NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

May 11, 2022

Search and Rescue Transponder (SART)

Specialist's Factual Report
By Sean Payne

1. EVENT

Location:	Port Fourchon, LA
Date:	April 13, 2021
Type:	Liftboat
Registration:	*SeacorPower*
Owner:	Falcon Global Offshore, LLC.
Operator:	Seacor Marine, LLC.
NTSB Number:	DCA21MM024

2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following device:

Device:	**Jotron Tron SART 20**
SART Type:	**Radar**
Device Serial Number:	**58057**

2.1. Search and Rescue Transponder (SART) Device Description

A Search and Rescue Transponder (SART) is a waterproof, self-contained, battery-operated device, intended for use in maritime search and rescue operations. A SART can be one of two types. The first type is a radar-based system that leverages shipborne and airborne radar systems to broadcast a rescue signal that appears on the radar display. The second type is an AIS-GPS system, which uses the Automatic Identification System (AIS) to broadcast a rescue signal that can be received by AIS receivers on the rescue craft.

A radar based SART is designed to be used in identifying either the position of survival craft or vessels in distress. The radar SART operates on the 9 GHz X-band spectrum (3 cm wavelength) which is commonly used in the maritime environment. The radar SART will not operate on other bands of radar, such as the S-band (10 cm wavelength) systems.

When activated, a response from a radar SART device can be triggered by any X-band radar system operating in the vicinity of the device. When the radar SART detects a pulse from a passing X-band system (an interrogation), it will transmit a response. Maritime X-band radar systems use several frequencies within a band. The SART's response is transmitted in a sweep which covers the entire band. When interrogated, the initial response from the SART is a rapid 0.4 microsecond sweep across this band, and then slow sweeps (7.5 microseconds) through the band until the SART returns to the first swept frequency. The sweep process upon interrogation is repeated for 12 cycles. During these sweeps, the radar SART frequency will match the frequency of the pass-band filter on the interrogating device. If the interrogating radar is in range, a response will be produced on the interrogating radar's display. When this occurs, the return signal will appear as a line of 12 dots on the interrogating radar system's display. When the interrogating radar is within 1 nautical mile (nm) of the activated radar SART, additional responses from the "fast" (0.4 microsecond) sweeps will also be displayed along with the original line of 12 dots. As the interrogating radar system gets closer to the activated radar SART, the response will appear as arcs, which will eventually display as full circles when near to the device.

2.2. Radar SART Performance Requirements

IMO Resolution A.802(19), entitled, Performance Standards for Survival Craft Radar Transponders for Use in Search and Rescue Operations, lays out the basic performance standards for radar SART devices.

In general, the following are excerpts from the document related to the designed operation of the SART. The excerpts selected are most applicable to this accident investigation.

The SART should:

- be capable of being easily activated by unskilled personnel
- be equipped with a means which is either visual or audible, or both visual and audible, to indicate correct operation and to alert survivors to the fact that a radar has triggered the SART
- be capable of manual activation and deactivation; provision for automatic activation may be included
- be provided with an indication of the stand-by condition;
- be watertight at a depth of 10 m for at least 5 min;
- maintain watertightness when subjected to a thermal shock of 45℃ under specified conditions of immersion;
- be capable of floating if it is not an integral part of the survival craft;

- be provided with a pole or other arrangement compatible with the antenna pocket in a survival craft, together with illustrated instructions.
- The height of the installed SART antenna should be at least 1 m above sea-level when activated.

IMO Resolution A.802(19)is attached to this report as attachment 1.

Additionally, the SART device is required to comply with a number of other standards, some overlapping. The following standards are applicable to the Tron SART20 device:

- SOLAS 74 as amended, Regulation III/6.2.2, IV/7.1.3,
- IMO Res. MSC.97 (73) 14.7.1.3
- MSC.247(83)
- IMO Res. A.530 (13)
- IMO Res.A.694 (17)
- ITU-R M.628-3 (11/93),
- COMSAR/Circ.32
- European Directive 2009/26/EC

More specifically, the International Electrotechnical Committee (IEC) specifies specific design and performance characteristics of the device. The following IEC documents contain radar SART performance standards

- IEC 61097-1:1992
- IEC 61097-1(2007)
- IEC 60945:1996
- IEC 60945 ed.4:2002

2.3. SART Carriage Requirements

In general, SOLAS chapter III defines the following carriage requirements for applicable vessels. The latest had been amended by MSC.256(84):

- One (1) SART on each side of every passenger ship, and of every cargo ship of 500 GRT and above.
- At least one (1) SART on every cargo ship between 300 GRT and 500 GRT.
- On ships carrying at least two (2) search and rescue locating devices and equipped with free-fall lifeboats one of the search and rescue locating devices shall be stowed in a free-fall lifeboat and the other located in the immediate

vicinity of the navigation bridge so that it can be utilized on board and ready for transfer to any of the other survival craft.

