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Agenda item 4

ICAO/IMO JOINT WORKING GROUP ON HARMONIZATION OF AERONAUTICAL AND MARITIME SEARCH AND RESCUE (ICAO/IMO JWG-SAR)

THIRTY FIRST MEETING

SAR OPERATIONAL PRINCIPLES, PROCEDURES AND TECHNIQUES

Radar SART detection and proposals for SAR procedures guidance to SAR units and RCCs

Presented by IMRF

SUMMARY

Executive summary: This document raises concerns regarding issues of detectability of radar SARTs, possible issues with broadband radar, and makes suggestions for SAR procedures to be implemented for radar SART searches.

Action to be taken: Paragraph 4.1

1 INTRODUCTION

1.1 During NCSR 11 in June 2024, document NCSR 11/18/5 was submitted by the United States raising concerns regarding the detection of radar search and rescue transponders (SART).

1.2 During the abandonment of a vessel in distress, the **Seacor Power**, one of the vessel's crew took a radar SART with them into a life raft. The SART was activated and it was noted that the 'received signal' light on the SART was triggered, indicating that radars were interrogating the transponder and that signals were being transmitted from the device.

1.3 However, vessels involved in the response to this incident reported not seeing any radar SART response appearing on their radar, as is supposed to occur when a radar SART is detected by a ship's radar.

1.4 Following this incident, the United States conducted tests on radar SARTs and discovered that modern radar and their processing may, unless correctly adjusted, filter out radar

SART signals. This raises some SAR procedural issues. The United States also raised concerns as to the effectiveness and practicability of the use of radar SARTs in a modern SAR environment and with modern radar signal processing.

2 DISCUSSION

2.1 Regarding radar SART usage, the United States document (NCSR 11/18/5) stated that:

> When IMO considered the use of the 9 GHz search and rescue radar transponder (SART), within the future GMDSS equipment framework nearly 40 years ago, signal processing circuitry used on shipboard radars at the time did not materially affect SART detection and display. For example, the United States' tests with a Raytheon Pathfinder radar displayed the SART response clearly and consistently, regardless of how operator-selected signal processing was set [1]. The radar SART was ultimately chosen to meet the distress locating requirements of the GMDSS, due to ships already carrying necessary locating equipment (3 cm X-band radar) and clear and consistent SART response demonstrated on radars of that time. However, the need for alternative methods for locating crew members separated from their vessels was highlighted by the **Seacor Power** incident in the Gulf of Mexico on 13 April 2021, which resulted in the loss of 13 crew members.

2.2 The document stated the following regarding the recent testing of radar SART detection:

> During post-casualty testing with a response boat and fire department boat, the United States National Transportation Safety Board found that crews were initially unable to see the SART signal. The range ring on the radar display was instead set appropriately for the navigational area and was not expanded to 12 NM rings as suggested by the SART user's manual. The SART signal was detected only after the crew became familiar with procedures addressing changes to the radar gain, clutter, and range necessary to accommodate the SART, rather than retaining settings necessary to accommodate radar targets in areas being searched or navigated. Follow-on testing with search and rescue aircraft was also successful only after training the air crews what to look for. Since SART activation is uncommon, crews of vessels and aircraft responding to a distress incident may not remember to tune their radars for optimal SART detection and may be reluctant to do so due to its degradation of the radar's normal operation.[2]

2.3 The document also raised navigational safety issues when setting up a radar to detect radar SARTs:

> Resolution MSC.192(79) on *Revised Recommendation on Performance Standards for Radar Equipment* provides that "It should be possible to switch off those signal processing functions, including polarization modes, which might prevent an X-Band radar

[1] Signal processing capabilities of the Raytheon Pathfinder at that time included anti-clutter rain, anti-clutter sea and interference rejection.

