*International Civil Aviation Organization*

**Ninth Meeting of the ICAO Asia/Pacific Search and Rescue Working Group (APSAR/WG/9)**

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**Agenda Item 4: Asia/Pacific and inter-regional SAR planning, coordination and cooperation**

# OPTIMISING HOMING OPERATIONS FOR 406 MHZ DISTRESS BEACON AND AUTOMATIC IDENTIFICATION SYSTEM (AIS) SIGNALS

(Presented by Australia)

**SUMMARY**

This paper presents some considerations which may assist Rescue Coordination Centres (RCCs) and search and rescue (SAR) agencies to optimize the deployment of SAR units capable of receiving and interpreting 406 MHz distress beacon transmissions, plus some general considerations regarding homing operations for maritime radio equipment which transmit an Automatic Identification System (AIS) signal with freeform number identities.

## 1. INTRODUCTION

1.1 Rescue Coordination Centres (RCCs) play an important role in the support of 406 MHz homer equipped SAR units to optimise their effectiveness when deployed for 406 MHz distress beacon homing missions.

1.2 Australia has observed that, on occasions, the specific 406.0 to 406.1 MHz radio frequency detected and reported in initial Cospas-Sarsat SIT185 messages may be different to the specific radio frequency detected and reported in later SIT185 messages for the same 406 MHz distress beacon. It is important during SAR operations that RCCs monitor the frequency reported in SIT185 messages and notify SAR units that have been deployed with a 406 MHz homing capability of any change to the briefed 406 MHz frequency to enable those units to optimise their homing performance.

1.3 Now that EPIRB-AIS and PLB-AIS distress devices are available that transmit both a 406 MHz and an Automatic Identification System (AIS) signal, it is important that RCCs carefully brief deployed SAR units that are equipped with both a 406 MHz homing and an AIS receiving capability to ensure that any AIS targets received by those SAR units are correctly correlated and identified. RCCs and SAR units need to consider that other maritime radio equipment that transmit an AIS signal may be operational in the search area, including AIS-SART (search and rescue transponder) and man overboard (MOB) distress devices, which use similar identities and symbology.

## 2. DISCUSSION

Some 406 MHz beacon homing considerations

2.1 When RCCs are considering deployment of SAR units on mission tasks to home to the location of 406 MHz distress beacons, the most appropriate SAR unit is normally one capable of

detecting both the digital 406 MHz radio signal as well as the analogue 121.5 MHz (and for some units the 243.0 MHz) homing signal.

2.2 Although homers with only a 121.5 MHz (and sometimes 243.0 MHz) homer are suitable, they do not offer the additional advantages that a 406 MHz homer provides. However, to take advantage of the additional capabilities that a 406 MHz homer offers, the 406 MHz frequency of the homer receiver must match the 406 MHz frequency of the transmitting beacon. This is important noting that there are different 406 MHz frequencies (channels) for type approved beacons according to the *Cospas-Sarsat 406 MHz Channel Assignment Table*, C/S T.012 Issue 1 Rev. 18 (cospas-sarsat.int), ANNEX H, which currently allows for beacons to transmit on 406.025 MHz, 406.028 MHz, 406.031 MHz, 406.037 MHz, 406.040 MHz and from 1 January 2025 on 406.076 MHz.

2.3 Some homing systems require the beacon's specific 406 MHz frequency to be manually selected to enable reception of that beacon's 406 MHz digital data. It is therefore important that the RCC provides the SAR unit crew with the frequency reported by the SIT185 message so that the homer operator can preset that frequency into the homing equipment to receive the beacon's 406 MHz signal and decode the beacon's transmitted data.

2.4 There are also homing systems which automatically scan the distress beacon 406.0 - 406.1 MHz frequency band and lock onto the 406 MHz beacon signal when received. Although these systems don't rely on the crew knowing the specific 406 MHz frequency of the beacon being searched for, it is suggested as good technique that the RCC provides the crew with the frequency reported by the SIT185 message for cross-checking with the frequency detected by the homer. It is also suggested as good technique that the crew is briefed to periodically reset the homing system to scan mode to allow for the possibility of another beacon transmitting in the search area.