- Life rafts carried on ro-ro passenger ships shall be fitted with a search and rescue locating device in the ratio of one search and rescue locating device for every four life rafts

2.4. SART Device Examination

Attachment 2 is the user's manual for the Tron SART 20, and descriptions of the device's parts are referenced from the user's manual.

The SART device the NTSB received is photographed below in figure 1. The device appeared watertight and undamaged. The device was missing the winder hook and reel which is typically attached and inset to the bottom lid (rubber and plastic cap of the device). There was a remnant of the attached reel (the black string pictured).

The device's activation pin was examined. The device activation pin's safety wire was broken (figure 2), indicating that the device had been activated at some time.

The device was then briefly activated in the laboratory. Activation of the device was performed in accordance with section 5.1 of the user's manual. The locking pin was pulled with relatively little effort, the device responded with a low audible beep and a flashing red LED, as per the description in the user's manual. No anomalies were noted. The device's locking pin was then re-inserted and the device was secured and confirmed in an "off" state.

The device's component seal (sticker) affixed at the interface between the bottom lid and the housing was examined and was not broken. The device was then disassembled by unscrewing the bottom lid from the housing. During this process, it was noted that the component seal did not break and the seal slipped around the bottom lid as it was unscrewed. Figure 3 is a photograph of the device after the bottom lid had been removed. All internal components were as described. The desiccant packs were removed and found to be dry. The internal components were examined and found to be dry with no evidence of water intrusion, or corrosion.

The device's battery was then unplugged an inspected. The battery and battery label are pictured in figure 4. The battery had a manufacture date of September 2020. The battery was tested with a voltmeter and was found to be holding 7.3 volts. This is consistent with a near full battery charge according to the manufacturer's specifications.

The device was then reassembled and tested briefly again, per section 5.1 in the user's manual. The device indicated that its functions were performing normally. With the locking pin pulled out once again, the device's switch was moved briefly to the

"TEST" position. The device behaved as per the user's manual. The locking pin was reinserted and secured to the "OFF" position.

Figure 1. Front and back of the SART Device, as received.

Figure 2. Broken safety wire (copper color) indicating the device had been activated at some time.

Figure 3. Internal component view during inspection.

Figure 4. The battery after removal from the device.

2.5. Operational Testing

Section 5.3 of the user's manual describes a testing procedure for the SART20. Operational testing was conducted in multiple parts, they are described as follows:

- Initial on the water testing (OTW) with the United States Coast Guard (USCG)
- Operational testing and laboratory bench testing at the manufacturer's facility in Norway
- Follow on Pierside testing with the USCG
- Follow on OTW testing with the USCG
- Airborne reception testing with a USCG aircraft

The device was stored in between tests in a secure evidence locker at the NTSB. While in storage, the battery was disconnected and the activation switch was pinned. Prior to testing, the battery was reinstalled, and the activation pin was un-pinned, but not activated until testing was commenced.

In June 2021, the manufacturer, Jotron, was contacted and a support team was assigned to the investigation. The manufacturer provided prompt responses throughout the follow on testing work and supplied any necessary paperwork to support the device investigation.

Initial OTW Testing with USCG – June 2021

Initial OTW testing occurred on the Potomac River Washington, D.C., in June 2021. The OTW test procedure was similar to as described in section 5.3 of the Tron SART20 user's manual. The procedure used is attached to this report as attachment 3. The OTW test involved three vessels. One vessel, "Vessel TX" carried personnel who activated the SART beacon, a second vessel, "Vessel RX" carried personnel who operated radar to receive potential signals from the SART beacon, and a third "Observer" vessel contained extra personnel who operated radar that can receive potential signals from the SART beacon.

Vessels TX and RX were USCG 29-foot boats equipped with the "SINS-2" electronic package. The SINS-2 electronic package consisted of Raymarine RD424HD 24" Radome Kit T70169 (E92143) and a Raymarine e5127 12" Display with sonar (E70284-52). The third "Observer" vessel was the fireboat *John Glenn* which had a Garmin GMR 404 xHD radar system. Both radar systems are X-band systems.

