COSPAS-SARSAT
PHASE-OUT PLAN FOR 121.5/243 MHz SATELLITE ALERTING SERVICES

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Note that the reference to document C/S G.004, "Cospas-Sarsat Glossary" on page D-1 has been updated to reflect its reclassification as document C/S S.011.

COSPAS-SARSAT PHASE-OUT PLAN FOR 121.5/243 MHz SATELLITE ALERTING SERVICES

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EXECUTIVE SUMMARY

NOTE: Cospas-Sarsat ceased satellite processing at 121.5/243 MHz on 1 February 2009. This does not affect the use of these frequencies for homing devices in Cospas-Sarsat 406 MHz beacons.

BACKGROUND AND SCOPE OF THE PHASE-OUT PLAN

The Cospas-Sarsat System established pursuant to the International Cospas-Sarsat Programme Agreement, comprises several sub-systems which provide for the processing of two types of distress beacons:

- 406 MHz beacons specifically designed for use with the Cospas-Sarsat 406 MHz system, including the low-altitude Earth orbiting satellites of the LEOSAR system and the geostationary Earth-orbiting satellites of the GEOSAR system; and
- 121.5 MHz beacons which are suitable for use with the LEOSAR system only.

Sarsat LEOSAR satellites are also capable of processing signals from 243 MHz beacons in the same manner as 121.5 MHz distress beacons. The following discussion of the Phase-Out Plan for satellite processing of 121.5 MHz beacons also applies to 243 MHz beacons.

Because of the limitation of the 121.5 MHz beacon signal characteristics, there are specific limitations to the 121.5 MHz system performance. In particular, there are numerous false (non-distress) alerts generated by the 121.5 MHz system, which cannot be easily eliminated. This situation led to a request by the International Maritime Organization (IMO) that Cospas-Sarsat consider establishing a termination date for the satellite processing of 121.5 MHz signals, and the International Civil Aviation Organization (ICAO) has agreed that 121.5 MHz satellite processing could be terminated by Cospas-Sarsat from 2008.

The Phase-Out Plan reviews each component of the Cospas-Sarsat System affected by the decision to phase-out 121.5 MHz satellite alerting services, and a programme of actions for Cospas-Sarsat or recommendations to responsible Administrations and international organizations is provided to allow for the co-ordination of individual actions by Cospas-Sarsat Participants, the review of progress achieved, and the control of phase-out activities.

The status of actions and recommendations, and the projected availability of 121.5 MHz satellite processing instruments in orbit, are summarised in the Annexes to the Phase-Out Plan, which will be updated by the Cospas-Sarsat Council on an annual basis to track progress made in the preparation for phasing-out 121.5 MHz satellite alerting services prior to the planned termination date of 1 February 2009.

STRATEGY FOR TERMINATION OF 121.5 MHz SATELLITE SERVICES

Three basic strategies were considered for phasing-out 121.5 MHz satellite services:

- a firm termination date after which 121.5 MHz satellite capabilities would be switched off;
- a gradual phase-out over a period of time, until the last available satellite with 121.5 MHz capabilities is decommissioned; and
- a minimum level of service strategy, whereby the 121.5 MHz satellite instruments available in orbit are switched off when the minimum level of service required to contribute to efficient SAR operations cannot be maintained.

Although the firm termination date strategy had numerous advantages and received strong support from the majority of Cospas-Sarsat Participants, no agreement could be reached on a firm termination date due to the difficulty to forecast accurately many years in advance the availability of 121.5 MHz space segment capabilities and the availability of a low cost alternative to 121.5 MHz beacons.

Therefore, the Cospas-Sarsat Council decided to adopt a minimum level of service strategy with the planned termination date of 1 February 2009. The Council also decided that a review of space segment availability and preparations for the phase-out would take place annually. However, the Council also emphasised the need for Administrations and international organizations to prepare for the phase-out on the basis of the planned termination date, i.e., 1 February 2009.