2.5 For all 406 MHz homing systems, it is also important that the RCC provides the SAR unit crew with the beacon HEX ID and also briefs the crew that when they receive the 406 MHz signal they should cross-check that the HEX ID matches. This may help in the management of situations where more than one beacon is active, or becomes active, in the search area and that the correct beacon is identified.

406 MHz homing capability advantages

2.6 SAR units with a 406 MHz homing capability can directly receive and interpret important data transmitted by a 406 MHz distress beacon well before its arrival at the beacon location.

2.7 For a 406 MHz distress beacon that transmits its GNSS position, some benefits include:

a) The crew can receive the latest GNSS position directly from the beacon and track directly to it. This is particularly important for a moving beacon such as one drifting at sea and can save critical minutes (and SAR unit track miles) in reaching survivors. It may also improve the crew's ability to intercept the beacon's 121.5 MHz (or 243.0 MHz) homing signal more efficiently.

b) Early detection of the beacon's GNSS location by the SAR unit while it is in transit allows the crew to relay the latest position to other units not equipped with a homing capability that may be closer to the distress location, potentially improving the other unit's ability to conduct an earlier rescue.

c) The receipt of the GNSS position directly from the beacon provides the crew with an instantly updated beacon position without needing to wait for a delayed position update to process via the Cospas-Sarsat system to the RCC for relay to the SAR crew. This is particularly important in situations where communications are poor.

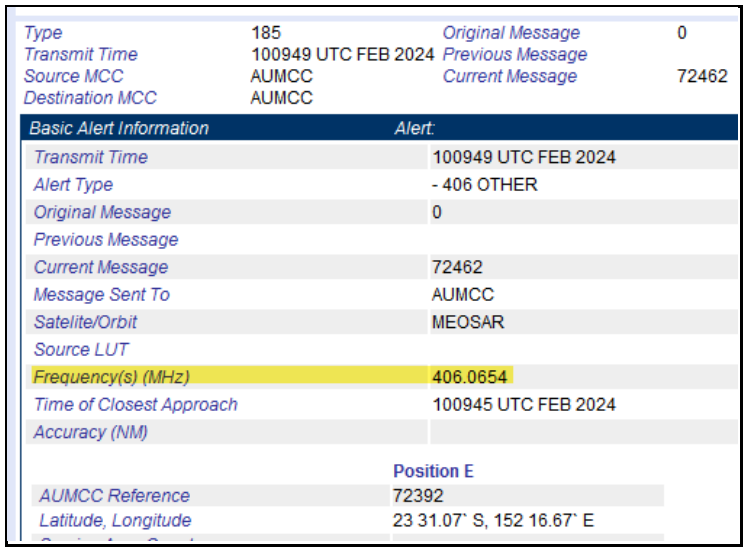
2.8 The SAR unit may receive the beacon's HEX ID and other identifying information allowing verification of the beacon identification, and the ability to distinguish individual beacons in situations involving multiple 406 MHz beacons.

2.9 The 406 MHz transmission itself, although only a very brief transmission every 50 seconds, may provide some early directional information to be displayed on the SAR unit's homer prior to receipt of the 121.5 MHz or 243.0 MHz homing signal.

406 MHz distress beacon frequency stabilisation

2.10 A recent example of a 406 MHz distress beacon frequency change is shown below, sourced from the JRCC Australia SAR incident management system:

a) The first SIT185 message reported frequency detected on 406.0654 MHz.

