NAVIGATION EQUIPMENT INTEGRATION IN THE SIMPLIFIED VOYAGE DATA RECORDER JRC JCY-1850

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Abstract: *Ship accident represents a major marine disaster since the historic days. Even in the age of modern ship building technology and innovative navigation equipment, ship accidents are an important area of maritime concern, including the loss of lives and huge financial implications. Nowadays international regulations regarding the safety of ships at sea agist the modern vessels to be equipped with a Voyage Data Recorder or atleast a Simplified Voyage Data Recorder to be able to investigate and reconstruct the maritime accidents. Like the black boxes carried on aircraft, VDRs enable accident investigators to review procedures and instructions in the moments before an incident, having access to the stored data in the protected unit. The article deals with the integration of the navigation equipment in the SVDR JRC JCY-1850 and describe the utility of the navigation sensors to describe the recovery information needed for the investigation.*
Key-words: *marine disaster, accident, Simplified Voyage Data Recorder JRC JCY-1850, data, navigation equipment integration*

INTRODUCTION

Increases in traffic on the seas and oceans of the world, it was necessary to develop the systems and navigation aids that provide high accuracy and safety. At the same time increased the role of the navigation specialists which is responsible for the smooth running of a voyage and the lives of the entire crew. Simplified Voyage Data Recorder (S-VDR) are systems installed on the modern ships and built to very exact standards and features the most innovative and flexible platforms on the market. The JCY-1850 Simplified Voyage Data Recorder (S-VDR) is a so-called black box which complies with IMO, MSC 163(78) performance standard according to IMO, SOLAS-V, Regulation 20 as well as a VDR, recording navigational information, bridge conversation and VHF communication. The recorder data is used to analyze causes of an accident or an incident as collision, grounding or sinking.

The Simplified Voyage Data Recorder is a lower cost simplified version of VDR for small ships with only basic ship's data recorded. The differences between S-VDR and VDR based on the required data recorded are on the following table (X indicates mandatory data):

S-VDR	Input	VDR
-	Acceleration and Hull Stresses	X
When no radar signal is available	AIS	X
X	Bridge Audio	X
X	Communications Audio	X
X	Date and time	X
-	Echo Sounder	X
-	Engine Order and Response	X
X	Heading	X
-	Hull Openings Status	X
-	Main Alarms	X
X	Radar Data	X
-	Rudder Order and Response	X
X	Ship's Position	X
X	Speed	X
-	Watertight and Fire Doors Status	X
-	Wind Speed and Direction	X

Table 1 Differences between S-VDR and VDR

S-VDR REQUIREMENTS

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). The MSC at its 79th session in December 2004 adopted amendments to regulation 20 of SOLAS chapter V on a phased-in carriage requirements for a shipborne simplified voyage data recorder (S-VDR). The regulation is subject for a VDR, which may be an S-VDR, to be fitted on existing cargo ships of 3,000 gross tonnage and upwards, phasing in the requirement for cargo ships of 20,000 gross tonnage and upwards first, to be followed by cargo ships of 3,000 gross tonnage and upwards.

The S-VDR is not required to store the same level of detailed data as a standard VDR, but also nonetheless should maintain a store, in a secure and savable form, of navigational information regarding the position, movement, command and control of a ship over the period that led up to an incident.

"To assist in casualty investigations, cargo ships, when engaged on international voyages, shall be fitted with a VDR which may be a simplified voyage data recorder (S-VDR) as follows:

- In the case of cargo ships of 20,000 gross tonnage and upwards constructed before 1st July 2002, at the first scheduled dry-docking after 1st July 2006 but not later than 1st July 2009;
- In the case of cargo ships of 3,000 gross tonnage and upwards but less than 20,000 gross tonnage constructed before 1st July 2002, at the first scheduled dry-docking after 1st July 2007 but not later than 1 July 2010;
- Administrations may exempt cargo ships from the application of the requirements when such ships will be taken permanently out of service within two years after the implementation date specified above."[1]

Also the Maritime Safety Committee approved at its 75th session a guideline on voyage data recorder, which have been developed five basic issues relevant to VDR ownership and recovery, which were ownership, custody, recovery, read-out and access to the VDR information. "The five issues are the following:

- **Ownership:** the ship owner will own the VDR and its information;
- **Recovery:** should be undertaken as soon as possible after an accident to best preserve the relevant evidence for use by

