BLUE OCEAN
VDR / S-VDR

Chapter 1
Short Technical Description

Blue Ocean VDR / S-VDR

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A. General

«Blue Ocean" VDR / S-VDR is a voyage data recorder, capable of operating as either simplified or full version. It is build according to **IEC61996(2000), PAS 61996-2 80/401/NP** and the July 2005 pre-standard. Paragraph numbers refer to the same topic in the standard and contain our clarifications.

Purpose (4.2)
The purpose of a simplified voyage data recorder (VDR / S-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 S-VDR should be made available to both the Administration and the ship owner. This information is for use during any subsequent investigation to identify the cause(s) of the incident.

The "Blue Ocean" consists of 3 major parts:

- The VDR or S-VDR consisting of
  - The main control computer
  - Interfaces and peripherals
  - Power supply
  - Enclosing box

- Float free capsule or fixed capsule

- The auxiliary programs
  - Data Player
  - Setup
  - Configuration program
  - Service utilities

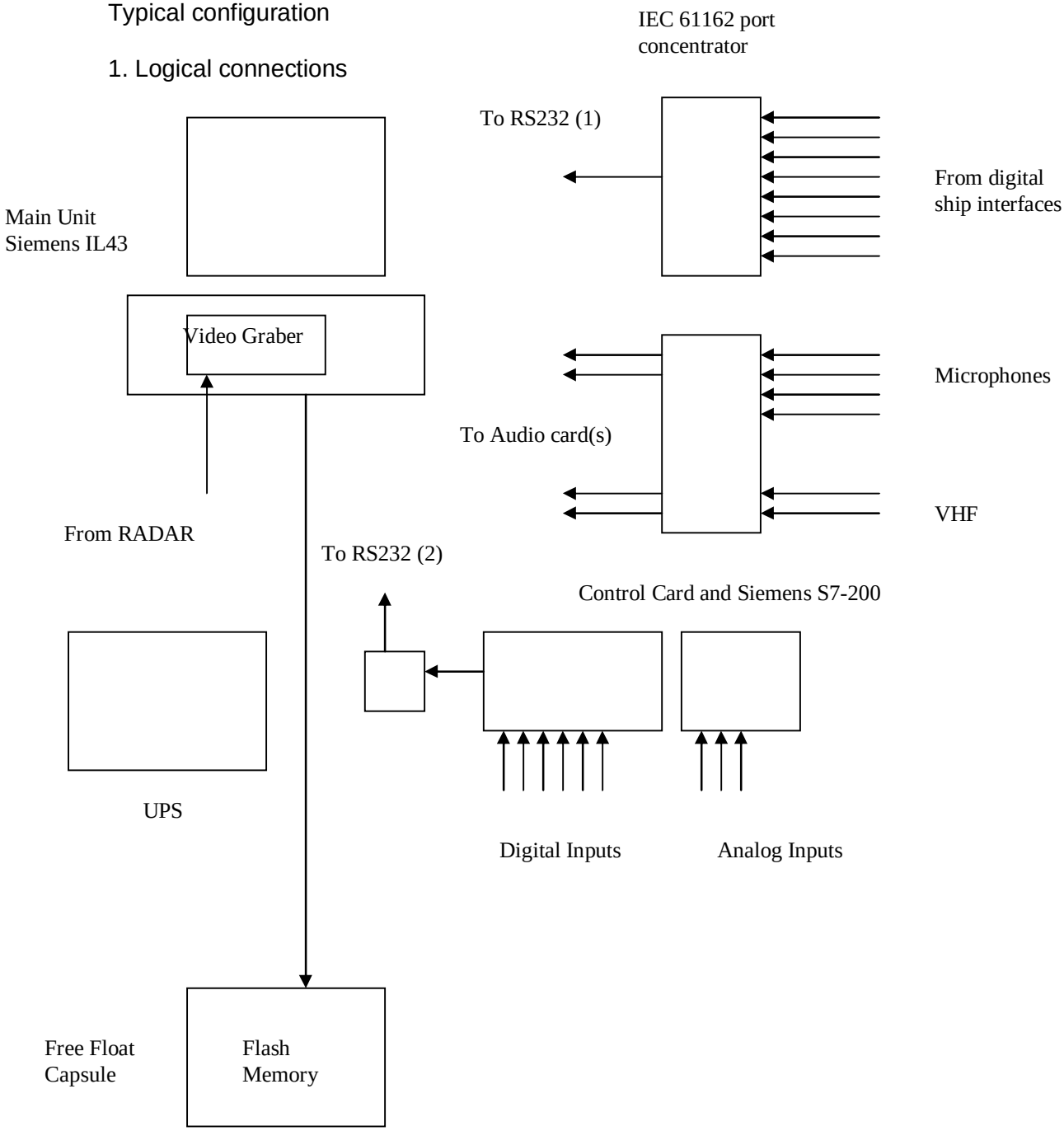
The VDR, S-VDR can record all mandatory signals in the capsule for at least twelve hours. Old data are deleted to make room for new. The same data, but for intervals up to some weeks, are recorded in the control computer and, on command, can be kept for as long as needed.

