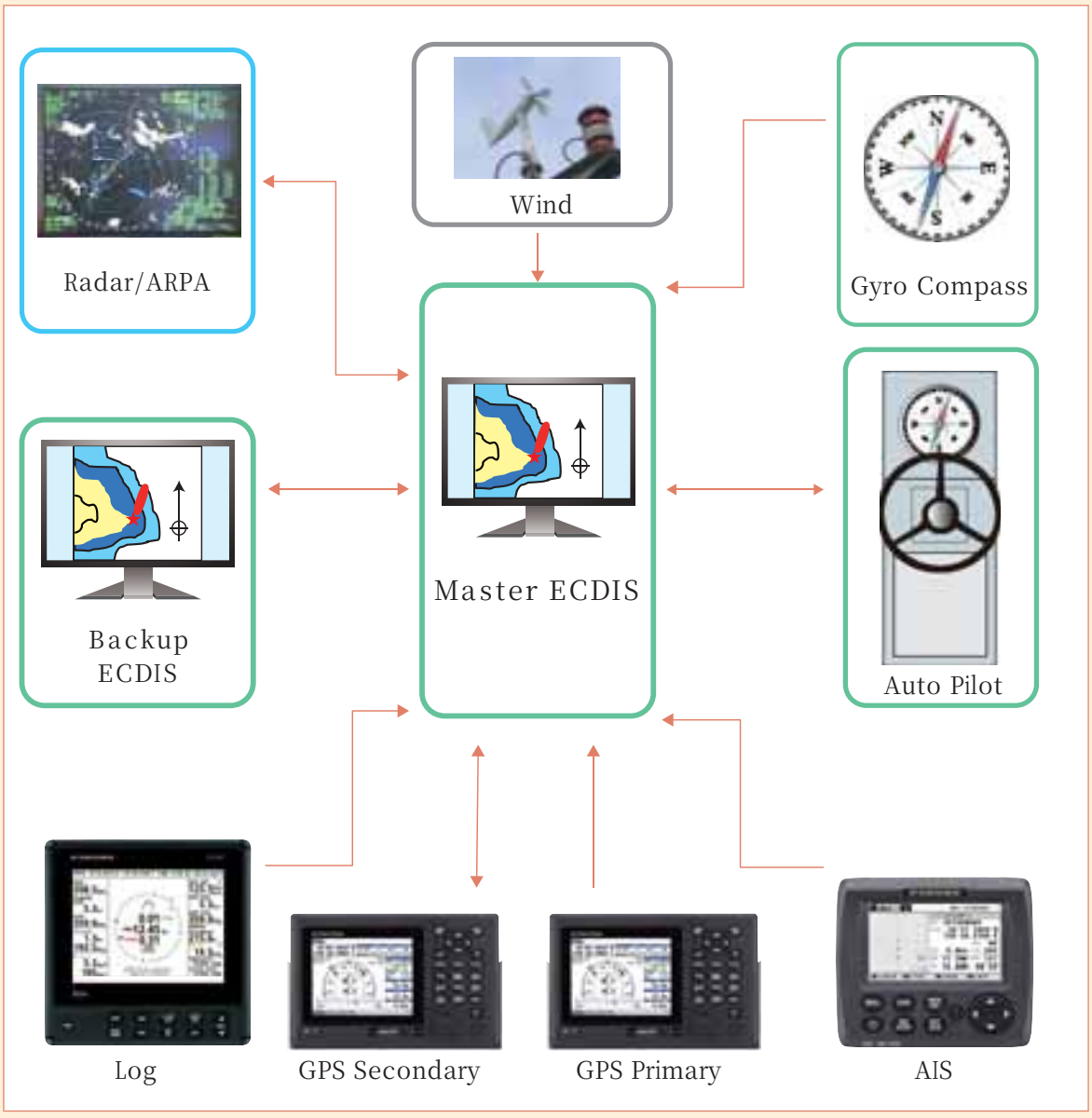
第五章

船長、航海士から見た電子海図の取り扱いについて

今まで各種船橋航海計器は独立した状態で操船者に情報提供を行っていました。ECDIS が導入されてきた現在、これら船橋の航海計器の情報が ECDIS に集中するようになりました。（図 15 ご参照）

図15　ECDIS と航海計器



航海計器写真 古野電気㈱ご提供

例えば、ARPA で表示された危険船情報について AIS で船名や動静を確認し、必要に応じて VHF で意図の確認を行った上で、コンパス示度を事前に確認してから Auto Pilot で本船の操舵を行い、LOG の表示器で速力の変化傾向の確認や、風向・風速計の表示で相対風向と風速を確認して問題があるかどうかも検討していました。また、避航操船前後では、Radar や GPS・物標方位などを使用して紙海図に船位を記入し、自船の操船に問題ないか、或いは、予定針路からの「ずれ」を確認していました。

古野電気（株）ご提供
Doppler Sonner DS-60

操船者は、このようにひとつひとつの航海計器から発せられる情報をそれぞれ確認し、頭の中で情報を整理して操船を行うといったスタイルから、ECDIS の画面を見ながら情報を可視情報として捉えて操船を行うといったものに変化していく可能性があります。
すなわち、ECDIS は船舶の自動運航に向けて船橋に設置される極度に情報集約された統合化航海システム（INS：Integrated Navigation System）のひとつとして見做すことができます。

古野電気（株）ご提供　次世代ブリッジシステム　Voyager

5－1　過度に依存することによるヒューマンエラー

ECDIS は有用な航海計器のひとつですが、使用方法を間違えると、衝突・座礁といった大事故に繋がる危険性をはらんでいます。現代のようにコンピューターが発達してくると、人はコンピューターに対して過剰な信頼を置く傾向があると言われています。しかしながら、コンピューターはプログラムを使用して入力されたデータに基づいて計算を行い、その結果を表示しているだけで、入力されるデータの正誤について判断はできません。したがって、誤ったデータを入力すれば、誤った情報に基づいた計算結果を出力し、それを表示します。

ここに、「人間の特性」（詳細は当組合ロスプリベンションガイド第 35 号 “ 安全について考える ” ご参照）を照らし合わせてみると、ECDIS に表示された情報の解釈を間違えることによるヒューマンエラーをより多く誘発することになり、ECDIS を使用したが故に危険な状況に陥ることになります。

人の行動特性から、ECDIS の過度な依存を行った場合の危険性がどのようなものか考えてみます。人の行

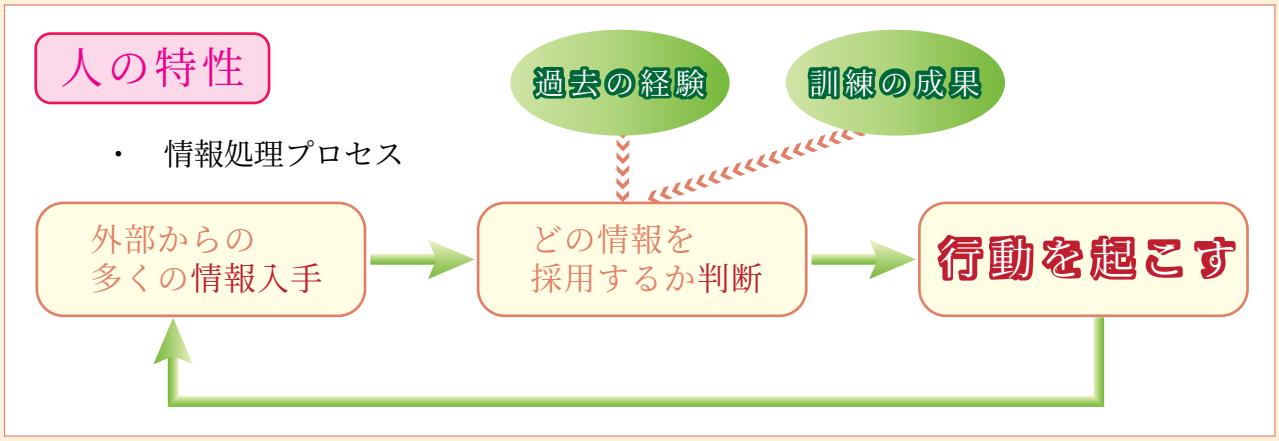
動特性（図 16）と、人の特性で行動する場合の情報処理プロセス（図 17）を下記に示します。

図16　人の行動特性

人の特性12ヶ条　：Web「安全の小窓」より

人間の特性			
①	間違えることがある	⑦	先を急ぐことがある
②	つい、うっかりすることがある	⑧	感情に走ることがある
③	忘れることがある	⑨	思い込みがある
④	気が付かないことがある	⑩	横着をすることがある
⑤	不注意の瞬間がある	⑪	パニックになることがある
⑥	ひとつしか見えない、考えられない	⑫	人が見ていないときに違反する

