An overview

The primary objective of a collision investigation is to establish the facts and to understand how the collision occurred. This is done by interviewing the bridge team and examining the bridge equipment. At the end of the investigation, you should be able to establish a chronological narrative of the ship's navigation leading up to the collision. The narrative should be supported by both the observations of the bridge team and the independent contemporaneous evidence from the ship's mechanical and electronic recording devices.

In the past, the investigation will only complete half the story as all you will know is what happened on your bridge. You will not know what happened on the bridge of the other ship. These days, however, ships are being equipped with increasingly more sophisticated navigational equipment and it is possible therefore to observe the movements of both ships leading up to the collision if you have access to data from the ship's VDR (Voyage Data Recorder) or AIS (Automatic Identification System).

Establishing the facts quickly and as accurately as possible is a crucial advantage as it will set the platform upon which the parties can negotiate the apportionment of liability for the collision and commence discussions on quantum, jurisdiction and limitation of liability.

The new technologies

Technological advancements, coupled with more stringent maritime safety standards imposed by the International Maritime Organisation (IMO), have led to ships being equipped with more sophisticated navigational equipment these days.

In the past, the main sources of evidence once on board the ship would be the testimonies of the crew and the working chart. The investigator would rely heavily on the observations of the bridge team to establish the sequence of events. The deck log and engine log books are secondary sources of evidence since they are only filled in after the incident and (quite often) tailored to put the best gloss on the navigation of one's own ship.

The working chart remains an important piece of the evidential puzzle. It is still usually the first piece of mechanical evidence you look at for several reasons. First, it will show you the course, speed and positions of your own ship before the collision and these markings are not easy to tamper with. Even if the crew does erase the markings, these can be recovered forensically in a laboratory. Second, while it might not show the collision, it usually shows the collision position and third, it is contemporaneous evidence which came into being before the collision and therefore good evidence of what the ship was doing prior to the incident.

These days, however, most ships may also have on board a course recorder, echo sounder, ECDIS, AIS, VDR, engine telegraph recorder and/or GPS navigator printer on the bridge. The data retrieved from these navigational devices is evidence of a high order as each device is an independent source of contemporaneous evidence and will enable the investigator to confirm and verify the observations of the bridge team leading up to the collision.

It is therefore always recommended that you put your investigator on board the ship as soon as possible. This is so that he can ensure that no evidence is accidentally destroyed. His task is two-fold; to record the observations of the bridge team and to secure all the supporting data/evidence from the navigational equipment on the bridge.

The range of navigational data available on board a ship will vary depending on the type of ship, her make, her age and the condition of the bridge equipment on board.

Of the various new technologies now available on the bridge, two devices in particular have become increasingly important and are gradually being used as the benchmark in terms of establishing the factual matrix of the collision and the basis upon which parties will commence negotiations in relation to the apportionment of liability for the collision. The two devices are the AIS and the VDR. The data/information from both these devices is independent and reliable. Parties are able therefore to cut through any potential disputes relating to the factual matrix and move on to deal with the issues of liability and quantum very quickly.

(a) AIS (Automatic Identification System)

In 2000, IMO adopted a new requirement (as part of a revised new SOLAS chapter V) for all ships to carry automatic identification systems capable of providing information about the ship to other ships and to coastal authorities automatically.

The regulation requires AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size. The requirement became effective for all ships by 31 December 2004.

The AIS is a system used by ships and vessel traffic systems principally for identification of vessels at sea. AIS helps to resolve the difficulty of identifying ships when not in sight (e.g. at night, in fog, in radar blind arcs or shadows or at distance) by providing a means for ships to exchange ID, position, course, speed and other ship data with all other nearby ships and VTS stations. It works by integrating a standardized VHF transceiver system with a GPS receiver and other navigational equipment on board ship (Gyro compass, Rate of turn indicator, etc.).

AIS transponders automatically transmit/broadcast the position and velocity of the ship at regular intervals via a VHF radio built into the AIS. The position and velocity originate from the ship's GPS or, if that fails, from an integral GPS receiver. The AIS also receives heading information from the ship's compass and transmits this at the same time. Other information, such as the vessel name and VHF call sign, is entered when installing the equipment and is transmitted less frequently. The signals are received by AIS transponders fitted on other ships or on land based systems, such as VTS (Vessel Traffic Service) systems.

In order to ensure that the VHF transmissions of different AIS do not occur at the same time they are time multiplexed, using a patented technology termed STDMA (Self organizing Time Division Multiple Access, also called SOTDMA). In order to make the most efficient use of the bandwidth available, vessels which are anchored or are moving slowly transmit less frequently than those that are moving faster or are maneuvering. The update rate of fast maneuvering vessels is similar to that of a conventional marine radar. The time reference is derived from the GPS system.

