Amendments to the
Performance Standards for Shipborne Voyage Data Recorders (VDRs)

Submitted by Germany and the United Kingdom

SUMMARY

Executive summary: This document contains a basis on which the Sub-Committee might recommend a revision of the Performance Standards for VDRs, incorporating proposed amendments submitted by Germany, Egypt and India and in view of applicable technological advances and experience in VDR data analysis over the past 12 years.

Strategic direction: 5.2
High-level action: 5.2.4
Planned output: Not assigned
Action to be taken: Paragraph 24
Related documents: A.861(20); MSC.163(78); MSC.214(81); MSC 83/25/4, MSC 83/25/8, MSC 83/25/9, MSC 83/28, MSC 83/25/18 and SOLAS chapter V

Introduction

1 The Sub-Committee is invited to recall that this item was placed on the Work Programme at MSC 83, in response to documents submitted by Germany, Egypt and India. This document supports these papers and incorporates amendments proposed by them.

2 There is a need for this Sub-Committee to amend the Performance Standards to cover data availability and quality issues to better enable the data to be used in the way the Organization intended, that is for the investigation of accidents and incidents.

3 These amendments are required to ensure that the pertinent data items now available as a result of advancing technologies are recorded and available to investigators in the most cost effective manner following an accident or incident.
4 The proposed amendments are not intended to be retrospective, and since the Performance Standard for S-VDRs, resolution MSC.163(78) will not apply after 1 July 2010, it is not proposed that any changes should be made to that standard.

5 A draft amended Recommendation on Performance Standards for Shipborne Voyage Data Recorders incorporating the required amendments is included in the annex.

Background

6 The present Performance Standards for Shipborne Voyage Data Recorders (VDRs), resolution A.861(20), ensures that 12 hours of specified data is available from the final recording medium in the event of a vessel being lost. This data has proved extremely valuable in determining the underlying causes of accidents and incidents. VDRs and S-VDRs are increasingly becoming the principal source of factual evidence for use in investigations by both Flag State accident investigation authorities and ship owners following an accident or incident. However, this resolution was adopted in 1997 and based on the capabilities of the technology that was available at that time. There have been major advances over the last 12 years and the current capabilities and costs of the relevant technologies permit significant, cost-effective improvements to be made to the standard.

7 In three of the four known cases worldwide, where the capsules containing the final recording medium have been recovered following loss of vessels, the data was secure and available as intended. In the fourth case, the last 12 hours of data was secure and available, unfortunately this data did not cover the accident which had occurred some 14 hours earlier. Over the last 12 years, the United Kingdom Marine Accident Investigation Branch has analysed, or facilitated the analysis of, in excess of 100 VDR data sets. All but two of these were recovered from the VDR’s internal recording medium, not the final recording medium.

8 As a result of the experience gained in identifying, recovering and analysing data from VDRs over the last 12 years and in view of the technological advances in the areas pertaining to VDR systems and other ship’s systems that may be usefully recorded on the VDR in this period, there is a need for the following amendments to the Performance Standards to cover data availability and quality issues.

Issues involved

9 Experience has shown that the vast majority of VDR data used in investigations following accidents and incidents comes from vessels that are still operational. One of the greatest difficulties in recovering data from operational vessels is that under the current Performance Standards the data may be overwritten 12 hours after the accident or incident. In many cases, this does not leave sufficient time to enable the flag State accident investigation organizations or the vessels’ owners to recover the data, especially if the vessel is at sea. In view of the huge reduction in the costs of electronic memory over the last 12 years, it is now inexpensive for VDRs to record over 30 days’ data in their internal recording medium, and 24 hours in their final recording medium. In fact, a number of manufacturers are already voluntarily offering more than 90 days in the internal recording medium and over 24 hours in the final recording medium.

10 Access to the data by flag State accident investigation organizations has been addressed by an earlier amendment to the Performance Standards, resolution MSC.214(81). However, to enable straightforward retention of the data in the case of abandonment, the internal recording medium should take the form of a removable device which may be easily carried by ships’ staff in line with the proposals by Egypt and India in MSC 83/25/9 and MCS 83/25/18 respectively.
Removal of this internal recording medium should not affect the recording of data to the final recording medium since it is possible that abandonment may take place some time before a ship is lost.