SPACE AND GROUND SEGMENT ISSUES

In respect of the space segment of the LEOSAR system, Cospas-Sarsat determined that the 121.5 MHz instruments on LEOSAR satellites could be disabled at the planned termination date without affecting Cospas-Sarsat or other satellite operations. In addition, the elimination of 121.5 MHz instruments in future satellites would allow a redesign of the SAR payload and provide savings in terms of weight, power, thermal control and space requirements, and reduce platform and payload complexity.

Cospas-Sarsat also acknowledged that the termination of 121.5 MHz satellite services would accelerate the transition to 406 MHz beacons. Therefore, actions should be taken to:

- re-assess the actual capacity of the 406 MHz GEOSAR and LEOSAR systems and develop appropriate mathematical models of the capacity of each system;
- develop procedures for periodically monitoring the GEOSAR and LEOSAR systems' capacity;
- move the carrier frequency of orbitography and test beacons to 406.022 MHz;
- determine the optimum method for spreading beacon carrier frequencies to ensure adequate GEOSAR and LEOSAR capacity; and
- develop a plan for managing the use of the 406.0 - 406.1 MHz frequency band.

The elimination of 121.5 MHz processing will also allow a simplification of the LEOLUT design. However, Cospas-Sarsat agreed that 121.5 MHz processing capabilities of the Ground Segment should be maintained until the actual phase-out of 121.5 MHz satellite services. Appropriate revised procedures should be developed as required to ensure that an adequate distribution of 121.5 MHz alert data to Cospas-Sarsat MCCs is maintained until the phase-out date. In addition, the Phase-Out Plan identifies several actions to deal with the forecast increase of 406 MHz alert message traffic in the Ground Segment.

406 MHz BEACON ISSUES

Over 600,000 beacons operating on 121.5 MHz will need to be replaced either by 406 MHz beacons or other means of distress alerting, prior to the termination of 121.5 MHz satellite services. This will undoubtedly lead to a significant growth of the 406 MHz beacon population, which raises several issues, including the need to spread the beacon carrier frequencies in the 406.0 - 406.1 MHz band, as mentioned above. As a prerequisite to the efficient management of the use of the frequency band, a model of the beacon population growth must be developed, and the existing model of the 406 MHz beacon message traffic must be validated.

The spreading of frequencies in the band also requires an amendment to the Cospas-Sarsat 406 MHz beacon specification (C/S T.001), which only addresses the frequencies 406.025 and 406.028 MHz, and to the Cospas-Sarsat type approval standard (C/S T.007). Other international organizations' specification for 406 MHz beacons will also need to be updated (e.g. IMO performance requirements, ICAO Annex 10 and ITU Recommendation M.633).

121.5 MHz beacons are attractive to many users because of their very low cost. The termination of 121.5 MHz satellite services raises the issue of an alternative to these low cost beacons. 406 MHz beacons provide for greatly improved performance, but their cost, although steadily decreasing, is clearly higher. This situation raises two potential problems:

- 121.5 MHz beacon users may decide not to replace their 121.5 MHz beacon; or
- users may delay the replacement with 406 MHz beacons until the last moment and could be faced with a shortage of equipment.

In both cases these users would be denied the service currently available. Administrations should note these potential problems and consider mandating the transition to 406 MHz beacons well in advance of the termination date. Additionally, Administrations may wish to review their existing operational requirements with the objective of reducing their impact on the cost of 406 MHz beacons intended as replacement of the cheaper 121.5 MHz models. In parallel, Cospas-Sarsat should determine whether new beacon designs, modifications to the existing specification, or new technologies could significantly lower the cost of 406 MHz beacons.

OPERATIONAL ISSUES

To prepare for the forecast increase of the 406 MHz beacon population, and the corresponding increase of the number of 406 MHz alerts, Cospas-Sarsat decided on several actions aimed at enhancing 406 MHz alert processing in the Cospas-Sarsat System, specifically with a view to:

- reducing wherever possible the number and impact of processing anomalies;
- reducing the number of false alerts; and
- ensuring adequate 406 MHz alert data distribution to MCCs and SPOCs world-wide, in the context of a vastly increased number of 406 MHz distress alerts.

