***INTERNATIONAL HYDROGRAPHIC ORGANIZATION S 61***

***PRODUCT SPECIFICATION***

***for***

***RASTER NAVIGATIONAL CHARTS (RNC)***

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**FOREWORD**

In December 1998, the International Maritime Organization's Maritime Safety Committee adopted

an amendment [IMO resolution MSC.86 (70)] to the then-current Performance Standards for Electronic

Chart Display and Information Systems (ECDIS), adopted by IMO resolution A.817 (19), as amended by

IMO resolution MSC.64 (67), which are also annexed to IHO Publication S-52.

IMO resolution MSC.86 (70) permits ECDIS equipment to operate in a Raster Chart Display

System (RCDS) mode in the absence of Electronic Navigational Charts (ENC). When operating in the

RCDS mode, ECDIS should be used together with an appropriate folio of up-to-date paper charts.

The RCDS mode of operation is described in a new Appendix 7 to the IMO Performance

Standards for ECDIS. For convenience it is annexed to this publication, with the kind permission of the

IMO. A key component of the RCDS mode is the Raster Navigational Chart (RNC). Section 4.1 of

Appendix 7 states that the RNC must conform to IHO standards. The necessary RNC Product Specification

was developed by the IHO's Transfer Standard Maintenance and Application Development Working Group

(TSMAD) during 1997 and 1998 and was adopted by the IHO's Committee on Hydrographic

Requirements and Information Systems (CHRIS) in October 1998.

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**Annex A -** RCDS Mode of Operation (Appendix 7 to IMO Performance Standards

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**1 INTRODUCTION**

1.1 The elements of this product specification define the minimum requirements a Raster

Navigational Chart (RNC) must have to satisfy the draft performance standard for a Raster

Chart Display System (RCDS).

1.2 This product specification does not define underlying raster data structures of a raster

navigational chart. The national hydrographic office producing the raster navigational chart

should select that data structure.

**2 DEFINITIONS**

2.1 For the purpose of this product specification:

2.1.1 **Raster Chart Display System (RCDS)** means a navigation information system displaying

RNCs with positional information from navigation sensors to assist the mariner in route

planning and route monitoring, and if required, display additional navigation-related

information.

2.1.2 **Raster Navigational Chart (RNC)** means a digital facsimile of a paper nautical chart,

produced by or distributed on the authority of a government authorized hydrographic

office. RNC is used in these specifications to mean either a single chart or a collection

of charts.

2.1.3 **Notice to Mariners (NtM**) means a published change to an RNC produced by or

distributed under the authority of a government authorized hydrographic office.

**3 RNC REQUIREMENTS**

3.1 An RNC should contain an image file, which is a digital facsimile of an existing, official

paper chart. It should also contain meta-data describing the RNC as stated in this product

specification.

3.2 The arrangement of the image data and the meta-data into one or more digital files should

be determined by the national hydrographic offices originating the RNC.

3.3 **Image Files**

3.3.1 The digital format of the image file should be determined by the national hydrographic office

producing the RNC.

3.3.2 The resolution of the digital image (pixels-per-inch) and any method used to compress or

process that image file should be sufficient to display clearly all information that was

contained on the original paper nautical chart. In particular, methods such as antialiasing

should be employed to achieve maximum contrast and fidelity of displayed chart

information compared to the printed chart.

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3.3.3 The accuracy of the digital image file, as measured by the ability to determine the correct

geographic coordinates of an individual pixel when the image file is used together with the

RNC meta-data, should allow a ship’s position to be displayed at least as accurately as when

using the original paper chart.

3.4 **Meta-Data**

3.4.1 The digital format of the meta-data should be determined by the national hydrographic office

originating the RNC.

3.4.2 The following meta-data should be included for each RNC. Where an image file contains

more than one discrete chart image, e.g. chart insets, in addition to the main panel of the

chart the meta-data should be included for each such discrete chart image.