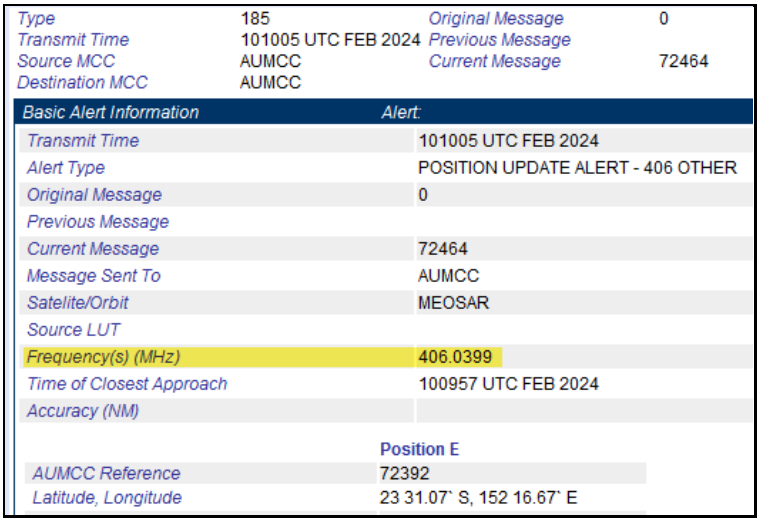


| | | | |
|---|---|---|---|
| Type | 185 | Original Message | 0 |
| Transmit Time | 100949 UTC FEB 2024 | Previous Message | |
| Source MCC | AUMCC | Current Message | 72462 |
| Destination MCC | AUMCC | | |

| Basic Alert Information | Alert: |
|---|---|
| Transmit Time | 100949 UTC FEB 2024 |
| Alert Type | - 406 OTHER |
| Original Message | 0 |
| Previous Message | |
| Current Message | 72462 |
| Message Sent To | AUMCC |
| Satelite/Orbit | MEOSAR |
| Source LUT | |
| Frequency(s) (MHz) | 406.0654 |
| Time of Closest Approach | 100945 UTC FEB 2024 |
| Accuracy (NM) | |

| | Position E |
|---|---|
| AUMCC Reference | 72392 |
| Latitude, Longitude | 23 31.07` S, 152 16.67` E |

b) SIT185 message 16 minutes later reported the frequency had changed to 406.0399 MHz.



| | | | |
|---|---|---|---|
| Type | 185 | Original Message | 0 |
| Transmit Time | 101005 UTC FEB 2024 | Previous Message | |
| Source MCC | AUMCC | Current Message | 72464 |
| Destination MCC | AUMCC | | |

| Basic Alert Information | Alert: |
|---|---|
| Transmit Time | 101005 UTC FEB 2024 |
| Alert Type | POSITION UPDATE ALERT - 406 OTHER |
| Original Message | 0 |
| Previous Message | |
| Current Message | 72464 |
| Message Sent To | AUMCC |
| Satelite/Orbit | MEOSAR |
| Source LUT | |
| Frequency(s) (MHz) | 406.0399 |
| Time of Closest Approach | 100957 UTC FEB 2024 |
| Accuracy (NM) | |

| | Position E |
|---|---|
| AUMCC Reference | 72392 |
| Latitude, Longitude | 23 31.07` S, 152 16.67` E |

2.11 The Cospas-Sarsat technical specifications C/S T.001 - Issue 4 - Rev. 11 (cospas-sarsat.int) define the frequency performance requirements (Section 2.3 Modulator and 406 MHz Transmitter, and sub-section 2.3.1 Transmitted Frequency).

2.12 From an operational perspective the 406 MHz distress transmission (carrier frequency) will commence 50 seconds after beacon activation, however potentially it may take up to 15 minutes for the beacon to warm up and the carrier frequency to stabilise compared to what was initially transmitted and detected.

2.13 After a review of several Australian distress beacon incidents, the detected carrier frequency appeared to stabilise immediately for most beacons, with some appearing to stabilise within a matter of minutes (from 2 to 15 minutes). It is beneficial to note, as outlined in the Cospas-Sarsat technical specifications, that the initial beacon carrier frequency stability may be impacted by environmental factors such as temperature and age of the beacon. Thermal shock may delay the beacon reaching its stabilised carrier frequency, for example relocating a beacon from a cabin into the water and activating it, and beacons older than 5 years may have variable frequency stabilisation.