CO-ORDINATION OF PHASE-OUT ACTIVITIES

The preparation for the phase-out of 121.5 MHz satellite services includes a large number of inter-related activities, which require specific internal co-ordination within Cospas-Sarsat, and external co-ordination with a number of Administrations and organizations, including user organizations and the manufacturers of Cospas-Sarsat equipment.

The Cospas-Sarsat Phase-Out Plan for 121.5 MHz Satellite Alerting Services is the main vehicle for the internal co-ordination of Cospas-Sarsat activities. External co-ordination will involve, inter-alia:

- publicising periodic statements on the status of the Cospas-Sarsat System and the progress of preparation for the phase-out of 121.5 MHz satellite services; and
- promoting the advantages of the 406 MHz system and encouraging an early transition to 406 MHz beacons.

Administrations may also wish to develop information campaigns and ensure that all appropriate users, regulatory bodies and manufacturing concerns are kept informed of the progress of the phase-out.

NATIONAL REGULATORY MATTERS

Changes to national requirements for the carriage of emergency beacons will probably be necessary as a consequence of the phase-out of 121.5 MHz satellite services. This may require co-ordination at national level amongst regulatory bodies to ensure that adequate legislation/regulations are in place, and to minimise the impact to beacon manufacturers and owners. Administrations should also ensure the availability of appropriate registration databases and efficient registration procedures. Finally, the development of adequate policies and specific education programmes may be required to assist users with the transition.

If necessary, Administrations may wish to consider developing their own national plan for the transition from 121.5 MHz to 406 MHz beacons, to ensure that all aspects of the transition and the time-line for the preparation are properly addressed.

1. INTRODUCTION

NOTE: Cospas-Sarsat ceased satellite processing at 121.5/243 MHz on 1 February 2009. This does not affect the use of these frequencies for homing devices in Cospas-Sarsat 406 MHz beacons.

The Cospas-Sarsat System established pursuant to the International Cospas-Sarsat Programme Agreement signed on 1 July 1988, comprises several sub-systems which provide for the processing of two types of distress beacons:

- 406 MHz beacons specifically designed for use with the Cospas-Sarsat 406 MHz satellite system, including both low-altitude Earth-orbiting (LEO) satellites for search and rescue (SAR), referred to as the LEOSAR system, and geostationary Earth-orbiting (GEO) satellites for search and rescue, referred to as the GEOSAR system.

- 121.5 MHz beacons which are suitable for use with Cospas-Sarsat LEOSAR satellites only. Some 121.5 MHz beacons also transmit an additional signal at 243 MHz which can be relayed by Sarsat satellites (but not Cospas satellites) for processing at a ground receiving station. 121.5/243 MHz beacons are not compatible with the Cospas-Sarsat GEOSAR system which operates at 406 MHz only.

Most 121.5 MHz beacons are Emergency Locator Transmitters (ELTs) carried on-board aircraft. These ELTs were initially designed for detection by overflying aircraft and were used in large numbers prior to the introduction of the Cospas-Sarsat LEOSAR system. Many 121.5 MHz beacons are also carried on fishing vessels or pleasure craft as Emergency Position Indicating Radio-Beacons (EPIRBs). When it was introduced in 1982, the Cospas-Sarsat System considerably improved the efficiency of existing 121.5 MHz beacons by providing a capability to automatically alert SAR services and determine the location of the distress beacon using Doppler positioning techniques.

However, because of the technology of 121.5 MHz beacons, in particular the radio signal characteristics, there are specific limitations to the 121.5 MHz system. The LEOLUT processing cannot differentiate between actual 121.5 MHz beacon transmissions and interference. Consequently, the Cospas-Sarsat 121.5 MHz system generates a large number of false (non-distress) alerts which cannot be easily eliminated and, therefore, add to the workload of SAR services.

