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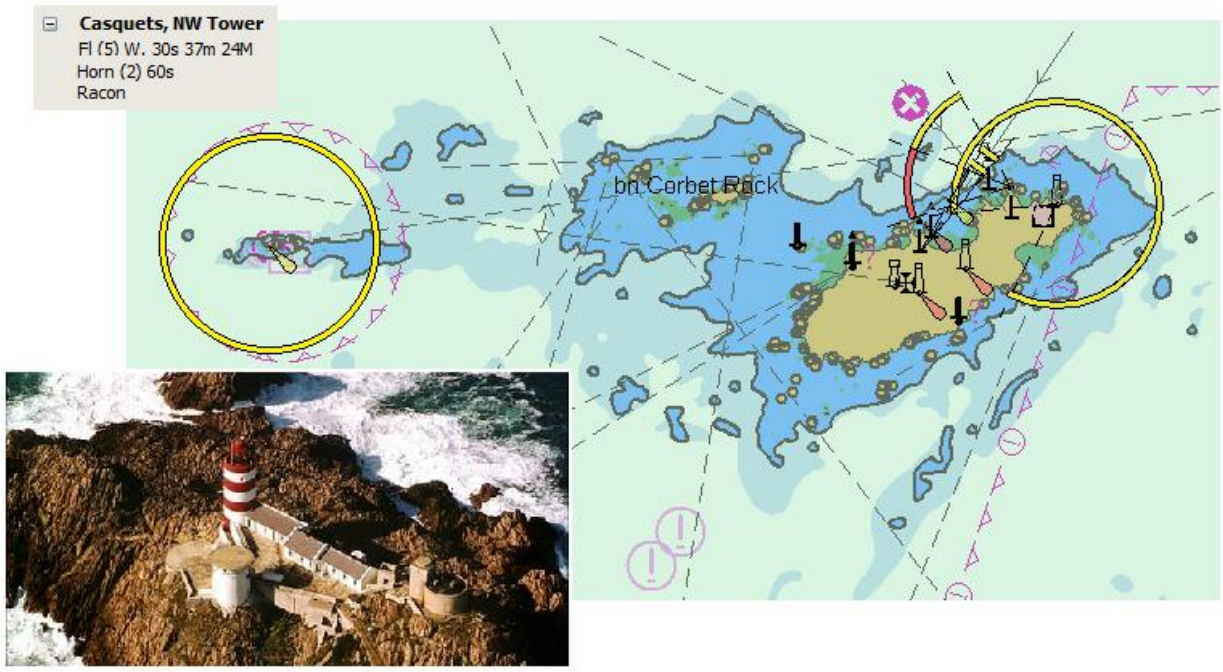
Digital Information and Portrayal Working Group (DIPWG)

IHO S-52 ECDIS Presentation Library

Major Lights with 360 Degree Sectors



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Introduction

The subject of major lights with all round arcs of visibility was discussed at DIPWG2 in Rostock. It was noted that these features were not always immediately evident on the ECDIS display. It was highlighted that relatively insignificant sectored lights were more prominent in the display and gave the impression they were more important than they were.

This problem was initially raised at a meeting between the UKHO and Condor Ferries. Condor Ferries was concerned that the major light on the Casquets (Channel Islands) did not stand out on the display. This light has a nominal range of 24nM and is by far the most important light in this area. Text placement on a paper chart ensures the light description is positioned so that it is not obscured by other features. This is not always the case on ENCs where the text is positioned at an arbitrary offset.

One of the OEMs present at DIPWG2 said that he has had strong claims from his customers for 360° sectors to be displayed on important lights. He went on to say that he would like this to be entered as a deferred amendment in S-52. However first of all it needs to be established what constitutes a major light as it would add considerably to screen clutter if all lights were displayed with a 360° sector. This paper seeks to define a major light and create rules for displaying them.

What is a Major Light in an ENC?

It would not be appropriate to insert a 360 degree sector symbol on every light with all round visibility. Not only would it add to screen clutter but it would defeat the object of the exercise. All lights are important in the context of their purpose and position. However certain lights, e.g. high intensity lights in open water, need to be given greater prominence at smaller scales so that they can be easily detected in the ECDIS display. In the first instance it is necessary to set the criteria for these types of lights.

Definitions

The following definitions have been *"Googled"* or are contained in various IHO publications:

Major Light can be described as a light of high intensity and reliability exhibited from a fixed structure or on marine site (except range lights). Major lights include primary seacoast lights and secondary lights.
Lighthouse: A distinctive structure exhibiting a major navigation light.
Secondary light: A major light, other than a primary (sea-coast) light, established at harbour entrances and other locations where high intensity and reliability are required.
Minor Light can be described as automatic unmanned light on a fixed structure usually showing low to moderate intensity. Minor lights are established in harbours, along channels, along rivers, and in isolated locations.

IHO S-4- Regulations of the IHO for International Charts and Chart Specifications
Major lights: That is lights intended for use at sea, usually with a range of 15 miles or more, and in outer approaches to harbours. As a guide, only those lights visible from 15 miles and over should be inserted on charts at scales smaller than 1:500 000.
Major floating lights are generally classed as those with a nominal range in excess of 10 nautical miles. Special circumstances, e.g. an isolated location, may mean that a floating light of lower range is given this status.
Fog Detector Lights: Fog detector lights may be fitted to the structure of a major light or may be established some distance from the light. Their purpose is to detect fog automatically and to switch on fog signals.

IHO S-12 Standardisation of List of Lights and Fog Signals
This does not define the difference between a major and minor light merely that all lights with a nominal range of **15nM** or more are shown in bold text in the list.

IHO S-32 - Hydrographic Dictionary (Glossary of Terms) makes no reference to major or minor lights.

Where does that leave us?

It has been established that a major light is one of high intensity/reliability and is normally for use at sea or at the approaches to harbours. The only method of determining the criteria for these types of light would appear to be the

intensity of the light and by inference the nominal range. It is now necessary to look at the different types of lights which appear on a navigation chart and their purpose.

Analysis of Light Features and Functions

The following section looks at the different types of lights which feature on a navigational chart and identify their intended purpose.

Lighthouses

Lighthouses have been defined above as distinctive structures exhibiting a major navigation light so this would be a good place to start when defining the nominal range for a major light. Annex A lists all lighthouses maintained by Trinity House around the coasts of England, Wales and the Channel Islands along with their characteristics. Inspection of this list shows that the nominal range for these varies between 4 and 26 Nautical Miles. Although the definition of a lighthouse defines that they exhibit a major navigational light this is quite obviously not true in the case of those with limited nominal ranges.

This list also highlights the fact that a significant proportion of these are sectored (approximately 70%) in which case they are already displayed prominently in the ECDIS display.

