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Agenda item [[2]](#footnote-2) n.n

Technical Domain / Task Number 2 WG3 TG-3.3

Author(s) / Submitter(s) CHINA MSA

Proposal on R0101 MARINE RADAR BEACONS modification

# Summary

This paper directs at IALA Recommendation R0101 MARINE RADAR BEACONS gives a proposal for racon upgrade.

## Purpose of the document

The paper provides some suggestions on R0101 modification and racon upgrading for the committee to consider.

## Related documents

R0101 Marine Radar Beacons

R0146 Srategy for Maintaining Rccon Service Capability

ENG15-3.1.3.3 Introduction to the tests information on next generation Racon

# Background

## Possible problems raised by the application of solid-state radar

At the end of the 20th century, solid-state radar technology was introduced into maritime sector as navigation radar. Compared with traditional magnetron radar, solid-state radar has the advantages of strong anti-jamming ability, strong anti-rain and fog ability, high resolution, maintenance free and low radiation etc. Due to the technological advantages, solid-state radars have been applied on increasing numbers of vessels, and widely equipped on MASS as well.

However, because the peak power of the new solid-state radar signal is much smaller than that of traditional radar, and due to the new signal processing method, the new technology solid-state radar cannot trigger the current racon. With the increasing number of users of solid-state radar, if racons still cannot respond to solid-state radar, it may bring potential risks to navigation safety in the future.

## ERPS System

IALA has been making great efforts for the development of ERPS. According to several ERPS experiments results, the signal feedback effect of ERPS is not ideal because of the single frequency of the traditional magnetron radar. However, this problem may be solved with the widespread application of solid-state radar with much wider range of frequency band, provided that the racon is upgraded in time to meet the corresponding technical requirements of solid-state radar.

## IMO

IMO has published regulations about racon on Nov 19, 1987 by IMO Resolution A.615(15).

The ANNEX 2 of Resolution A.615(15) states as follows:

***“2. Operating frequencies***

*2.1 Radar beacons designed to operate on a wavelength of 3 cm should be capable of being interrogated by any navigational radar equipment operating on any frequency between 9,320 MHz and 9,500 MHz and respond within this frequency band.”*

## IALA

## At ENG16, it was decided to include upgrading of IALA's recommendations and guidelines on racons in the work plan of 2023-2027.

# Discussion

## Next generation radar beacon test

In March 2021, CHINA MSA carried out an experiment on the availability of a new type of racon (please refer to: ENG15-3.1.3.3 Introduction to the tests information on next generation Racon). The test results indicate that this new type of racon can respond not only to the traditional magnetron radar, but also to the new technology solid-state radar, including FM continuous wave radar and pulse compression radar.

Again, the test in October 2022 showed that the response range of the new generation racon exceeded the practical response range of 10 nautical miles. (Refer to IALA 2023 Conference paper: "184 Paper New Generation Racon in an Increasingly Autonomous World")

On 23 August, 2023, the sidelobe suppression function of the new generation racon was further tested at the seaside of Hangzhou Bay in Shanghai, China. The experimental location was the same as the testing location in October 2022: the pulse compression radar Halo-3 was installed at the same location on the top of a residential building on the shore (see Figure 1 PC radar). This time, a continuous wave radar 4G (see Figure 2, CW radar) was installed on the left side of the pulse compression radar. The horizontal distance between the two radars was about 15 meters, and the continuous wave radar was about 4 meters higher than the pulse compression radar.

