

The Impact of Installing Simplified Voyage Data Recorder (SVDR) on Offshore Supply Vessel Collision Risk Analysis

Capt. Mohsen Fekry *Capt. Khaled M. Abu Bakr*
Arab Academy for Science and Technology and Maritime Transport

مستخلص

أقرت المنظمة البحرية الدولية استخدام جهاز مسجل بيانات الرحلة (VDR/SVDR) على السفن التجارية بينما لا تشترط استخدامة على سفن الإمداد للمنصات البحرية، علما بأن حوادث التصادم بين تلك السفن والمنصات تمثل خطرا كبيرا حيث اتضح ذلك من خلال قواعد بيانات الحوادث في السنوات الأخيرة. ولزيادة القدرة على التنبؤ وتفادي تلك الحوادث فإن تحليل مخاطر التصادم بين سفن الإمداد والمنصات البحرية يحتاج الي استخدام جهاز مسجل بيانات الرحلة (VDR/SVDR) من أجل الوقوف على الأسباب الحقيقية وراء حدوث التصادم؛ والتي كثيرا ما تصنف على أنها "غير معلومة" مما يعيق التحليل الدقيق. وهذا البحث يوضح عن طريق دراسة قاعدة بيانات حوادث السنوات الأربعة الأخيرة بخليج المكسيك الحاجة الي استخدام جهاز مسجل بيانات الرحلة على سفن الإمداد لتحليل أسباب تلك الحوادث .

Abstract

According to the United Kingdom Offshore Operators Association, ship collisions with offshore installation are a 'clear and present danger'. Ship collisions with offshore installation involve both supply and passing vessels, SOLAS ships forced by the International Maritime Organization (IMO) to carry a Voyage Data Recorder (VDR) or a Simplified Voyage Data Recorder (SVDR), while offshore supply vessels are not yet. In recent years, many parts of the world have witnessed a number of these accidents and normally investigations aimed at determining the initiating causes of each incident. However, some incidents remain with 'unknown' causes. Risk analysis depends on both frequency and consequences analysis. Thus, failure to determine the cause results in non-accurate frequency analysis and, therefore, non-accurate risk analysis. One of the methods that can minimize, to a great extent, the mystery around the initiating causes of some of the offshore supply vessel collisions is to enforce VDR or SVDR installation.

This paper presents a statistical analysis of the supply vessels collisions in a period of four years (2006-2009) in the Gulf of Mexico which are labeled with 'unknown' cause. Hence forward, this paper illustrates how SVDR could help complete the supply vessel collision risk analysis picture in relation to the Gulf of Mexico Case-study.

1. Introduction

As of the 1st of July 2010, almost all passenger ships and cargo ships of 3,000 gross tons and greater engaged on international voyages have installed a Voyage Data Recorder (VDR), or a Simplified Voyage Data Recorder (SVDR), as appropriate (www.broadgate-uk.com). These devices make automatic recordings of a variety of vital navigational and operational parameters, including, but not limited to: date and time; ship's position; speed; heading; bridge audio; communications audio; radar data; echo sounder; main alarms; rudder order and response; engine order and response; hull openings status; and watertight and fire door status. The VDR is intended to serve the same purpose for a ship that a so-called "black box" in aviation, namely to improve accident reconstruction. Though not as widely known or appreciated as the airplane black box, the VDR has lived up its billing. For marine casualties involving ships with VDRs, much of the prior uncertainty encountered by investigators has been reduced. Playing back the recordings, particularly if both vessels involved in a casualty are VDR-equipped, allows investigators to recreate most of what was happening in the minutes leading up to the casualty. The VDR also records the conversations on the bridge as the situation developed – and the statements made by bridge personnel immediately after the casualty. The true purpose of the VDR, though, is not to assign blame, but to better learn from casualties so that future maritime operations will be safer. The marine community is already reaping the benefits of this device.