3.4.2.1 Producing agency identifier specified using the producing agency codes listed in Annex A

to Appendix A of IHO publication S-57.

3.4.2.2 RNC number.

3.4.2.3 Chart identifier (e.g. chart number) if different from the RNC.

3.4.2.4 RNC edition date.

3.4.2.5 Chart edition date and/or chart edition number.

3.4.2.6 Last update or Notice to Mariners applied.

3.4.2.7 Previous updates or Notice to Mariners applied.

3.4.2.8 Chart scale.

3.4.2.9 Orientation of north (where appropriate for the chart projection in use).

3.4.2.10Projection and associated projection parameters.

3.4.2.11Horizontal datum.

3.4.2.12 Horizontal datum shift to WGS84 or PE-90 if the chart datum is not one of those two

datums.

3.4.2.13Vertical datums.

3.4.2.14Depth and height units.

3.4.2.15Pixel resolution of the image file as measured in pixels-per-millimeter or pixels-per-inch.

3.4.2.16A mechanism, such as parameters and an algorithm, to allow geographical positions to be converted

to RNC (pixel) coordinates and vice-versa.

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3.4.2.17Colour palettes for daytime, nighttime and dusk.

3.4.2.17.1 Colours used for daytime viewing should be those used on the paper versions of the same

charts.

3.4.2.17.2 Colours for dusk and nighttime should follow as closely as practicable the Colours and

Symbols Standards specified in IHO Special Publication S-52, Appendix 2.

3.4.2.18Sufficient information which will allow each note, diagram, item of marginalia or other chart subarea

of special interest to be found and displayed clearly, simply and quickly even though that

subarea may not be located on the portion of the chart currently being displayed.

3.4.2.19Sufficient information to allow any source diagram, which provides information about data quality,

to be displayed clearly, simply and quickly even though the source diagram may not be

located on the portion of the chart currently being displayed.

3.5 **Updates**

3.5.1 The following meta-data should be included for each RNC update. Where an RNC image

file contains one or more discrete chart image, e.g. chart insets, in addition to the main panel

of the chart, the meta-data should be sufficient to identify to which the update applies.

3.5.1.1 Producing agency identifier specified using the producing agency codes listed in Annex A

to Appendix A of the IHO publication S-57.

3.5.1.2 Update number.

3.5.1.3 Update date.

3.5.1.4 RNC to which the update applies.

3.5.1.5.1 Chart edition date to which the update applies.

3.5.1.6 Any changes to the meta-data of the RNC being updated (e.g. if a chart note changes, the

relevant changes in RNC meta-data need to be included in the update).

3.5.1.7 Sufficient information to allow the update to be applied automatically to the RNC and for

the update to be displayed.

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**ANNEX A**

**RCDS MODE OF OPERATION**

**(Appendix 7 to the IMO Performance Standards for ECDIS)**

*Notes: 1) The RCDS Mode of Operation, adopted by IMO resolution MSC.86 (70) in December*

*1998, is reproduced in this publication for convenience, with the kind permission of the*

*International Maritime Organization, London.*

*2) This should be read in conjunction with the IMO Performance Standards for ECDIS,*

*which have been reproduced in Annex B to Publication S-52, 5th Edition.*

Whenever in this appendix reference is made to provisions of the Annex related to ECDIS, ECDIS should

be substituted by RCDS, SENC by SRNC and ENC by RNC, as appropriate.

All paragraphs of the Annex related to ECDIS are indicated as to whether they apply to RCDS, do not

apply to RCDS, or are modified in order to apply to RCDS. These paragraphs are followed by additional

requirements for ECDIS equipment in the RCDS mode.

**1. INTRODUCTION**

1.1 Paragraph applies to RCDS.

1.2 When operating in the RCDS mode, ECDIS equipment should be used together with an

appropriate folio of up-to-date paper charts.

1.3 - 1.7 Paragraphs apply to RCDS.