406 MHz beacons provide improved performance in terms of alerting and position determination accuracy. In particular, the identification of the transmitting 406 MHz beacon, obtained from the encoding of their digital message, provides SAR forces with a means of retrieving additional data on the vessel or aircraft in distress and may facilitate the resolution of false alerts without despatching SAR resources.

As a result of the 121.5 MHz system limitations, and because of the availability of the newer 406 MHz beacons with better performance, the International Maritime Organization (IMO)

and a number of national Administrations responsible for search and rescue have requested Cospas-Sarsat to consider phasing-out the satellite processing of 121.5 MHz beacons. The International Civil Aviation Organization (ICAO) also agreed that 121.5 MHz satellite processing services could be terminated from 2008.

1.1 Purpose

The purpose of this document is to provide guidance, define the tasks to be accomplished by Cospas-Sarsat Participants, and highlight recommendations to responsible Administrations, with the aim to assist in the timely preparation for the phasing-out of 121.5/243 MHz satellite processing.

In the remainder of this Phase-Out Plan, references to 121.5 MHz phasing-out also apply to 243 MHz phasing-out, as appropriate (see section 3.2).

1.2 Scope

On the basis of the work initiated at the Cospas-Sarsat Task Group Meeting held from 15 to 19 March 1999 in Hampton, Virginia (TG-1/99), the subsequent work at JC-13 (16 - 23 June 1999) and the TG-3/2000 Meeting held in Canberra, Australia from 13 to 15 March 2000, this document describes the technical, operational, legal, regulatory and educational aspects of the issues which pertain to the phasing-out of 121.5 MHz satellite services.

Each component of the Cospas-Sarsat System affected by the decision to phase-out the 121.5 MHz alerting service is reviewed. A programme of actions for Cospas-Sarsat, or recommendations to responsible Administrations and international organizations, is provided to allow for the co-ordination of individual actions by Cospas-Sarsat Participants, the review of progress achieved, and the control of phase-out activities by the Cospas-Sarsat Council. This document will be updated as necessary during the transition period towards the phasing-out of 121.5 MHz services, to reflect the status of preparations by Cospas-Sarsat.

1.3 Background

1.3.1 Cospas-Sarsat System Status and Operation

As of October 2000, the Cospas-Sarsat System comprised:

- 8 LEOSAR satellites, in polar, low-altitude orbit, all equipped with a 121.5 MHz repeater capability. In addition, amongst these 8 satellites, 4 Sarsat satellites also provided a 243 MHz repeater capability. The forecast evolution of the LEOSAR space segment is described at section 3 and shown in Figure B.1.

- 37 ground receiving stations in the LEOSAR system (called local user terminals or LEOLUTs), which processed 121.5 MHz beacon signals relayed on the downlink frequency (1544.5 MHz) for determining the Doppler location of the transmitting beacons. 32 of these LEOLUTs also processed 243 MHz beacon transmissions. All Cospas-Sarsat LEOLUTs process 406 MHz distress transmissions, using the LEOSAR satellites' search and rescue processor (SARP) capability and, for some LEOLUTs, the Sarsat satellites 406 MHz repeater (SARR) capability.

- 3 GEOSAR satellites in geostationary orbit and 7 receiving stations (GEOLUTs) providing distress alerts from 406 MHz beacon transmissions relayed by the GEOSAR satellites.

- 22 Mission Control Centres (MCCs) receiving distress alert data from LEOLUTs and GEOLUTs for distribution to SAR services in accordance with the Cospas-Sarsat Data Distribution Plan (document C/S A.001).

- Over 220,000 EPIRBs, ELTs or PLBs (Personal Locator Beacons) operating on 406 MHz, which, for most of them, also include a 121.5 MHz homing transmitter.