2. Differences between VDR and SVDR

VDR, is a data recording system designed for all vessels required to comply with the IMO's international convention SOLAS requirements, in order to collect data from various sensors on board the vessel. It then digitizes, 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 such as fire, explosion, collision and sinking (IMO, 1997).

The protective storage unit may be in a retrievable fixed unit or free float unit - or combined with Emergency Position Indicating Radio Beacons (EPIRB) - when the ship sinks in marine incident. The last 12 hours of stored data in the 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 are connected to various equipment and sensors on board a ship.

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

SVDR, as defined by the requirements of IMO Performance Standard MSC.163 (78), is a lower cost simplified version VDR for small ships with only basic ship's data recorded but there is no principal difference between the VDR and SVDR. The only difference between these two is the amount of data that can be recorded in each unit (IMO, 2004). Table (1) shows the data items to be recorded by VDR and SVDR.

Table (1): Data Items to be Recorded by VDR and SVDR

Interface	VDR	SVDR
Date and Time	√	√
Ship's position	√	√
Speed	√	√
Heading	√	√
Bridge Audio	√	√
Communication Audio	√	√
Radar data	√	Unless impossible
AIS	X	If no Radar
Echo-Sounder	√	Only if the data is available on the bridge and in accordance with the international digital interface standard
Main alarms	√	
Rudder order and Response	√	
Engine order and Response	√	
Hull Opening (doors) Status	√	
Watertight and Fire Door Status	√	
Acceleration and Hull Stresses	√	
Wind Speed and direction	√	

3. Impact of VDR Technology

To recapitulate the introduction explained that the purpose of a VDR as stated by the IMO is to maintain a store, in a secure and retrievable form, of information concerning the position, movement, physical status, command and control of a vessel over a period leading up to, and following an incident and having an impact thereon". The impact of VDR technology will be considered from the two separate perspectives:

- Engineers and Investigators who seek to make technical improvements to develop safety standards.
- The Legal sector, which aim to arbitrate with cogent facts.

3.1. The Importance of VDRs with Respect to Technical Improvements

A VDR can be used to assess the efficiency of a vessels crew, whilst at sea. This would ensure the vessel and its gear to be operated properly and that the general rules of good seamanship are maintained. This device would also ensure seaworthiness of a vessel and reduce claims of Un-seaworthiness. The VDR would also improve safety at sea because the data it provides might uncover high risk operations such as those associated with navigation. In the long term the VDR might be used to train supply vessels crew (Wilson, et al, 2008).

VDRs may not be a first line safety tool, such as life jackets, it certainly has great value in ensuring that a vessel is operated safely. In addition, the management benefits derived from installing a VDR system would quickly offset the cost of its installation.

3.2. The Importance of VDRs with Respect to Legal Sector

A VDR stores data which might provide evidence in court or help to uncover the key events/facts relating to a court case. The human memory is known to be both frail and fallible, and even the most honest witnesses or survivors describe a version of the incident which may contradict whatever firm evidence is available. In summary, therefore the VDR will help to record and prove facts the human accounts often failed to.

The VDR will also reduce the cost of investigating casualties at sea and time wasted on board a ship trying to trap evidence from the vessel or crew. The introduction of the VDR and even compared it with the Black Box Flight Recorder installed on all aircrafts. They remind us that the Black Box Flight Recorder has improved safety standards associated with air travel and has also

reduced the rate of human deaths immensely. The introduction of the VDR on board shipping vessels brings the same advantages to the maritime community.

In most cases the installation of a VDR on board a vessel should allow incidents to be investigated hence insurers may also reduce their insurance rate and possibly the premiums to be paid. This is very beneficial for the ship-owner as insurance premium rates depend on the risk of any casualties and the nature/number of past insurance claims. (Wilson, et al, 2008)

Above all, VDRs should ensure that there is justice and fairness after a maritime disaster. This is because the aim of arbitration is to determine which party is responsible and to make that party bear the associated cost together with any legal penalties. In cases where it is unclear who was to blame both parties are normally charged in accordance with the size of their individual responsibilities. This system has not always been fair as lawyers or judges may come to conclusions which those on board the vessel may find unreasonable. From a lawyer's point of view, the use of information collected by a VDR might reduce the need for witnesses. This would, in turn, lead to a considerable saving of time and cost by reducing the need for witness examination, by counsel, and for cross examination of the witnesses. The question of who is to blame would be answered without uncertainty and the injustices sometimes caused by the use of unscrupulous witnesses will be avoided.