FEATURE OBJECT/ATTRIBUTES
Landmark Object [LNDMRK], Category of Landmark [CATLMK] = [17] Tower, FUNCTION = [33] Light Support Building, Single [BUISGL], FUNCTION = [33] Light Support

Light Vessels

Light vessels are also considered to be major lights. They have all round visibility since they are stationed offshore and not generally affected by land or urban relief. The following list identifies all light vessels stationed around UK waters:

Light Vessel	Light Characteristics	Fog Signal	Radar Transponder	Other
Channel	Fl.W.15s 15nM	Horn 20s	Racon	AIS
East Goodwin	Fl.W.15s 15nM	Horn 30s	Racon	
Foxtrot 3	Fl.W.10s 15nM	Horn 10s	Racon	
Greenwich	Fl.W.5s 15nM	Horn 30s	Racon	
Sandettie	Fl.W.5s 22nM	Horn 30s	Racon	
Seven Stones	Fl(3)W.30s 15nM	Horn(3) 60s	Racon	
Sunk Centre	Fl(2)W.20s 16nM	Horn(2) 60s	Racon	AIS
Sunk Inner	Iso.W.3s 12nM	Horn 30s	Racon	AIS
Varne	Fl.R.5s 15nM	Horn 30s	Racon	AIS

It can be seen from the list that the nominal range varies from between 12 and 16nM. It would not seem sensible to exclude a light vessel with an NR of 12nM from being a major light because arguably it is.

FEATURE OBJECT
Light Vessel [LITVES]
Light Float [LITFLT]

Other Navigational Non-Sectored Lights

(England, Wales & Channel Islands only)

Having looked at lighthouses and light vessels it is time to look at other candidates for major lights. One of the definitions provided above states lights intended for use at sea, usually with a range of 15 miles or more, and in outer approaches to harbours. It is the second part of this sentence that needs to be analysed now. Annex B contains a list of all non-sectored lights around England, Wales and the Channel Islands exhibiting a light with a nominal range of 10nM

or more. The purpose is to identify those that are used in harbour approaches and review the range of these types of light. This list provided the following types of light with a nominal range of 10nM or more:

1. Harbour Approaches
2. Meteorological Masts (Usually associated with Wind Farms)
3. Offshore Production Areas
4. Air Obstruction Lights
5. Super Buoys

NOTE: It is not possible to review the complete lights database however this sub sample could be considered an average on which to base a reasonable hypothesis.

Harbour Approach Lights

There are 34 harbour approach lights around England, Wales and the Channel Islands that exhibit a light with a nominal range of 10nM or more with all round visibility (360°). This is out of approximately 2,500 navigational lights and excluding light houses, light vessels, offshore production areas, etc. These 34 represent a very small proportion and would not unduly clutter the ECDIS display if displayed with a 360° sector.

Recommendation

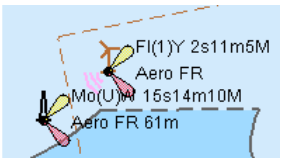
Since lights with a nominal range of 10nM or more are a very small percentage there seems little sense in omitting these from being major lights. In the context of their surroundings and depending on the ECDIS viewing scale these are indeed significant aids to navigation.

Offshore Production Area Lights

Offshore production areas are potentially hazardous to navigation and always exhibit lights according to defined standards. These lights are not, for the most part, intended for navigation but to warn mariners when in close proximity to these features

Offshore Wind Farms (Meteorological Mast & Perimeter Lights)

Offshore wind farms are fast becoming a common feature around the coastline of many countries. These are always marked by lights especially around the perimeter of the production area. Each lit wind motor in UK waters normally exhibits a flashing yellow light with a nominal range of between 2 and 5nM (see Annex C). In UK waters these features are sometimes accompanied by a meteorological mast exhibiting a light with a nominal range of 10nM. Since these lights are in open water they invariably have all round visibility. This would appear to give more weight in defining a major light as one with a nominal range of 10nM.

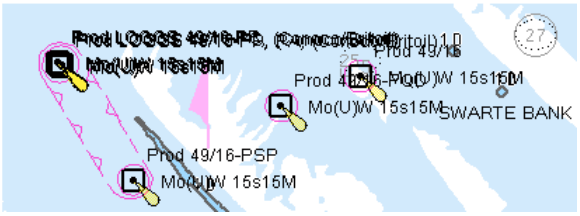


Recommendation

Lights marking wind turbines or marking the perimeter of wind farm have limited range light and therefore do not really constitute major light features. Also they can be grouped in large numbers therefore displaying them with 360 degree sectors would add considerably to screen clutter. Meteorological masts whist exhibiting lights with a nominal range of 10nM or more do not meet the criteria defined earlier. These could be excluded from any rules created using the fact that these exhibit a *Morse*[1] light characteristic.

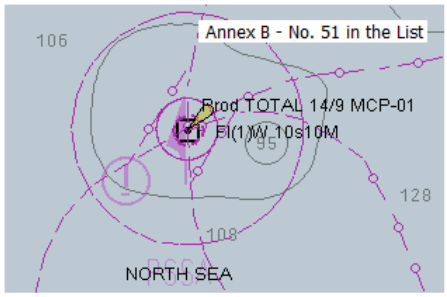
Oil and Gas Production Installations (North Sea Warning Lights)

These structures must be marked at night by one or more white lights so constructed and fixed as to ensure that at least one light is visible upon approaching the structure from any direction (see Annex D). There are numerous oil and gas production installations in the North Sea exhibiting lights with a nominal range of between 10 and 15nM. Many of these are in close proximity to one another so displaying 360 degree sector around each would create



[1] Morse Flashing Lights (Offshore Production Areas)
A 360° white light (or lights operated in unison) flashing Morse code (U) (meaning 'You are standing into danger') every 15 seconds, visible 15 miles and exhibited at an elevation of between 12 and 30 metres.

a great deal of screen clutter. Many of these installations also have reserve lights with 10nM range encoded which further adds to the clutter. The screenshot across highlights this showing a blurred image where this occurs.



These offshore platforms must have lights with a minimum effective intensity of 1400 candelas and operated with a flashing character according to Morse letter « U » with a maximum period of 15 seconds. In special cases (see across) due to navigational requirements additional marking maybe required. These consist of a high intensity light with specific character.

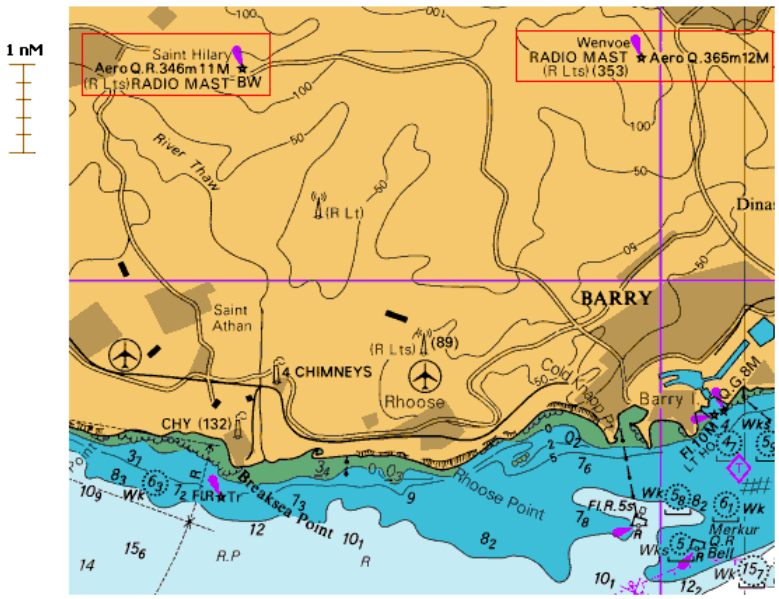
Recommendation
Unlike offshore wind turbines and wind farms these structures carry lights with larger nominal ranges, most have ranges between 10nM and 15nM. These lights are in open water and are not usually obscured by other charted detail. If the North Sea can be used as an example production platforms are often closely grouped in large numbers. For these reasons it is considered inappropriate and unnecessary to display 360 degree sectors. These could be excluded from any rules created using the fact that these exhibit a *Morse* light characteristic. The special cases identified previously do not carry morse characteristics and are only a few in number, these should be displayed with 360 degree sectors.

