Lesson Plan - 7.3-1 RADAR	Date: 16/1/18 Jason Hughes Cowes Helm

AIM:

To give crew an understanding of: how RADAR works, the controls, how to operate it and potential drawbacks and hazards.

Training Shoreside - It is worth having a 10-15 minute talk about RADAR before going afloat and operating the unit. Items that can be covered are:

- What RADAR stands for
- What is RADAR
- Physical hazards associated with RADAR
- What targets you can acquire
- What makes an effective target
- The main purposes of RADAR

This list can be expanded if the opportunity arises and crew already have a knowledge of the subject. The SIMS Manual is a good teaching aid to cover further subjects ashore if going afloat is not an option.

Training Afloat - Once afloat the RADAR unit can be switched on and set up appropriately. Crew can work in pairs on seats 2 and 3 with the Helm sat on seat 4 overseeing the lesson. It is helpful to have an experienced driver on seat 1 as teaching RADAR can be consuming. The lesson will involve crew identifying the controls and tools of the RADAR unit and using them in the appropriate manner. Once a task is completed crew positions can be rotated.

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What is RADAR?

RADAR is an acronym and stands for RAdio Detection And Ranging. This helps us understand what it does. It is an electronic device that measures the bearing and distance of solid objects.

How?

Distance - Microwaves are sent out and reflected back from the target in a straight line. The time it takes to do this is measured. From this the distance is calculated.

Bearing - As the antenna turns the RADAR knows what bearing the target is on relative to our position.

Hazards

The hazards associated with RADAR are:

- Radiation
- RADAR is classed as High Voltage Equipment
- Incorrect set up can lead to misleading information and risk of collision

Switching on the RADAR and Setting Up

Switching On

Demonstrate how the unit is switched on, how to take control (slave/master) and use the TX/STBY.

Check the navigational information: Head Up or North Up against chartplotter.

Set up for optimum performance: Brightness, Auto Tune, Manual Gain, Manual Tuning.

Check accuracy of VRM against the fixed Range Rings and the EBL against a compass bearing of a known target.

Adjustment for Sea and Weather Conditions and Orientation

Demonstrate how to manually adjust for sea and rain clutter.

Manual anti sea clutter - reduces reception of wave echoes at short range.

Manual anti rain clutter - reduces the size of large block echoes (rain/snow) on the display.

Remember use of clutter controls can cause loss of targets.

Demonstrate the different orientations of the RADAR display.

Head Up - Heading marker always at the top of the display. Use closer to land.

North Up - Heading marker aligned with vessels compass. Use in open sea. More like a chart. Easier to use when in same orientation as the chart plotter.

Additional Controls

Demonstrate how to adjust the RADAR for Day/Night.

Day/Night Palette and Dimmer Control

Demonstrate how and explain why the Pulse Length can be altered.

Pulse Length: Long pulse is better for target detection. Short pulse is better for target discrimination.

Demonstrate other functions:

- Trails
- Off Centering
- Parallel Index Lines (PIL)
- AIS
- Range Rings

Trails

Leaves a “shadow” behind a target as a trail. This helps us determine if a target is moving. However it is relevant to our motion as well so to be truly effective we must be stopped.

Off Centering

Allows us to move our position which is usually the centre of the screen to somewhere on the edge. This allows part of the screen to be clear to look for targets. Useful in a shoreline search.

Limitations of RADAR

There are limitations of RADAR for target identification. Size, shape, texture, aspect and material construction can all make a difference. The larger the object the better. Large flat sides give a better signal than a sloping one. A spherical buoy or a cone are poor targets as they reflect the microwaves back in different directions. A cliff will appear more clearly than a shallow bank. Metal reflects better than wood.

RADAR waves travel in almost straight lines, so distant objects may be hidden below the RADAR Horizon. The waves bend very slightly so follow the curvature of the earth better than light waves which means the RADAR Horizon is about 10% more distant than we can see.

Weather can affect RADAR detection. High pressure and dry conditions mean better detection ranges. Low pressure and wet conditions reduce detection ranges. Rain, hail, sleet and snow will all affect detection capability.

Blind or Shadow Areas are caused by obstructions on land or another vessel close by. If a target is in a bay behind high land or buildings the RADAR will not detect it. Similarly if a large vessel is between you and the target, the area behind the vessel will be in a blind spot.

Incorrect RADAR set up can lead to:

- Poor Target Detection - Targets can be lost if the RADAR is not tuned properly.Unreliable Information - Is the target closing or not?
- Misinterpretation - Objects detected can be mistaken for non hazardous targets.
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THESE CAN ALL LEAD TO A RISK OF COLLISION

Alarms

Identify alarms fitted:

- CPA (Closest Point of Approach)
- Lost Targets
- Guard Zone
- Lost GPS data
- System errors

RADAR Lookout

Main purposes of RADAR

The three main purposes of RADAR are:

- Collision Avoidance
- Safe Navigation

- Casualty Location (How? SART. Signal looks like a line of curves towards the target which become concentric circles as we get nearer.