4. IMO's Legislation on Recovery, Custody and Read out of the VDR after an Incident

One of the most important pieces of legislation passed by the IMO concerns the recovery of data from the VDR. The F.S.I24 Sub – Committee of the IMO have ruled that in the aftermath of an incident the VDR should be retrieved as soon as possible in order to preserve the important information which it stores. This should be the procedure in any scenario where the accident is 'non catastrophic'. In the event of an incident it is the owner's duty to remove and preserve the VDR for investigation purposes at the earliest possible opportunity. In the event that the crew is about to abandon the vessel, the master must follow previously laid down instructions regarding the best method to preserve the VDR. The VDR would then be handed on to the Marine Accident Investigation Branch and the owner of the vessel, for further inquiries. When a catastrophic accident occurs the crew might be unable to retrieve the data. In such instances the flag state and any other states that might have an interest in the sunken vessel would decide whether or not to

instigate an expedition to retrieve the VDR. This expedition would be led by the investigator. The investigators and other technical specialists would keep an open mind on the condition of the 'capsule'. If the VDR is undamaged, the specialist's team would carefully retrieve the 'capsule' in order to avoid damaging it and to safeguard the precious information which it holds.

Furthermore, the ship owner and investigator have the duty of custody over the VDR, at all times. It is also the responsibility of the investigator to download and read-out the information stored by the VDR. The investigator shall inform the owner of the investigations progress and provide him with a copy of the data retrieved from the VDR. The investigator may be assisted by other experts of other disciplines, if required (IMO, 2002).

5. The Necessity of Installing SVDR Onboard Supply Vessels

The most recent recognized collision incidents database is that of the Minerals Management Service (MMS) covering only the Gulf of Mexico. The database was officially publicized and revised by the Bureau of Ocean Management, Regulation and Enforcement. This paper selects for statistical analysis the most recent four years of the data base; namely the years 2006-2009. The analysis aims at determining the average percentage of incidents whose initiating cause is labeled 'unknown' so as to illustrate the contribution of the SVDR onboard Offshore Supply Vessels. These years were specifically selected because the MMS has altered the classification of the main initiating causes after 2005. It is also worth mentioning that the MMS database classified the general initiating causes to be: 'equipment failure', 'human error', 'weather', 'leak', 'overboard fluid', 'slip trip fall', 'upset H₂O system', 'external damage' and 'other cause' which includes the 'unknown' description for the 'other cause' label which is represented in the table by the division of the slice, (www.mms.gov/incidents/collisions.htm). Table (2) represents the number of incidents initiated by each cause in the years 2006-2009, where each year is analyzed separately. Where a certain cause resulted in 'ZERO' number of incidents in any of the selected years, it was not represented on the table. In addition, the number of incidents caused by 'unknown' cause in the year 2009 was equivalent to the number of incidents under 'other cause'.

The incidents analysis shows that an average of 30% of the incidents had 'unknown' causes, this proves the need of obtaining information about causation factors. Therefore, the installation of the SVDR emerges as one of the most effective methods that could help identify the frequency and consequences of events in cases of accidents. Table (2) illustrates the average percentage of collision incidents with 'unknown' causes in the Gulf of Mexico in the years 2006-2009.

Table (2): The Percentage of Incidents Labeled ‘Unknown’ in Golf of Mexico

Year	Total no. of Incidents	Known Causes no.			Other Causes no.		Percentage of Unknown Causes
		Equipment Failure	Human Error	External Damage	Other	Unknown	
2006	27	3	15	2	1	6	22.2%
2007	20	2	12	1	2	4	20%
2008	22	2	11	0	1	8	36.4%
2009	29	4	7	5	0	13	44.8%
Average	24.5					7.75	30.85%

Source: (www.mms.gov/incidents/collisions.htm.)