All necessary programs for the analysis of data are provided. Cryptographic measures make it extremely difficult to tamper with the data.

The configuration, together with the ship data, is preserved in the capsule.
Information on signal source, connections and resolution of the devices is recorded.

Typical configuration

1. Logical connections



B. Supported Interfaces

Interfaces (4.3.6)
Interfacing to the various sensors required shall be in accordance with the relevant international interface standard, IEC 61162 series, where possible.

Any interface units which may be required to convert non-IEC 61162 signals, shall conform to the requirements of IEC 60945.

Interface types:
1. IEC 61162. Multiply interfaces needed: many devices support one-way serial data transmission from a single talker to one or more listeners. Possible talkers include:
    a. Main engine control
    b. GPS
    c. Gyro
    d. Depth Sounder
    e. AIS

No standard connector is specified. The listener receive circuit shall consist of an optoisolator and shall have protective circuits to limit current, reverse bias and power dissipation at the optodiode.
A concentrator with 8 inputs is used. The inputs are according to IEC61162 and the output is RS232, to be connected to the control computer. In most applications 8 inputs are sufficient, but more concentrators can be used if more inputs are needed.

2. Analogue Inputs from old equipment

3. Digital Inputs from alarms, doors and other simple equipment
The connection of such inputs is not a requirement for an S-VDR but for the full model (VDR). Our design accommodates both cases.
The chosen solution is Siemens PLC of the S7-200 series

Siemens has numerous approvals from all possible standard bodies. The list is really impressive. As the PLC is in contact with ship equipment it is the most critical device, so the highest quality devices have been chosen.

4. Video grabber for radar
Video grabbers are used with a maximum analysis of 1280x1024.

5. Microphone and VHF inputs
The requirements of these inputs can be meet with a standard audio card with suitable preamplifier-mixer. 2 recording channels are used. As an analogue front end a mixer is used with 8 inputs for microphones and 4 for VHF, each with its own gain control. Tone controls at the outputs are used to cut unwanted noise, as human voice recording is the main requirement of the standard. On the “flat” setting frequency response is better than specified in the standard.

C. Recorded Items

4.6 Data items to be recorded

4.6.1 Date and time
Date and time referenced to UTC, shall be obtained from a source external to the ship (for example, an EPFS or radio time signal) if available, or from an internal clock

at least once per hour. The recording shall indicate which source is in use. The recording method shall 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, not worse than 1 s.

To meet this requirement the Blue Ocean S-VDR records ship state once per second. The records contain date and time at the moment of the recording with a resolution of 0.01 sec. The time is synchronised to the external source not only once per hour but every time the external reference has data available. Special bit in every record indicate the malfunction of the external reference, together with other diagnostics of system state. The normal source for time data, as it is for all high resolution numerical data, is NMEA.

4.6.2 Ship's position

Latitude and longitude, and the datum used, shall be derived from a designated EPFS or INS if available. The recording shall ensure that the identity and status of the source can always be determined on playback. The ship's position shall be recorded, as available on the ship, up to a resolution of 0,0001 min of arc.
Every available NMEA source, and some non-NMEA, can be used up to its native resolution, be it 0,0001 min of arc or other. The saved configuration file not only determines the source but describes it in detail. For example, it contains information on the resolution of the device.

4.6.3 Speed

Speed through the water, or speed over the ground (transverse as well as longitudinal in either case, as available on the ship), including an indication from which it is, derived from the ship's designated speed and distance measuring equipment, shall be recorded, as available on the ship, up to a resolution of 0,1 knot.

4.6.4 Heading

As indicated by a designated ship's compass. The ship's heading shall be recorded, as available on the ship, up to a resolution of 0,1°.

4.6.5 Bridge audio

One or more microphones positioned on the bridge shall be placed, such that conversation at or near the conning stations, radar displays, chart tables etc., (for example at work stations as defined in (3.1.9) may be adequately recorded. As far as is practicable, the positioning of microphones shall also capture the input and output of intercom, public address systems and the audible alarms on the bridge (bridge mounted equipment).
The audio signals at all work stations are recorded continuously. The recordings are time stamped. Up to 8 microphones can be used in the basic configuration.

4.6.6 Communications audio

VHF communications relating to ship operations shall be recorded, independently of the bridge audio. The recording shall include both transmitted and received audio signals and shall be continuous from a directly connected fixed VHF set to be designated at installation. Four channels can be recorded.

