship installed with two (2) units of Mitsubishi Electric engine, each of it generating 37 kW.

According to the operation permit issued by the Directorate of Sea Traffic, the *KM. Dumai Express 10* should operating thorugh the inland water way from Dumai, Riau – Bengkalis to Batam Island.

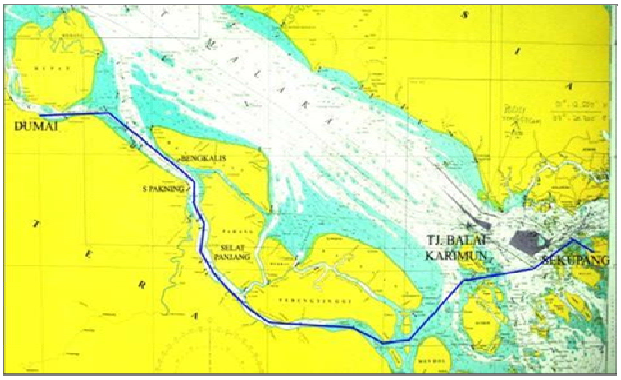

Figure 2: Route permit for KM. Dumai Express 10 issued by the Directorate of Sea Traffic

At 08.05 LT (Local Time) on 22 November 2009 the *KM. Dumai Express 10*, leaved port of Sekupang, Batam bound for Dumai via Bengkalis, Sumatra. The weather when the ship departed was in good condition. The master decided to take normal route of Batam directly crossing the Malacca strait to Dumai.

At about 09.00 LT, the vessel had reached the sea between Nipa Island and Karimun Kecil Island. The weather condition was changed. The North West wind speed was about 22 knots and the wave of 2.5 ~ 4.0 meters in height.

At 09.28 LT, the Master and the ship crew at the wheel house heard a relatively loud noise of crack originated from the main deck under the wheel house. The ship crew found that the front wall of passenger main cabin was breached. Hence, the sea water from outside strongly penetrated into the cabin and flooding the fore part of the main deck. The heavy blow of bow waves on the front wall of the vessel's superstructure worsened the damage. The progressively increasing volume of sea water into the vessel caused the fore deck immersed and the vessel was rapidly listed to Port Side.

At about 09.55 LT the vessel was fully sank at position of 01^{o} 12'500" N /103^{o} 20'30" E, in about 30 m deep and at a distance of about 1.3 Nautical Miles North of Iyu Kecil Island.

As result of the accident, the vessel was totally loss, 42 passengers were found dead and other 32 passengers were reported missing.

It is concluded that the loss of the vessel was caused by the progressive penetration of sea water into the forepart of the passenger main cabin through the damage of superstructure's front wall due to the multiple rapid wave pressure against the ahead movement of the vessel. The contributing factors of the accident are related to the construction of the ship and the stability.

2.2. CAPSIZED OF *KM. ACITA-03* ACCIDENT

KM. Acita-03 was a wooden constructed passenger cargo, built traditionally in 2003 by local shipyard of Talibu, South east Celebes. The ship were operated and managed by a local. The ship was designed to provide accommodation to the passengers up to 30 pax.

The ship has overall length of 24 m, a beam of 4.35 m, a depth of 1.5 m. The ship's single screw was provided by a Mitsubishi 6D16, direct reversing single acting four stroke diesel engine, developing 160 Hp. The auxiliary power provided with two unit of four stroke diesel engine providing, each of it providing 1 kW and 3 kW.

On 18 October 2007 at about 10.30 LT, *KM. Acita-03* leaved Tomia Port of Tomia Island for Port of Jembatan Batu, Bau-Bau, South East Sulawesi Province and as stated on the sailing declaration that the vessels carried 60 passengers and also carrying approximately 15 tonnes of cargo.

At about 21.00 LT, the ship had reached 4 NM to the port of destination Jembatan Batu.