2.14 It is therefore possible that the 406 MHz frequency originally briefed to the SAR unit may change so it is important that the RCC monitors further SIT185 messages for any change to the 406 MHz frequency and that any frequency change is relayed to the SAR unit crew.

Upgrading SAR Unit 406 MHz Homing Equipment

2.15 As noted in paragraph 2.2, new 406 MHz beacon channels periodically become available for assignment to new beacon models. It is therefore important for SAR agencies to confirm that their SAR units upgrade their existing 406 MHz homing system equipment to ensure they are ready to receive and interpret new channels before beacons with the new channels become available.

Homing operations and maritime radio equipment that transmits an AIS signal

**2.16 406 MHz EPIRBs and PLBs with AIS (EPIRB-AIS and PLB-AIS)**

a) RCCs should be aware that there are now 406 MHz EPIRB-AIS and PLB-AIS which transmit an AIS signal containing a freeform number identity (AIS User ID) in accordance with Recommendation ITU-R M.585 (Annex 2, section 2). SAR units equipped with AIS capability should be briefed to monitor for this. The 121.5 MHz and AIS transmissions will interleave.

b) It is critical that RCCs and SAR units recognize that the AIS signal of an EPIRB-AIS or PLB-AIS contains a freeform number identity that indicates the identity of these AIS devices, and not the Maritime Mobile Service Identity (MMSI) of the ship.

c) When within communication (detection/homing) range of an EPIRB-AIS or PLB-AIS, the SAR units with AIS receiver capability should receive the AIS safety related broadcast (message 14)[1] which includes the 9-digit AIS User ID (in the format 974xxyyyy for an EPIRB-AIS and 972xxyyyy for a PLB-AIS) and 15-character HEX ID. This will assist the SAR unit crew when they arrive on scene to correlate and correctly identify the beacon and distinguish the beacon from other AIS signal sources that may also be present.

**2.17 AIS-SART and MOB with AIS**

a) A freeform number identity (AIS User ID) is also used to identify maritime radio equipment like the AIS-SART (970xxyyyy) and man overboard (MOB) with AIS (972xxyyyy).

[1] Recommendation ITU-R M.1371: Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile frequency band

b) It is critical that RCC and SAR units recognize that the AIS User ID of a PLB-AIS and MOB with AIS may use the same format (972xxyyyy). When the AIS safety related broadcast (message 14) is received, the SAR unit crew will be able to determine whether the device is a PLB-AIS or MOB with AIS from the AIS User ID if a HEX ID is displayed (or not) on their receiving equipment. This will assist the SAR unit crew when they arrive on scene to correlate and correctly identify devices and distinguish them from other AIS signal sources that may also be present.

AIS symbology

2.18 The AIS safety related broadcast (message 14) causes a symbol to display on the AIS receiver system as a circle with a red cross in accordance with IMO Circular requirements (SN.1/Circ.322). The message text associated with the symbol allows users to determine if the device is ‘active’ or a ‘test’.


2.19 Because the AIS safety related broadcast message is applicable to EPIRB-AIS, PLB-AIS, AIS-SART and MOB with AIS, the SAR unit must review the associated message text with the symbology to extract the AIS User ID and HEX ID (if provided) to determine the type of device.

## 3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) consider, with respect to operations by SAR units equipped with a 406 MHz homing capability and/or AIS receiver, recommending that RCC and SAR unit crew procedures and training includes the information contained within this paper;

c) consider recommending under national SAR plan arrangements that SAR agencies ensure that SAR units with 406 MHz homing equipment are capable of receiving and interpreting all currently allocated 406 MHz beacon channels, and plan to upgrade that equipment for beacons that will transmit on the newly allocated Channel S (406.076 MHz) from 1 January 2025;

d) where applicable, consider recommending that States consider equipping their SAR units with a 406 MHz homing capability and AIS receiver, or where that is not practicable, recommend that States have arrangements in place for the deployment of SAR units with such capabilities from a neighbouring State or States through bilateral SAR arrangements; and

e) discuss any relevant matters as appropriate.

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