図17　人の特性：　行動する場合の情報処理プロセス



海難事故の原因はおよそ９割がヒューマンエラーと言われており、そのヒューマンエラーを誘発する 12 個の人の行動特性があります。また、人が行動を起こす場合の情報処理プロセスは図 17 に示す通り、外部からの多くの情報を入手し、その中から必要な情報を過去の経験や訓練の成果などと照らし合わせて選択し、そして行動を起こします。行動を取ると、新たな情報が出現するのでこれを繰り返しますが、12 個の行動特性のひとつ、ないし、いくつかが原因となって誤った情報を選択すると、ヒューマンエラーが発生して事故やトラブルに繋がります。

ECDIS が導入前と導入後では、当てはまる人の行動特性がどのように変化するのかを図 18 にまとめてみました。行動特性の③、⑥、⑧、⑨、⑩および⑪でリスクが高まっていると考えられます。

図18　人の特性の ECDIS 導入前後比較

人間の特性				
	特性	ECDIS 導入前	ECDIS 導入後	評価
①	間違えることがある	○	○	不変
②	つい、うっかりすることがある	○	○	不変
③	忘れることがある	△	○	リスク増加
④	気が付かないことがある	○	○	不変
⑤	不注意の瞬間がある	○	○	不変
⑥	ひとつしか見えない、考えられない	△	○	リスク増加
⑦	先を急ぐことがある	○	○	不変
⑧	感情に走ることがある	△	○	リスク増加
⑨	思い込みがある	△	○	リスク増加
⑩	横着をすることがある	△	○	リスク増加
⑪	パニックになることがある	△	○	リスク増加
⑫	人が見ていないときに違反する	○	○	不変

（番号は上記行動特性の番号）

③　忘れることがある

紙海図の場合であれば、船位確認に合わせてコンパスやログなどの状態なども無意識の内に確認していることがありますが、電子海図の場合で画面上での確認になると重要な情報を見落とすことがあります。

⑥　ひとつしか見えない、考えられない

電子海図の画面に集中するあまり、本来の最も重要である見張りが疎かになることがあると思われます。

⑧　感情に走ることがある

電子海図画面に集中するあまり、当直者どうしの会話が少なくなりがちです。また、こうしたことから作業を阻害されると、お互いに感情的になることもあります。

⑨　思い込みがある

例えば海図に記載されている水深などは誤差を含んでいることは十分承知しているのですが、デジタル映像で表示された情報を過信する傾向があります。

⑩　横着をすることがある

針路・速力などの情報がデジタル化されていることで、その数値をそのまま信頼し、電子海図導入前であれば、各航海計器が発信する情報を頭の中で整理して判断するといった行動であったものが、そのままデジタルデータを信じ込む傾向があります。

⑪　パニックになることがある

ECDIS が何等かの原因で表示が消えた場合、パニックに陥る可能性があります。その結果、復旧作業に集中するあまり、本来の航海当直の主たる業務である「見張り」が疎かになる傾向があります。

公益社団法人 日本航海学会の第 131 回講演会（2014 年 10 月 31 日 , 11 月 1 日）、日本航海学会講演予稿集 2 巻 2 号 2014 年 9 月 30 日「「ECDIS」による航行支援の効果と安全性（西井典子（富山高等専門学校）他）」において、次のようなことが報告されています。同予稿集からの抜粋を以下に転記します。（公益社団法人　日本航海学会転載許可：2016 年 9 月 26 日　航学第 28-85 号）

「ECDIS」への過信と若年層傾向：
日本航海学会講演予稿集 2 巻 2 号 2014 年 9 月 30 日「ECDIS」による航行支援の効果と安全性

船舶職員養成施設では、「ECDIS」に関する能力基準を満たすために、平成 26 年度より「ECDIS」に関する講習が開始された。「ECDIS」が搭載された校内練習船での当直や操船シミュレータによる航海当直体制での避航操船演習を実施しているが、最近の学生に、これまでと異なる傾向が見られるようになってきた。GPS、AIS、レーダー等の情報の外部入力の追加によって、「ECDIS」をカーナビやパソコン、スマートフォンと同じ感覚で認識し操作している様子が見受けられるのである。カーナビには、GPS、3D ジャイロ、車速、VICS 等の情報から正確な現在位置が表示され、目的地までの距離と到着予想時刻も正確に算出表示できるなど、「ECDIS」と内容が変わらない。ゆえに、「ECDIS」のみで航行できると考えている学生も少なくないようである。この傾向は、若年航海士にもみられ、ECDIS、AIS 等の機器に頼りすぎている傾向にある。目視での見張りを疎かにしているとの声が多くのベテラン航海士から聞かれる。

筆者自身も電子海図を搭載した船舶に船長として数多く乗船してきましたが、ECDIS が設置されていると、若手航海士は双眼鏡で他船の動静を確認することが少ないだけではなく、どちらかいうと ECDIS の前に立ったままで、前方の目視確認を行わず、時には避航操船を開始するといった姿勢が多く見られたことを経験しました。

5－2　ECDIS の目的

IMO MSC.232（82）の Scope of ECDIS の中で、下記目的が定義されています。

The primary function of the ECDIS is to contribute to safe navigation
（仮訳：ECDIS の最も重要な機能は、安全な航海に貢献することである。）

紙海図の使用目的を今一度振り返ると、航海計画（いわゆる、コースラインを引いて航海計画を立案する）と、実際にその海域を航行する場合に船位確認を行う、或いは、避航作業を行う場合に安全に避航できるか判断するといったことなどに使用しており、これは主として座礁防止機能と最短・最適航路の選択にあると考えられます。すなわち、ECDIS 使用においても、紙海図使用以上の付加価値を船長と航海士は電子海図に求めるべきではないと考えます。

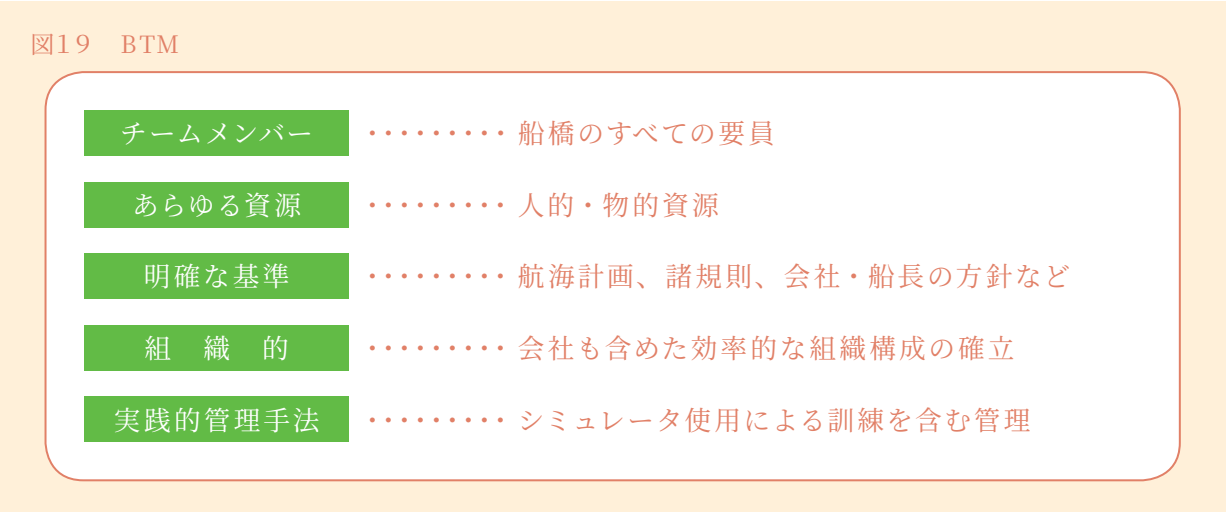
こうして考えると、ECDIS は、海上衝突予防法第 5 条（見張り）および第 7 条（衝突のおそれ）において、「その時の状況に適したすべての手段」の一つとして考えられ、航行支援にも貢献する機器かも知れませんが、見張りの重要性を考えた場合、「衝突防止の見張り作業」として採用する情報について、表示されているデータを過度に信頼し、目視確認とレーダー情報の確認、相手船の方位変化といった衝突防止の基本動作を疎かにしてはならないと考えます。

しかしながら、ECDIS 搭載船に筆者が船長として乗船した際、前述したように、特に若手航海士が双眼鏡も持たず、電子海図の前から一歩も動くことなく、また、目視による見張りも行わない、或は、避航操船を行う場合でもコンパス方位を確認しないまま操舵手に指示を与えるといった傾向が多く見られました。そして、ECDIS の操作に没頭するあまり、操舵手の報告にも注意を払わず、ECDIS の画面にのめり込んでいることが散見されました。
このような事態は、既に BTM（Bridge Team Management）が崩壊している状態にあり、船舶の安全運航を脅かすことになります。

5－3　BTM とECDIS

BTM とは、船舶が航海中に船橋のチームメンバーが船橋のあらゆる資源を利用し、明確な基準のもとに、組織的に安全運航を達成させるための実践的な管理手法です。（図 19 ご参照）

図19　BTM



すなわち、船橋に立つ者全員をひとつのチームとし、個人の過失が事故に直結しないようにチームワークを有効に発揮するマネジメント手法であると考えられます。
船橋チームが第一に果たすべき責任と役割は、いうまでもなく安全運航の達成です。この責任と役割を全うするためには、自分以外の人も含む資源の利用です。