Aero Obstruction Lights (Aviation Lights)

These are often of great intensity and elevation. Their intensity is usually greater than that of most navigational lights and they may be the first lights, or looms of lights, to be sighted when approaching the land. The light characteristic is always preceded by the word 'Aero'. These lights are not designed for marine navigation and they are subject to changes which are not always notified to hydrographic offices. The details of the lights may not be complete and this information should be treated with caution.

These lights mark radio towers, chimneys and other obstructions to aircraft. They are usually *red* in colour, either, *fixed, flashing* or *occulting*, but other colours and characteristics may be employed.

These lights are not intended for navigation however they may be the first light that the mariner sights when approaching land. The following illustration shows two such air obstruction lights whose nominal range extends well into the Bristol Channel.



ATTRIBUTE
Category of Light [CATLIT] = [5] Aero Light or [6] Air obstruction light

Recommendation
Since these are not considered navigational lights these should not be displayed with 360° sectors and as mentioned earlier they may be unreliable. These can be excluded using the *Category of Light* attributes *Aero Light* and *Air Obstruction Light*.

Buoys & Super Buoys

A buoy is a floating object moored to the bottom in a particular charted geographical position, as an aid to navigation or for some other specific purposes. The following section although not exhaustive outlines some of the particular types which can be lit. These types of buoy are used, for example, to mark a location, warn of danger, or indicate a navigational channel. Many are lit so that they can be identified at night. The light characteristics displayed on these feature in UK water do not carry a nominal range on the chart. However a super buoy is a very large BUOY designed to carry a signal light of high luminous intensity at a high elevation. ODAS and LANBY buoys are two examples of these.

ODAS Buoys
ODAS (Ocean Data Acquisition System) buoys are placed Worldwide. These buoys are placed in prominent locations, and transmit data on Sea Conditions and Meteorological Conditions from their respective locations.

LANBY
Lanby buoys (Large Automatic Navigation Buoy) were used from the 1970s onwards. The buoys are intended to replace light vessels and are constructed as a circular hull with a central light to provide all-round visibility and a foghorn. They may also contain radio and radio beacons. The navigation buoy is monitored remotely from onshore and is designed to run for extended periods without repair. Although some remain these are now largely obsolete.

ATTRIBUTES
Buoy Shape [BOYSHP] = Super-buoy
Category of Special Purpose Mark [CATSPM] = ODAS (Ocean Data Acquisition System) or LANBY (Large Automatic Navigational Buoy)

Recommendation
Normal navigation buoys will not probably carry a nominal range; if they do it is not likely that it will have nominal range greater than 10nM. However it is quite probable that a lit super buoy, if attributed with a range, will have a nominal range of 10nM or more. Since these are in open water and are relatively small in number it is proposed to show 360° sectors on these features.

Conclusion

It has been determined that only lights with a nominal range of 15nM or greater should be shown on paper charts at 1:500,000 or smaller. Vessels operating on this scale of chart will be in open seas usually when transiting large bodies of water. Vessels operating in more confined waters will be using significantly larger scale charts where other lights with smaller ranges become significant. It has been established that a harbour approach light can be considered a major light. Many of these do not have a nominal range of 15nM or greater yet many exhibit major lights in the context of the scales they are being used. There has to be a cut off point, whilst being conscious of not wanting to clutter the ECDIS display more than is necessary. **It is considered that lights with nominal range of 10 Nautical Miles or greater be considered major lights.**

Impact on ECDIS - Lights Database

The following table is a breakdown of the number of lights that fall into various nominal range categories.

Range	Number	Percentage
All lights in DB*	80,135	100.0000%
Over 10M	12,960	16.1727%
Over 15M	5,273	6.5801%

Over 18M	2,992	3.7336%
Over 20M	2,016	2.5157%
Over 25M	594	0.7412%
Over 30 M	109	0.1360%

* Correct as of 4th February 2011

The table above identifies approximately 16% of all lights have a nominal range of 10nM or greater. However it has been established that a great many of these are on offshore production platforms and will be excluded. A great many of these, as mentioned earlier, are sectored and as such will be already be present in the ECDIS display. Whilst it is not possible to put a figure on the additional impact these sectors will have on the display it is not considered very high.

It is the author's opinion that the display of sectored lights should be managed more intelligently by the ECDIS and that it is the responsibility of the DIPWG to define these rules more clearly. The following section provides a high level look at how this might be achieved.

Presentation of Sectored Lights

Whilst the benefits of displaying 360° sectors on major lights is acknowledge it may be worth considering the current methods for displaying sectored lights to see if these can be improved on.

What the Current Standard Defines

The IHO ECDIS PL, Ed 3.4, S-52 Annex A of Appendix 2 has the following to say about *Light Sectors*:

Notes on light sectors:

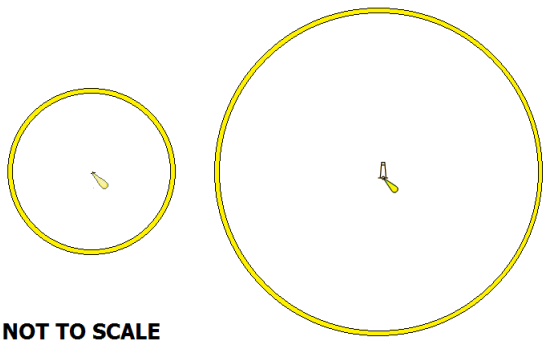
1. *The radial leg-lines defining the light sectors are normally drawn to only 25mm from the light to avoid clutter (see continuation B). However, the mariner should be able to select «full light-sector lines» and have the leg-lines extended to the nominal range of the light (VALMAR).*

2. *Continuation B of this procedure symbolises the sectors at the light itself. In addition, it should be possible, upon request, for the mariner to be capable of identifying the colour and sector limit lines of the sectors affecting the ship even if the light itself is off the display.* (Not sure if this option has been implemented or is even possible)

Presentation of Major and Minor Light Sectors

At first it was considered to give all major lights with all round visibility a larger radius, e.g. 50mm, to differentiate them from sectored lights. However this would be impractical because many sectored lights have similar nominal ranges. The illustration at ANNEX F shows the Casquets light, with all round visibility, which has a nominal range of 24nM. The Alderney North Coast light, due east, is sectored and has a nominal range of 23nM.

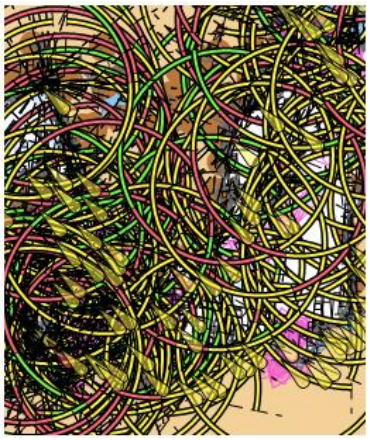
A better method would be to differentiate between major and minor light sectors and assign them different radii. The current definition states *"The radial leg-lines defining the light sectors are normally drawn to only 25mm from the light to avoid clutter"*. Using this as guideline we could define a radius of 15mm for lights <10nM and 30mm for lights with sectors 10nM or greater. The default would be 15 in instances when the nominal range is not encoded; if it is unknown it is unlikely to be a major light.