1.8 RCDS should provide appropriate alarms or indications with respect to the information

displayed or malfunction of the equipment (see Table 1 of this Appendix).

**2. DEFINITIONS**

2.1 Raster Chart Display System (RCDS) means a navigation information system displaying

RNCs with positional information from navigation sensors to assist the mariner in route

planning and route monitoring, and if required, display additional navigation-related

information.

2.2 Raster Nautical Chart (RNC) means a facsimile of a paper chart originated by, or

distributed on the authority of, a government-authorized hydrographic office. RNC is

used in these standards to mean either a single chart or a collection of charts.

2.3 System Raster Nautical Chart Database (SRNC) means a database resulting from the

transformation of the RNC by the RCDS to include updates to the RNC by appropriate

means.

2.4-2.5 Paragraphs do not apply to RCDS.

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2.6 Paragraph applies to RCDS.

**3. DISPLAY OF SRNC INFORMATION**

3.1 Paragraph applies to RCDS.

3.2 SRNC information available for display during route planning and route monitoring

should be subdivided into two categories:

.1 the RCDS standard display consisting of RNC and its updates, including its scale,

the scale at which it is displayed, its horizontal datum, and its units of depths and

heights; and

.2 any other information such as mariner's notes.

3.3 Paragraph applies to RCDS.

3.4 When a RNC is displayed on the RCDS, it should provide an indication advising the

mariner if a more detailed (larger scale) RNC is available for the displayed area.

3.5 It should be easy to add to, or remove from, the RCDS display any information additional

to the RNC data, such as mariner's notes. It should not be possible to remove any

information from the RNC.

3.6 - 3.7 Paragraphs do not apply to RCDS.

3.8-3.10 Paragraphs apply to RCDS.

3.11 There should always be an indication if the ECDIS equipment is operating in the RCDS

mode.

**4. PROVISION AND UPDATING OF CHART INFORMATION**

4.1 The RNC used in RCDS should be the latest edition of that originated by, or distributed

on the authority of, a government authorized hydrographic office and conform to IHO

standards. RNCs not on WGS-84 or PE-90 should carry meta-data (i.e., additional data)

to allow geo-referenced positional data to be displayed in the correct relationship to

SRNC data.

4.2 The contents of the SRNC should be adequate and up-to-date for that part of the intended

voyage not covered by ENC.

4.3- 4.8 All paragraphs apply to RCDS.

**5. SCALE**

This section applies to RCDS.

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**6. DISPLAY OF OTHER NAVIGATIONAL INFORMATION**

6.1-6.3 All paragraphs apply to RCDS.

**7. DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA**

7.1 It should always be possible to display the SRNC in "chart-up" orientation. Other

orientations are permitted.

7.2-7.4 All paragraphs apply to RCDS.

**8. COLOURS AND SYMBOLS**

8.1 IHO recommended colours and symbols should be used to represent SRNC information.

8.2 Paragraph applies to RCDS.

8.3 Paragraph does not apply to RCDS.

8.4 Paragraph applies to RCDS.

**9. DISPLAY REQUIREMENTS**

9.1-9.2 Paragraphs apply to RCDS.

9.3 Paragraph does not apply to RCDS.

9.4 Paragraph applies to RCDS.

9.5 RCDS should be capable of displaying, simply and quickly, chart notes which are not

located on the portion of the chart currently being displayed.

**10. ROUTE PLANNING, MONITORING AND VOYAGE RECORDING**

10.1-10.2 Paragraphs apply to RCDS.

10.3 Paragraph does not apply to RCDS.

10.4 Route Planning

10.4.1-.10.4.3 Paragraphs apply to RCDS.

10.4.4-.10.4.5 Paragraphs do not apply to RCDS.

10.4.6 Paragraph applies to RCDS.

10.4.7 It should be possible for the mariner to enter points, lines and areas which activate an

automatic alarm. The display of these features should not degrade the SRNC information

and it should be clearly distinguishable from the SRNC information.