6. The Importance of SVDR in Determining the Consequences of Offshore Supply Vessel Collisions

Since OSVs operate in extremely dangerous environments where accident occurrence is probable; therefore great attention must be given to them. Consequences are defined as "the number of people affected (injured or killed), property damaged, amount of spill, area affected, outage time, mission delay, money lost". (Kristiansen, 2004)

These consequences are sometimes as vague as the initiating causes themselves. The role of the SVDR is to help specify the sequence of events that take place when an accident occurs and specify the consequences and results of each event in the chain that starts with the initiating cause and ends with the final outcome of the accident. There are many methods of analyzing consequences which include Consequence Models, Reliability Assessment, Evacuation Models, Fault Tree Analysis (FTA), simulation and Event Tree Analysis (ETA) (Aven, 2005). Arguably, the (ETA) is the best method when comparing the advantages and disadvantages of each technique. (Abu Bakr, 2009). Therefore, this paper adopts (ETA) method to give an example of consequence analysis.

Event Tree Analysis (ETA) is a logical representation of the various events that may follow from an initiating event such as a component failure. Construction starts with the initiating event then it is divided into a series binary branches. A branch is defined in terms of a question like ‘Protective device fails’ the answers are usually binary like ‘true’ or ‘false’ (HSE, 2006). Usually an event tree is presented with the initiating events on the left side and the outcomes on the right side. The questions defining the branches are placed across the top of the tree, with upward branches signifying ‘true’ and downward ones for ‘false’. The ETA method is used to identify the

probabilities of accidental scenarios leading to, for example, collision, an explosion, a pool fire or a jet fire (Shetty, 1998). Figure (1) illustrates the true/false consequences of a collision accident that happened on 7 January 2003 at the Gulf of Mexico, South Timablier between M/V (whose name was not specified in the report) and a platform (Rig A operated by Walter Oil & Gas Corporation) resulting in fire, several explosions and pipeline damage. (www.boemre.gov/incidents/pipe2003.htm). The given example highlights the consequences of the collision incident; however, these consequences were determined via investigation and they depended on eye witnesses and not reliable data which could be collected from a SVDR as it has been installed.