The initial OTW testing involved positioning the three boats to vary distance from the SART beacon as well as to minimize land radar reflection. The test plan considered three reception distances, where the height of the SART was varied from sea level, to approximately 9 feet above sea level. The orientation of the SART was also varied from upright (antenna pointing to the sky) to upside down (antenna pointing toward the sea).

Upon activation a low volume tone from the SART was audible. The SART's red LED light flashed approximately twice per second. At test point 1 (range inside 0.5 nm), the SART was not observed by vessel RX or the *John Glenn*. The height and orientation of the SART was changed at test point 1. The SART was activated at various heights, including mounted to a bosun's pole approximately 9 feet above the water. The SART was held in these orientations for approximately 5 minutes. Figure 5 is a picture of the SINS-2 radar display on the USCG 29' Vessel RX. Figure 6 is a picture of the Garmin radar display on the *John Glenn*. Note that range in figure 5 was set to 1/8 nautical miles (NM) and the range in figure 6 was set to 2 NM.

Figure 5. Display from Vessel RX at range rings of 1/8 NM. The location of Vessel TX is shown on the radar display as target "CG29109".

Figure 6. Display from the *John Glenn* at range rings of 2 NM.

Note that during the initial OTW testing, the USCG personnel operating the SINS-2 radar package on Vessel RX did not vary the range of the radar display, nor did the operators of the SINS-2 radar package adjust the gain, clutter features, or sea-state settings of the radar system. 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 SART20 user's manual. Similarly, the radar operator on the *John Glenn*, did not change the settings of the Garmin radar system. No one discussed with the vessel operators the need to change the radar settings. Neither radar system was able to observe the SART at test point 1, and subsequent test points were suspended and the test was abandoned after approximately one half hour of beacon operation.

The SART was returned to shore at a USCG facility. The SART was opened and inspected. The battery voltage was tested and found to be 7.3 volts which was within the manufacturer's published acceptable range.

Testing at the Manufacturer's Facility – Norway, September 2021

The NTSB approached Jotron with the results of the OTW testing conducted in June 2021. The manufacturer appointed representatives offered to evaluate the SART device using both bench test equipment at the manufacturer's facility in Larvik, Norway, as well as a live OTW test in nearby Sandefjordsfjorden, Norway. The NTSB asked if the work could be performed in the United States, but the manufacturer responded that the test equipment only existed at the company's offices in Larvik. As such, the NTSB typically oversees tests at the manufacturer's facility, however, due to the COVID-19 pandemic travel was prohibited for United States citizens to Norway. Instead, the NTSB contacted the Norwegian Safety Investigation Authority (NSIA) who assigned a representative to both receive the shipment of the beacon from the United States and subsequently to oversee the manufacturer's testing of the device at the facility in Norway. The beacon was received by NSIA in September 2021 and testing began shortly thereafter. The tests in Larvik were overseen by two representatives of NSIA, as well as a party representative from Seacor Marine[1].

The first portion of the manufacturer's testing was performed on a laboratory bench using a system that was designed to test production SART20 systems. The bench testing system used is identical to the bench testing system the company uses to validate the functionality of SART beacons at their manufacturing facility. The bench test system consists of a signal generator and a spectrum analyzer. The system is able to emulate a radar signal and then read the SART's response on an oscilloscope which can display the SARTs behavior and measure the device's response. The manufacturer's system measures the following parameters:

[1] The party representative from Seacor Marine was based in the United Kingdom, and Norway's COVID-19 travel requirements had provisions for UK citizens to enter the country more easily than citizens from the United States.

- the device's sensitivity in various X-band ranges (to determine if the SART is properly sweeping the X-band frequency).
- transmitter delay time.
- transmission time.
- frequency sweep time.
- transmitter power output and "recovery time" (time for the transmitter to complete a frequency sweep and begin to transmit again).

Figure 7 is a photo of the accident device inserted into the bench test system at the facility in Larvik.