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10.5 Route monitoring

10.5.1 Paragraph applies to RCDS.

10.5.2 It should be possible to display a sea area that does not have the ship on the display (e.g.

for look ahead, route planning), while route monitoring. If this is done on the display

used for route monitoring, the automatic route monitoring functions in 10.4.6 and 10.4.7

should be continuous. It should be possible to return to the route monitoring display

covering own ship's position immediately by single operator action.

10.5.3-10.5.4 Paragraphs do not apply to RCDS.

10.5.5-10.5.8 Paragraphs apply to RCDS.

10.5.9 The RCDS should only accept data referenced to the WGS-84 or PE-90 geodetic datum.

RCDS should give an alarm if the positional data is not referenced to one of these datums.

10.5.10-10.5.13 Paragraphs apply to RCDS.

10.5.14 RCDS should allow the user to manually align the SRNC with positional data. This can

be necessary, for example, to compensate for local charting errors.

10.5.15 It should be possible to activate an automatic alarm when the ship crosses a point, line,

or is within the boundary of a mariner-entered feature within a specified time or distance.

10.6 Voyage recording

10.6.1-10.6.4 All paragraphs apply to RCDS.

**11. ACCURACY**

11.1-11.2 All paragraphs apply to RCDS.

**12. CONNECTIONS WITH OTHER EQUIPMENT**

12.1-12.2 All paragraphs apply to RCDS.

**13. PERFORMANCE TESTS, MALFUNCTION ALARMS AND INDICATIONS**

13.1-13.2 All paragraphs apply to RCDS.

**14. BACK-UP ARRANGEMENTS**

All paragraphs apply to RCDS.

**15. POWER SUPPLY**

15.1-15.2 All paragraphs apply to RCDS.

**Table 1**

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**ALARMS AND INDICATIONS IN THE RCDS MODE OF OPERATION**

Para Requirement Information

10.4.6, 10.5.5 Alarm Deviation from route

10.4.7, 10.5.15 Alarm Approach to critical point, line, area or mariner-entered

feature

10.5.7 Alarm Position system failure

10.5.8 Alarm Approach to critical point

10.5.9 Alarm Different geodetic datum

13.2 Alarm Malfunction of RCDS mode

3.11 Indication ECDIS operating in the raster mode

3.4, 5.1 Indication Information under-scale or overscale

5.2 Indication Larger scale RNC available for the area of the vessel

**ANNEX**

**ADDITIONAL GUIDANCE ON CHART DATUMS AND THE ACCURACY**

**OF POSITIONS ON CHARTS**

In some areas of the world there are charts that are based on old surveys for which there is

no determined geodetic datum or the datum is imprecise. Therefore in such areas, paper charts

(and thus raster navigational charts) are not compatible with GNSS navigation, and it will take

some time to resolve this problem. This makes it extremely difficult to accurately plot the ship.s

position obtained by the GNSS in relation to surrounding dangers on such charts. The difference

in the plotted position can often be significant and could lead to a casualty or unnecessary risk in

restricted waters.

Cross-checking of position using visual or radar fixing or ECDIS radar overlay can

provide for the immediate detection of datum inconsistencies in electronic charts, and

immediately alert the mariner on potential positional shifts required for particular charts. Some

ECDIS equipment exceeds the minimum requirements of the ECDIS Performance standards, by

providing such features as radar overlay.

In general, when navigating with GNSS, mariners should undertake all available

measures to check the position of the ship obtained by continuous position fixing systems and

plotted on any charts, such as using radar and visual observation methods.

**STAGE 1 – DEFINE THE HAZARD**

1.1 ECDIS has two official modes of operation: ECDIS mode when Electronic Navigational Chart (ENC) data is available and Raster Chart Display System (RCDS) mode when ENC data is unavailable. Hazards associated with the operation and use of ECDIS can be convenientlycategorised under these two modes.