[1] International Maritime Organization, International Convention for the Safety of Life at Sea, SOLAS, 1974

both investigator and the ship owner; in case of abandonment, master should take necessary steps to preserve the VDR information;

- **Custody:** during the course of an investigation, the investigator should have custody of the original VDR information;
- **Read-out:** the investigator is responsible to arrange downloading and read-out of the information;
- **Access:** a copy of the VDR information must be provided to the ship owner at an early stage in all circumstances."[2]

S-VDR JRC JCY-1850 SYSTEM CONFIGURATION

This basic overview shows the JCY-1850 mandatory recording data, as defined by the requirements of International Maritime Organization performance standard. The S-VDR is able to connect to multiple international navigation equipment and sensors onboard a vessel. As compulsory data we can mention date and time, latitude and longitude, speed, heading, radar, bridge and VHF audio and as multiple sensors we can indicate GPS or GPS compass, speed log, gyro compass, microphone and radar.

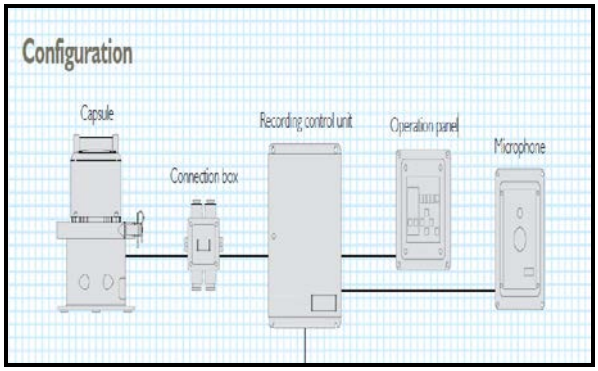
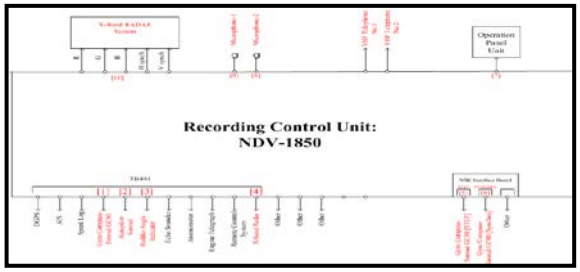


Figure 1 System configuration of S-VDR JRC JCY-1850

- **Protective capsule unit (PCU):** records data on the recording medium in the recovery protective capsule; at the time of sinking, the underwater acoustic beacon helps the searchers to detect the position of the PCU;
- **Connection box:** connects the PCU and the RCU with a power supply cable and a LAN cable;
- **Recording control unit (RCU):** outputs the recorded data to the PCU and on the CARD, inputs radar images, audio data and monitors the conditions of the system;
- **Operation panel unit (OPU):** displays the status of S-VDR; alarm BUZZER, alarm ACK switch and LEDs are equipped;
- **Microphone unit (MIC):** records the conversation in the bridge and outputs into the RCU.

Recording Control Unit (NDV-1850)

The Recording Control Unit outputs the recorded data to the Protective Capsule Unit, inputs radar images, audio data and monitors the conditions of the system. In



what follows we will present the diagram system of the S-VDR with different products connected with the recording control unit.

As a first connectivity we have the gyro compass Simrad GC-80 (fig.2 System Diagram-[1]), which eliminate the inconvenience and limitations of magnetic compasses, and provide a variety of electrical outputs to supply accurate and consistent heading information to other navigational equipment.

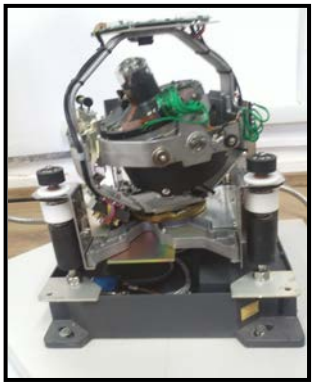


Figure 2 System Diagram of JRC JCY-1850

Further is connected the autopilot Simrad AP-50 (fig. 2 System Diagram-[2]), a system with an intelligent junction unit that communicates with all others system modules on a network. The network is developed to establish a reliable digital communication between the units in the system.

[2] International Maritime Organization, Guidelines on Voyage Data Recorder (VDR) Ownership and Recovery, MSC, 2002, Annex, page 1-2.