11 The successful recovery to date of three fixed capsules containing the final recording medium proves the value of this method of ensuring the availability of the data following a loss. However, the costs associated with the recovery of these capsules can be high. While it is essential to ensure that the fixed capsule remains a requirement, since these have proven to be the most secure means of retaining the data, the availability of cheap float-free capsules, and the facility for these to be combined EPIRB/VDR devices makes it practical to fit both fixed and float-free capsules. This will ensure that following the loss of a vessel, the data will be available for recovery by the most cost effective means.

12 Despite the intention of the existing Performance Standards to enable playback of all the various required data items correlated in date and time, this has often proved to be impossible. This has been due to the VDR manufacturer’s playback software being unable to convert proprietary data from other instrumentation into meaningful information. The VDR has recorded the data as required, but the manufacturer of the other instrumentation might not have provided the VDR manufacturer with the tools required to display the information contained in their proprietary data, or, the VDR manufacturer has not configured their replay to display the information contained in the data. So as to remove any doubt surrounding the need to be able to replay and display in a meaningful manner the information held by all data items, the playback software should be included in the performance standard. Its inclusion in the Performance Standards would enable its full functionality to be tested as an integral part of the VDR system. Playback equipment is not currently regarded as part of the VDR for the purposes of these Performance Standards, since it was not required to be installed with the VDR. However, replay software is now required by resolution MSC.214(81) to be provided with each installation, and therefore is now installed on the ship.

13 Experience has shown that in cases where the internal clock is used, as permitted under A.861(20), this has led to significant difficulties in accurately reconstructing the history of the incident. Since all data recovered to date includes data recorded from a GPS unit, it is no longer necessary to permit the use of internal clocks except where the signal from the external clock has been lost.

14 The United Kingdom’s and Germany’s experience with audio taken from VDRs is in line with that described in MSC 83/25/4, and we support the proposals made in that paper.

15 AIS data is proving to be extremely valuable for investigations and its inclusion as a data item to be recorded would significantly enhance the ability of flag State accident investigation organizations and shipowners to reconstruct the history of an incident in detail. Since AIS is now required for all vessels that will be fitted with VDRs, and in view of the ease with which this data can be recorded, the proposals regarding AIS made in MSC 83/25/4 are supported and extended to include all AIS signals, including those received from Aids to Navigation. This would enable own ship signals to be assessed along with signals received from target ships and Aids to Navigation, providing a complete reconstruction of the AIS information that was available at the time of an accident or incident.

16 It has been our experience that the radar recorded by the VDR is often not that which is in use. Additionally, where the ship is fitted with a 3GHz radar this may be the preferred display during poor visibility, and is usually not recorded. The intent of the current performance standard was to ensure that the radar image as seen by the operator was available for playback so
as to enable investigators to reconstruct the history of an incident in detail. This cannot be achieved unless both radars required by SOLAS regulation V/19 are recorded. This is in line with the proposal made by Egypt in MSC 83/25/8.

17 With the increasing use of ECDIS as a navigation tool, and in light of the mandatory carriage requirement for ECDIS, the availability of recorded data from the ECDIS on the VDR is now necessary. It is a requirement of the ECDIS performance standard resolution A.817(19), as amended and resolution MSC.232(82) that the system records some voyage data internally. However, this data does not include information regarding how the ECDIS was being used, is only required to be stored at 1 min intervals, is not protected in the event of the vessel being lost, and is often not capable of replay other than on board. Hence it is not possible to replay the information that was available to the operator after an accident or incident. In order to fully reconstruct the events, it is necessary to have access to the images seen by the operator. Therefore, where an ECDIS system is fitted, the post processed images from the in use ECDIS should be recorded in the same way as the vessel’s radar.

18 Currently, the requirement to record the status of mandatory alarms on the bridge has occasionally been fulfilled by simply recording the audio alarms on the bridge. This does not provide flag State accident investigation organizations or owners with the means to identify and analyse the sequence of alarms from the VDR data. This information can be essential in reconstructing the events leading up to an accident or incident. To clarify the situation, the status of all mandatory alarms should be recorded as a data parameter. The bridge audio recording will still record any audible alarms and these can be correlated to the data parameters during subsequent analysis.

19 While the recording of rudder and engine order and response has typically been good, many vessels are now equipped with many stations from which the rudder and engines may be controlled. There have been a number of cases where the control station in use was not the control station being used by the operator and this information is not always recorded. To facilitate a better understanding of the use of bridge equipment leading up to an accident or incident, it is necessary to specify that the control stations in use for rudders and engines are recorded.