**1.2 Defining the hazard when operating in ECDIS mode and ENC data is available.**

1.2.1 In this mode, hazards could be failure of all or part of the system; the most obvious would be loss of electrical power. However, other hazards (e.g. virus infection of software) need to be considered.

1.2.2 In defining the hazards in this mode, the following should be among those considered:

1. Hardware failure.
2. Software failure.
3. Power failure.
4. Failure to update charts correctly.
5. Input failure.
6. Virus infection.
7. Operator error through lack of training and/or familiarisation.

**1.3 Defining the hazards when operating in RCDS mode when ENC data is unavailable**

1.3.1 When operating ECDIS in the RCDS mode, due to the unavailability of ENC data, the full functionality of ECDIS is unachievable when operating ECDIS in the RCDS mode and therefore it can only be used together with an appropriate portfolio of paper charts. Therefore, by analysing this reduced functionality – specifically, each of the practical navigational limitations of the modeas specified in paragraph 3 of SN/Circ.207 (See Annex 14 of the MCA Special Publication) associated hazards can be defined. For example, 3.1 of SN/Circ.207 states “…RCDS is a chart-based system similar to a portfolio of paper charts”. This limitation therefore generates a potential hazard that the next chart may be unavailable. All RCDS limitations can be analysed in a similar fashion to establish potential hazards. An example of such an analysis is contained in Annex I.

**1.4 Failure Analysis**

1.4.1 A useful tool in defining the hazards is a Failure Mode and Effects Analysis (FMEA) or similarfailure analysis. An FMEA identifies the consequences if the primary element of ECDIS was to fail. This assists in defining the hazards associated with a particular ECDIS. System manufacturers will normally supply an FMEA on request.

**STAGE 2 – DETERMINE RISK**

2.1 The risk from the hazard may be determined by estimating:

* The potential severity of the hazard occurring
* The likelihood that the hazard will occur

2.2 These two components need to be established independently, then combined to establish the level of risk referred to as the risk factor.

**Risk Factor = Severity of Hazard X Likelihood of Hazard Occurring**

**2.3 Severity of hazard**

2.3.1 The severity of the hazard is the consequence of the hazard occurring. The consequence could result in damage to own or other vessel, damage to the environment, or to personnel. The extent or severity of a hazard occurring is dependent on the individual type of vessel, the area ofoperation and the competence of the operators.

2.3.2 For example, a deep laden tanker transiting the Dover Strait without an appropriate electronic chart would experience greater difficulties than a shallow draught high-speed ferry operating in the same area.

2.3.3 During the risk assessment it is important that the individual characteristics of the vessel and area of operation are considered.

2.3.4 The following list indicates issues among those that need to be considered:

1. Draught.
2. Dimensions of vessel.
3. Manoeuvring characteristics, including stopping distance.
4. Squat criteria.
5. Navigational constraints, ports, narrow channels, traffic separation schemes etc.
6. Weather.
7. Local assistance available.
8. Competence of ECDIS operators.
9. Reliance on ECDIS for navigation.
10. Nature of cargo.

2.3.5 The consequence of each hazard occurring needs to be carefully considered in relation to specific aspects of the vessel and the area of operation. Those completing the risk assessment can estimatethe level of severity of the consequence as MINOR, MAJOR or CRITICAL.

2.3.6 For each vessel it can then be established if the hazard would result in a minor, major or critical situation. In determining the severity of each identified hazard the following factors need to be among those considered.

**2.3.7 MINOR**

* Interruption of availability of navigation information.
* Reduced functionality of ECDIS in the RCDS mode.
* Increased workload of bridge team.

**2.3.8 MAJOR**

* Severe disruption to availability of navigation information.
* Loss of alarm functions.
* Unable to continuously monitor vessel’s position.
* Difficulty in maintaining planned track.