[2] See Docket Items 82 to 88 for the Search and Rescue Transponder (SART) Specialist's Factual Report and its six annexes (https://data.ntsb.gov/Docket/?NTSBNumber=DCA21MM024)

beacon or SARTs from being detected and displayed. The status should be indicated." Switching off those signal processing functions and changing range settings in order to check for the possibility of a SART signal, while losing the radar's ability to display other detected targets in a given area, could in itself hinder the ship's ability to navigate and detect objects in the water during a SAR response.[3]

2.4 In September 2024, the IMRF published an operational information document to its members, following NCSR 11, and raised the above concerns with the membership. One of the member organizations responded with comments on the possible lack of radar SART detection by broadband (solid state) radar. These devices are stated to have a very good detection capability and definition against small targets, objects and obstacles close to the radar, and advantages to users and are safer to use, have faster warm up times, smaller size and lower power demands. A much better performance is claimed than for many conventional radar types, but there are concerns regarding radar SART detection by this radar type.

2.5 A question on this matter was asked by the IMRF of the United States RTCM GMDSS Taskforce meeting on 5 September 2024, and it was suggested that, as broadband radar uses frequency modulated continuous wave (FMCW) transmission, that it would not be able to detect a radar SART because it requires a pulsed radar to activate a SART response. However, it was also said that some manufacturers might have designed a capability into broadband radar to enable detection of radar SARTs, but that it should not be expected that all such radars had this feature. For SAR response, this category of radar may present new problems that need to be discussed and resolved.

2.6 Document NCSR 11/18/5 also proposed that IMO consider recommending that AIS SART be promoted as an alternative or replacement for radar SART due to the AIS SART being detectable by any AIS receiver. However, the IMRF notes that AIS SART do not cause an alarm to be sounded on an AIS display and rely wholly on a person looking at the display and noticing an AIS SART symbol – which may only be identified by small image enhancement. It is accepted that an AIS SART is only a locating device, but nevertheless, the difficulties of identifying them against possibly numerous other AIS targets should be considered.

3 SUGGESTED SAR PROCEDURES

3.1 Because of the concerns raised by the United States in their NCSR document, the IMRF is of the view that the international community should provide recommended procedural advice to SAR unit operators and SAR mission coordinators in RCCs. The rationale for this is that it is more complex, and probably less effective, to send operational advice to all ships in a flag State on the use of radar to detect SARTs. Given that most ships will never need to use this procedure, it may be simpler to provide the procedural advice to the SAR responders to use when required. If SAR responders embed this advice into operational instructions and training, then there may be a greater likelihood of it being implemented in a SAR situation.

3.2 SAR units should be advised to consider the information in document NCSR 11/18/5, as well as this document, and review their operations manuals, checklists or other relevant

[3] SN/Circ.197 on *Operation of marine radar for SART detection* warns that "Care should be taken in operating the radar in the detuned condition as other wanted navigational and anti-collision information may be removed."

instructions, regarding searching for and detecting radar SARTs to ensure that radars on SAR surface craft and aircraft can do so when required.

3.3 RCCs should be recommended to consider that operational instructions and checklists contain guidance to RCC staff to ensure that, if survivors may or are known to have radar SARTs, the RCC advises all ships, and SAR units responding, to tune their radar as advised in the above text, and to also warn that the navigational and collision detection capability of the radar may be reduced or be ineffective. Vessels should be asked, if they have a second radar, to use, if possible, one (9 GHz, X band) for radar SART detection and any other for safety of navigation functions.

3.4 Further consideration might be that the RCC (and SAR units working with other vessels and boats), where radar SART is to be searched for, ask them if they have radar and, if yes, what type e.g. broadband or conventional. They can then ask vessels with conventional pulsed radar to set their radar to detect SART.

3.5 It is also felt by the IMRF that further discussion is required at IMO, and amongst relevant SAR expert groups, to explore the recommendation of the use of AIS SART in place of radar SART, and the SAR implications of this, and how AIS SART can be more reliably detected amongst other AIS target clutter, and whether other changes to AIS SART should be recommended to IMO.

4 ACTION REQUESTED OF THE JWG

4.1 The JWG is invited consider the following:

.1 challenges caused by modern ships' radar processing for detection of radar SARTs;

.2 the wider issue of recommending that radar SART be discontinued in favour of AIS SART;

.3 the challenges associated with identifying AIS SART icons on the navigation displays of vessels;

.4 broadband radar weaknesses in detecting radar SART; and

.5 proposals for SAR procedures guidance for SAR units and RCCs.