20 There have been a number of occasions when the reconstruction of the events leading up to an accident or incident has been hampered by the lack of information regarding the angle of heel or list of the ship. This information can be extremely valuable when attempting to understand the circumstances of an accident or incident including the motion of the ship or its cargo. Electronic inclinometers are available, and could form part of the VDR system itself where not fitted as part of the ship’s instrumentation.

21 It is likely that as ships’ instrumentation becomes more automated, the use of electronic logbooks, bilge, ballast, fire and alarm monitoring and recording systems will become more prevalent. Where such systems are approved by the Organization, the inclusion of data items stored by them as data items on the VDR should form part of that approval. The VDR is the only approved, secure, purpose designed shipborne repository for essential data records and should be recognized and used as such.

22 It has been our experience that while the means to save recorded data are provided, the instructions on how to do so are not always available and, in some cases, it has been necessary to talk ships’ staff through the process while the vessel was on passage. So as to clarify this for ships’ staff, there is a need for posted instructions in the working language of the vessel, describing how to secure and preserve data in the event of an accident or incident.
23 Experience has shown that repair or maintenance work on sensors or other equipment delivering data to the VDR has often led to the subsequent failure of that data being correctly recorded. A VDR performance test needs to be performed following such repair or maintenance work to ensure that all necessary data is being correctly recorded on the VDR.

**Action requested of the Sub-Committee**

24 The Sub-Committee is invited to note the foregoing and consider the draft amended performance standard in the annex.
ANNEX

DRAFT AMENDED RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE VOYAGE DATA RECORDERS (VDRs)

1 PURPOSE

The purpose of a voyage data recorder (VDR) 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 the period leading up to and following an incident having an impact thereon. Information contained in a VDR should be made available to both the Administration and the shipowner. This information is for use during any subsequent investigation to identify the cause(s) of the incident.

2 APPLICATION

A VDR with capabilities not inferior to those defined in these performance standards is required to be fitted to ships of classes defined in SOLAS chapter V, as amended.

3 REFERENCES

3.1 SOLAS:


3.2 IMO resolutions:

– A.662(16) Performance standards for float-free release and activation arrangements for emergency radio equipment
– A.694(17) General requirements for shipborne radio equipment forming Part of the GMDSS and for electronic navigational aids
– A.802(19) Performance standards for survival craft radar transponders for use in search and rescue operations
– A.812(19) Performance standards for float-free satellite emergency position-indicating radio beacons operating through the geostationary Inmarsat satellite system on 1.6 GHz
– A.817(19), Performance standards for electronic chart display and information as amended systems (ECDIS)
– Resolution MSC.232(82) Revised performance standards for electronic chart display and information systems (ECDIS)
– A.824(19) Performance standards for devices to indicate speed and distance
– A.830(19) Code on alarms and indicators, 1995
4 DEFINITIONS

[4.1 Voyage data recorder (VDR) means a complete system, including any items required to interface with the sources of input data, for processing and encoding the data, the final recording media in its capsules, the internal recording medium, the playback software, the power supply and dedicated reserve power source.]

4.2 Sensor means any unit external to the VDR, to which the VDR is connected and from which it obtains data to be recorded.

[4.3 Final recording media means the two items of hardware on which the data is simultaneously recorded such that access to either of them would enable the data to be recovered and played back by use of suitable equipment.]

[4.4 Playback equipment means the playback software installed on a commercial-off-the-shelf laptop computer.]

4.5 Dedicated reserve power source means a secondary battery, with suitable automatic charging arrangements, dedicated solely to the VDR, of sufficient capacity to operate it as required by 5.3.2.

[4.6 Playback software means a copy of the software programme providing the capability to download the stored data and playback the information. The software should be compatible with an operating system available with commercial-off-the-shelf laptop computers and where non-standard or proprietary formats are used for storing the data in the VDR, the software should convert the stored data into open industry standard formats.]

[4.7 Internal recording medium means the removable item of hardware on which the data is recorded such that access to it would enable the data to be recovered and played back by use of suitable equipment.]

5 OPERATIONAL REQUIREMENTS

5.1 General

5.1.1 The VDR should continuously maintain sequential records of preselected data items relating to the status and output of the ship’s equipment, and command and control of the ship, referred to in 5.4.

5.1.2 To permit subsequent analysis of factors surrounding an incident, the method of recording should ensure that the various data items can be correlated in date and time during playback on suitable equipment.

[5.1.3 Final recording media]
5.1.3.1 The final recording media should be installed in protective capsules of both fixed and float-free type, which should meet all of the following requirements:

1. be capable of being accessed following an incident but secure against tampering;
2. maintain the recorded data for a period of at least 2 years following termination of recording;
3. be of a highly visible colour and marked with retro-reflective materials; and
4. be fitted with an appropriate device to aid location.