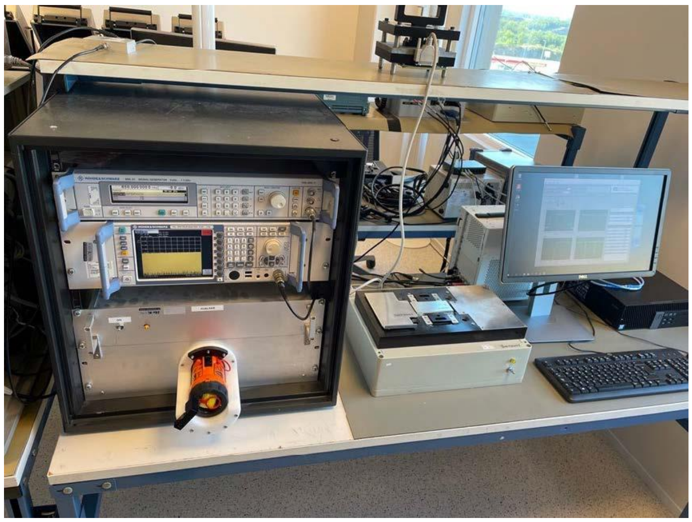

Figure 7. Photo of the accident device inserted in the test system at the facility in Larvik, Norway

The manufacturer noted that activation of the device responded as expected and the device's LED responded appropriately (slow flashing) and one beep was audible. When the device was introduced to the signal generator which emulated X-band radar waves, the manufacturer noted the LED status light changed to rapid flashing and multiple audio beeps were heard. The manufacturer then read the test results from the spectrum analyzer. The results of the spectrum analyzer are shown in figure 8. The manufacturer stated the spectrum analyzer results showed no anomalies with the device and the test results were "TEST OK."

Factory Acceptance Test	
Receiver Sensitivity	
Signal Frequency	**Signal Strength**
9.20GHz	<-50dBm
	OK
9.35GHz	<-50dBm
	OK
9.50GHz	<-50dBm
	OK
Transmitter Characteristics	
Characteristic	**Limits**
High Frequency	9500-9560 MHz
	9542.0
Low Frequency	9140-9200 MHz
	9166.0
Delay Time	< 500ns
	360.0
Transmission Time	< 100us
	97.0
Forward Sweep	7.5us +/-1.0us
	8.1
Radiated Power	> 26 dBm
	29.3
Recovery Time	<= 10 us
	9.2

Figure 8. Results from the bench test's spectrum analyzer.

The manufacturer then conducted the OTW portion of testing in Sandefjordsfjorden. The OTW testing consisted of operating the beacon at two different land locations with a stationary X-band radar system at a third, stationary location. In "position A" the SART was placed approximately 1 NM from the stationary X-band system, and in "position B" the SART was placed approximately 0.4 NM from the X-band system. The stationary X-band system was a Raymarine E120 4kW X-band system. One NSIA representative and the representative from Seacor Marine was placed on the stationary X-band radar system, and another NSIA representative was placed with the beacon. In both positions the beacon was activated and the radar image response was documented at the stationary system. The height of the beacon at "position A" was approximately 1 meter above sea level and the height of the beacon at "position B" was approximately 3 meters above sea level. Figure 9 shows the radar's display at "Position A" and figure 10 shows the radar's display at "position B." Both displays showed the appropriate response at the given distance (a 12 striped converging cone at distances > 1 NM and a series of 12 concentric circles at a position < 0.4 NM).

Figure 9. The radar's display at "position A." Note one image shows the radar display's range rings set to 6 NM, and the other to 12 NM.

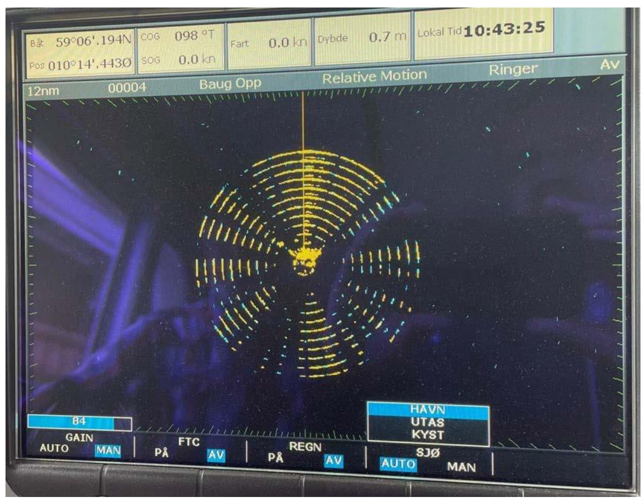

Figure 10. The radar's display at "position B." Note the image shows the radar's display's range rings set to 12 NM.