4.6.7 Radar data - post-display selection

This shall include electronic signal information from within one of the ship's radar installations which records all the information which was actually being presented on the master display of that radar at the time of recording. This shall 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 display. The recording method shall 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 S-VDR.
All the required resolutions are supported. The compression is adjustable, but the quality cannot be set under a limit, so that the signal quality is preserved. The signal is recorded every 15 seconds.

4.6.8 AIS
Where there is no commercial off-the-shelf interface available to obtain radar data then AIS target data shall be recorded as a source of information regarding other ships, otherwise AIS information may be recorded additionally as a beneficial secondary source of information on both other and own ship.
The VDM message shall be recorded in such a way, that all target data available from the onboard AIS are acquired.
If the VDO message is recorded, this shall be additional to the recording of individual sensor data as per sections 4.6.1 - 4.6.4.
NMEA AIS are supported. AIS messages are recorded in special files, together with other textual data. The configuration can be set to record any message, based on its header.

4.6.9 Other Items
Any additional data items listed by IMO with the requirements set out in resolution A. 861(20) (clauses 4.6.10 - 4.6.17 below) shall be recorded where the data is available in accordance with the international digital interface standards using approved sentence formatters. 8 standard NMEA inputs are provided and optionally up to 32 can be used to record extended signals.

4.6.10 Echo sounder
This shall include depth under keel, up to a resolution of 0,1 m as available on the ship. The depth scale currently being displayed and other status information shall be recorded where available.
Every available NMEA source can be used up to its native resolution. The saved configuration file not only determines the source but describes it in detail. For example, it contains information on the resolution of the device

4.6.11 Main alarms
This shall include the status of all IMO mandatory alarms on the bridge.
The status of all IMO mandatory alarms is recorded by the bridge audio and as a data parameter where available. Additional alarms can be accommodated, up to 256 items.

4.6.12 Rudder order and response
Both rudder order and response angles shall be recorded up to a resolution of 1° as available and permitted on the ship. Status and settings of heading or track controller, if fitted, shall also be recorded.

4.6.13 Engine order and response
This shall include the positions of any engine telegraphs or direct engine/propeller controls, including shaft(s) rpm.(or equivalent), and feedback indications, if fitted, including ahead/astern indicators. This shall also include status of bow and stern thrusters if fitted. Rpm shall be recorded up to a resolution of 1 rpm and pitch shall be recorded up to a resolution of 1°.

4.6.14 Hull openings (doors) status
This shall include all IMO mandatory status information required to be displayed on the bridge. Up to 256 sources can be connected.

4.6.15 Watertight and fire door status
This shall include ail IMO mandatory status information required to be displayed on the bridge. Up to 256 sources can be connected.

4.6.16 Accelerations and hull stresses
Where a ship is fitted with IMO mandated hull stress and response monitoring equipment, all the data items that have been preselected within that equipment and are available shall be recorded.

4.6.17 Wind speed and direction
This shall 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 shall be recorded.

D. Capsule

Float-Free capsule (4.3.4.1.2)

The capsule is so constructed as to minimize the risk of loss of damage to the recording medium during recovery operations.
The capsule is fitted with means to facilitate grappling and recovery, is designed with due regard to preventing it from being fouled during release

Access to capsule (4.3.4.2)

The capsule is capable of being accessed following an incident but secure against tampering.
The capsule is enclosing the final recording medium. The final recording medium is not accessible by standard operating procedures during normal ship operations.
A means is provided to retrieve stored information via an external device without opening the protective capsule. The information can be retrieved through the normal recording connector. If the connector is destructed during an incident a protective hinge is removed and a second connector is used. Finally, the recording medium can be removed, but not without leaving clear marks on the capsule.
The integrity of the recordings are protected by cryptographic means, making it very difficult to change the recordings without leaving a trail.

Assessment of recording medium (4.3.5)
Where the storage medium cannot be readily and reliably inspected after an incident, means shall be provided to enable an accident investigator to determine, prior to an attempted replay, whether the storage medium has been subjected to an excessive level of heat, where the survival of the stored data may be in doubt.
During the recording the capsule is continuously checked for errors (4.4.3) The replay program can check the integrity of the media, find and attempt to correct errors due to heat or other calamities and find which data can be reliably replayed.

Location (4.3.4.3.1)

The capsule is fitted with an appropriate device to aid location.

Visibility and marking (4.3.4.3.2)

The capsule, together with any outermost shell, is of a highly visible fluorescent orange colour, marked with retro-reflective materials that comply with the relevant requirements of IMO A.658 and marked with the legend:

•VOYAGE DATA RECORDER - DO NOT OPEN -
REPORT TO AUTHORITIES"