5.1.3.2 The fixed capsule should maximize the probability of survival and recovery of the final recorded data after any incident.

5.1.3.2 The float-free type protective capsule should:

1. be fitted with means to facilitate grappling and recovery;
2. be so constructed as to comply with the requirements specified in resolutions A.810(19) or A.812(19) and to minimize risk of damage during recovery operations; and
3. the device should be capable of transmitting an initial locating signal and further locating homing signal for at least 48 hours over a period of not less than 7 days/168 hours.

5.1.4 The design and construction, which should be in accordance with the requirements of resolution A.694(17) and international standards acceptable to the Organization*, should take special account of the requirements for data security and continuity of operation as detailed in 5.2 and 5.3.

5.1.5 The internal recording medium should be installed in a removable device which should meet all of the following requirements:

1. be capable of being accessed easily by ship’s staff from an internal manned area of the vessel;
2. be clearly marked and labelled; and
3. provide easy access to the data held on it but be secure against tampering.

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* Refer to publication IEC 945 – Maritime navigation and radiocommunication equipment and systems – General requirements, methods of testing and required test results.
5.2  Data selection and security

5.2.1 The minimum selections of data items to be recorded by the VDR are specified in 5.4. Optionally, additional items may be recorded provided that the requirements for the recording and storage of the specified selections are not compromised.

5.2.2 The equipment should be so designed that, as far as is practical, it is not possible to tamper with the selection of data being input to the equipment, the data itself nor that which has already been recorded. Any attempt to interfere with the integrity of the data or the recording should be recorded.

5.2.3 The recording method should be such that each item of the recorded data is checked for integrity and an alarm given if a non-correctable error is detected.

[5.2.4 A performance test should be performed annually and following repair or maintenance work to the VDR or any sensors or devices providing data to the VDR. This test should ensure that all the required data items are being correctly recorded.]

5.3  Continuity of operation

5.3.1 To ensure that the VDR continues to record events during an incident, it should be capable of operating from the ship's emergency source of electrical power.

5.3.2 If the ship's emergency source of electrical power supply fails, the VDR should continue to record Bridge Audio (see 5.4.5) from a dedicated reserve source of power for a period of 2 h. At the end of this 2-h period all recording should cease automatically.

[5.3.3 Recording should be continuous unless interrupted briefly in accordance with 6 or terminated in accordance with 5.3.2. The time for which all stored data items are retained should be at least 30 days/720 hours on the internal recording medium and at least 24 hours on the final recording media. Data items which are older than this may be overwritten with new data.]

[5.3.4 Removal of the internal recording medium should not interrupt the operation of the VDR and recording to the final recording medium should continue in accordance with 6 or terminated in accordance with 5.3.2.]

5.4  Data items to be recorded

[5.4.1 Date and time

Date and time, referenced to UTC, should be obtained from a source external to the ship. In the event of a loss of the external source, an internal clock may be used. The recording should indicate which source is in use. The recording method should be such that the timing of all other recorded data items can be derived on playback with a resolution sufficient to reconstruct the history of the incident in detail.]
5.4.2 Ship’s position

Latitude and longitude, and the datum used, should be derived from an electronic position-fixing system (EPFS). The recording should ensure that the identity and status of the EPFS can always be determined on playback.

5.4.3 Speed

Speed through the water or speed over the ground, including an indication of which it is, derived from the ship’s speed and distance measuring equipment.

5.4.4 Heading

As indicated by the ship’s compass.

5.4.5 Bridge Audio

Two or more microphones positioned on the bridge should be placed so that conversation at or near the conning stations, radar displays, chart tables, bridge wings, etc., is adequately recorded. As far as practicable, the positioning of microphones should also capture intercom, public address systems and audible alarms on the bridge.

Two separate recording tracks should be provided for the two microphones installed near the conning stations; additional microphones should use at least one separate track.

5.4.6 Communications audio

VHF communications relating to ship operations should be recorded on a separate track to those referred to in 5.4.5.

5.4.7 Radar data, post-display selection

This should include electronic signal information from within both of the ship’s radar installations as required by SOLAS regulation V/19, and records all the information which was actually being presented on the master displays of these radars at the time of recording. This should include any range rings or markers, bearing markers, electronic plotting symbols, radar maps, whatever parts of the SENC or other electronic chart or map that were selected, the voyage plan, navigational data, navigational alarms and the radar status data that were visible on the displays. The recording method should be such that, on playback, it is possible to present a faithful replica of the entire radar display that was on view at the time of recording, albeit within the limitations of any bandwidth compression techniques that are essential to the working of the VDR.