AIS transceiver sends the following data every 2 to 10 seconds depending on vessels speed while underway, and every 3 minutes while vessel is at anchor. This data includes:

- MMSI number of vessel - vessel's unique identification
- Navigation status - "at anchor", "under way using engine(s)", "not under command", etc
- Rate of turn - right or left, 0 to 720 degrees per minute
- Speed over ground - 0.1 knot resolution from 0 to 102 knots
- Position accuracy
- Longitude - to 1/10000 minute and Latitude - to 1/10000 minute
- Course over ground - relative to true north to 0.1 degree
- True Heading - 0 to 359 degrees from eg. gyro compass
- Time stamp - UTC time accurate to nearest second when this data was generated

In addition, the following data is broadcast every 6 minutes:

- MMSI number - vessel's unique identification
- IMO number - number remains unchanged upon transfer of the ship to other flag(s).

- Radio call sign - international radio call sign assigned to vessel
- Name - Name of vessel, max 20 characters
- Type of ship/cargo
- Dimensions of ship - to nearest meter
- Location of positioning system's (eg. GPS) antenna onboard the vessel
- Type of positioning system - usually GPS or DGPS
- Draught of ship - 0.1 meter to 25.5 meters
- Destination - max 20 characters
- ETA (estimated time of arrival) at destination - UTC month/date hour:minute

By obtaining the AIS data of both ships, the investigator will be able to plot accurately the positions of each ship leading up to the collision, including their speed, course and heading.

(b) VDR (Voyage Data Recorder)

Under regulations adopted in 2000 (which entered into force on 1 July 2002), all passenger ships and ships other than passenger ships of 3000 gross tonnage and upwards constructed on or after 1 July 2002 are required to carry voyage data recorders (VDRs) to assist in accident investigations.

The mandatory regulations are contained in chapter V on Safety of Navigation of the International Convention for the Safety of Life at Sea, 1974 (SOLAS).

Like the black boxes carried on aircraft, VDRs enable accident investigators to review procedures and instructions in the moments before an incident and help to identify the cause of any accident.

A VDR is a data recording system designed to collect data from various sensors on board the vessel. It then digitises, compresses and stores this information in an externally mounted protective storage unit. The protective storage unit is a tamper-proof unit designed to withstand the extreme shock, impact, pressure and heat, which could be associated with a marine incident (fire, explosion, collision, sinking, etc).

The protective storage unit may be in a retrievable fixed unit or free float unit (or combined with EPRIB) when the ship sunk in marine incident. The last 12 hours stored data in protected unit can be recovered and replayed by the authorities or ship owners for incident investigation. Beside the protective storage unit, the VDR system may consist of recording control unit and data acquisition unit, which connected to various equipment and sensors on board a ship.

Although the primary purpose of the VDR is for accident investigation after the fact, there can be other uses of recorded data for preventive maintenance, performance efficiency monitoring, heavy weather damage, accident avoidance and training purpose to improve safety and reduce running cost.

(c) VTS (Vessel Traffic Service) or VTIS (Vessel Traffic Information System)

In addition to the AIS and VDR, there is also an external independent source of data that can assist the investigator to establish the navigation of the ships leading up to the collision and that is the VTS (Vessel Traffic Service) or VTIS (Vessel Traffic Information System).

A VTS or VTIS is a marine traffic monitoring system established by harbor or port authorities, similar to air traffic control for aircraft. Typical VTS systems use radar, closed-circuit television, VHF radiotelephony and AIS to keep track of vessel movements and provide navigational safety in a limited geographical area.

VTS coverage is not worldwide and, at the present moment, only the following countries have VTS coverage:

- Argentina
- Australia
- Benin
- Bermuda
- Canada
- China
- Hong Kong SAR
- Taiwan
- Denmark
- Finland
- France
- Germany
- Japan
- Netherlands
- Norway
- Poland
- Portugal
- Russia
- Singapore
- Sweden
- Turkey
- Ukraine
- United Kingdom
- United States

If the collision occurred within the coverage zone of a VTS or VTIS, the investigator should be able to obtain the navigation plots of the respective ships leading up to the collision from the relevant authorities.

Analysing the evidence

Once the investigator has collected all the evidence that is available, his task is to fit all the pieces together and make sure the story works. This is a purely objective exercise and may require the investigator to ask hard questions of his bridge team.

He will need to ensure that the observations of the bridge team are consistent with both the mechanical and electronic evidence retrieved from the ship's navigational equipment and the data from AIS or VTIS, if this is available. Where they do differ, he will need to be able to explain the discrepancies. Any errors in the evidence must be eliminated or explained. There is no point in ignoring this vital part of the investigation. If you have a story based on false evidence you will not be able to negotiate liability with the other ship.

A collision is a function of course, speed and error. The error is normally human but it can be mechanical or electrical. Sometimes the engine does not respond to orders from the bridge. At other times the ARPA can malfunction or the steering goes off course. All these usually happen at a time when you are passing close by to the other ship with which you collide. Whilst these events can explain a collision it is generally one of a chain of events leading to the collision.

Impact of the new technologies

It is obvious that parties will not be able to progress to discuss the possibility of any settlement unless a common set of facts is established and accepted by both sides. This is why getting the facts accurate during the investigation process is so important.

With the evidence from devices such as AIS, VDR and ECDIS now more commonly available on board ships, it is easier to establish what happened more quickly and far more accurately. This means parties will have fewer disputes relating to the facts and are able to focus instead on the issues of liability and quantum. The net result is collision matters are now concluded within a much shorter period of time, which is good news for shipowners and underwriters but not so for lawyers!

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