NOT TO SCALE

Presentation Rules

S-52 does not provide any guidance on what scales sectored lights, regardless of nominal range, should be displayed. It would seem pointless to display a light sector for a light with NR of 4nM at a scale of 100,000. It is left up to the ENC producers to apply a SCAMIN value to the object to suppress it at certain scales. However if SCAMIN is switched off in the ECDIS or it has not been encoded by the producer then the display could be cluttered by insignificant and unnecessary light sectors.

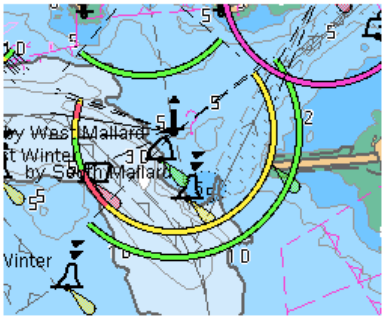


The example across, although extreme, is an example taken from one ECS which shows all sectored lights even when the display is zoomed out. All other ENC information is obscured to the extent the user cannot make out the coastline.

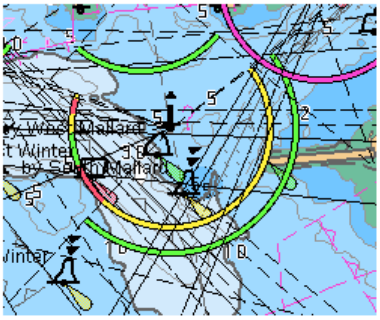
It may also be useful to create a set of rules which identifies at which display scale certain sectors are shown. Using the paper chart as an example it defines that only lights with a nominal range of 15nM should be included on charts at scales of 500,000 or smaller. A sliding scale could be defined so that only certain sectors are displayed when zooming in and out. A method such as this could mitigate the arbitrary use of SCAMIN by ENC producers.

Extended Radial Leg Lines

The current standard allows the user to extend the leg lines of a sectored light to the actual nominal range of the light. The problem with this option is that it extends the leg lines of ALL sectored lights which can result in a mass of intersecting leg lines. The examples below and at Annex G shows that with this option "set to on" the display becomes confusing and is of no help to the user.



Full Light-Sector Lines <OFF>



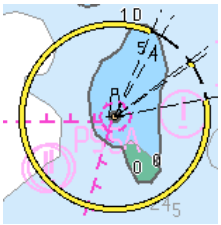
Full Light-Sector Lines <ON>

It would be more useful if this option could be selectively carried out for individual groups (aggregation) of lights. This could be achieved either through a *Cursor Pick Report* option or by hovering over the light with the cursor and selecting *Extend Sector Lines*.

User Configuration

The *Cursor Pick Report* could allow users to customise the display and set their own viewing options. The following options are provided as possible options:

1. Show only Minor Light Sectors
2. Show only Major Light Sectors
3. Show all Light Sectors
4. Show individual light sector (radial leg lines) with actual nominal range shown to scale



Symbol Transparency

At present there appears to be no transparency when sectored lights are displayed. Maybe we should consider reducing the drawing priority of these so that other more important information is not obscured by the sector symbol. The example across shows the sector symbol takes priority over the sounding (bottom right).

Work Around for Encoders

It is possible for encoders to improve the prominence of major lights but it involves bending the rules a bit. Producers can encode these types of lights with two 180 degree sectors both with identical attributes (except Sector 1 and 2 values). An illustration is provided at Annex E.

ANNEXES

ANNEX A – Trinity House Lighthouse Characteristics
ANNEX B – 10nM+ Non-Sectored Lights
ANNEX C – Marking Wind Turbines (Motors) and Wind Farms
ANNEX D - Marking Offshore Production Platforms
ANNEX E - Possible Workaround for Encoders
ANNEX F – Sectored Lights v All Round Visibility
ANNEX G – Full Light Sectors

ANNEX A – Trinity House Lighthouse Characteristics

The following table lists all lighthouses and their characteristics in England and Wales and under the management of Trinity House (General Lighthouse Authority for England, Wales, the Channel Islands and Gibraltar, responsible for a range of general aids to navigation).

Lighthouse Name	Height	Characteristics	Intensity [Candela]	Nominal Range [Nautical Miles]	Remarks
1. Alderney	37	Fl(4)W 15s	294,000	23	Fog Signal (Horn 30s) Sectored
2. Anvil Point	45	Fl.W 10s	500,000	19	Sectored
3. Bamburgh	*12*	*Oc(2) WRG 8s*	*27,000*	*W 14* *R & G 11*	Sectored
4. Bardsey	39	Fl(5)W 15s	667,000	26	All Round – LL column 8 states obscured by island
5. Beachy Head	31	Fl(2)W 20s	635,000	20	Sectored
6. Berry Head	58	Fl(2)W 15s	9,000	19	Sectored
7. Bishop Rock	44	Fl(2)W 15s	600,000	20	Sectored Racon
8. Bull Point	54 48	Fl(3)W 10s F.R	800,000	W 20 R 12	Sectored
9. Caldey Island	*65*	*Fl(3) WR 20s*	*W 5010* *R 939*	*W 13* *R 9*	Sectored
10. Casquets	37	Fl(5)W 30s	452,000	24	All Round Fog Signal (Horn(2) 60s) Racon
11. Coquet	25	Fl(3) WR 30s	W 155,000 R 21,830	W 19 R 15	Fog Signal (Horn 30s) Sectored
12. Cromer	84	Fl.W.5s	294,000	21	Racon AIS Sectored
13. Crow Point	*7.6*	*Fl.WR.2.5s*		*W 6* *R 5*	*Sectored*
14. Dungeness	40 37	Fl.W.10s F RG	452,000	W 21 R & G 10	Fog Signal (Horn (3) 60s) Sectored
15. Eddystone	41	Fl(2) W 10s Iso.R.10s Emergency Light	199,000	W 17 R 8 10	All Round (Primary Light) Sectored (Secondary light) Fog Signal (Horn 30s) Racon
16. Europa Point	49	Iso.W 10s Oc.R 10s FR	W 1070 R 208	W 19/17 R 15 R 15	Sectored Fog Signal (Horn 20s)
17. Farne	*27*	*Fl(2) WR 15s*	*W 1070* *R 208*	*W 10* *R 7*	*Sectored*
18. Flamborough	65	Fl(4)W 15s	650,000 (Peak) 433,333 (Effective)	24	All Round
19. Flatholm	50	Fl(3)WR 10s	W 17,100 R 3,200	W 15 R 12	Sectored
20. Godrevy	*37*	*Fl WR 10s*	*W Sector 4370* *R Sector 817*	*W 12* *R 9*	Sectored
21. Guile Point East	*9*	*Occ WRG 6s*		*4*	*Sectored*