5.4.8 ECDIS data, post-display selection

Where a vessel is fitted with an ECDIS installation, this data should include electronic signal information from within the in use ECDIS installation, which records all the information which was actually being presented on the master display of that ECDIS at the time of recording. This should include the source of the chart data and the version used, all layers selected for display, any range rings or markers, bearing markers, electronic plotting symbols, radar overlay, the voyage plan, navigational data,
navigational alarms, manual updates and any other information that were visible on the display. The recording method should be such that, on playback, it is possible to present a faithful replica of the entire ECDIS display that was on view at the time of recording, albeit within the limitations of any bandwidth compression techniques that are essential to the working of the VDR.]

5.4.8 [9]  Echo sounder

This should include depth under keel, the depth scale currently being displayed and other status information where available.

[5.4.10  Main alarms

This should include the status of all mandatory alarms on the bridge recorded as data parameters.]

[5.4.11  Rudder order and response

This should include status and settings of auto-pilot if fitted and indicate the control station in use.]

[5.4.12  Engine order and response

This should include the positions of any engine telegraphs or direct engine/propeller controls and feedback indications, if fitted, including ahead/astern indicators and indicate the control station in use. This should also include status of bow thrusters if fitted and indicate the control station in use for them.]

5.4.12 [13]  Hull openings status

This should include all mandatory status information required to be displayed on the bridge.

5.4.13 [14]  Watertight and fire door status

This should include all mandatory status information required to be displayed on the bridge.

5.4.14 [15]  Accelerations and hull stresses

Where a ship is fitted with hull stress and response monitoring equipment, all the data items that have been pre-selected within that equipment should be recorded.

5.4.15 [16]  Wind speed and direction

This should be applicable where a ship is fitted with a suitable sensor. Either relative or true wind speed and direction may be recorded, but an indication of which it is should be recorded.
[5.4.17] AIS
All AIS data should be recorded as a source of information regarding other ships, transmitted own ship data and signals from aids to navigation.]

[5.4.18] Inclinometer
The angle of heel or list of the vessel should be recorded. Where a ship is not equipped with a suitable inclinometer, one may be included as an integral part of the VDR system.]

[5.4.19] Electronic logs
Where a ship is fitted with an approved electronic logbook, bilge, ballast, fire or alarm monitoring or recording system, the information from these should be recorded.]

6 OPERATION

[6.1] The unit should be entirely automatic in normal operation. Means should be provided whereby recorded data may be saved by an appropriate method following an incident, with minimal interruption to the recording process.]

[6.2] Instructions describing the means of saving data following an incident along with the location of the internal recording medium should be displayed in a prominent position on the bridge and in the working language of the ship.]

[6.3] The means of removal of the internal recording medium should be displayed at a prominent position as close to the internal recording medium as practicable and in the working language of the ship.]

7 INTERFACING

Interfacing to the various sensors required should be in accordance with the relevant international interface standard, where possible. Any connection to any item of the ship’s equipment should be such that the operation of that equipment suffers no deterioration, even if the VDR system develops faults.

8 DOWNLOAD AND PLAYBACK EQUIPMENT FOR INVESTIGATION AUTHORITIES

8.1 Data output interface
The VDR should provide an interface for downloading the stored data and playback the information to an external computer. The interface should be compatible with an internationally recognized format, such as Ethernet, USB, FireWire, or equivalent.

8.2 Software for data downloading and playback

8.2.1 A copy of the software programme providing the capability to download the stored data and playback the information onto a connected external laptop computer and for the playback of the data should be provided for each VDR installation.
8.2.2 The software should be compatible with an operating system available with commercial-off-the-shelf laptop computers and provided on a portable storage device such as a CD-ROM, DVD, USB-memory stick, etc.

8.2.3 Instructions for executing the software and for connecting the external laptop computer to the VDR should be provided.

8.2.4 The portable storage device containing the software, the instructions and any special (not commercial-off-the-shelf) parts necessary for the physical connection of the external laptop computer, should be stored within the main unit of the VDR.

8.2.5 Where non-standard or proprietary formats are used for storing the data in the VDR, the software for converting the stored data into open industry standard formats should be provided on the portable storage device or resident in the VDR.