2015 年 7 月に発行した当組合ロスプリベンションガイド第 35 号「安全について考える」の中で、BRM と BTM の違いについて以下のような説明をしていますが、実際には「明確に BRM と BTM の違いを定義付けたものはない」のが実情であることを補足説明し、このような考え方もあるということに留めたいと考えます。

BRM

人を含む資源（リソース）の有効活用を促進することを目的とし、特に、人間資源の有効活用において組織されたチームのリーダーが実施すべき管理機能を対象としている。

BTM

安全運航の達成は、リーダーのみの努力だけでは不十分であり、チームに所属する全ての人間による活動を高める必要がある。リーダーを含めチームに所属する全員の機能の向上が不可欠であり、これを達成するためのマネージメント。

すなわち、BRM も BTM も目的とすることは同じで、あえて、それぞれの目的を分ける必要はないものと考えます。

BRM（Bridge Resource Management）は、航空業界の CRM（Cockpit Resource Management）の概念から生まれ、CRM 訓練は、1977 年に起きた「テネリフェの悲劇」と呼ばれている航空機事故を契機に、1980 年以降各国の航空会社で実施されるようになりました。一方、BTM 訓練は 1977 年より英国 Warsash Maritime Centre（当時）で実施されており、その起源は CRM とほぼ同時と言われています。現在、BTM と BRM は関係規則や各国の訓練施設によりその呼び名が異なり、その定義、あるいは違いに関し議論するのは意味のあるものでないとされています。

（実践航海術：　㈱日本海洋科学著　関根　博監修　成山堂書店より）

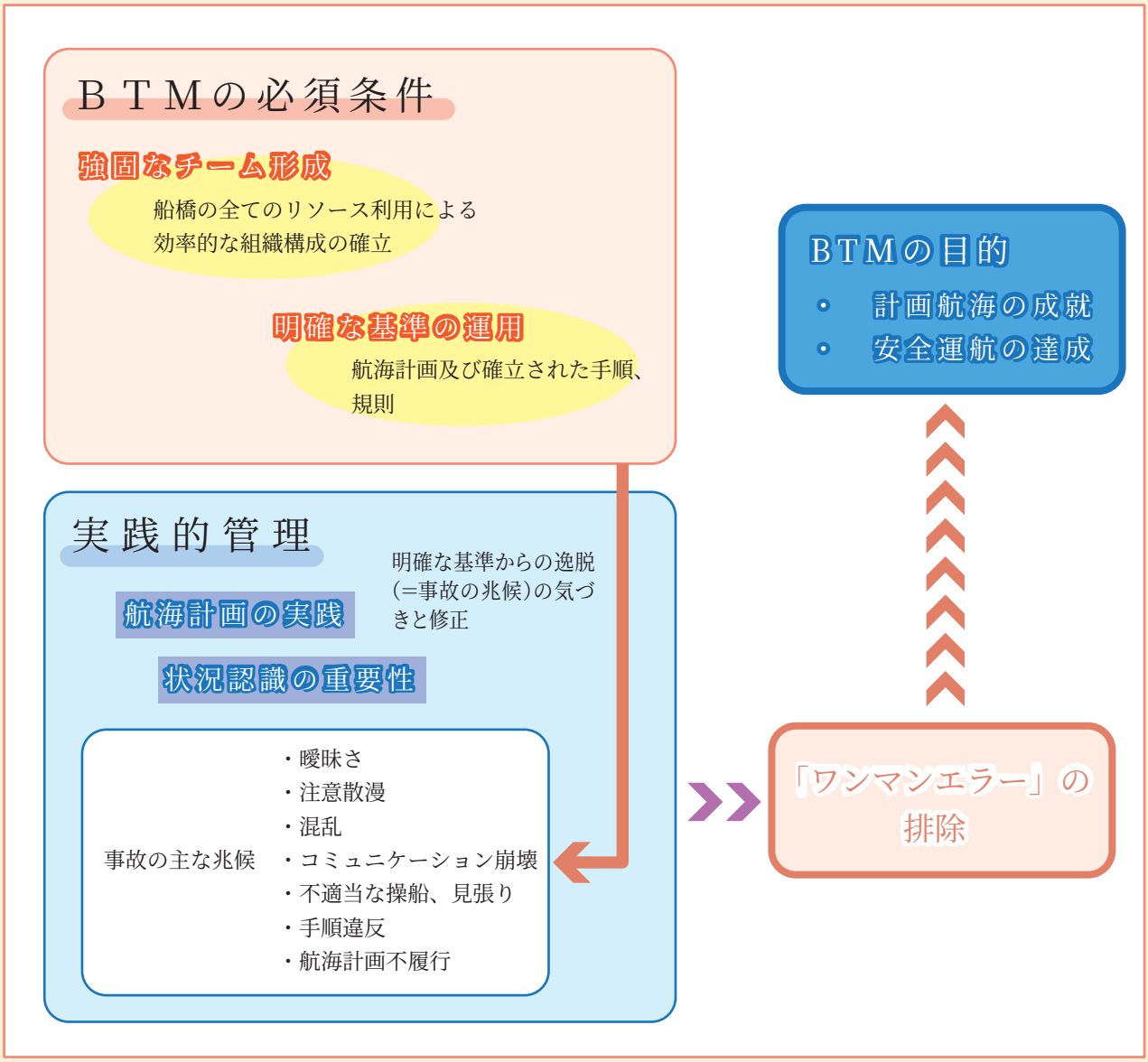
BTM の最大の目的は、ワンマンエラーを排除することで、船橋チームのすべてのメンバーが本船の安全運航に意識を向け続けなければなりません。　例え、水先人が乗船したとしても、水先人も支援メンバーとして見做し、船橋において重要な役割を担い、船橋メンバーの乗組員が水先人の補佐をすることは、船橋チームの責務であると考えることが必要です。

日本船長協会発行 DVD「BRM の効果的な実戦に向けて」より

水先人乗船中の事故をみますと、その殆どは操船を水先人に任せてしまい、船長以下の船橋メンバーは、見張りも行わずに、ただ水先人の指示に従って行動をしているだけのことが殆どです。この時点で水先人を含めた BTM が崩壊していると判断できます。

一人の人間のミスが危険な状況を生み出さず、時期を逸することなくミスに気付き、修正できるように結束して職務に辺り、お互いをサポートすることが求められます。
ECDIS が導入されたからといって、この基本的な安全運航体制が変わるものではありません。このような BTM の概念を図 20 に示します。

図２０　ＢＴＭの概念



更に、リソースどうしの関係を示すと図 21（M-SHELL モデル）になりますが、コミュニケーションは「人」対「人」だけに限らず、「人」対、「ソフトウェア（Ｓ：いわゆる文書)」・「ハードウェア（Ｈ：機器)」・「環境（Ｅ：外部情報)」ともコミュニケーションを取り、それぞれのリソースどうしでコミュニケーションが成り立っているならば、各リソースはぴったりとくっついて良好な関係を築いているので、エラーの入る隙間（ギャップ）は生じません。

しかし、一旦、コミュニケーションが崩れると、各リソースは容易に離れていき、お互いの間に隙間が生じます。ギャップを生じさせるということは、ここにヒューマンエラーが安易に入り込む可能性を大きくし、結果として事故（トラブル）が発生するといった結果を招くことになります。

この M-SHELL モデルの観点から考えるならば、ECDIS 情報は H（ハードウェア：Hardware）が発信する情報のひとつで、船橋に存在するリソースのひとつでしかありません。

図21　M-SHELL モデル

ところが、ECDIS 情報を過剰に信頼するあまり、或いは、ECDIS とだけ会話するあまり、自分以外の人（L）やソフトウェア（S）、ECDIS 以外の機器（Hardware）が発する情報とコミュニケーションが満足に行われなくなってしまうと、それぞれのリソースとの会話が阻害されることになり、過信による ECDIS とのコミュニケーションギャップだけでなく、他のリソースとのコミュニケーションギャップも生じさせてしまいます。図 22（ECDIS 導入前）と図 23（ECDIS 導入後）に船橋当直のイメージ図を示します。

また、コンピューターである ECDIS に誤った情報が入力されていることに気が付くことなく過度にデータを信頼している状態に陥っている場合では、ECDIS というリソースとのコミュニケーションの状態が、最初からギャップを生じさせており、会話そのものが成り立たないことになります。
例えば、水深と喫水に関する情報に関する警報設定を誤って入力しており、それに気が付かないまま警報も鳴らないので、そのまま通航不能な浅瀬に座礁した事故が報告されています。