**2.3.9 CRITICAL**

* Loss of safety critical navigational information.
* ECDIS, in the RCDS mode, is totally unreliable.
* Unable to monitor vessel’s track.
* Unable to maintain planned track.

2.3.10 For example, a vessel finding that the “next RNC chart is unavailable” may be able to use a different scale chart of the area and maintain track with parallel indexing and clearing bearings techniques. In this case, the severity of the hazard “next RNC chart unavailable” could be deemedas “MAJOR”. However, if the same vessel did not have any other chart of the area, either electronic or paper, and had not adopted parallel indexing or visual means of navigation then the severity could be deemed as “CRITICAL”.

2.3.11 In the majority of cases the severity of the hazard varies according to the location of the vessel.The severity of “next RNC chart unavailable” would be less whilst a vessel was in open waters than if navigating in coastal or harbour approaches. For the risk assessment, the worst-case scenario should be used to assess the severity of the risk.

**2.4 Likelihood of hazard occurring**

2.4.1 In order to establish the likelihood of the hazard occurring, the adequacy of control measures already in place need to be considered. Such control measures include procedures or ECDIS specifications that reduce the likelihood of the risk occurring. These include the back-up arrangements in place and onboard operational procedures.

2.4.2 Each identified hazard needs to be separately considered.

2.4.3 Methods of controlling or reducing the particular hazard should then be considered to establish the probability or likelihood of the hazard occurring. Improving the procedures of ECDISoperation can often reduce the likelihood of the hazard occurring.

1. Navigational constraints, ports, narrow channels, traffic separation schemes etc.
2. Weather.
3. Local assistance available.
4. Competence of ECDIS operators.
5. Reliance on ECDIS for navigation.
6. Nature of cargo.

2.3.5 The consequence of each hazard occurring needs to be carefully considered in relation to specific aspects of the vessel and the area of operation. Those completing the risk assessment can estimatethe level of severity of the consequence as MINOR, MAJOR or CRITICAL.

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**2.4 Likelihood of hazard occurring**

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2.4.2 Each identified hazard needs to be separately considered.

2.4.3 Methods of controlling or reducing the particular hazard should then be considered to establish the probability or likelihood of the hazard occurring. Improving the procedures of ECDISoperation can often reduce the likelihood of the hazard occurring.

2.4.4 For example the likelihood of the hazard “next RNC chart unavailable” is reduced if the charts are loaded onto the ECDIS hard drive and charts are reviewed at the passage planning stage. A review of the onboard operating procedures may, therefore, be all that is required. Similarly, when considering the purchase of an ECDIS system, the built-in control features need to be considered.

2.4.5 The hazards identified in Table I and those in Annex II are intended to provide guidance in assessing the likelihood of a hazard occurring. The personnel completing the risk assessment should consider which section best describes their ECDIS specification and control procedures. The adjacent section identifies the likelihood of the hazard occurring. This identified likelihood is then used in the risk assessment process. It can be seen from this process that the greater thespecification of the ECDIS and the better the onboard control procedures, then the likelihood of the hazard occurring is, as a consequence, reduced.

**2.6 Risk Severity**

2.6.1 The level of risk forms the basis of deciding whether additional or improved controls are required and the timescale for action.

**2.6.2 TRIVIAL** No action required.

**2.6.3 TOLERABLE** No additional controls required. Monitoring required.

**2.6.4 MODERATE** Efforts made to reduce the risk within a defined period.

**2.6.5 SUBSTANTIAL** Urgent action to be taken, ECDIS can not to be relied upon.

**2.6.6 INTOLERABLE** ECDIS not to be used for navigation until risk has been reduced. Immediateaction required for reducing risk.