22. Hartland Point	37	Fl(6) 15s	635,000	22	All Round
23. Heugh Hill	*24*	*Occ WRG 6s*		*5*	*Sectored*
24. Hilbre Island	*14*	*Fl.R 3s*	*13,500*	*5*	*Sectored*
25. Hurst Point	23 19	Fl.WR 15s Dir Iso.WRG	W 4,540 R 1,760	W 13/R 11 W 21/R 18/G 17	Sectored
26. Les Hanois	33	Fl(2)W 13s	89,900	20	Fog Signal (Horn (2) 60s) Sectored
27. Lizard	70	Fl.W.3s	800,000	26	Fog Signal (Horn 30s) Sectored
28. Longships	35	Fl(2)WR 10s	40,500	W 15/R 11	Fog Signal (Horn 10s) Sectored
29. Longstone	23	Fl 20s	640,000	24	Fog Signal (Horn (2) 60s) All Round
30. Lowestoft	37	Fl.W.15s	380,000	23	Sectored
31. Lundy South	53	Fl 5s	11,100	15	Fog Signal (Horn 25s) Sectored
32. Lundy North	48	Fl 15s	11,740	17	Sectored
33. Lynmouth Foreland	67	Fl(4)W.15s	1,000,000	18	Sectored
34. Maryport	*10*	*Fl.W.1.5s*	*120*	*6*	*All Round*
35. Monkstone	*13*	*Fl.W.5s*	*4 Candelaða*	*12*	*All Round*
36. Mumbles	35	Fl(4)W.20s	17,100	15	Fog Signal (Horn(3) 60s) All Round
37. Nab Tower	27	Fl.W.10s	11,739	16	Fog Signal (Horn(2) 20s) Racon All Round
38. Nash Point	56	Fl(2)WR.15s	140,000	W 21 R 16	Sectored
39. Needles	24	Occ(2) WRG 20s	R (Int) 3,950 W 12,300 R 14 G 14	W 17 R 14 R 13 G 14	Fog Signal (Horn(2) 30s) Sectored
40. North Foreland	57	Fl(2)WR.20s		W 19 R 16 R 15	AIS Sectored
41. Orford Ness	28 14 13	Fl.W.5s F.WRG F.R	635,000	20 W 17 R 13 G 15 12	Racon/AIS All Round Sectored Sectored
42. Pendeen	59	Fl(4)W.15s	150,000	16	Sectored
43. Peninnis	36	Fl.W.20s	4,500	17	Sectored
44. Point Lynas	39	Oc.W.10s	112,000	18	Fog Signal (Horn 45s) Sectored
45. Portland Bill	43 19	Fl(4)W.20s F.R.	635,000	25 13	Fog Signal (Dia 30s) All Round Sectored
46. Round Island	55	Fl.W.10s	340,000	18	Fog Signal (Horn (4) 60s) Racon Sectored
47. Royal Sovereign	*28*	*Fl.W.20s*	*3,500*	*12*	*Fog Signal (Horn(2) 30s)* *All Round*
48. Sark	65	Fl.W.15s	45,000	20	Fog Signal (Horn(2) 30s) Sectored
49. Skokholm	54	Fl.WR.10s	57,900	W 19 R 14	Sectored

50. Smalls	36 33	Fl(3)W.15s Iso.R.4s	1,000,000	18 13	Fog Signal (Horn (2) 60s) Racon All Round Sectored
51. South Bishop	44	Fl.W.5s	60,000	16	Fog Signal (Horn (3) 45s) Racon All Round
52. South Stack	60	Fl.W.10s	1,370,000	24	Fog Signal (Horn 30s) All Round
53. Southwold	37	Fl(4)WR. 20s		W 16 R 12	AIS Sectored
54. St Ann's Head	48	Fl.WR.5s	94,000	W 18 R 15 R 14	Fog Signal (Horn (2) 60s) Sectored
55. St Anthony's	22	Iso.WR.15s		W 16 R 14	Fog Signal (Horn 30s) Sectored
56. St Bees	102	Fl(2)W.20s	134,000	18	Sectored
57. St Catherine's	41 35	Fl.W.5s F.R	927,000	25 13	Sectored
58. St Tudwal's	*46*	*Fl.WR.15s*	*12,000*	*W 14* *R 10*	*Sectored*
59. Start Point	62 55	Fl(3)W.10s F.R	200,000	25 12	Fog Signal (Horn 60s) Sectored
60. Strumble Head	45	Fl(4)W.15s	1,000,000	26	Sectored
61. Tater Du	34 31	Fl(3)W.15s F.R	294,000 11,100	20 13	Fog Signal (Horn (2) 60s) Sectored
62. The Skerries	36 26	Fl(2)W.15s Iso.R.4s	1,150,000	20 10	Fog Signal (Horn (2) 60s) Racon All Round Sectored
63. Trevose Head	62	Fl.W.7.5s	89,900	21	Fog Signal (Horn (2) 30s) All Round
64. Trwyn Du	*19*	*Fl.W.5s*	*15,000*	*12*	*Fog Signal (Bell (1) 30s)* *Sectored*
65. Whitby	73	Fl.WR.5s	W 39,800 R 17,100	W 18 R 16	Sectored
66. Wolf Rock	34	Fl.W.15s	378,000	16	Fog Signal (Horn 30s) Racon All Round

66 Trinity House (England & Wales) Lighthouses listed above
46 Sectored
15 All Round
5 All Round & Sectored
13 lighthouses with lights less than NR = 15nM
5 lighthouses with lights less than NR = 10nM

ANNEX B – 10nM+ Non-Sectored Lights

Green = Harbour Approaches
Red = Offshore Production Areas
Blue = Aero or Air Obstruction Light
Black = Offshore Production Area with a navigational requirement to be marked

	Area	Location	Light	H	R	Remarks
1	Mevagissey Harbour	Victoria Pier Head	Fl(2)W 10s	9	12	Diaphone 30s
2	Portland Harbour	NE Breakwater. SE end A Head	Fl.W.2.5s	22	10	
3	Portland Harbour	SE end	2F.R.(vert)	9	10	
4	Shoreham Harbour	Middle Pier	Oc.W.5s	8	10	Front Ldg Lt
5	Newhaven Harbour	Breakwater Head	Oc(2)W.10s	17	12	Port of Newhaven VHF Ch.12
6	Folkestone harbour	Breakwater Head	Fl(2)W. 10s	14	22	Dia(4) 60s
7	Dover Harbour	S Breakwater W Head	Oc.R.30s	21	18	
8	St Peter Port	White Rock Pier Head	Oc.G.5s	11	14	
9	St Peter Port	Victoria Marina, S Pier Head	Oc.R.5s	10	14	Front Ldg Lt
10	Jersey E Coast	St Catherine Bay, Verclut Breakwater, Head	Fl.W.1.5s	18	13	Front Lt in line
11	St Helier	Small Roads, Elizabeth E Berth	Oc.G.5s	10	11	Front Ldg Lt
12	St Helier	Albert Pier Elbow	Oc.R.5s	10	12	Rear Ldg Lt
13	Jersey S Coast	Noirmont Point	Fl(4)W.12s	18	10	
14	Îles Chausey	Grande Île, SE Point	Fl.W.5s	39	23	Horn 30s
15	Thames Estuary	Long Sands Bank, Meteorological Mast	Mo(U)W.15s	12	10	Horn Mo(U) 30s
16	Thames Estuary	River Medway, Long Reach, Head	Aero FR	198	15	Obstruction Light
17	River Thames	Crayford Ness	Fl.W.5s	19	14	Also F.W.17m3nM
18	England East Coast	Happisburgh	Fl(3)W.30s	41	14	
19	England East Coast	Docking Shoal, Wind Farm Meteorological Mast	Mo(U)W.15s	12	10	Also F.R.87m Horn Mo(U) 30s
20	England East Coast	Race Bank, Wind Farm, Meteorological Mast	Mo(U)W. 15s	12	10	Also F.R.87m Horn Mo(U) 30s
21	England East Coast	Humber Gateway Wind Farm	Mo(U)W. 15s	12	10	Also Aero F.R.89m Horn Mo(U) 30s
22	River Humber & Humber Port	Killinghome, Front South Low Light	Iso.R.2s	10	14	Front Ldg Lt
23	Tees Bay, River Tees	Front Ldg Lt	F.R.	18	13	
24	Tees Bay, River Tees	Rear Ldg Lt	F.R.	20	16	
25	Hartlepool Bay	Hartlepool, The Heugh	Fl(2)W.10s	19	19	
26	Port of Sunderland	New S Pier, near Head	Fl.W.10s	14	10	
27	River Tyne, Entrance	N Pier Head	Fl(3)W.10s	26	26	Horn 10s
28	Blyth Harbour	E Pier Head	Fl(4)W.10s	19	21	Horn(3) 30s
29	Blyth Harbour	Front Ldg Lt	F.Bu	11	10	
30	Blyth Harbour	Rear Ldg Lt	F.Bu	17	10	
31	Barrow in Furness	Isle of Walney	Fl.W.15s	21	23	
32	Barrow in Furness	Isle of Walney, Outer Channel, Halfway Shoal	Q.R.	16	10	Also Emergency Q.R.
33	River Mersey, Garston	Stalbridge Dock, Front Ldg Lt	F.R.		10	Also by day F.R.