The passengers which were previously on their steady position began to move and concentrated at the starboard side of the top deck. They were endeavouring to obtain cellular phone signal and tried to communicate their families. Some other passengers were also prepared for disembark the vessel. The movement and the concentration of the passenger to the one side of the vessel caused the vessel heeled rapidly, then totally capsized and finally the vessel was still afloat but in bottom up position.

Figure 3: *KM. Acita-03* after evacuated to the Lakeba shore, Bau-bau.

As result of the accident, 30 passengers and one ship crew were found dead, 9 passengers were officially stated lost but the vessel was still afloat.

It is concluded that the capsize of the vessel was caused by the loss of stability due to the movement of the passengers to one side of the vessel and accumulated at the Starboard Side of the top deck. The contributing factors of the accident are related to the construction of the ship and the stability.

2.3. SUNK OF *KM. TERATAI PRIMA*.

The *KM. Teratai Prima* was a steel constructed passenger ship, built in 1999 at Samarinda shipyard. The ship was owned and operated by the PT. Bunga Teratai, Samarinda.

The propulsion of twin screw was provided by two units of Nissan RA10, single acting, direct reversing, four strokes diesel engine, each of it developing 520 Hp at 1850 RPM. The propulsion system provided the ship speed of 7 knots.

Figure 4: the *KM. Teratai Prima*

The auxiliary power provided with two units of Yanmar diesel engine each of it providing 23 kW and one unit of Mitsubishi diesel engine providing 85 kW. The ship was built not under any Ship Classification Society.

According to the shipping lane permit issued by the directorate of marine traffics, the ship operated in the ferry lane of East Kalimantan to Pare-pare, South Celebes crossing the Celebes strait.

On 10 January 2009 at about 19.00 LT *KM. Teratai Prima* leaved the Cappa Ujung Port Pare-Pare, South Sulawesi Province bound for the Samarinda Port of East Kalimantan Province. The ship was carrying 365 passengers and approximately 443 tons general cargo. The weather condition at the time of ship departure was light raining, the wind speed in the range of 4 ~ 13 knots and wave height on average of 0.5~2.0 m with maximum height on average of 0.75 ~ 2.50 m.

On 11 January 2009, at about 03.00 LT, the vessel had passing Batu Roro cape water. She began experienced bad weather condition with wave height up to 3.0 ~ 4.0 m. The vessel began rolling heavily caused by the wave combined with the local strong stream. Only in a very short time the vessel capsized and preceded by the stern finally she sank in the deep sea of Batu Roro cape at the position of 03°27’00”S/ 118°47’00”E.

In this accident, only 35 seafarers were survived, 9 seafarers were found dead and the rest of 321 seafarers were lost.

It is concluded that the loss of the vessel was caused by the loss of stability. It was due to the condition of the vessel in overweight and improper cargo loading arrangement which was sailed in bad weather.

The accident contributing factor was that the sea water flooded in spaces under freeboard deck due to less height of hatchway coamings and less height of the sill of engine room entrance door. The contributing factors of the accident are related to the construction of the ship and the stability.

3. THE MINISTRY OF TRANSPORTATION DECREE “KM. 65 TAHUN 2009”: NON-CONVENTION VESSELS STANDARD (NCVS).

3.1. GENERAL REMARKS

The provisions of the regulations for Indonesian Non Convention Vessel Standard (NCVS) as stipulated in the attachments of KM. 65 / 2009 decree would facilitate the operations of small ships as the three observed ships to which the relevant IMO Conventions are not applicable. By applying the NCVS, it is expected to ensure a higher level of safety of the ships and the seafarers on board.

The standard shall apply to all new non-convention vessels:

1. All passenger vessels on domestic voyages;
2. All cargo vessels on domestic voyages and;
3. All cargo vessels less than 500 gross tonnages on international voyages;
4. All existing vessels that are upgraded in services.

In particular, Chapter II of the decree covers the regulations for the construction and stability of NCVS vessel and Chapter VI covers the Load Lines regulations for NCVS vessel.

