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Agenda item [[2]](#footnote-3) 3.1

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Proposal on Promoting the Standardization of ERPS

# Summary

This paper shares the research information about ERPS in China, and proposes a roadmap to promote the standardization of Enhanced Radar Positioning System (ERPS). This paper points out that it is necessary to sort out relevant IALA documents in terms of racon and start the revision work, which could be included in the *Work Programme for Committees 2023-2027*.

## Purpose of the document

Share the research information about ERPS in China.

Propose to review R0101 Recommendation, and add the reviewing task into Work Programme for Committees 2023-2027.

## Related documents

R0101 MARINE RADAR BEACONS (RACONS)

R0146 STRATEGY FOR MAINTAINING RACON SERVICE CAPABILITY

G1010 ED2 RACON RANGE PERFORMANCE.

# Background

On the first half of 2022, the drafting work of *G1147-THE USE OF ENHANCED RADAR POSITIONING SYSTEMS* was completed by ENG WG3 TG-3.3 on ENG15, and then approved by 75th IALA Council.

The guideline provides ERPS technical information, installation suggestions and ERPS signal specification etc. for mariners and manufacturers. Additionally, it demonstrates the challenges that ERPS faces today.

According to the discussion of TG-3.3, racon is deemed as an important role for maritime safety. In order to promote the development of racon and achieve the standardization of ERPS, it is necessary to further expand the application and popularization of the racon services like ERPS, especially in the upcoming era of MASS, and to introduce relevant information to IMO, CIRM and other organizations.

TG-3.3 also notes that the document such as R0101, G1010 and R0146 may outdated. The relevant follow-up work will be discussed at ENG16 meeting.

# Discussion

## ERPS Research

1. Unlike the traditional magnetron radar only has one narrow-band signal, solid-state radar emits about 4-6 signals of different frequency bands and different waveforms, and most of the signals are FM signals. The time width of the solid-state radar signal is also much larger than that of the magnetron radar signal (usually nanosecond to about 1us). The longest time width of the pulse compression solid-state radar signal is about 100us. The signal time width of continuous wave solid-state radar is more than 1 ms.
2. In view of the above reasons, the racon cannot respond to the solid-state radar signal using the traditional "receive - compare & judge - reply" response mode. Because the radar emits a variety of signals, but the racon cannot know which is the effective signal, so if the racon only replies some signals, it is likely to be ignored because they are invalid signals. Therefore, only when the radar beacon can reply to each received signal with as little delay as possible can the morse code of the racon be displayed on the radar screen.

This is also the working principle of the new generation of racons.

1. The first paragraph of A1 of G1147 states "The eRacon does this by embedding a data packet in the leading dash of a standard racon Morse code response". As a result of such processing, the Morse code becomes obscure. (See the third paragraph of ANNEX B of G1147: The trial also found that modulation of the eRacon signal can be visible on radar displays e.g. "fuzzy" traces). The main reason is that the "1" in the data packet is realized by adding 15M to the carrier frequency, that is, the radar frequency (see the fourth row of A3 of G1147). When the radar receives a signal with an increased frequency of 15M, it is likely to be filtered out as clutter, so it will not be displayed on the radar screen, and the "dash" of Morse code will become blurred.
2. Furthermore, one bit of the data packet needs to occupy a signal time width of 200ns (see the third line of part A3 of G1147). A complete data packet is 14 bytes (see part A2 of G1147), or 112 bits (14x8), that is, 22.4us (112x0.2us) This is equivalent to the display length of 3360m (22.4x150m) radar screen. 3360m is generally far more than the first "dash" of Morse code. This will make the display of the first 3360m Morse code blurred or even inaccurate.
3. For the solid-state radar, to add 15M on the frequency of the signal artificially, if the modulated signal exceeds the bandwidth of the solid-state radar signal, it will also be ignored by the solid-state radar; If the modulation result is still within the bandwidth of the radar, some disordered bright spots may be displayed on the radar screen.

Therefore, it is not appropriate to encode the data packet into the "dash" at the beginning of the standard Morse code. That is to say, it is necessary to separate the Morse code response function and the ERPS ranging function of racon.

## Lesson learned

To sum up, in order to achieve an effective ERPS system, the following methods should be considered:

1. ERPS needs to adopt a special frequency band, which is separate from the radar detection channel. For example, X-band radar detection uses 9.3-9.5G frequency band. Can ERPS use 9.20-9.28G frequency band
2. An ERPS function button is added to the radar, which can be turned on when necessary to transmit the signal of special frequency of ERPS to trigger the reply of eRacon.
3. The frequency band of ERPS shall be as wide as possible so that the radar can freely select the transmission frequency and reduce the probability that different radars use the same frequency.
4. The solid-state radar is to be used because the signal transmission frequency of the solid-state radar can be adjusted independently within the frequency band.
5. Racon Morse code response function and ERPS function are separated. The ERPS function of racon can be set as the user-selectable mode, that is, the user-selectable mode defined in item 2.1.2 of IMO A.615 (15). Because racon does not reply Morse code in ERPS state, the ERPS function mode is the last one described in section 2.1.2 (. 2.3 not be shown on the radar display), that is, no display is made on the radar screen.
6. The signal of the enhanced radar positioning system can be a simple pulse signal.

## Information of China transportation industry standard Navigation radar on inland waterway vessels

See Annex 1 for details.

## A proposed roadmap of promoting ERPS standardization

According to the above research results, ERPS effectively adapt to new technology radar like solid-state radar, while the wide application of the new technology radar is based on upgrading the performance of the existing racon. Thus, in order to promote the standardization of ERPS and upgrade of existing racon, the suggestions from following roadmap can be incorporated into the previous ERPS standardization roadmap.

1. Review the current R0101 Recommendation to upgrade the technical standards of radar beacons so as to be able to respond to new technology radars. See ANNEX2 for *Draft Proposal on R0101 MARINE RADAR BEACONS modification*.
2. During 2023-2027 period, more workshops on ERPS should be hold which IALA could invite relevant members of racon and radar manufacturers to discuss the standardization issue of ERPS.
3. ERPS tests could be conducted by interested party to improve the ERPS standards through continuous testing and improvement until practical requirements are met. ERPS test information and any work progress information could be gathered by IALA and shared with sister organization.

# References

1. IALA WORKSHOP ON ENHANCED RADAR POSITIONING SYSTEM STANDARDIZATION
2. G1147-THE USE OF ENHANCED RADAR POSITIONING SYSTEMS

# Action requested of the Committee

The Committee is invited to consider the information and take actions as appropriate.

1. Annex1：Information from China transportation industry standard: Navigation radar on inland waterway vessels
2. Annex2：Draft Proposal on R0101 MARINE RADAR BEACONS modification

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)