各リソースとコミュニケーションを良くし、ギャップを生じさせず、エラーが入り込むことのないようにするといった BTM の基本を忘れてはなりません。

図22　ＥＣＤＩＳ導入前

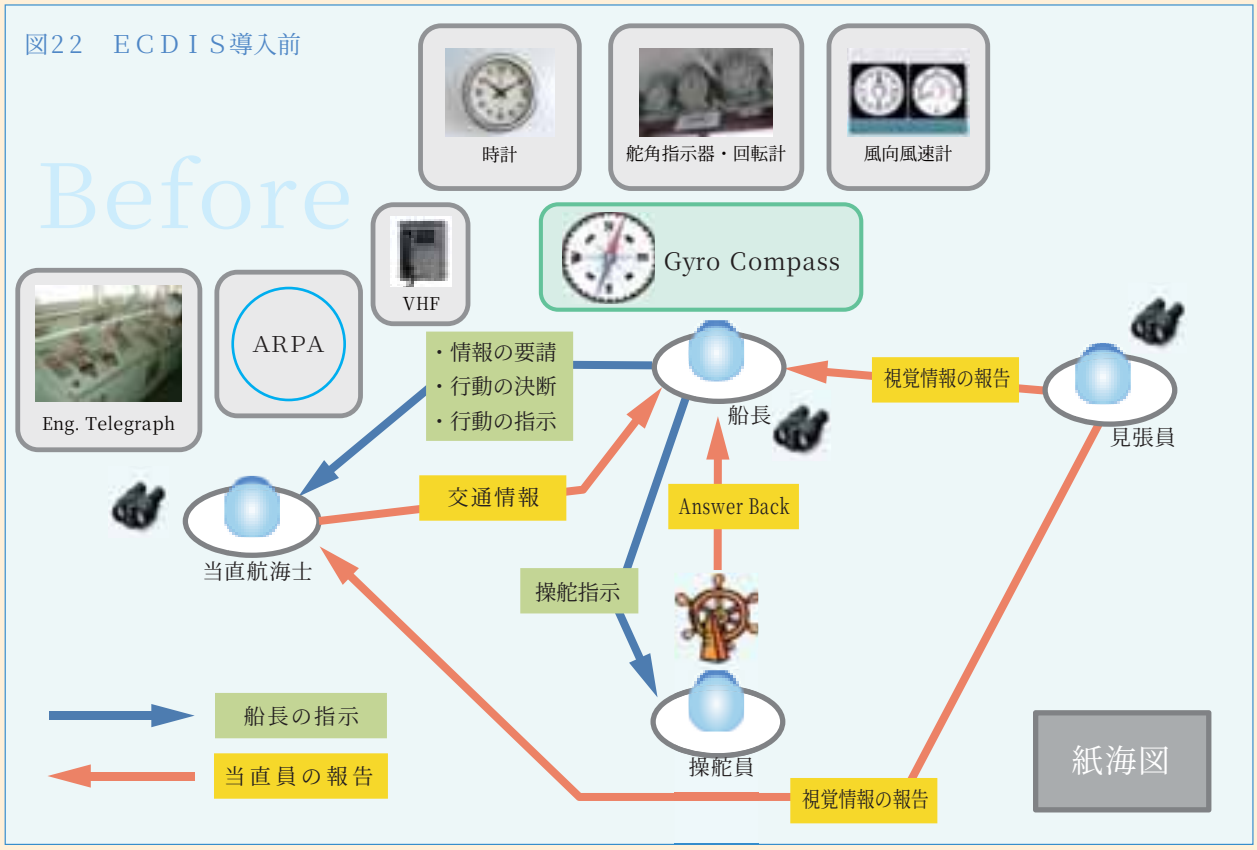
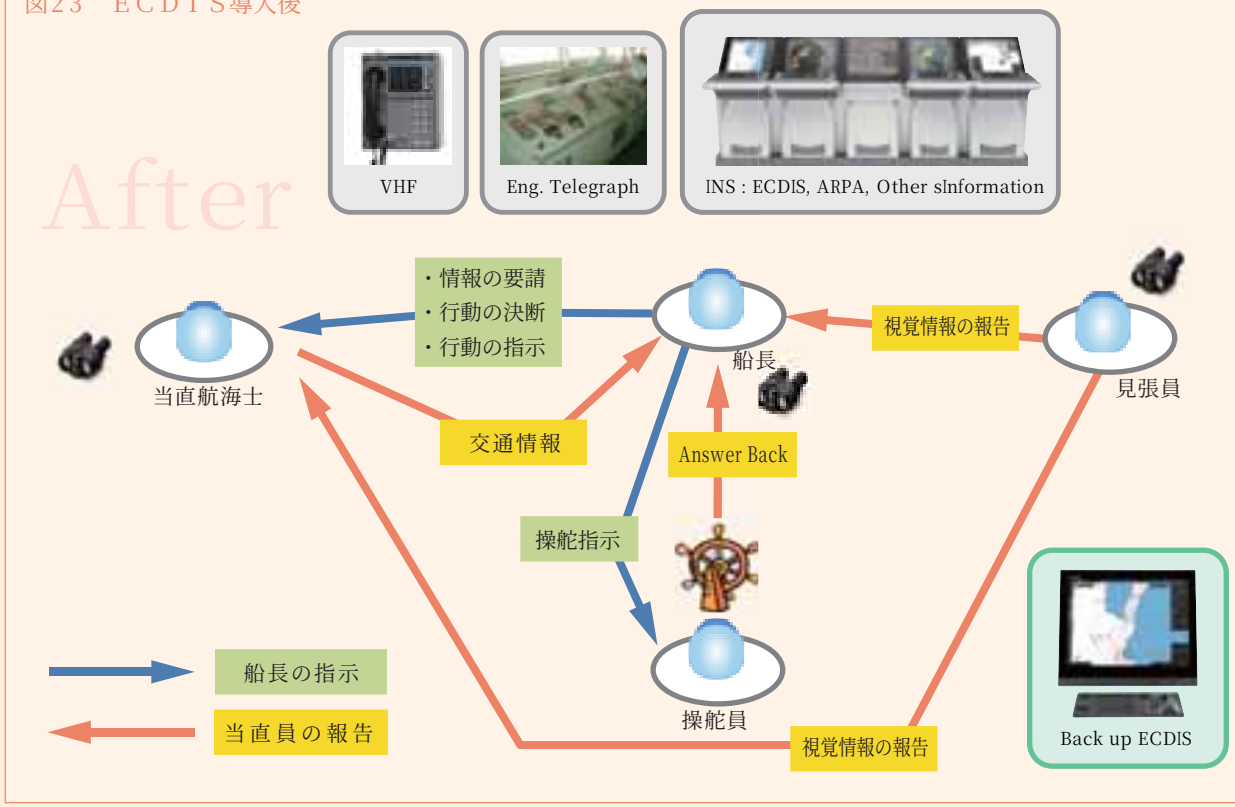


図23　ＥＣＤＩＳ導入後



5－4　ECDIS 情報管理

現在搭載されている ECDIS の多くは Windows XP を基本ソフトとして使用しています。既に、Windows XP はウィルス対策のサポートが終了しており、コンピュータウィルスに対する脆弱性があると思われます。
例えば、航路計画などのデータを個人の USB などに保存することで、作業の軽減を図ることがありますが、ECDIS をコンピュータウィルスの脅威にさらさないためには、乗組員が所持している USB からデータを Upload しないといった SMS や安全管理規程の規定を策定することも必要です。

おわりに

ECDIS は今までの紙海図を使用していた航海当直のスタイルを大きく変えるもので、航海当直の革命といえるかも知れません。
しかしながら、ECDIS の構成を十分理解しないまま、ECDIS に表示される情報の判定や ECDIS の取扱いを一歩間違えると、そこにはトラブルが潜んでいることを理解しておく必要があります。

どうしても便利な機器で頼りがちになること、表示される情報がデジタル表示なので、表示された数値を鵜呑みにし、他航海計器の情報と比較する、あるいは、継続的に監視するということが疎かになって誤った判断を行うことが他の航海計器のトラブルと比較して安全運航を大きく脅かすことがあること、また、パソコンなどで経験しているようにフリーズや突然のシャットダウンといった突発的な電子機器固有のトラブルが発生する可能性があることを忘れてはなりません。

5－4 ECDIS の情報管理で説明したように、コンピュータウィルスを取り込んでしまうようなことを行うのも「人」です。したがって、こうしたコンピュータウィルスの侵入を防ぐ手段も構築しなくてはなりません。
さらに、航海当直の基本は見張りであることを今一度思い出し、ECDIS の取扱いには十分な知識を持つことと、注意を払うことが必要です。