3.2. NCVS CHAPTER II: CONSTRUCTION AND STABILITY

The Chapter consisting of three Sections, i.e. Section 1 Introduction, Definition and Application, Section 2 Categories of Vessels and Section 3 Hull Construction and Stability.

The provisions in the Section 3 Para. 1 regulate the structural strength, watertight subdivision of passenger vessel (Class 1), watertight subdivision of Class 2 and Class 3 vessels, number of passengers, design loading, ship’s material, hull’s appendages and anchoring system.

This section details construction requirements to be satisfied by vessels built to the survey of a related Authority appointed by the Administration. In addition to the general structural requirements, additional special requirements to be met by vessels built of one or more of the following materials steel, aluminium, ferro-cement, fibre reinforced plastic (FRP) and timber/wood.

Section 3.1.2 of chapter II described requirement for the structural strength. In particular, Point B.1 stated that 'The structural strength of every vessel to which this Section applies shall be sufficient for the service for which the vessel is intended'.

Point B.2 also stated that 'A vessel constructed in accordance with the appropriate Rules of a Classification Society or with the appropriate provisions of this Section shall be accepted as complying with sub-clause B.1'.

Section 3 Sub Section 3.2 regulates the Intact Stability i.e. the application of the provisions and the method of Inclining Test.

3.3. NCVS CHAPTER VI: LOAD LINES

The Chapter of Load lines consisting of nine teen Sections, among other things, Section 3 Application, Section 7 Strength of Ship, Section 8 Condition of Assignment, Section 9 Calculation and Assignment of Freeboards, Section 10 Load Line Zone, Section 11 Information to be carried onboard a vessel and Section 17 Overloading. The provisions in the Sub Section 8.2 Section 8 regulate the stability requirement of the vessel.

The standard applies to Indonesia and non-Indonesian which do not carry load lines certificate in accordance with the international load-lines convention 1966 (ILCC '96) and which are operating continually for at least three month within navigational areas of Indonesia.

Following the requirement for the load lines, the standard has categorised the object vessels into two types:

The chapter VI point 8 of 'condition of assignment' also required stability information to be supplied to master so it could be used as reference to arrange loading and ballasting of the ship in such a way to avoid risk increment of faulty and unexpected condition such as unacceptable stress to ship's structure or exceeding stability criteria.

In case of a vessel built in traditional way or other vessel which was manned by the crews that have limited knowledge on reading stability information, the information should be provided as simple as possible so its easily to comprehend by the crew.

4. APPLICATION OF THE DECREE ON THE OBSERVED VESSELS

As mentioned above, the "KM 65/2009" decree was enforced on 17 September 2009 and the observed vessels casualties were occurred before the applied date. The compliance of related requirements of the regulations on the vessels at that time will be observed.

4.1. *KM. DUMAI EXPRESS 10*

The ship was categorised as a high speed craft for carrying passenger. The ship was designed and built by a local shipyard. The material of FRP hull and superstructure of the vessel were not approved yet by any recognized Ship Classification Society. The process during construction until sea trial was only supervised by the personnel in charge of the shipyard.

However, during the extension of the seaworthiness certificate, the ship was annually inspected by the local port authority. The inspection was covering the navigational equipment, machinery and vessel's construction of hull and superstructure. All inspection carried before the accident was stated that the ship was in good and firm condition. *KM. Dumai Express 10* last inspection was carried on 16 November 2009. The results of the inspection stated that the condition of the hull was declared intact and robust. According to the ship's maintenance data, last annual dock was in May 2009.

The superstructure's front wall was a position that gets direct pressure with waves of sea water, both arising from the movement of the ship or from the wave coming. Investigation found that the construction of rigid fore bulwark and freeing port installed in the bow structure was not sufficient to let the large volume of sea water escaped freely. According to the statement provided by the master, before the accident, the ship's bow was submerged

Construction of buildings on the bow of the ship is flat and composed by his side. This construction is designed in such a way as to provide an aerodynamic effect and facilitate the entry of sea water into the bow of the ship with easy exit from the open deck.