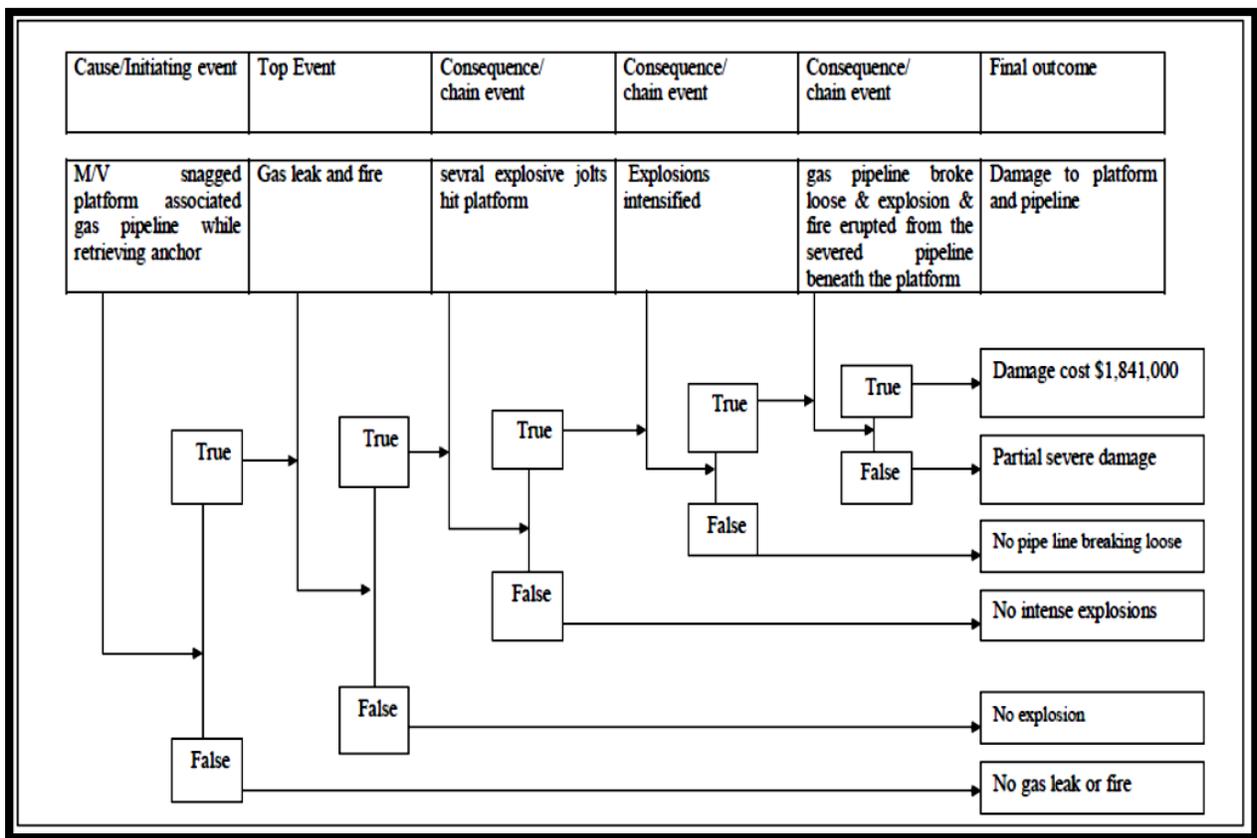


Figure (1): Event tree analysis for collision incident between M/V and platform resulting in fire, several explosions and pipeline damage. Source: (Abu Bakr, 2009)

The quantification of the results of each event is not possible if the SVDR is not installed and the poor attempts of quantification will solely depend on historical data. Therefore, this asserts the importance of installing SVDR in order to move a further step into a whole different level of

analysis which is called consequence modeling and which is the actual reference of decision makers.

7. Conclusion and Recommendations

Having conducted the analysis on the selected case-study of the Gulf of Mexico, and after deducting that the average percentage of accidents with ‘unknown causes’ in this area, as one of the world’s busiest traffic with offshore operations, reaches up to 30%, the study highlights the benefits of installing of SVDR on board OSV as summarized in the following points:

- The introduction of the SVDR on board OSV if compared to the VDR installed on all SOLAS vessels and how it has improved safety standards associated with these vessels reducing human deaths rate immensely, then the same advantages would be brought to the OSVs
- SVDR certainly have great value in ensuring that an OSV is operated safely. In addition, the management benefits derived from installing a SVDR system would quickly offset the cost of its installation.
- The SVDR will also reduce the cost of investigating casualties at sea and time wasted on board a ship trying to trap evidence from the ship or crew
- The SVDR should allow incidents to be investigated as emphasized via the presented event tree analysis; hence, insurance companies may also reduce the insurance premiums to be paid. This is very beneficial for the supply-owner as insurance premium rates depend on the risk of any casualties and the nature/number of past insurance claims.
- SVDR can be used to assess the efficiency of a supply vessel's crew, whilst at sea. This would ensure the supply vessel and its gear to be operated properly and that the general rules of good seamanship are maintained. This device would also ensure seaworthiness of a vessel and reduce claims of un-seaworthiness. The SVDR would also improve safety at sea because the data it provides might uncover high risk operations such as those associated with navigation. In the long term the SVDR might be used to train staff after acquiring authentic data.

Therefore, this paper recommends the use of SVDR onboard OSVs for the safety of both the ship and the international marine society.

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