添付資料

No.	資　料　名
①	ANNEX24　Resolution MSC.232(82)「Performance standards for Electric Chart Display and Information System(ECDIS)：IMO 決議 MSC.232(82) 電子海図 https://www.nauticalcharts.noaa.gov/staff/docs/IMO_MSC.232(82)ECDIS.pdf
②	Ref. T2-OSSHE/2.7.1 SN.1/Circ.255(24 July 2006)「ADDITIONAL GUIDANCE ON CHART DATUMS AND THE ACCURACY OF POSITIONS ON CHARTS」：IMO 航行安全小委員会回章　海図の測地系と海図上の位置の精度に関する指針 http://www.ecdis.it/Normativa/IMO%20SN.1_Circ%20255.pdf
③	Ref. T2-OSS/2.7 SN.1/Circ.207/Rev.1(22 October 2007)「DIFFERENCES BETWEEN RCDS AND ECDIS」：IMO 航行安全小委員会回章　ラスター海図表示システム (RCDS) と電子海図情報表示システム (ECDIS) の違い https://www.iho.int/mtg_docs/industry/ECDIS_workshop_12-3/SN.1-Circ.207-Rev.1%20-%20Secretariat.pdf
④	Ref. T2-OSS/2.7.1 SN.1/Circ.276(10 December 2008)「TRANSITIONING FROM PAPER CHART TO ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS) NAVIGATION」：「紙海図による航海」から「ECDIS による航海」への移行に関する指針 https://www.iho.int/mtg_docs/International_Organizations/IMO/ECDIS-ENCDocuments/English/SN_Circ276.pdf
⑤	STCW 条約　Table A-Ⅱ/2 抜粋

参考文献

本ロスプリガイド発行にあたり下記の多数の参考文献や資料をご提供いただきました。ご提供いただきましたこと、ここに深謝申し上げます。

・財団法人　日本水路協会発行
S-66 電子海図とその船舶搭載要件の実際　日本語暫定仮訳版（2010 年 2 月発行）
http://www.jha.or.jp/jp/jha/purchase/pdf/guide_00.pdf
註：　上記には、添付資料②～④の仮和訳も掲載されています。

・公益社団法人　日本航海学会
第 131 回講演会（2014 年 10 月 31 日 , 11 月 1 日）日本航海学会講演予稿集 2 巻 2 号 2014 年 9 月 30 日 「ECDIS」による航行支援の効果と安全性
http://members.j-navigation.org/jkouen/doc/k00202/k00202023.pdf

・株式会社　日本海洋科学
ECDIS 研修資料

・成山堂書店「実践航海術」 株式会社　日本海洋科学著　関根 博 船長 監修

・海文堂「ECDIS 訓練テキスト」 海技大学校 ECDIS 研究会　編

・古野電気株式会社　：各航海計器写真のご提供

・(一社) 日本船長協会　：　写真ご提供

添付資料 ①

ANNEX24 Resolution MSC.232 (82)「Performance standards for Electric Chart Display and Information System (ECDIS)：IMO 決議 MSC.232 (82) 電子海図

ANNEX 24

RESOLUTION MSC.232(82)

(adopted on 5 December 2006)

ADOPTION OF THE REVISED PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO resolution A.886(21), by which the Assembly resolved that the function of adopting performance standards and technical specifications, as well as amendments thereto shall be performed by the Maritime Safety Committee and/or the Marine Environment Protection Committee, as appropriate, on behalf of the Organization,

RECALLING ALSO regulations V/19 and V/27 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, which requires all ships to carry adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage,

NOTING that the up-to-date charts required by SOLAS regulations V/19 and V/27 can be provided and displayed electronically on board ships by electronic chart display and information systems (ECDIS), and that the other nautical publications required by regulation V/27 may also be so provided and displayed,

RECOGNIZING the need to improve the previously adopted, by resolution A.817(19), as amended, performance standards for ECDIS in order to ensure the operational reliability of such equipment and taking into account the technological progress and experience gained,

HAVING CONSIDERED the recommendation made by the Sub-Committee on Safety of Navigation, at its fifty-second session,

1. ADOPTS the Revised performance standards for electronic chart display and information systems (ECDIS), set out in the Annex to the present resolution;

2. RECOMMENDS Governments ensure that ECDIS equipment:

(a) if installed on or after 1 January 2009, conform to performance standards not inferior to those specified in the Annex to the present resolution; and

(b) if installed on or after 1 January 1996 but before 1 January 2009, conform to performance standards not inferior to those specified in the Annex to resolution A.817(19), as amended by resolutions MSC.64(67) and MSC.86(70).

ANNEX

REVISED PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)

1 SCOPE OF ECDIS

1.1 The primary function of the ECDIS is to contribute to safe navigation.

1.2 ECDIS with adequate back-up arrangements may be accepted as complying with the up-to-date charts required by regulations V/19 and V/27 of the 1974 SOLAS Convention, as amended.

1.3 ECDIS should be capable of displaying all chart information necessary for safe and efficient navigation originated by, and distributed on the authority of, government authorized hydrographic offices.

1.4 ECDIS should facilitate simple and reliable updating of the electronic navigational chart.

1.5 ECDIS should reduce the navigational workload compared to using the paper chart. It should enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It should be capable of continuously plotting the ship's position.

1.6 The ECDIS display may also be used for the display of radar, radar tracked target information, AIS and other appropriate data layers to assist in route monitoring.

1.7 ECDIS should have at least the same reliability and availability of presentation as the paper chart published by government authorized hydrographic offices.

1.8 ECDIS should provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment (see appendix 5).

1.9 When the relevant chart information is not available in the appropriate form (see section 4), some ECDIS equipment may operate in the Raster Chart Display System (RCDS) mode as defined in appendix 7. RCDS mode of operation should conform to performance standards not inferior to those set out in appendix 7.

2 APPLICATION OF THESE STANDARDS

2.1 These performance standards should apply to all ECDIS equipment carried on all ships, as follows:

- dedicated standalone workstation.
- a multifunction workstation as part of an INS.

2.2 These performance standards apply to ECDIS mode of operation, ECDIS in RCDS mode of operation as specified in appendix 7 and ECDIS backup arrangements as specified in appendix 6.

2.3 Requirements for structure and format of the chart data, encryption of chart data as well as the presentation of chart data are within the scope of relevant IHO standards, including those listed in appendix 1.

2.4 In addition to the general requirements set out in resolution A.694(17)*, the presentation requirements set out in resolution MSC.191(79), ECDIS equipment should meet the requirements of these standards and follow the relevant guidelines on ergonomic principles adopted by the Organization[1].

3 DEFINITIONS

For the purpose of these performance standards:

3.1 *Electronic Chart Display and Information System (ECDIS)* means a navigation information system which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulations V/19 and V/27 of the 1974 SOLAS Convention, as amended, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and if required display additional navigation-related information.

3.2 *Electronic Navigational Chart (ENC)* means the database, standardized as to content, structure and format, issued for use with ECDIS by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution, and conform to IHO standards. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.

3.3 *System Electronic Navigational Chart (SENC)* means a database, in the manufacturer's internal ECDIS format, resulting from the lossless transformation of the entire ENC contents and its updates. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is equivalent to an up-to-date paper chart. The SENC may also contain information added by the mariner and information from other sources.

3.4 *Standard Display* is the display mode intended to be used as a minimum during route planning and route monitoring. The chart content is listed in appendix 2.

3.5 *Display Base* means the chart content as listed in appendix 2 and which cannot be removed from the display. It is not intended to be sufficient for safe navigation.

3.6 Further information on ECDIS definitions may be found in IHO Hydrographic Dictionary Special Publication S-32 (see appendix 1).

* Refer to Publication IEC 60945.
1 MSC/Circ.982.

MODULE A - DATABASE

4 PROVISION AND UPDATING OF CHART INFORMATION

4.1 The chart information to be used in ECDIS should be the latest edition, as corrected by official updates, of that issued by or on the authority of a Government, government-authorized Hydrographic Office or other relevant government institution, and conform to IHO standards[2].

4.2 The contents of the SENC should be adequate and up-to-date for the intended voyage to comply with regulation V/27 of the 1974 SOLAS Convention as amended.

4.3 It should not be possible to alter the contents of the ENC or SENC information transformed from the ENC.

4.4 Updates should be stored separately from the ENC.

4.5 ECDIS should be capable of accepting official updates to the ENC data provided in conformity with IHO standards. These updates should be automatically applied to the SENC. By whatever means updates are received, the implementation procedure should not interfere with the display in use.

4.6 ECDIS should also be capable of accepting updates to the ENC data entered manually with simple means for verification prior to the final acceptance of the data. They should be distinguishable on the display from ENC information and its official updates and not affect display legibility.

4.7 ECDIS should keep and display on demand a record of updates including time of application to the SENC. This record should include updates for each ENC until it is superseded by a new edition.

4.8 ECDIS should allow the mariner to display updates in order to review their contents and to ascertain that they have been included in the SENC.

4.9 ECDIS should be capable of accepting both non-encrypted ENCs and ENCs encrypted in accordance with the IHO Data Protection Scheme[3]

2 IHO Special Publication S-52 and S-57 (see appendix 1).
3 IHO Special Publication S-63 (see appendix 1).

MODULE B – OPERATIONAL AND FUNCTIONAL REQUIREMENTS

5 DISPLAY OF SENC INFORMATION

5.1 ECDIS should be capable of displaying all SENC information. An ECDIS should be capable of accepting and converting an ENC and its updates into a SENC. The ECDIS may also be capable of accepting a SENC resulting from conversion of ENC to SENC ashore, in accordance with IHO TR 3.11[4]. This method of ENC supply is known as SENC delivery.

5.2 SENC information available for display during route planning and route monitoring should be subdivided into the following three categories, Display Base, Standard Display and All Other Information (see appendix 2).