The manufacturer stated the OTW portion of the test returned nominal results.

The manufacturer's report also discussed "Radar detection issues" which they stated applied not only to the accident SART, but all SARTs in general as the principals of the operation are defined by the same standards. The manufacturer stated that radar system gain, anti-sea clutter, chart overlay options and range display options all effect the ability to detect SART devices, and that having improper settings, or improper range display, may make detection more difficult or impossible. The manufacturer's report also discussed SART activation height and stressed that the SART device will "normally be mounted in a bracket or mounted on a telescopic pole when activated. It can also be hung in a lifeboat/life raft by a mounting strap or placed in a 'SART pocket.'" The report also described an additional test point conducted at "position B" in which the SART was activated by holding the device by hand at the antenna portion. The manufacturer noted that the "transmitted signal can be reduced with as much as 20 dB if holding the SART20 in the antenna." The report showed a picture of the radar display at this position showing signal reception degradation, but still a detectible return from the SART.

The manufacturer's report concluded that SART20 behaved normally in both bench and OTW testing conducted in Norway and that the device was performing according to specification (IEC 61097-1). The manufacturer recommended retesting the device using information from chapter 4 of the user's manual which defines detection practices, specifically related to gain and range control of the radar system. The manufacturer's test report is attached to this report as Attachment 4.

Follow on Pierside Testing with USCG – December 2021

In early December 2021, the NTSB revisited the USCG station to conduct pierside testing of the SART after it had been returned from Norway. Prior to the test, the beacon was disassembled, the battery tested, and the unit tested for activation and the device returned to service. The pierside test consisted of setting the SART on a tripod in a field next to a USCG 29-foot boat with a SINS-2 electronics package. The SART was placed on the tripod in proper orientation with the antenna side toward the sky, and no obstructions between the SART antenna and the 29-foot boat's radome. The SART was activated. After activation, range rings of the radar were set to 6NM, gain and clutter settings were adjusted on the radar system. Shortly after activation, the radar system displayed the appropriate response for a closely placed SART (concentric rings appear on the display). Figure 11 is a photograph of the radar display during pierside testing. In the photo, the radar displays rings were set to a range of greater than 12 NM. Additionally, the gain and clutter settings were changed, and variants of the same pattern were detected on the radar display. The range remained set at greater than 12 NM. Figure 12 is a photograph of the radar display with gain and clutter settings changed.

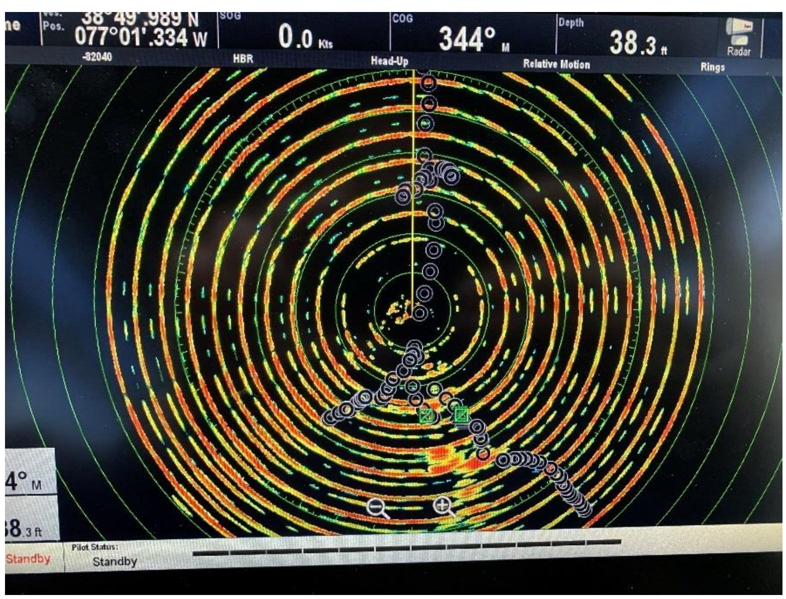

Figure 11. A picture of the display of the pierside radar system with the range rings set to > 12 NM and the gain and clutter settings adjusted to maximize the return of the SART system.