The rudder angle indicator, Simrad RI35 Mk2 is another sensor that helps to gain an overview of the system (fig.2 System Diagram-[3]). The rudder angle it is designed to operate from frequency or current signals generated by an autopilot feedback unit.

Also the system S-VDR includes 2 microphones (fig.2 System Diagram-[8],[9])., each one recommended to be installed in the bridge near to the most frequently equipment used during the watchkeeping and a pair of VHF telephones used by the officer of the watch.

Data Processor Unit

The data processor unit has the function to control the recording navigation, hull data and collects data of navigation condition. Also has the capability to capture, encode and record a conversation audio on the bridge, VHF communications and radar image shown on the display. The data collected are as follows:

1. Date and time;
2. Ship's position measured by the electronic position fixing system;
3. Ship's speed (over ground/water);
4. Ship's heading with a gyrocompass or magnetic compass;
5. Under keel clearance;
6. Main alarms (indicated in the bridge);
7. Rudder order and response data;

The S-VDR system has the capability to input up to 16 channels and recording interval of 1 second, the bridge audio input up to 9 channels and a recording interval continuously. The VHF communications are able to connect up to 3 channels with a maximum sensitivity of 3.5 kHz and can record continuous, 1 audio file/minute. The radar image has an input of 2 channels with an auto selection of a radar image from both channels, a refresh rate of 60 till 85 Hz and the recording interval to a maximum 1 image at every 15 seconds. In case of need it has the recording data backup, a card with a storage capacity of 2 Gb. As for the gyrocompass we have a performance of a synchro signal with 360X ratio, primary voltage AC 110V, 50/60Hz and secondary voltage AC 24V (fig.2 System Diagram-[5],[6]).

The environmental condition for the S-VDR is an operating temperature between -15° to +55°C, temperature to a maximum of +40°C and 93% humidity and a vibration of 13.2 Hz.

Operation Panel Unit

The operation panel unit (OPU) is a visible indication and audible alarm for S-VDR system and displays the cause of an error input of heading initial value. The OPU is supplied from the RCU and has an indication by a LED lighting. The error code indication is made by a 4 digit LED. The OPU functions as in the same environmental conditions as the RCU with an operating temperature of maximum +55°C. All failures of the RCU are indicated by the OPU as an error code. The RCU error code are presented as it follows in the table:

Symptom/ Error code	*Causes*	*Actions to be taken*
LEDs blink and the alarm buzzer sounds	The software of the RCU lost control	Reboot the RCU Check the wiring between RCU and OPU
Recording LED fails to light	The RCU is off The supply is off Recording of data stop	Check the switchboard Check the connection box Reboot the RCU
"01__"	Heading is not registered yet	Enter the initial value of heading
"03__"	Protection against overwriting data	Normal operation since the recorded data in accident are protected against unauthorized overwriting
"00__"	Mismatching in the information between the RCU and the PCU	Check the connection box Press the REC START for ten seconds
"20__"	Malfunction in PCU	Reboot RCU
"21__"	Fault in recording	The error is canceled in less than 2 days automatically
"60**"	Fault in sensors	Check the sensor equipment
"5*_"	Fault in microphone	Check wiring between the MIC and the RCU
"10__"	Power failure	Check the power supply in the RCU
"33__"	GPS is faulty	Check the GPS
"70__/71__"	Radar is faulty	Check the radar

Table 2 Failures of the RCU

CONCLUSIONS

The latest investigations into ship accidents is emphasizing the capabilities of the Voyage Data Recorder / Simplified Voyage Data Recorder systems and requests the supplier or the ship owner to give more attention to this types of products because they have reliable information before an incident is occurred. As the time passes we can admit that the technology is being in a full expending phase and can develop a new way to storage multiple information from different type of sensors and become more protective for the owner.

In this article we talked about the VDR requirements and the guidelines used by the investigators and ship owner, represented a system configuration used in practice on board of ships, some types of failure of the Recording Control Unit and steps regarding the actions to be made to acknowledge the failure of the system.

REFERENCES:

[1] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, (Amended in 1995)

[2] International Convention for the Safety of Life at Sea (SOLAS), 1986

[3] International Maritime Organization, "Performance standards for shipborne Voyage Data Recorders (VDRs)", adopted on November 27, 1997

[4] International Maritime Organization, "Performance standards for shipborne simplified Voyage Data Recorder (S-VDRs)", adopted on May 27, 2004

[5] http://www.simrad-yachting.com/

[6] http://www.jrc.co.jp/eng/product/index.html