- Over 600,000 ELTs, EPIRBs or PLBs operating on 121.5 and/or 243 MHz.

From January to December 1999, the Cospas-Sarsat System provided assistance in rescuing 1,227 persons in 340 SAR events. The 406 MHz system was used in 180 of these events, contributing to the rescue of 882 persons, while the 121.5 MHz system was used in the other 160 SAR events contributing to the rescue of 345 persons.

Although the 121.5 MHz satellite processing has proved extremely valuable in assisting SAR services when ships and aircraft in distress were equipped with 121.5 MHz beacons, it is unfortunately the source of a considerable number of false alerts which result in heavy workload for rescue co-ordination centre (RCC) personnel. 121.5 MHz false alerts also affect the efficiency of SAR services as resources could be diverted instead of being made available for the processing of genuine SAR incidents. From statistics collected by Administrations, on average, only one in one thousand 121.5 MHz Doppler locations provided by the Cospas-Sarsat system corresponds to a real distress case. This situation has lead some SAR authorities to defer responding to 121.5 MHz alerts until some other information is received confirming the reality of the distress case.

Whilst 406 MHz beacons are also a source of false alerts, although in substantially lesser numbers than the 121.5 MHz system, their processing by RCCs is facilitated, when the beacon is properly registered, by the unique identity code included in the alert message of the transmitting beacon. This feature allows RCCs, in many cases, to retrieve additional information and verify the nature of a 406 MHz alert prior to committing SAR resources. Specifications of the 406 MHz signal characteristics and the packaging and installation requirements of 406 MHz beacons are also far more stringent than for most 121.5 MHz equipment. This results in 406 MHz beacons being more reliable, and more expensive, than 121.5 MHz beacons.

1.3.2 Decisions / Recommendations from International Organizations

1.3.2.1 International Maritime Organization (IMO)

121.5 MHz EPIRBs are not accepted by IMO as satellite-EPIRBs for the ship to shore alerting function of the Global Maritime Distress and Safety System (GMDSS). 406 MHz EPIRBs have been accepted by IMO for this function and a number of

Resolutions have been adopted by the IMO Assembly in respect of their performance characteristics, coding and registration.

Because of the high level of false alerts and the resulting additional workload on rescue co-ordination centres, the IMO Maritime Safety Committee (MSC), at its 70th Session in December 1998 agreed with the statement of the Third Meeting of the IMO Sub-Committee on Radiocommunications and Search and Rescue (COMSAR 3) that the satellite processing of 121.5 MHz distress alerts should be phased-out, and a plan for such phasing-out should be developed by Cospas-Sarsat giving the approximate period of time needed.

1.3.2.2 International Civil Aviation Organization (ICAO)

The ICAO Air Navigation Commission, in December 1998, agreed to proposed amendments to the ICAO Convention Annexes 6 and 10, to mandate the carriage of ELTs operating on both 406 MHz and 121.5 MHz by new aircraft from 1 January 2002, and by all aircraft from 1 January 2005.

In March 1999 the ICAO Council adopted the amendments to Annexes 6 and 10 to the Convention, and agreed that the satellite processing of 121.5 MHz emissions could be terminated from 2008.

However, it should also be noted that the ICAO Convention provisions only apply to aircraft operating under the jurisdiction of the ICAO Convention. Aircraft operated strictly inside national airspace are subject only to national regulations which may, or may not, follow ICAO's provisions.

1.3.3 Cospas-Sarsat Council Policy and Decisions in Respect of 121.5 MHz

The Cospas-Sarsat policy statement agreed at the 19th Session of the Cospas-Sarsat Council in October 1997 underlines that, "in accordance with the terms of the International Cospas-Sarsat Programme Agreement, the basic Cospas-Sarsat policy is to continue providing 121.5 MHz and 406 MHz satellite services as long as such services contribute to efficient search and rescue operations". In addition, the Cospas-Sarsat policy statement declares that "the Parties will take into account the views of ICAO, IMO and States concerned, as appropriate".