5.3 ECDIS should present the Standard Display at any time by a single operator action.

5.4 When an ECDIS is switched on following a switch off or power failure, it should return to the most recent manually selected settings for display.

5.5 It should be easy to add or remove information from the ECDIS display. It should not be possible to remove information contained in the Display Base.

5.6 For any operator identified geographical position (e.g. by cursor picking) ECDIS should display on demand the information about the chart objects associated with such a position.

5.7 It should be possible to change the display scale by appropriate steps e.g. by means of either chart scale values or ranges in nautical miles.

5.8 It should be possible for the mariner to select a safety contour from the depth contours provided by the SENC. ECDIS should emphasize the safety contour over other contours on the display, however:

.1 if the mariner does not specify a safety contour, this should default to 30m. If the safety contour specified by the mariner or the default 30 m contour is not in the displayed SENC, the safety contour shown should default to the next deeper contour;

.2 if the safety contour in use becomes unavailable due to a change in source data, the safety contour should default to the next deeper contour; and

.3 in each of the above cases, an indication should be provided.

5.9 It should be possible for the mariner to select a safety depth. ECDIS should emphasize soundings equal to or less than the safety depth whenever spot soundings are selected for display.

5.10 The ENC and all updates to it should be displayed without any degradation of their information content.

[4] IHO Miscellaneous Publication M-3.

5.11 ECDIS should provide a means to ensure that the ENC and all updates to it have been correctly loaded into the SENC.

5.12 The ENC data and updates to it should be clearly distinguishable from other displayed information, including those listed in appendix 3.

6 SCALE

6.1 ECDIS should provide an indication if:

.1 the information is displayed at a larger scale than that contained in the ENC; or

.2 own ship's position is covered by an ENC at a larger scale than that provided by the display.

7 DISPLAY OF OTHER NAVIGATIONAL INFORMATION

7.1 Radar information and/or AIS information may be transferred from systems compliant with the relevant standards of the Organization. Other navigational information may be added to the ECDIS display. However, it should not degrade the displayed SENC information and it should be clearly distinguishable from the SENC information.

7.2 It should be possible to remove the radar information, AIS information and other navigational information by single operator action.

7.3 ECDIS and added navigational information should use a common reference system. If this is not the case, an indication should be provided.

7.4 Radar

7.4.1 Transferred radar information may contain a radar image and/or tracked target information.

7.4.2 If the radar image is added to the ECDIS display, the chart and the radar image should match in scale, projection and in orientation.

7.4.3 The radar image and the position from the position sensor should both be adjusted automatically for antenna offset from the conning position.

8 DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

8.1 It should always be possible to display the SENC information in a "north-up" orientation. Other orientations are permitted. When such orientations are displayed, the orientation should be altered in steps large enough to avoid unstable display of the chart information.

8.2 ECDIS should provide for true motion mode. Other modes are permitted.

8.3 When true motion mode is in use, reset and generation of the chart display of the neighbouring area should take place automatically at own ship's distance from the edge of the display as determined by the mariner.

8.4 It should be possible to manually change the displayed chart area and the position of own ship relative to the edge of the display.

8.5 If the area covered by the ECDIS display includes waters for which no ENC at a scale appropriate for navigation is available, the areas representing those waters should carry an indication (see appendix 5) to the mariner to refer to the paper chart or to the RCDS mode of operation (see appendix 7).

9 COLOURS AND SYMBOLS

9.1 IHO recommended colours and symbols should be used to represent SENC information[5].

9.2 The colours and symbols other than those mentioned in 9.1 should comply with the applicable requirements contained in the IMO standards for navigational symbols[6].

9.3 SENC information displayed at the scale specified in the ENC should use the specified size of symbols, figures and letters[5].

9.4 ECDIS should allow the mariner to select whether own ship is displayed in true scale or as a symbol.

10 DISPLAY REQUIREMENTS

10.1 ECDIS should be capable of displaying information for:

.1 route planning and supplementary navigation tasks; and

.2 route monitoring.

10.2 The effective size of the chart presentation for route monitoring should be at least 270 mm x 270 mm.

10.3 The display should be capable of meeting colour and resolution recommendations of IHO[5].

10.4 The method of presentation should ensure that the displayed information is clearly visible to more than one observer in the conditions of light normally experienced on the bridge of the ship by day and by night.

10.5 If information categories included in the Standard Display (See appendix 2) are removed to customize the display, this should be permanently indicated. Identification of categories which are removed from the Standard Display should be shown on demand.

[5] Special Publication S-52, Appendix 2 (see appendix 1)

11 ROUTE PLANNING, MONITORING AND VOYAGE RECORDING

11.1 It should be possible to carry out route planning and route monitoring in a simple and reliable manner.

11.2 The largest scale data available in the SENC for the area given should always be used by the ECDIS for all alarms or indications of crossing the ship's safety contour and of entering a prohibited area, and for alarms and indications according to appendix 5.

11.3 Route Planning

11.3.1 It should be possible to carry out route planning including both straight and curved segments.

11.3.2 It should be possible to adjust a planned route alphanumerically and graphically including:

.1 adding waypoints to a route;

.2 deleting waypoints from a route; and

.3 changing the position of a waypoint.

11.3.3 It should be possible to plan one or more alternative routes in addition to the selected route. The selected route should be clearly distinguishable from the other routes.

11.3.4 An indication is required if the mariner plans a route across an own ship's safety contour.

11.3.5 An indication should be given if the mariner plans a route closer than a user-specified distance from the boundary of a prohibited area or a geographic area for which special conditions exist (see appendix 4).An indication should also be given if the mariner plans a route closer than a user-specified distance from a point object, such as a fixed or floating aid to navigation or isolated danger.

11.3.6 It should be possible for the mariner to specify a cross track limit of deviation from the planned route at which an automatic off-track alarm should be activated.

11.4 Route monitoring

11.4.1 For route monitoring the selected route and own ship's position should appear whenever the display covers that area.

11.4.2 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 (e.g. updating ship's position, and providing alarms and indications) should be continuous. It should be possible to return to the route monitoring display covering own ship's position immediately by single operator action.

11.4.3 ECDIS should give an alarm if, within a specified time set by the mariner, own ship will cross the safety contour.

11.4.4 ECDIS should give an alarm or indication, as selected by the mariner, if, within a specified time set by the mariner, own ship will cross the boundary of a prohibited area or of a geographical area for which special conditions exist (see appendix 4).

11.4.5 An alarm should be given when the specified cross track limit for deviation from the planned route is exceeded.

11.4.6 An indication should be given to the mariner if, continuing on its present course and speed, over a specified time or distance set by the mariner, own ship will pass closer than a user-specified distance from a danger (e.g. obstruction, wreck, rock) that is shallower than the mariner's safety contour or an aid to navigation.

11.4.7 The ship's position should be derived from a continuous positioning system of an accuracy consistent with the requirements of safe navigation. Whenever possible, a second independent positioning source, preferably of a different type, should be provided. In such cases ECDIS should be capable of identifying discrepancies between the two sources.

11.4.8 ECDIS should provide an alarm when the input from position, heading or speed sources is lost. ECDIS should also repeat, but only as an indication, any alarm or indication passed to it from position, heading or speed sources.

11.4.9 An alarm should be given by ECDIS when the ship reaches a specified time or distance, set by the mariner, in advance of a critical point on the planned route.

11.4.10 The positioning system and the SENC should be on the same geodetic datum. ECDIS should give an alarm if this is not the case.

11.4.11 It should be possible to display alternative routes in addition to the selected route. The selected route should be clearly distinguishable from the other routes. During the voyage, it should be possible for the mariner to modify the selected sailing route or change to an alternative route.

11.4.12 It should be possible to display:

.1 time-labels along a ship's track manually on demand and automatically at intervals selected between 1 and 120 minutes; and

.2 an adequate number of: points, free movable electronic bearing lines, variable and fixed range markers and other symbols required for navigation purposes and specified in appendix 3.

11.4.13 It should be possible to enter the geographical co-ordinates of any position and then display that position on demand. Also, it should be possible to select any point (features, symbol or position) on the display and read its geographical co-ordinates on demand.

11.4.14 It should be possible to adjust the displayed geographic position of the ship manually. This manual adjustment should be noted alpha-numerically on the screen, maintained until altered by the mariner and automatically recorded.

11.4.15.1 ECDIS should provide the capability to enter and plot manually obtained bearing and distance lines of position (LOP), and calculate the resulting position of own ship. It should be possible to use the resulting position as an origin for dead-reckoning.

11.4.15.2 ECDIS should indicate discrepancies between the positions obtained by continuous positioning systems and positions obtained by manual observations.

11.5 Voyage recording

11.5.1 ECDIS should store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours. The following data should be recorded at one minute intervals:

.1 to ensure a record of own ship's past track: time, position, heading, and speed; and

.2 to ensure a record of official data used: ENC source, edition, date, cell and update history.

11.5.2 In addition, ECDIS should record the complete track for the entire voyage, with time marks at intervals not exceeding 4 hours.