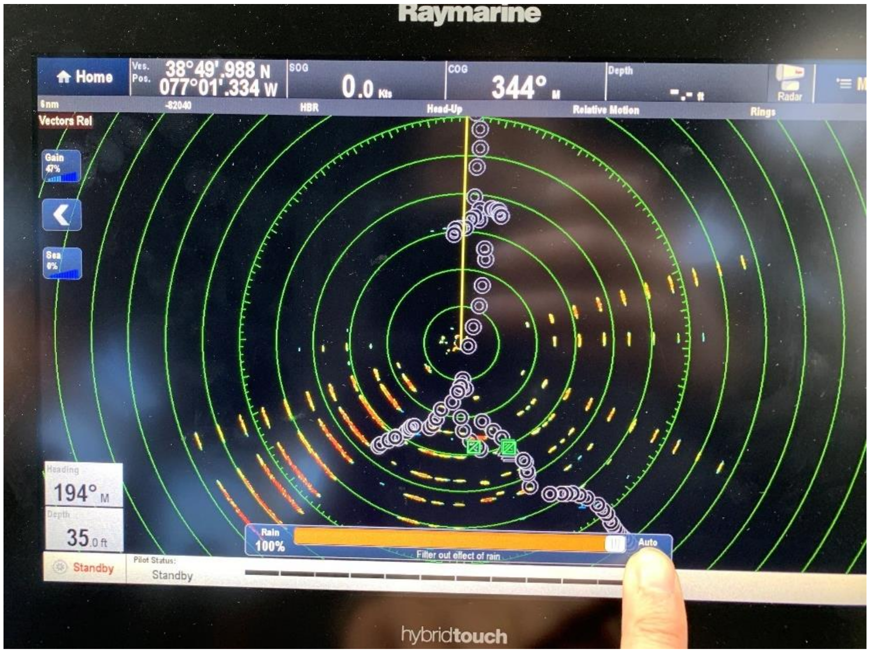

Figure 12. A picture of the display of the pierside radar system with the range rings set to > 12 NM. The gain and clutter settings have been adjusted to minimize the return of the SART system.

Follow on OTW Testing with USCG

Updated test procedures were developed that considered radar range, gain and clutter setting changes to best receive the SART. The test was conducted in February 2022 on the Potomac River. Instead of a third vessel being used to hold the SART, the SART was placed on Haines Point, an area of land that would minimize land reflections and was similar to the position used in the Norwegian test at the manufacturer's facility. The SART was placed on a tripod in an antenna skyward orientation at a height of approximately 3 m above sea level. Only one USCG vessel was on the water to receive the signal during this test.

Different USCG personnel from the initial test were utilized. The USCG personnel involved in the test were not notified of the effects of range, gain and clutter settings on the reception of the beacon. Instead, the personnel were instructed to use the test plan, and any variance outside of the test plan would be noted.

The SART beacon was once again not displayed using the radar's standard settings. After NTSB personnel onboard the vessel familiarized the USCG personnel and adjusted the gain and range settings on the radar, the SART appeared at close range. Figure 13 shows a set of concentric rings indicating the SART had been received. In this photo, the gain was set to auto, the range was set to properly display the SART and sea and rain clutter settings were set to "0%." Adjusting the range settings to an appropriate level to show features in the area the vessel was navigating caused the concentric rings to disappear from the display. Additionally, as the vessel increased distance from the beacon (to ranges outside of 0.4 NM), the SART became more difficult to receive, likely due to land reflection and range issues. Only at extremely high gain settings, with the range set properly, was the SART able to be received at distances further than 0.4 NM in this particular location. A picture of the radar display at this time is shown in figure 14.

The updated OTW test plan for the February 2022 test has been attached to this report as Attachment 5.