34	River Mersey, Garston	Stalbridge Dock, Rear Ldg Lt	F.R.		10	Also by day F.R.
35	Liverpool Bay	Gwynt Y Mor Wind Farm Meteorological Mast East	Mo(U)W.15s	12	10	Also F.R.80m2nM Horn Mo(U) 30s
36	Liverpool Bay	North Hoyle Wind Farm Meteorological Mast	Mo(U)W.15s	14	10	Also F.R.61m
37	Liverpool Bay	Rhys Flats Wind Farm Meteorological Mast	Mo(U)W.15s	13	10	Also 2F.R(vert).39m and F.R.59m
38	Anglesey, Holy Island	Holyhead Harbour, Breakwater Head	Fl(3)G.10s	21	14	Siren 20s
39	Cardigan Bay, Fishguard Bay	Fishguard Harbour, N Breakwater Head	Fl.G.4.5s	18	13	Bell(1) 8s
40	Carmarthen Bay	Burry Inlet, Burry Port	Fl.W.5s	7	15	
41	Swansea Bay	Scarweather Sands, Meteorological Mast	Mo(U)W.15s	14	10	Also Fl.R.4s 75m 2nM Horn Mo(U) 30s
42	Severn Estuary	Saint Hilary	Aero Q.R.	346	11	Obstruction Also F.R(vert) 6nM
43	Severn Estuary	Wenvoe	Aero Q.R.	389	12	Obstruction
44	Severn Estuary	Barry Docks, W Breakwater Head	Fl.W.2.5s	12	10	
45	River Severn	The Shoots, Redcliffe Rear Ldg Lt	F.Bu	33	10	
46	Hewett Gasfield*	Lemon Bank, Westwards	Mo(U)W.15s		15	Also Reserve light, Mo(U)W.15s 10nM Horn Mo(U) 15s
47	Wenlock Gasfield	Wenlock	Mo(U)W.15s		15	Also Reserve light, Mo(U)W.15s 10nM Horn Mo(U) 15s
48	Windermere Gasfield	Windermere	Mo(U)W.15s	14	10	Horn Mo(U) 15s
49	Chiswick Gasfield	Chiswick	Mo(U)W.15s	37	15	Also Reserve light, Mo(U)W.15s 10nM Horn Mo(U) 15s
50	Cleeton Gasfield	Flamborough Head Eastwards	Mo(U)W.15s		10	Horn
51	Claymore Oilfield	Moray Firth Ground North-eastwards	2Fl.W.10s	60	10	Racon
52	Frigg Gasfield	Bergen Bank	L.Fl.W.15s		10	
53	Frigg Gasfield	Bergen Bank	Fl.W.10s		10	Racon

Note: There are numerous (in excess of 100) cross references to platforms in this and other areas stating that the platform is marked in the same way as Lemon Bank.

ANNEX C – Marking Wind Turbines (Motors) and Wind Farms

Marking of Individual Structures (Wind Turbines)
The tower of every wind generator should be painted yellow all round from the level of Highest Astronomical Tide (HAT) to 15 metres or the height of the Aid to Navigation, if fitted, whichever is greater. Alternative marking may include horizontal yellow bands of not less than 2 metres in height and separation. Consideration may be given to the use of additional retro reflective material. Due to the increased danger posed by an isolated structure, it should be lighted with a white light flashing Morse code « U » (dot/dot/dash)

Aids to Navigation for marking Individual Structures
The AtoNs on the structure of a wind generator should be mounted below the lowest point of the arc of the rotor blades. They should be exhibited at a height of at least 6 metres above the level of the HAT. Aids to Navigation on wind turbines should comply with IALA Recommendations and have an availability of not less than 99.0%.

Marking of Groups of Structures (Wind Farms)
A Significant Peripheral Structure (SPS) is the 'corner' or other significant point on the periphery of the wind farm. Every individual SPS should be fitted with lights visible from all directions in the horizontal plane. These lights should be synchronized to display an IALA 'special mark' characteristic, flashing yellow, with a range of not less than five (5) nautical miles.

As a minimum, lights on individual SPSs should exhibit synchronised flashing characteristics, however Administrations should consider the synchronisation of all SPSs. In the case of a large or extended wind farm, the distance between SPSs should not normally exceed three (3) nautical miles.

Selected intermediate structures on the periphery of a wind farm other than the SPSs, should be marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane. The flash character of these lights should be distinctly different from those displayed on the SPSs, with a range of not less than two (2) nautical miles. The lateral distance between such lit structures or the nearest SPS should not exceed two (2) nautical miles.

Aids to Navigation for marking Wind Farms
In addition to the use of lights for marking the SPSs and selected intermediate peripheral structures of a wind farm, further consideration should be given to the use of:

- Lighting all peripheral structures
- Lighting all structures within the wind farm
- Racons
- Radar Reflectors and Radar Target Enhancers; and/or
- AIS as an Aid to Navigation

It is important that these AtoNs be used with care to mark the grouping of wind generators.

Consideration may be given to the provision of sound signals where appropriate, taking into account the prevailing visibility, topography and vessel traffic conditions. The typical range of such a sound signal should not be less than two (2) nautical miles.

SPS - lights visible from all directions in the horizontal plane. These lights should be synchronized to display an IALA 'special mark' characteristic, flashing yellow, with a range of not less than five (5) nautical miles

Intermediate structures on the periphery of a wind farm other than the SPSs - marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane with a flash character distinctly different from those displayed on the SPSs and with a range of not less than two (2) nautical miles.

Additional Considerations
Depending on the marking, lighting and lateral separation of the peripheral structures, the additional marking of the individual structures within a wind farm may be considered as follows:

- Lighting of each structure;

- Individual structures unlighted with retro-reflective areas;
- Individual structures illuminated with down-lights on ladders and access platforms;
- Use of flashing yellow lights with a range of not less than two (2) nautical miles;
- Identifying numbers on each individual structure either lit or unlit.

Note an electrical transformer station, meteorological, or wind measuring mast (pictured right), if considered to be a composite part of the wind farm, should be included as part of the overall wind farm marking. If not considered to be within the wind farm block it should be marked as an offshore structure (i.e. a white light flashing Morse code « U » (dot/dot/dash)). As far as practicable, Aeronautical obstruction warning lights fitted to the tops of wind generators should not be visible below the horizontal plane of these lights. Aviation Authorities should be consulted regarding the specification of such lights.