At its 21st Session in October 1998, the Cospas-Sarsat Council noted the views of IMO reported above and decided to establish a task group of experts on practical aspects of phasing-out 121.5/243 MHz satellite services (TG-1/99). The TG-1/99 Report was reviewed by the Cospas-Sarsat Joint Committee in June 1999 and the draft Issue 1 of the "Cospas-Sarsat Phase-out Plan for 121.5/243 MHz Satellite Alerting Services" was submitted for consideration by the Cospas-Sarsat Council at its October 1999 session (CSC-23).

1.3.3.1 At its 23rd Session, the Cospas-Sarsat Council decided:

a) that, in response to the guidance from IMO and ICAO and the views expressed by Cospas-Sarsat Participants, the satellite processing of 121.5/243 MHz alerts would eventually be phased-out from the Cospas-Sarsat System […];

b) that the 121.5/243 MHz SARR payloads would not be carried on board future Sarsat satellites, starting with the USA NPOESS satellite and the EUMETSAT METOP-3 satellite, and the 121.5 MHz SARR payload would not be carried on board future Cospas satellites, starting from Cospas-13; and

c) to convene in 2000 a group of experts (TG-3/2000) with the goal of revising the draft Phase-Out Plan to reflect the above decisions and [..] submitting the final draft of the Plan to CSC-25 for approval.

1.3.3.2 At its 25th Session, the Cospas-Sarsat Council decided:

a) to approve Issue 1 of the document C/S R.010 "Cospas-Sarsat Phase-Out Plan for 121.5/243 MHz Satellite Alerting Services";

b) to plan and prepare for the termination of 121.5/243 MHz satellite alerting services on 1 February 2009;

c) to review annually at the Open Meeting of the Council the status of preparation by Participants for the phasing-out of 121.5/243 MHz satellite alerting services; and

d) to invite Administrations and international organizations to note the planned phase-out date of 1 February 2009 and the recommendations listed at Annex C to this document in view of their preparation for the phase-out of 121.5/243 MHz satellite alerting services.

Note: ***The phasing-out of 121.5/243 MHz satellite processing will not affect the use of these frequencies for homing devices in the Cospas-Sarsat 406 MHz beacons.***

2. STRATEGY FOR TERMINATION OF 121.5 MHz SATELLITE SERVICES

Three basic strategies were considered for phasing-out 121.5 MHz satellite services:

- a firm termination date, set by the Cospas-Sarsat Council to provide sufficient time for all necessary preparations, after which 121.5 MHz satellite service capabilities would be switched off;

- a gradual phase-out over a period of time, until the last available satellite with a 121.5 MHz capability is decommissioned; and

- a minimum level of service strategy, whereby a given date is selected by the Cospas-Sarsat Council when the level of service is expected to no longer contribute to efficient SAR operations and the remaining payloads are switched-off.

The three strategies are reviewed and the choice of the selected Minimum Level of Service Strategy is explained in the following sections.

2.1 Firm Termination Date Strategy

The stages of a firm termination date (FTD) strategy, illustrated in Figure 2.1, are as follows:

- The Cospas-Sarsat Council decides that 121.5 MHz satellite processing will be terminated at a predetermined date (i.e. the Firm Termination Date). This announcement initiates a transition period, i.e. the period of time between the announcement and FTD.

- Up to the FTD, 121.5 MHz satellite alerting is provided in accordance with the commitments of the International Cospas-Sarsat Programme Agreement (ICSPA).