According to the information from the shipyard, the thickness of the superstructure front wall which fully made from FRP was only 4 mm and reinforced by 500 mm spacing stiffeners. At the time the ship was constructed, there was no material testing nor any inspection ever performed. The FRP layer constructions were built by the experience from the ship builder.

In general, a layer of FRP is composed of resins, reinforcements, fillers, and additives. Each of these constituent materials or ingredients plays an important role in the processing and final performance of the end product. The correct composition of resin and catalyst in a layer would provide strength to the fibre that meets the requirements of the construction. When a fibre layer comprise with higher catalyst than its resin, fibre layer structure can become brittle. According to the wreckage obtained from salvage, it was indicated that there were significant defect on the FRP used in the superstructures front wall. The superstructure's front wall construction of 4 mm could not handle with the immense cyclic load generated by wave and the ship's forward movement.

Following the water ingress from the breached superstructures front wall, the water was trapped inside the foreside of the accomodation area as there were no opening or freeing port on the deck. This condition has worsen the ship bouyancy as there was no escape point for the seawater.

Figure 5: the breached position of 4 mm superstructure's front wall as indicated by white arrow

The weather tight door, the height of hatch opening coaming at fore deck and also the condition of the freeboard deck were not complying with the current Load Line regulation at that time as well as NCVS Chapter II, the Assignment of Freeboards in particular.

The investigation found that the height of forcastle deck coaming was insufficient to prevent the seawater entering the forepeak tank. The investigation also found that the forepeak tank directly connected to the accomodation deck without separated by a watertight bulkhead. According to the passengers statement who were sat in the main fore accomodation deck, they found sea water start to flood from the access point to the forepeak tank.

4.2. *KM. ACITA-03*

The vessel was a traditional wooden cargo & passenger boat designed and built by a local boat building yard. The building process was only supervised by the owner and the shipwright. The height of the tween deck up to the main deck only 1.20 m and used as accommodation space for the passengers. The passenger at the tween deck could not stand up properly, hence the space was only occupied by passengers to rest and most of them preferred on the upper deck and top deck. The condition would worsen the stability of the vessel.

The ship's hull was constructed in 'V' type. The advantage of V type hull was good in providing required ship's speed with less main engine power as the ship's resistance was reduced. However, V type hull was not provides good stability for a ship.

Distribution of passengers on the outer side of the top deck had provided a significant moment of heel so that it can beat the moment of the return of the ship. This condition has been known by the crew who then tried to warn passengers to return to their original place, but was ignored.

With increasing number of passengers who distributed at the starboard side and at the top deck of the ship, the external force from this distribution shall be greater and to eventually exceed the righting moment and subsequently the ship was capsized.

Following the passenger manifest data obtained during investigation, the number of passenger were exceeding its designed limit. No stability booklet or information as required by the standard was ever established. With overcapacity of passengers, and lack of stability knowledge by the crew, it has put the ship into greater risk to the accident.

4.3. *KM. TERATAI PRIMA*

The steel vessel *KM. Teratai Prima* was designed and built by a local shipyard. There were no authorities to supervise the construction ship from very early stages. The construction of the ship also not supervised by any recognized Ship Classification Society.

Once the construction was completed, the owner reported to the Port authority and PT. BKI (Indonesian class society) and requesting assistance to produce technical drawing which subsequently proposing for a vessel certificates and other documents, however no stability booklet ever been made. Therefore, when the cargo arrangements were conducted, the crew disregard the stability aspect and resulting the stability was not in safe operation condition. According to the passenger list and cargo manifest data compare to the ship technical information, it was indicated that during departure, the ship was in the overloaded condition at about twice than allowed.