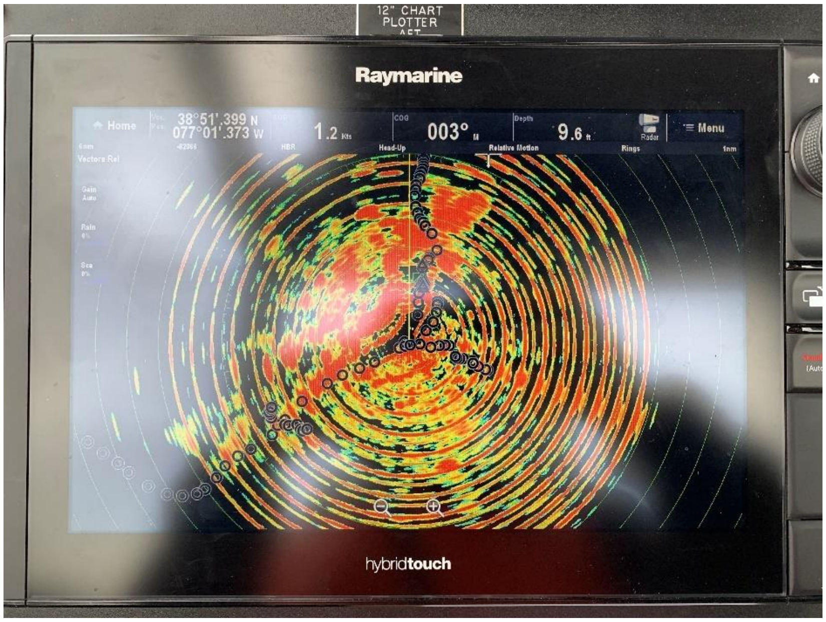

Figure 13. A picture of the radar display of the USCG vessel's radar display detecting the SART at close range.

Figure 14. A picture of the radar display of the USCG vessel's radar display detecting the SART at a range greater than 0.4 NM and with the gain setting adjusted to 92%. The SART return has been annotated in yellow.

Airborne Reception Test with USCG – February 2022

A request was made by USCG personnel involved in the investigation to test the reception of the SART beacon using a USCG aircraft. Some USCG aircraft are equipped with X-band radar systems that can theoretically detect a SART beacon. The Atlantic City Air Station detachment at Washington National/Reagan Airport was contacted to support the test using a X-band radar equipped MH-65C Dolphin helicopter. The MH-65C used in this test was equipped with an RDR-1300C X-band radar system. The RDR-1300C is an airborne X-band radar that provides detection of surface targets at short range, ground mapping to enhance navigation, and long-range weather surveillance for storm avoidance or penetration. The radar system has a number of search modes that essentially equate to clutter settings as well as a gain adjustment knob. The test was conducted on the Potomac River in the vicinity of Fort Washington, Maryland, which was selected due to its geography that could minimize land reflection and it's position relative to restricted Washington, D.C., airspace.

For safety reasons, the USCG aircrew was specifically briefed on the operation and best practices to detect the SART beacon. A set of specific test points were designed to maximize operational safety of the helicopter and the chance of a successful reception of the beacon. These cards were supplied to the USCG aircrew prior to the test and were briefed prior to the flight by NTSB personnel. The SART beacon was placed on a tripod approximately 3 m above sea level, with the antenna facing skyward. The USCG helicopter flew the test points as described on the test cards and was able to successfully receive the beacon. The test cards are attached to this report as Attachment 6. Figure 15 is a photo of the MH-65C's radar display showing a successful reception of the beacon. Note that the RDR-1300C radar system is forward looking, and is unable to display concentric rings displayed from an activated SART at close ranges.

Figure 15. A picture of the MH-65C's RDR-1300C radar display when receiving the SART.

USCG SART Familiarity

Only a small cross section of USCG personnel was utilized in the OTW testing and the personnel stationed at the JBAB Coast Guard station do not necessarily have a SAR mission. The training records of the personnel used at the JBAB USCG station used for the OTW testing were not evaluated. The airborne personnel, however, were trained in USCG SAR procedures.

Familiarity - OTW Testing

Boat crews used in OTW testing supplied by the USCG detachment at Joint Base Anacostia Bowling (JBAB) were not immediately familiar with SART beacons. The majority of the personnel used in the OTW testing from the JBAB detachment did not know what a SART beacon was. Additionally, the few personnel that stated they were familiar with the SART beacon, confused a SART's operation with that of a radar reflector. No personnel that the author of this report spoke to at the JBAB detachment was familiar with the exact functionality, operation, or detection of SART beacons.

In the initial OTW test, the USCG personnel who operated the radar system did not adjust range, gain or clutter settings on the 29-foot boats to successfully detect the SART beacon. During the follow up testing, while the test plan did define potential adjustments that needed to be made to the radar display to receive a SART beacon, the personnel used in the test did not suggest adjustments to the radar system during the test to receive the SART beacon. Instead, the NTSB personnel onboard for the follow up OTW testing adjusted the radar settings to successfully receive the beacon as per instructions from the manufacturer.