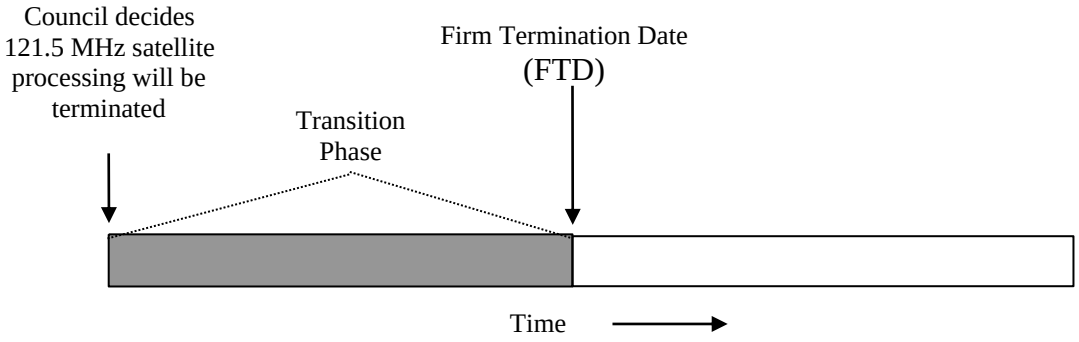
- At FTD the remaining 121.5 MHz SARR instruments on the available satellites are disabled.

2.2 Gradual Phase-Out Strategy

The various stages of a gradual phase-out strategy are illustrated in Figure 2.2 and described below:

- The Council decides that 121.5 MHz satellite processing will eventually be terminated, although no firm termination date is set at this stage. This announcement initiates a transition phase, i.e. the period of time between the announcement and the termination of the satellite alerting service.

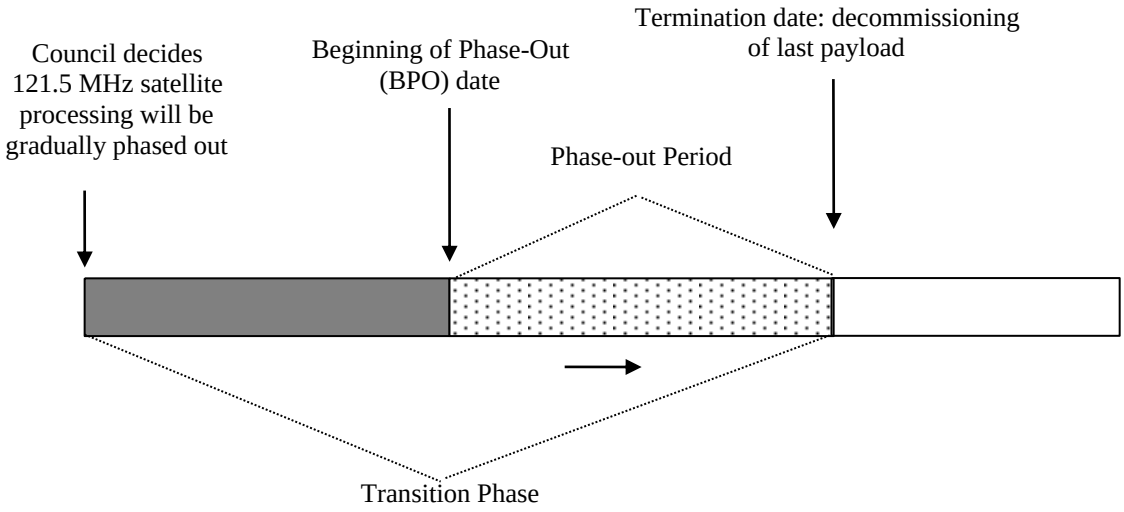
Figure 2.1: Firm Termination Date Strategy



121.5 MHz satellite processing is provided in accordance with the commitments of the ICSPA.

121.5 MHz satellite processing has been switched off and is no longer available.

Figure 2.2: Gradual Phase-Out Strategy



121.5 MHz satellite processing is provided in accordance with the commitments of the ICSPA.

121.5 MHz satellite processing continues subject to availability. After BPO the 121.5 MHz alerting service may not be at the level of the ICSPA commitments.