The NTSC investigation found that the deck openings and the condition of the Freeboard deck was not in compliance with the required assignment of Freeboard as stipulated in current Load Line Regulation for domestic vessel at that time.

Analysis of the accident indicated that the freeing port was not sufficient to allow large amount of sea water escaped freely. The free surface effect was believed that became one of the contributing factors in the accident.

To analyse the stability condition for the *KM. Teratai Prima*, NTSC has cooperated with the Naval Architecture and Ship Engineering department of Sepuluh November Institute of Technology (ITS) Surabaya.

The stability analysis established five different scenarios following the ship condition based on the information provided by all involved parties i.e.: survivor's statement, passenger list and cargo manifest, sailing declaration, available technical drawing and other relevant document.

The analysis indicated that the ship stability was not complying with the criteria prescribed in the IMO

stability standard. It was also indicated that the GM of the ship at the departure was small. Therefore, at the time the ship dealing with significant change of weather, the stability turn to negative hence the ship capsized.

5. CONCLUSIONS

According to the analysis provided in the previous section, following the criteria and requirement on the construction, stability and the load lines, the respected ships were yet to fully comply with the standard for non-convention vessels. However, it is acknowledged that it would take an outstanding effort to implement the standard fully as the number of the non-convention vessel was significantly increased.

To prevent the recurrence, NTSC has issued number of safety recommendation to all directly involving parties following safety issue identified in the investigation. It is recommended that all parties to comprehend all requirements enlisted in the standard.

It is recommended to the safety regulator, to enhance the socialisation of the NCV standard to the the ship owner and operator and the conventional dockyard.

The regulator was also recommended to provide adequate training to the marine inspector which is responsible in ensuring the safety of the ship, mainly in the remote port authority where numbers of the non-convention vessels were operated.

It was also strongly recommended to re-inspect existing ships which might still not comply with the standard.

The ship owner and operator also required to take appropriate preparation and action in the implementation of the standard, so the safety of their fleet could be improved. It is also recommended to the ship's safety management company, that sufficient familiarisation and training of the current standard should be provided to the crew. Therefore, there would be a clear understanding for all parties in the implementation of the standard.

6. ACKNOWLEDGEMENTS

Thanks and appreciation to Chairman of National Transportation Safety Committee of the Republic of Indonesia (NTSC) who supports in preparing this paper and allowing us to refer the related NTSC investigation reports.

7. REFERENCES

1. THE NATIONAL TRANSPORTATION SAFETY COMMITTEE, 'Investigation report into sunken high speed passenger vessel *KM. Dumai Express 10* at Iyu Kecil island, on 22 November 2009', 2010.
2. THE NATIONAL TRANSPORTATION SAFETY COMMITTEE, 'Investigation report into capsized passenger vessel *KM. Acita-03* at, on 22 November 2009', 2010.
3. THE NATIONAL TRANSPORTATION SAFETY COMMITTEE, 'Investigation report into sunken passenger vessel *KM. Teratai Prima* at Batu roro cape, on 13 January 2009', 2010.
4. MINISTRY OF TRANSPORTATION, 'Ministerial Decree No. 65/2009, Standard of Non-Convention Vessels', 2006.

8. AUTHORS BIOGRAPHY

Teguh Sastrodiwongso holds the current position of senior transport safety investigator (marine) at The National Transportation Safety Committee, Ministry of Transportation. He is responsible for conducting investigation into marine casualty, analysing the evidence, identifying safety factors which contribute to the accident and write relevant recommendations to prevent the recurrence. He is also one of the senior lecturer in the Faculty of Marine Technology, Darma Persada University of Jakarta.

Aleik Nurwahyudy holds the current position of transport safety investigator (Marine) at the National Transportation Safety Committee. He is responsible for conducting investigation into marine casualty, collecting relevant evidence on the accident site, writing investigation report which covering the factual information, analysis of the evidence and the identification of the contributing safety factors.