11.5.3 It should not be possible to manipulate or change the recorded information.

11.5.4 ECDIS should have a capability to preserve the record of the previous 12 hours and of the voyage track.

12 CALCULATIONS AND ACCURACY

12.1 The accuracy of all calculations performed by ECDIS should be independent of the characteristics of the output device and should be consistent with the SENC accuracy.

12.2 Bearings and distances drawn on the display or those measured between features already drawn on the display should have accuracy no less than that afforded by the resolution of the display.

12.3 The system should be capable of performing and presenting the results of at least the following calculations:

.1 true distance and azimuth between two geographical positions;

.2 geographic position from known position and distance/azimuth; and

.3 geodetic calculations such as spheroidal distance, rhumb line, and great circle.

13 PERFORMANCE TESTS, MALFUNCTIONS ALARMS AND INDICATIONS

13.1 ECDIS should be provided with means for either automatically or manually carrying out on-board tests of major functions. In case of a failure, the test should display information to indicate which module is at fault.

13.2 ECDIS should provide a suitable alarm or indication of system malfunction.

14 BACK-UP ARRANGEMENTS

Adequate back-up arrangements should be provided to ensure safe navigation in case of an ECDIS failure; see appendix 6.

.1 Facilities enabling a safe take-over of the ECDIS functions should be provided in order to ensure that an ECDIS failure does not develop into a critical situation.

.2 A back-up arrangement should provide means of safe navigation for the remaining part of a voyage in the case of an ECDIS failure.

MODULE C – INTERFACING AND INTEGRATION

15 CONNECTIONS WITH OTHER EQUIPMENT [7]

15.1 ECDIS should not degrade the performance of any equipment providing sensor inputs. Nor should the connection of optional equipment degrade the performance of ECDIS below this standard.

15.2 ECDIS should be connected to the ship's position fixing system, to the gyro compass and to the speed and distance measuring device. For ships not fitted with a gyro compass, ECDIS should be connected to a marine transmitting heading device.

15.3 ECDIS may provide a means to supply SENC information to external equipment.

16 POWER SUPPLY

16.1 It should be possible to operate ECDIS and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention, as amended.

16.2 Changing from one source of power supply to another or any interruption of the supply for a period of up to 45 seconds should not require the equipment to be manually re-initialized.

7 Publication IEC 61162.

Appendix 1

REFERENCE DOCUMENTS

The following international organizations have developed technical standards and specifications, as listed below, for use in conjunction with this standard. The latest edition of these documents should be obtained from the organization concerned:

INTERNATIONAL MARITIME ORGANIZATION (IMO)

Address: International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom

Phone: +44 207 735 76 11
Fax: +44 207 587 32 10
E-mail:info@imo.org
Web: http://www.imo.org

Publications

IMO resolution MSC.191(79) on Performance Standards for the presentation of navigation related information on shipborne navigational displays

IMO resolution A.694(17) on Recommendations on general requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids

SN.Circ/207 (1999) on Differences between RCDS and ECDIS

IMO SN/Circ.243 (2004) on Guidelines for the Presentation of Navigation-related Symbols, Terms and Abbreviations

IMO MSC/Circ.982 (2000) on Guidelines on ergonomic criteria for bridge equipment and layout

INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO)

Address: Directing Committee
International Hydrographic Bureau
BP 445
MC 98011 Monaco Cedex
Principality of Monaco

Phone: +377 93 10 81 00
Fax: +377 93 10 81 40
E-mail:info@ihb.mc
Web: http://www.iho.shom.fr

Publications

Special Publication No. S-52, Specifications for Chart Content and Display Aspects of ECDIS

Special Publication No. S-52 appendix 1, Guidance on Updating the Electronic Navigational Chart

Special Publication No. S-52 appendix 2, Colour and Symbol Specifications for ECDIS

Special Publication No. S-32, Hydrographic Dictionary

Special Publication No. S-57, IHO Transfer Standard for Digital Hydrographic Data

Special Publication No. S-61, IHO Product specification for Raster Navigational Charts (RNC)

Special Publication No. S-63, IHO Data Protection Scheme

Miscellaneous Publication No. M-3, *Resolutions of the IHO*

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

Address: IEC Central Office
3 rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Phone: +41 22 734 01 50
Fax: +41 22 733 38 43

Publications

IEC Publication 61174, Electronic Chart Display and Information Systems (ECDIS) - Operational and Performance Requirements, Method of Testing and Required Test Results.

IEC Publication 60945, General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System and Marine Navigational Equipment.

IEC Publication 61162, *Digital Interfaces - Navigation and Radiocommunication Equipment On board Ship*.

[IEC Publication 62288, Maritime Navigation and Radiocommunication Equipment and Systems – Presentation of navigation related information – General requirements, methods of test and required test results.]

Appendix 2

SENC INFORMATION AVAILABLE FOR DISPLAY DURING ROUTE PLANNING AND ROUTE MONITORING

1 Display base to be permanently shown on the ECDIS display, consisting of:

.1 coastline (high water);
.2 own ship's safety contour;
.3 isolated underwater dangers of depths less than the safety contour which lie within the safe waters defined by the safety contour;
.4 isolated dangers which lie within the safe water defined by the safety contour, such as fixed structures, overhead wires, etc.;
.5 scale, range and north arrow;
.6 units of depth and height; and
.7 display mode.

2 Standard display consisting of:

.1 display base
.2 drying line
.3 buoys, beacons, other aids to navigation and fixed structures
.4 boundaries of fairways, channels, etc.
.5 visual and radar conspicuous features
.6 prohibited and restricted areas
.7 chart scale boundaries
.8 indication of cautionary notes
.9 ships' routeing systems and ferry routes
.10 archipelagic sea lanes.

3 All other information, to be displayed individually on demand, for example:

.1 spot soundings
.2 submarine cables and pipelines
.3 details of all isolated dangers
.4 details of aids to navigation
.5 contents of cautionary notes
.6 ENC edition date
.7 most recent chart update number
.8 magnetic variation
.9 graticule
.10 place names.

Appendix 3

NAVIGATIONAL ELEMENTS AND PARAMETERS

1 Own ship.

.1 Past track with time marks for primary track.
.2 Past track with time marks for secondary track.

2 Vector for course and speed made good.

3 Variable range marker and/or electronic bearing line.

4 Cursor.

5 Event.

.1 Dead reckoning position and time (DR).
.2 Estimated position and time (EP).

6 Fix and time.

7 Position line and time.

8 Transferred position line and time.

.1 Predicted tidal stream or current vector with effective time and strength.
.2 Measured tidal stream or current vector with effective time and strength.

9 Danger highlight.

10 Clearing line.

11 Planned course and speed to make good.

12 Waypoint.

13 Distance to run.

14 Planned position with date and time.

15 Visual limits of lights arc to show rising/dipping range.

16 Position and time of "wheel over".

Appendix 4

AREAS FOR WHICH SPECIAL CONDITIONS EXIST

The following are the areas which ECDIS should detect and provide an alarm or indication under sections 11.3.5 and 11.4.4:

Traffic separation zone
Inshore traffic zone
Restricted area
Caution area
Offshore production area
Areas to be avoided
User defined areas to be avoided
Military practise area
Seaplane landing area
Submarine transit lane
Anchorage area
Marine farm/aquaculture
PSSA (Particularly Sensitive Sea Area)

Appendix 5

ALARMS AND INDICATORS

Section	Requirements	Information
11.4.3	Alarm	Crossing safety contour
11.4.4	Alarm or Indication	Area with special conditions
11.4.5	Alarm	Deviation from route
11.4.8	Alarm	Positioning system failure
11.4.9	Alarm	Approach to critical point
11.4.10	Alarm	Different geodetic datum
13.2	Alarm or Indication	Malfunction of ECDIS
5.8.3	Indication	Default safety contour
6.1.1	Indication	Information overscale
6.1.2	Indication	Larger scale ENC available
7.3	Indication	Different reference system
8.5	Indication	No ENC available
10.5	Indication	Customized display
11.3 4	Indication	Route planning across safety contour
11.3.5	Indication	Route planning across specified area
11.4.6	Indication	Crossing a danger in route monitoring mode
13.1	Indication	System test failure

In this Performance Standard the definitions of Indicators and Alarms provided in the IMO resolution A.830(19) "Code on Alarms and Indicators, 1995" apply.

Alarm: An alarm or alarm system which announces by audible means, or audible and visual means, a condition requiring attention.

Indicator: Visual indication giving information about the condition of a system or equipment.

Appendix 6

BACK-UP REQUIREMENTS

1 INTRODUCTION

As prescribed in section 14 of this performance standard, adequate independent back-up arrangements should be provided to ensure safe navigation in case of ECDIS failure. Such arrangements include:

.1 facilities enabling a safe take-over of the ECDIS functions in order to ensure that an ECDIS failure does not result in a critical situation;

.2 a means to provide for safe navigation for the remaining part of the voyage in case of ECDIS failure.