**STAGE 3 – DECIDE IF RISK IS TOLERABLE**

3.1 Having established the severity of a hazard and the likelihood of that hazard occurring, the riskassessment then requires the risk factor to be established. The risk factor establishes the level of risk and whether that risk is tolerable. For example a vessel may have established a hazard with a “MAJOR” severity yet, due to control procedures, the likelihood is “HIGHLY UNLIKELY”. As can be seen from Table II the risk, in this case, would be tolerable. However, if for the same hazard the likelihood was “LIKELY” then the risk would no longer be tolerable.

3.2 Using the example hazard of “Next RNC chart is unavailable”, as can be seen in Table III:

The severity has been determined as **MAJOR**

The likelihood has been determined as **HIGHLY UNLIKELY**

Using the table above the risk is determined as **TOLERABLE RISK** 9

**3.3 Risk factor related to paper chart reduction**

3.3.1 The exact number, scale and type of paper charts required should be identified during the risk assessment process and will vary depending on type of vessel and area of operation. The severity or likelihood of some hazards can be reduced by use of appropriate up-to-date paper charts as aback-up system.

3.3.2 Individual vessels must give consideration to own ship dimensions and take into account navigationally critical areas such as:

1. Harbour approaches.
2. Traffic separation schemes.
3. Narrow channels.
4. Anchorages.
5. Areas to be avoided (ATBA).
6. Areas of high traffic density.

3.3.3 The level of paper chart reduction relates to the established risk factor; the greater the risk factor, the less the paper chart reduction. A vessel with an intolerable risk factor will not achieve any reduction in paper charts, whilst a trivial risk factor could result in maximum paper chart reduction. When all the identified hazards have been assessed the greatest risk factor is taken asthe level of overall risk.

3.3.4 The appropriate portfolio of up-to-date paper charts will reduce the risk factor of ECDIS operating in RCDS mode, by reducing the severity of the hazard or by reducing the likelihood ofthe hazard occurring and should therefore be established during the risk assessment process.

3.3.5 However, the justification for any reduction in paper charts has to be fully supported by the outcome and results of the risk assessment.

**STAGE 4 – CONTROL PROCEDURES**

4.1 **Control Procedures**

4.1.1 Control is the adoption of procedures or equipment that eliminates or reduces the establishedrisk. In developing additional or improved control procedures the following points are among those that need to be considered:

1. Ensuring against over reliance of ECDIS by adopting traditional navigational methods such as parallel indexing and clearing bearings.
2. Developing procedures to maximise the efficiency of the ECDIS system.
3. Developing procedures to guard against human error whilst operating and supporting the ECDIS. This includes the correct procedure for chart corrections and data installation.
4. Considering the levels of training and familiarisation of navigating officers.
5. Ensuring adequate technical support is available.
6. Number and scale of paper charts constituting the appropriate portfolio.

4.2 **Emergency Procedures**

4.2.1 In the event of an ECDIS failure, suitable and sufficient procedures are required to ensure that safe navigation is not compromised. The risk assessment will identify the principal hazards andcontrol measures required. For each of these hazards, emergency procedures are required in the event of the hazard occurring. For example, if the ECDIS did not produce the next RNC chart, despite the control measures in place, then the navigating officer must initiate emergency procedures, such as switching to the approved back-up arrangements.

4.2.2 It is therefore important that each vessel considers the appropriate emergency procedures for its particular onboard system. In establishing these procedures the following should be taken into account:

1. Back up systems, including second ECDIS system or other method approved by the nationalmaritime administration. 10

1. The provision of appropriate paper charts.
2. Technical support available both onboard and ashore.
3. Changing to other sensor inputs such as second gyro compass or GPS system.

4.2.3 The developed control procedures should be incorporated into the onboard Safety ManagementSystem. Existing procedures will need to be reviewed to ensure that no conflicting instructions or policies occur.

**STAGE 5 – REVIEW THE RISK**

5.1 A successful risk assessment will ensure hazards have been identified and a system to manage the risks associated with those hazards has been successfully established onboard.