Operating the RADAR

The main RADAR functions to optimise target detection and location are:

- Tuning (Automatic with a manual override)
- Gain (Automatic with a manual override)
- Clutter (Automatic with a manual override)
- Pulse Length (Automatic with a manual override)
- Orientation (Head Up or North Up)
- VRM (Variable Range Marker)
- EBL (Electronic Bearing Line)
- Relative Motion

Variable Range Marker

VRM - measures the distance to a target when the circle is placed on the nearest edge of the target.

Electronic Bearing Line

EBL - line can be placed on a target to determine a bearing.

Using VRM and EBL a target can be acquired and a risk of collision assessed. If there is a constant bearing and decrease in distance a risk of collision is deemed to be likely.

Relative Motion

Some RADAR can show Relative Motion and True Motion. With Relative Motion our boat position is fixed - usually in the centre of the screen. True Motion refers to when our boat and the target both move across the screen. On our set we use Relative Motion.

The range and scale should be periodically adjusted to aid the identity of targets at long and short distances.

If manually tuning the RADAR, the picture and controls must be adjusted following any change in range.

Determining if a RADAR echo is a target

Once an echo has been identified on screen we need to cross reference it with other sources of information to identify it as a target. This we can do using the chart plotter and/or paper charts, AIS or by visual contact.

Automatic Identification System

AIS - We have onboard the SAR unit an Automatic Identification System which picks up information from other vessels telling us their name, speed, course etc. They will also appear on our RADAR and chartplotter screens as a boat symbol. This is only relevant if they are carrying the AIS transponder and broadcasting. We in turn carry our own transponder and can be seen by those monitoring AIS information such as other vessels or the Coastguard.

Once a target has been identified it must be prioritised as being an immediate hazard or not.

Plot and Monitor Targets

Assess Targets

Using the VRM and EBL we can note the range and bearing of the target and determine if there is a risk of collision.

We can also use the Mini Automatic RADAR Plotting Aid known as MARPA.

MARPA - Mini Automatic RADAR Plotting Aids - Benefits and Limitations

Many RADAR systems have Automatic RADAR Plotting Aids known as ARPA. Our system has a Miniature version known as MARPA. We can track various targets at the same time by clicking on them with the cursor. It takes time for all the information to be acquired. It will calculate the target's Bearing, Range, Course and Speed and show CPA and TCPA (Time to Closest Point of Approach). It will display potentially dangerous targets and we can set an alarm for the Closest Point of Approach (CPA).

There are however limitations. The information is historic; it shows what the target WAS doing. It requires a constant strong signal for reliable information, so weak echoes, rapid manoeuvres by our boat, heavy seas or rain can all lead to false readings. It also relies on accurate heading information from our compass. **Do not rely upon it.**

Target Types

- Vessels
- Navigation Marks
- Land
- Man made structures
- Racon (short for RADAR Beacon)
- SARTs (Search And Rescue Transponder)
- Aircraft

Small curved shapes are hard to detect. Large angular shapes are better.

Target information required to aid in it's identification are:

- Position
- Size

- Range
- Bearing
- Heading
- Speed
- CPA
- TCPA

Monitoring a Target

Remember - When monitoring a target the two factors that identify a risk of collision are:

Constant Bearing and Decreasing Range.

Collision Avoidance

If a risk of collision has been identified you must inform the Helm.

Search and Rescue

SART - Search And Rescue Transponder

A SART would be used primarily to aid in the location of survivors. On the screen a line of 12 blips appear along the bearing of the SART. As range to the SART decreases the blips become arcs until at about 1nm they become concentric circles.

Small Craft

To aid detection of small craft we can use a long pulse and manually increase the gain.

Chart Plotter Information

Some information is available on both the chart plotter and the RADAR:

Casualty Location (once entered), AIS positions, A live route showing the last waypoint and the next 4, the SAR Unit Lat /Long.

General Navigation

Position Fixing

We can use the VRM and EBL to help fix the position of the SAR Unit. We must ensure proper identification of targets first.

Pilotage

When using RADAR for pilotage we should always use Head Up orientation and lower ranges. Ranging in and out to look further ahead and around. In narrow channels or along shoreside we can use VRM or PIL (Parallel Index Lines).

Parallel Index Lines

PIL - Parallel Index Lines are lines that can be placed on the screen to use as guides to help keep us away from hazards. They should be used in North Up to align with the chart plotter.

Closing Down

Standby Mode

To put into standby mode we click on the TX/STBY button.

There are times when we need to stop the RADAR transmitting but keep it on standby. These are:

- During Helo Ops
- Close to high sided buildings or in a lock
- Alongside a quay or other vessels
- When the mast is lowered

Closing Down

Switch to standby and shut down the SIMS System as per the screen instructions.

Top Tip - When switched on the readings on the Directional Finder can be viewed on the RADAR screen.

Reference Material:

Crew Handbook

The SIMS Manual