2 PURPOSE

The purpose of an ECDIS back-up system is to ensure that safe navigation is not compromised in the event of ECDIS failure. This should include a timely transfer to the back-up system during critical navigation situations. The back-up system shall allow the vessel to be navigated safely until the termination of the voyage.

3 FUNCTIONAL REQUIREMENTS

3.1 Required functions and their availability

3.1.1 Presentation of chart information

The back-up system should display in graphical (chart) form the relevant information of the hydrographic and geographic environment which are necessary for safe navigation.

3.1.2 Route planning

The back-up system should be capable of performing the route planning functions, including:

.1 taking over of the route plan originally performed on the ECDIS;

.2 adjusting a planned route manually or by transfer from a route planning device.

3.1.3 Route monitoring

The back-up system should enable a take-over of the route monitoring originally performed by the ECDIS, and provide at least the following functions:

.1 plotting own ship's position automatically, or manually on a chart;

.2 taking courses, distances and bearings from the chart;

.3 displaying the planned route;

.4 displaying time labels along ship's track;

.5 plotting an adequate number of points, bearing lines, range markers, etc., on the chart.

3.1.4 Display information

If the back-up is an electronic device, it should be capable of displaying at least the information equivalent to the standard display as defined in this performance standard.

3.1.5 Provision of chart information

.1 The chart information to be used in the backup arrangement should be the latest edition, as corrected by official updates, of that issued by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution, and conform to IHO standards.

.2 It should not be possible to alter the contents of the electronic chart information.

.3 The chart or chart data edition and issuing date should be indicated.

3.1.6 Updating

The information displayed by the ECDIS back-up arrangements should be up-to-date for the entire voyage.

3.1.7 Scale

If an electronic device is used, it should provide an indication:

.1 if the information is displayed at a larger scale than that contained in the database; and

.2 if own ship's position is covered by a chart at a larger scale than that provided by the system.

3.1.8 If radar and other navigational information are added to an electronic back-up display, all the corresponding requirements for radar information and other navigation information of this performance standard should be met.

3.1.9 If an electronic device is used, the display mode and generation of the neighbouring area should be in accordance with section 8 of this performance standard.

3.1.10 Voyage recording

The back-up arrangements should be able to keep a record of the ship's actual track, including positions and corresponding times.

3.2 Reliability and accuracy

3.2.1 Reliability

The back-up arrangements should provide reliable operation under prevailing environmental and normal operating conditions.

3.2.2 Accuracy

Accuracy should be in accordance with section 12 of this performance standard.

3.3 Malfunctions, warnings, alarms and indications

If an electronic device is used, it should provide a suitable alarm or indication of system malfunction.

4 OPERATIONAL REQUIREMENTS

4.1 Ergonomics

If an electronic device is used, it should be designed in accordance with the ergonomic principles of ECDIS.

4.2 Presentation of information

If an electronic device is used:

.1 Colours and symbols should be in accordance with the colours and symbols requirements of ECDIS.

.2 The effective size of the chart presentation should be not less than 250 mm x 250 mm or 250 mm diameter.

5 POWER SUPPLY

If an electronic device is used:

.1 the back-up power supply should be separate from the ECDIS; and

.2 conform to the requirements in this ECDIS performance standard.

6 CONNECTIONS WITH OTHER EQUIPMENT

6.1 If an electronic device is used, it should:

.1 be connected to systems providing continuous position-fixing capability; and

.2 not degrade the performance of any equipment providing sensor input.

6.2 If radar with selected parts of the ENC chart information overlay is used as an element of the back-up, the radar should comply with resolution MSC.192(79).

Appendix 7

RCDS MODE OF OPERATION

Whenever in this appendix reference is made to any provisions of the annex related to ECDIS, the term ECDIS should be substituted by the term RCDS, SENC by SRNC and ENC by RNC, as appropriate.

This appendix refers to each paragraph of the performance standards for ECDIS (i.e. the Annex to which this part is appendix 7) and specifies which paragraphs of the Annex either:

.1 apply to RCDS; or

.2 do not apply to RCDS; or

.3 are modified or replaced as shown in order to apply to RCDS.

Any additional requirements applicable to RCDS are also described.

1 SCOPE

1.1 Paragraph applies to RCDS.

1.2 When operating in RCDS-mode, an appropriate portfolio of up-to-date paper charts (APC) should be carried on board and be readily available to the mariner.

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).

1.9 Refers to Appendix 7 and applies to RCDS.

2 APPLICATION OF THESE STANDARDS

2.1 – 2.4 Paragraphs apply to RCDS.

3 DEFINITIONS

3.1 *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.

3.2 *Raster Navigational 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.

3.3 *System Raster Navigational 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.

3.4-3.5 Paragraphs do not apply to RCDS.

3.6 Paragraph applies to RCDS.

3.7 Appropriate Portfolio of up to date paper Charts (APC) means a suite of paper charts of a scale to show sufficient detail of topography, depths, navigational hazards, aids to navigation, charted routes, and routeing measures to provide the mariner with information on the overall navigational environment. The APC should provide adequate look-ahead capability. Coastal States will provide details of the charts which meet the requirement of this portfolio, and these details are included in a worldwide database maintained by the IHO. Consideration should be given to the details contained in this database when determining the content of the APC.

MODULE A - DATABASE

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 It should not be possible to alter the contents of the RNC.

4.4 – 4.8 All paragraphs apply to RCDS.

4.9 Paragraph does not apply to RCDS

MODULE B – OPERATIONAL AND FUNCTIONAL REQUIREMENTS

5 DISPLAY OF SRNC INFORMATION

5.1 RCDS should be capable of displaying all SRNC information.

5.2 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.

5.3- 5.4 Paragraphs apply to RCDS.

5.5 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.

5.6 – 5.9 Paragraphs do not apply to RCDS.

5.10 – 5.12 Paragraphs apply to RCDS.

5.13 There should always be an indication if the ECDIS equipment is operating in RCDS mode.

6 SCALE

This section applies to RCDS.

7 DISPLAY OF OTHER NAVIGATIONAL INFORMATION

7.1 - 7.4 All paragraphs apply to RCDS.

8 DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

8.1 It should always be possible to display the SRNC in "chart-up" orientation. Other orientations are permitted.

8.2 - 8.4 All paragraphs apply to RCDS.

8.5 Paragraph refers to RCDS mode of operation.

9 COLOURS AND SYMBOLS

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

9.2 Paragraph applies to RCDS.

9.3 Paragraph does not apply to RCDS.

9.4 Paragraph applies to RCDS.

10 DISPLAY REQUIREMENTS

10.1-10.2 Paragraphs apply to RCDS.

10.3 Paragraph does not apply to RCDS.

10.4 Paragraph applies to RCDS.

10.5 Paragraph does not apply to RCDS.

10.6 RCDS should be capable of displaying, simply and quickly, chart notes which are not located on the portion of the chart currently being displayed.

11 ROUTE PLANNING, MONITORING AND VOYAGE RECORDING

11.1 Paragraphs apply to RCDS.

11.2 Paragraph does not apply to RCDS.

11.3 Route Planning

11.3.1-11.3.3 Paragraphs apply to RCDS.

11.3.4-11.3.5 Paragraphs do not apply to RCDS.

11.3.6 Paragraph applies to RCDS.

11.3.7 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.

11.4 Route monitoring

11.4.1 Paragraph applies to RCDS.

11.4.2 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.

11.4.3-11.4.4 Paragraphs do not apply to RCDS.

11.4.5 Paragraph apply to RCDS.

11.4.6 Paragraphs do not apply to RCDS.

11.4.7-11.4.9 Paragraphs apply to RCDS.

11.4.10 The RCDS should only accept positional 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 datum. If the displayed RNC cannot be referenced to the WGS 84 or PE-90 datum then a continuous indication should be provided.

11.4.11-11.4.15 Paragraphs apply to RCDS.

11.4.16 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.

11.4.17 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.

11.5 Voyage recording

11.5.1-11.5.4 All paragraphs apply to RCDS.

12 CALCULATIONS AND ACCURACY

12.1-12.3 All paragraphs apply to RCDS.

12.4 RCDS should be capable of performing transformations between a local datum and WGS 84 Datum.

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.

MODULE C – INTERFACING AND INTEGRATION

15 CONNECTIONS WITH OTHER EQUIPMENT

15.1-15.3 All paragraphs apply to RCDS.

16 POWER SUPPLY

16.1-16.2 All paragraphs apply to RCDS.

Table 1

ALARMS AND INDICATORS IN THE RCDS MODE OF OPERATION

Paragraph	Requirement	Information
11.4.5	Alarm	Deviation from route
11.4.17	Alarm	Approach to mariner entered feature, e.g. area, line
11.4.8	Alarm	Position system failure
11.4.9	Alarm	Approach to critical point
11.4.10	Alarm or indication	Different geodetic datum
13.2	Alarm or indication	Malfunction of RCDS mode
5.13	Indication	ECDIS operating in the raster mode
6.1	Indication	Larger scale information available, or overscale
6.1.2	Indication	Larger scale RNC available for the area of the vessel

Note: The definitions of alarms and indicators are given in appendix 5.

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