**5.2 Review adequacy of control plan**

5.2.1 The adequacy and practicality of the established procedures should be verified by asking:

1. Will the revised controls lead to tolerable risk levels?
2. Are new hazards created?
3. Are the control methods practical?
4. Are the control methods possible within navigational time constraints?
5. What do the ship’s officers think of the ECDIS control methods?

5.2.2 The value of the risk assessment depends on the appropriateness of the control and emergency measures developed. It is important to develop a policy of continual review to ensure theprocedures remain meaningful and practical.

**5.3 Record Keeping**

5.3.1 Having established the action plan and procedures the results should be recorded by a simplemethod, which allows for quick reference. Such an example is illustrated in Table III overleaf.

**5.4 Regular Review**

5.4.1 A further stage of the risk assessment is to adopt a procedure to ensure the risks are regularlyreviewed and that the control procedures are practical.

5.4.2 As can be seen from the pro-forma Risk Assessment Record (at Annex III) it is recommended that a future review date is set. This date should be recorded elsewhere so that review takes place as planned. If it does not, this would constitute a breach of the ISM Code.

5.4.3 It should be noted that the pro-forma allows for the determination of the ‘inherent risk’ before any control procedures have been initiated, followed by the subsequent determination of the ‘residual risk’ after various mitigating options have been implemented. 1

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**DIFFERENCES BETWEEN RCDS AND ECDIS**

1 The Maritime Safety Committee, at its seventieth session (7 to 11 December 1998), adopted

amendments to the performance standards for Electronic Chart Display and Information Systems (ECDIS)

to include the use of Raster Chart Display Systems (RCDS).

2 These amendments permit ECDIS equipment to operate in two modes:

.1 the ECDIS mode when ENC data is used; and

.2 the RCDS mode when ENC data is not available.

However, the RCDS mode does not have the full functionality of ECDIS, and can only be used together

with an appropriate portfolio of up-to-date paper charts.

3 The mariners' attention is therefore drawn to the following limitations of the RCDS mode:

.1 unlike ECDIS where there are no chart boundaries, RCDS is a chart-based system similar

to a portfolio of paper charts;

.2 Raster navigational chart (RNC) data, itself, will not trigger automatic alarms

(e.g. anti-grounding). However, some alarms can be generated by the RCDS from

user-inserted information. These can include:

- clearing lines

- ship safety contour lines

- isolated dangers

- danger areas

.3 horizontal datums and chart projections may differ between RNCs. Mariners should

understand how the chart horizontal datum relates to the datum of the position fixing

system. In some instances, this may appear as a shift in position. This difference may be

most noticeable at grid intersections and during route monitoring;

.4 chart features cannot be simplified or removed to suit a particular navigational

circumstance or task at hand. This could affect the superimposition of radar/ARPA;

.5 without selecting different scale charts, the look-ahead capability may be somewhat

limited. This may lead to some inconvenience when determining range and bearing or the

identity of distant objects;

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.6 orientation of the RCDS display to other than chart-up, may affect the readability of chart

text and symbols (e.g., course-up, route-up);

.7 it may not be possible to interrogate RNC features to gain additional information about

charted objects;

.8 it is not possible to display a ship's safety contour or safety depth and highlight it on the

display, unless these features are manually entered during route planning;

.9 depending on the source of the RNC, different colours may be used to show similar chart

information. There may also be differences in colours used during day and nighttime;

.10 an RNC should be displayed at the scale of the paper chart. Excessive zooming in or

zooming out can seriously degrade RCDS capability, for example, by degrading the

legibility of the chart image; and

.11 mariners should be aware that in confined waters, the accuracy of chart data (i.e., paper

charts, ENC or RNC data) may be less than that of the position-fixing system in use. This

may be the case when using differential GNSS. ECDIS provides an indication in the ENC

which allows a determination of the quality of the data.

3 Member Governments are requested to bring this information to the attention of the relevant

authorities and all seafarers for guidance and action, as appropriate.