ANNEX D - Marking Offshore Production Platforms

The Offshore Structures section should be marked as a single unit or a block or field as follows:

1 Any structure shall be marked at night by one or more white lights so constructed and fixed as to ensure that at least one light is visible upon approaching the structure from any direction.

2 The lights shall be placed not less than 6m and not more than 30m above Mean High Water Springs (MHWS) with a minimum effective intensity of 1400 candelas. The lights shall be operated in unison with a flashing character according to Morse letter « U » (dot/dot/dash) and with a maximum period of 15 seconds. The vertical distribution of the projected beam shall be such that the light will be visible from the immediate vicinity of the structure to the maximum luminous range of the light.

3 The horizontal and vertical extremities of the structure shall be adequately marked in a manner determined by the Authority and in conformity with the requirements of air navigation regulations.

4 Each structure shall, where practicable, display identification panels with black letters or numbers 1 m high on a yellow background visible in all directions. These panels shall be easily visible in daylight as well as at night, either by the use of illumination or retro reflecting material.

5 Each structure may carry one or more sound signals so constructed and fixed as to be audible upon approaching the structure from any direction.

6 The sound signals should be placed not less than 6m and not more than 30m above MHWS with a range of at least 2 nautical miles. The character shall be rhythmic blasts corresponding to Morse letter « U » (dot/dot/dash) every 30 seconds.

7 The minimum duration of the short blast shall be 0.75 seconds. The sound signals shall be operated when the meteorological visibility is two nautical miles or less.

8 Where there is a requirement to identify a particular structure, a radar beacon may be fitted. The range and code shall be determined by the authority. Any radar beacon on a temporary uncharted structure shall be coded « D » (dash/dot/dot).

9 Where a number of structures are situated so that the safety of navigation in the area may be secured without each of the structures being individually equipped with lights and sound signals, in accordance with these recommendations, or where the Authority considers that local conditions permit a relaxation of the requirements for the intensity of the light, the Authority shall determine what marking shall be applied.

10 Wherever deemed necessary by the authority, buoys or beacons shall be placed to mark the perimeter of a group of structures, or to mark channels through a group of structures, or to mark any fixed structure while being erected or dismantled. The characteristics of such marks shall be determined by the Authority in accordance with the IALA Maritime Buoyage System (MBS).

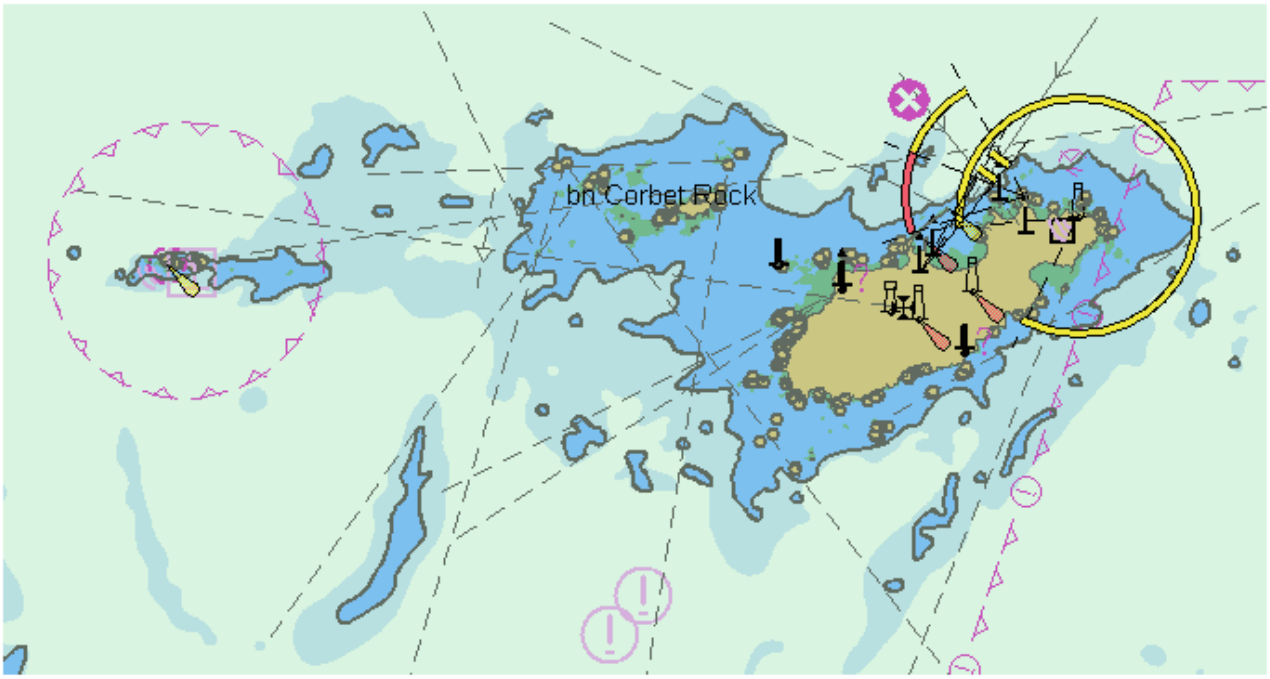
11 Where underwater obstructions, such as submerged wells or pipelines, exist in depths of water so as to be a hazard to surface borne vessels, they should be adequately marked in accordance with the IALA MBS.

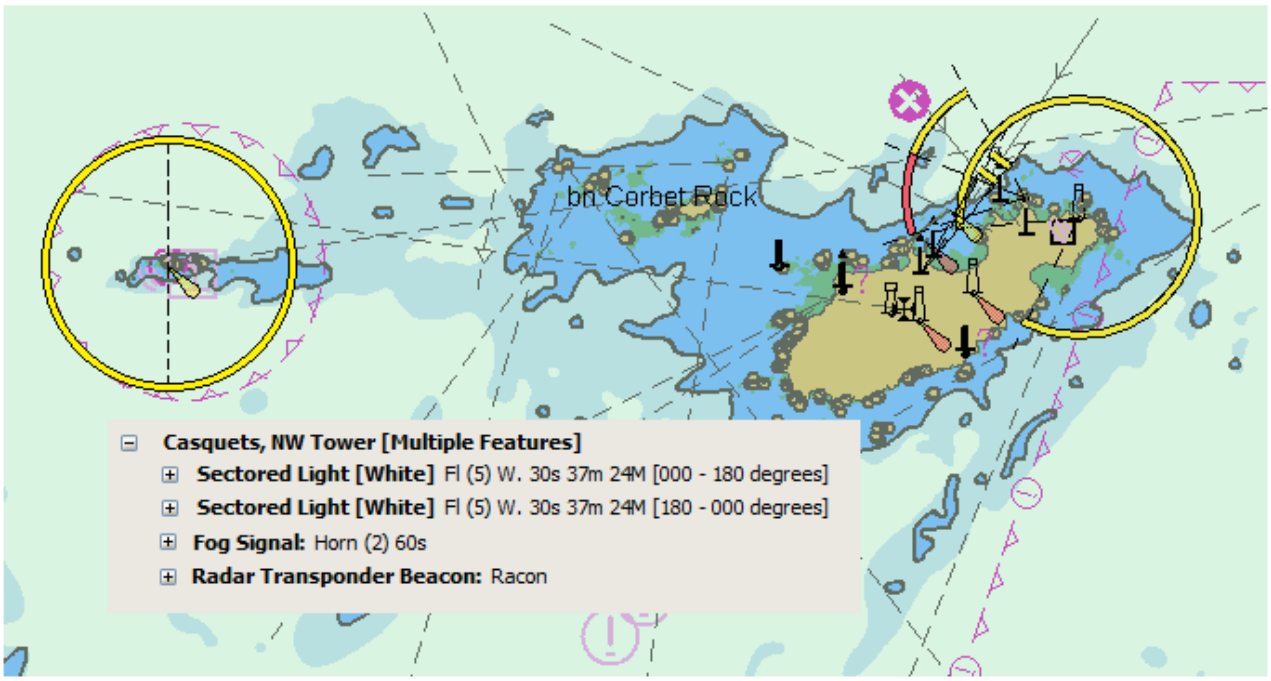
Additional marking

Authorities may, in special cases due to navigational requirements, demand that additional marking equipment are needed such as:

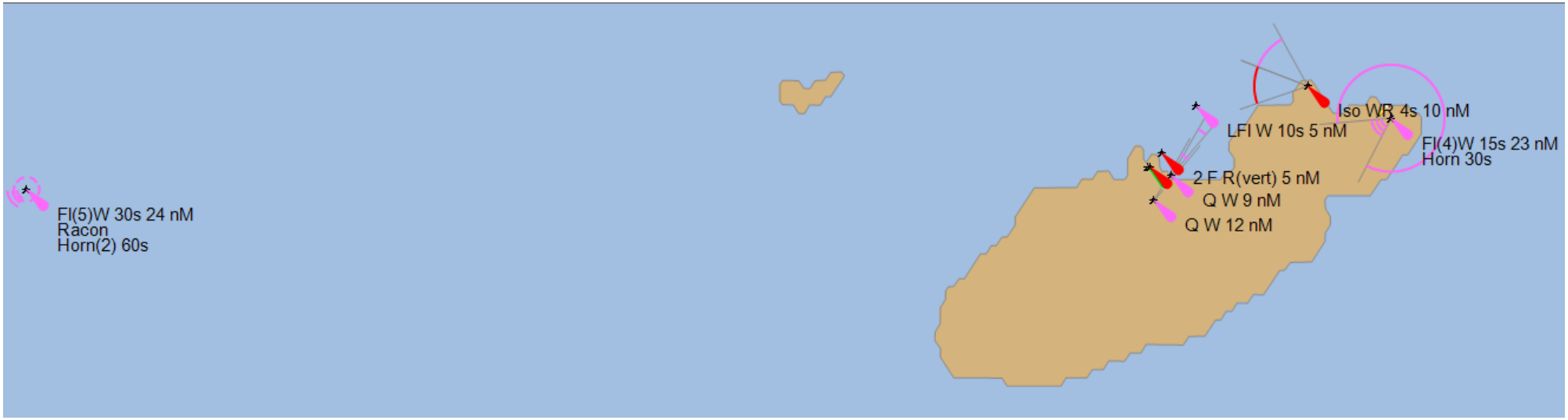
- A high intensity light with specific character
- Maritime radio beacon with specially determined range, frequency and character.
- Radar beacon with specific range and character
- Buoys in accordance with the IALA MBS

ANNEX E - Possible Workaround for Encoders



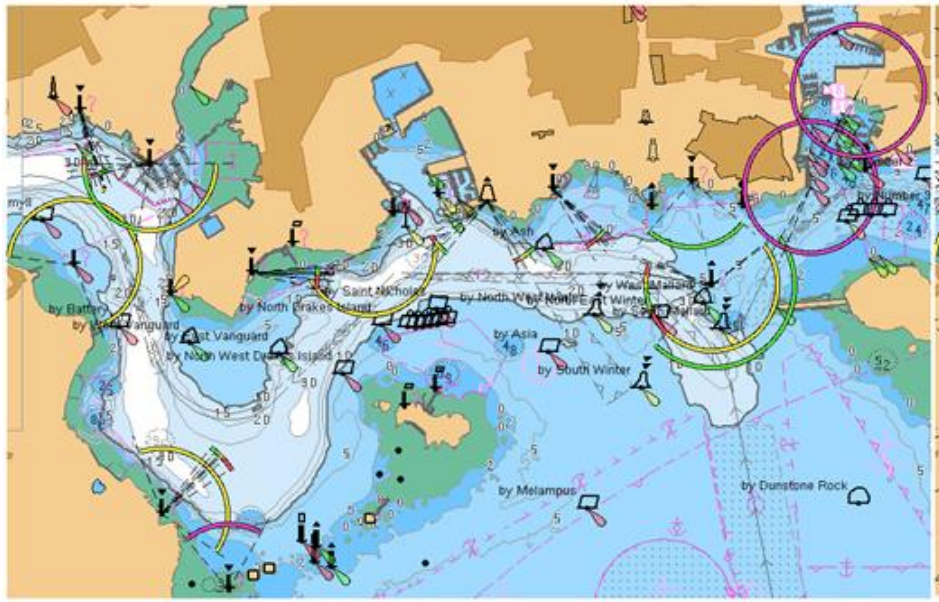


ANNEX F – Sectored Lights v All Round Visibility



Casquets (left) and Alderney (right)
The Casquets light has all round visibility with a nominal range of 24nM. The Alderney North Coast light is sectored and has a nominal range of 23nM.

ANNEX G – Full Light Sectors



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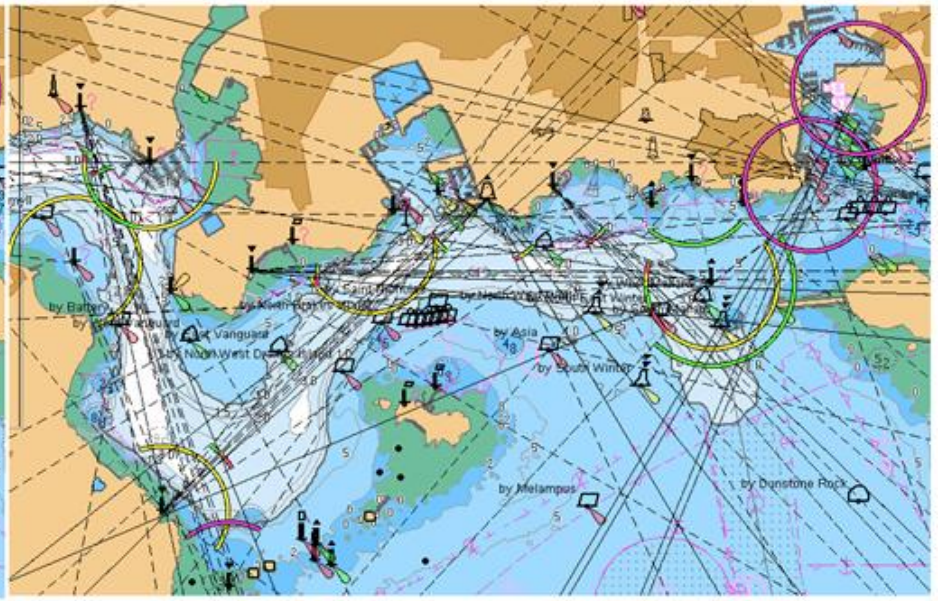

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