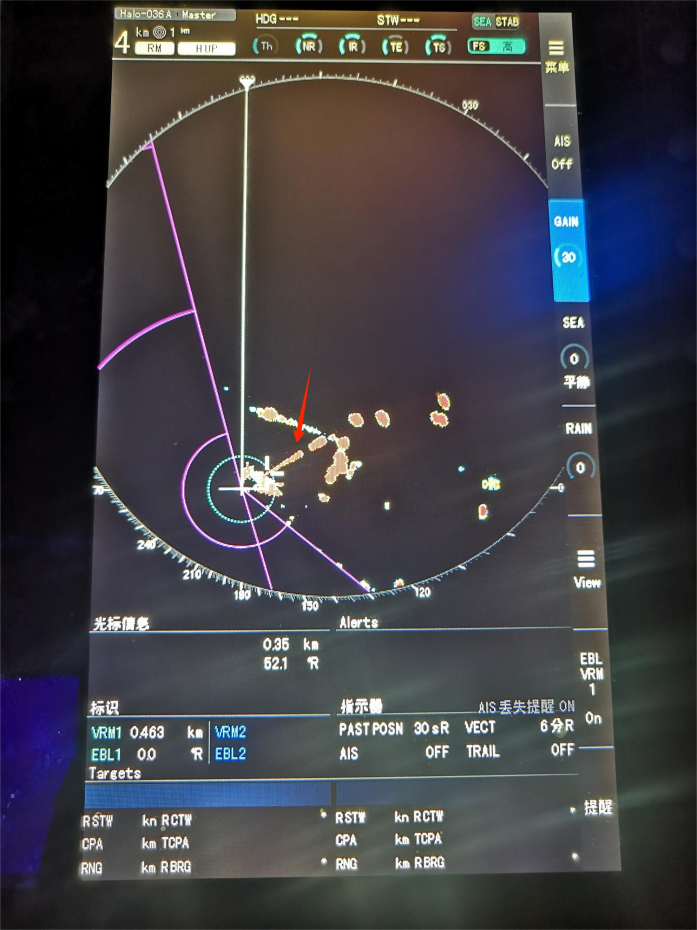
The racon was installed on the seawall to the south of the radar (see Figure 3).



*Figure 1 PC radar Figure 2 CW radar Figure 3 NT racon*

The cursor position of the pulse compression radar shows that the distance between the radar and the racon is approximately 0.35kms (0.19nms) (Figure 4, PC radar screen)

During the experiment, both radars were turned on and working simultaneously. The Morse code "N" appears simultaneously on both radar screens and was clearly visible (Figure 5, CW radar screen). However, no sidelobes were found on the radars throughout the entire experimental period.



*Figure 4 PC radar screen Figure 5 CW radar screen*

Traditional racons might be triggered by the radar at a distance of approximately 0.5 nms or less, thereby interfering with the display of the radar screen. (See IALA Recommendation R0101 Marine Radar Becons(RACONS))

The distance between the radar and the racon in this experiment was only about 0.19nms, and no sidelobe phenomenon was found on either radar. The new generation of racons, through a "natural" processing method, receive weak radar signals (or radar signals reflected by ships and other objects) and reply with weak signals, utilizing the radar's own sidelobe suppression function to achieve sidelobe suppression.

Thereby, it has been proved that racon upgrading is technical feasible. However, racon upgrade cannot be done only with technical solutions, it is essential to obtain support from technical standards and normative documents of relevant organizations, so as to remove obstacles for the development of technology and industry.

## Suggestions for R0101 Modification

The following changes to R0101 are proposed for the ENG committee:

1. Add a line "4 Compatibility" to the fourth item (Response) in Part 1 and Table 1, which reads: "the design of a racon should be compatible with all types of conventional and NT radars.".

This sentence is actually described in part 5.4 of *IALA R0146 STRATEGY FOR MAINTAINING RACON SERVICE CAPABILITY*.

1. Add the following sentence at the end of **A 3.3. SIDELOBE SUPPRESSION** in PART 3: “Or by using radar’s sidelobe suppression function to suppress the rest - the racon replies with weak signals upon receipt of weak signals.”
2. To the end of PART 3，add：

“A 3.7 Multi radars and busy harbor

Racon should be able to respond to multi radars at the same time and suitable for working at busy harbors.”

The 2015 Singapore experiment showed that conventional racons perform poorly in busy harbours (see IALA,ENAV20-13.11-On-Racons-in-Busy-Harbours-24-February-2017). Therefore, the new generation racons need to adopt new technological solutions to adapt to the working scenarios of busy ports.

# References

1. IMO Resolution A.615(15)
2. IALA ENAV20-13.11-On-Racons-in-Busy-Harbours-24-February-2017

# Action requested of the Committee

The ENG Committee is invited to consider the information provided in this document and upgrade the Recommendation R0101 on racon.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)