Familiarity - Airborne Testing

The pilot contacted to coordinate the airborne test at the Washington National/Reagan Airport detachment was not immediately familiar with the operation or functionality of a SART beacon. The pilot, at first confused the SART beacon's operation with that of an EPIRB. NTSB personnel began correcting the officer about the differences between SARTs and EPIRBS, and the officer then recalled what a SART beacon was. The officer was still not explicitly familiar with the device's operation after some conversation.

The aircrew that was assigned to and performed the airborne testing was not familiar with SART beacons. The aircrew stated that they do not recall having an experience with a SART beacon in the past, nor do they recall being trained on what vessels are required to carry SART beacons, how SARTs may be deployed or how they are detected. Once the functionality of the SART beacon was described to the aircrew, the aircrew had an understanding of how to use the RDR-1300C to search for the beacon but did not specifically mention adjusting gain, search or range settings to better detect the SART beacon.

When the airborne testing was conducted, and the SART beacon was received on the RDR-1300C display for the first time, one of the aircrew participating in the test stated, *"had I seen this on my radar display and not known what it was, I would have written up the radar system for maintenance."* The aircrew completed the test using the test card properly and were able to receive the SART beacon during various test points.

Fireboat (*John Glenn)* Familiarity

The operators on the *John Glenn* did not modify radar settings to successfully receive the SART beacon.

SART Maintenance Records

SART maintenance records provided by Seacor Marine were viewed. The records listed the following inspection criteria for the beacon:

- Verify location per Fire/Safety Plan and proper mounting of bracket
- Verify that the instructions for use are posted
- Utilizing instructions, verify that the SART can be removed from the bracket for use
- Follow the manufacturer's testing instructions
- Verify battery life

Additionally, the operator provided an inspection record dated April 1, 2021. Figure 16 is an excerpt from a "Lifesaving Appliance Inspection Checklist" that shows the noted items related to the inspection of the SART.

2	**Search and Rescue Transponder(s) (SART)**	
2.1	How many SARTs are available?	2
2.2	Date SART(s) last tested.	03/05/2021
2.3	Each SART is located as per the Vessel's Lifesaving Equipment Plan.	pass
2.4	Each SART is operating as intended and within expiry date.	pass
2.5	Additional Comments	None at this time

Figure 16. An excerpt from the Lifesaving Appliance Checklist, as supplied by the operator.

Visual and Audible Alerting

Resolution A.802(19), Performance Standards for Survival Craft Radar Transponders for Use in Search and Rescue Operations defines performance standards for SART devices. Section 2.1.3 states the following:

- Be equipped with a means which is either visual or audible, or both visual and audible, to indicate correct operation and to alert survivors to the fact that a radar has triggered the SART.

Section 5.1 of the SART20 operations manual describes how to activate the SART. The manual states, "Pull locking pin and make sure that the switch enters the "ON" position. An audible "BEEP" will be heard and the indicator LED will start to flash every 4 sec."

When activated in the laboratory, the following was observed:

- The "BEEP" measured about 45-50 dB[2] when the SART was activated.
- The sound of the locking pin being removed measured about 80 dB[3] when the SART was activated.
- The L.E.D consisted of a single red L.E.D behind a translucent ring in the area of the device's bottom lid. The L.E.D faces one direction and the translucent area of the device's bottom lid permits visual observation from some, but not all viewing angles to the device, depending on lighting conditions.
- The L.E.D flashed once every four seconds upon activation.

When the SART was activated under live test conditions, the following was noted:

- The "BEEP" sound level was unable to be measured due to ambient noise environment.
- The "BEEP" became an uninterrupted tone at times (at the same frequency), and the L.E.D flashed more rapidly.
- The User's manual does not specifically describe the characteristics of the visual and audible alerting mechanisms when the device is receiving/responding to a radar signal.

In general, the ground crew operating the SART during the various tests conducted described the visual and audible alerting as "not obvious" and discussed the possibility of hearing the audible portion of the alert in adverse weather conditions.

2.6. Attachments

Attachment 1: IMO Resolution A.802(19),

[2] Measurement was taken at a distance of 1 foot and were uncorrected.
[3] Measurement was taken at a distance of 1 foot and were uncorrected.

Attachment 2: Manual Tron SART20

Attachment 3: Initial OTW Test "NTSB SART Test Plan" – June 2021

Attachment 4: Manufacturer's test report from Bench/OTW testing in Norway – September 2021

Attachment 5: Updated OTW Test Plan – February 2022

Attachment 6: USCG Airborne Reception Test – Kneeboard Test Cards