121.5 MHz satellite processing is no longer available.

- The Council also specifies a "beginning of phase-out" (BPO) date. Until BPO, 121.5 MHz satellite processing is provided in accordance with the commitments of the International Cospas-Sarsat Programme Agreement (ICSPA). After BPO, 121.5 MHz satellite alerting services are continued subject to availability, i.e. these services may not be at the level of the ICSPA commitments. The BPO date initiates the phase-out period.

2.3 Discussion of the Firm Termination Date and Gradual Phase-Out Strategies

2.3.1 Advantages of the Firm Termination Date Strategy

The advantages of the firm termination date strategy are as follows:

a) From a SAR services' perspective, a firm termination date for end-of-service would:

- respond more accurately to inputs provided by international organizations;

- provide better confidence in the capability of the 121.5 MHz system up to the termination date;

- ease the burden on RCCs in responding to 121.5 MHz false alerts at an earlier date than a gradual phase-out would allow;

- force users to take the termination of 121.5 MHz satellite alerting services seriously and encourage a quicker transition to the more capable 406 MHz beacons, therefore, users would benefit if required to transition to a better alerting system; and

- allow a more efficient use of SAR forces by providing for quicker resolution of false alerts through the use of 406 MHz beacon identification and registration information.

b) From the point of view of the satellite service providers (i.e. the Cospas-Sarsat Space Segment Providers and Ground Segment Providers/Operators), the firm termination date would:

- ease the planning and management of the transition by Cospas-Sarsat Participants and Administrations, as it could be implemented globally (at satellite level) providing standard implementation, and would allow clear guidance to be provided to user Administrations (i.e. SPOCs, RCCs, registration offices, regulatory authorities);

- not be dependent upon satellite availability (full Space Segment availability is maintained until FTD);

- minimise potential legal responsibility concerns of Ground Segment Providers;

- facilitate communications with users/Administrations and simplify the explanation of System operational capabilities in cases of inquiries or investigations; and

- lead to less costly operation for Cospas-Sarsat Participants (i.e. simplified LEOLUTs and data distribution procedures).

c) From the beacon owners' point of view, the firm termination date would encourage mass production of 406 MHz beacons which should lead to an earlier decrease of their price and facilitate the transition.

2.3.2 Operational Impact of the Gradual Phase-Out Strategy

The gradual phase-out strategy makes use of all available hardware and clearly allows an extension of the transition period at minimum cost to the System providers. This is the only clear advantage of the gradual phase-out. However, the gradual phase-out concept complicates the management of the transition and may discourage a timely preparation by users and Administrations.

In particular, the gradual phase-out strategy implies accepting a further degradation of the 121.5 MHz satellite alerting service provided to SAR during the phase-out period (i.e. after the beginning of phase-out (BPO) date), when the decreasing number of available satellites would result in longer waiting times for 121.5 MHz beacon detections, additional delay for resolving the Doppler location ambiguity, or failure to detect short duration transmissions. In addition, some Ground Segment Providers may take the view that, after BPO, there is no strong requirement for maintaining the 121.5 MHz processing capability in their LEOLUTs. A diminishing coverage and further increase of the waiting time would also result from reduced 121.5 MHz alert processing capabilities in the Ground Segment.

Therefore, in a gradual phase-out strategy, a special mechanism would be required for monitoring/publicising the up-to-date space and ground segment status and the availability of the service provided during the phase-out period.

2.4 Minimum Level of Service Strategy

The gradual phase-out strategy allows maximum flexibility in deciding when the 121.5 MHz satellite alerting service would be actually terminated. However, this approach also entails a number of consequences in respect of the management of the satellite system during the phase-out period, as well as for the preparation which should be made by Administrations and users. In particular, it ignores an essential requirement of Administrations in respect of a minimum advance notice before actually terminating the 121.5 MHz satellite alerting service.

Based on the above considerations, the firm termination date strategy would definitely appear as the preferred choice for Cospas-Sarsat Participants, as well as Administrations and users. However, it presents the significant difficulty that the final termination date needs to be agreed with a very long advance notice (i.e. between 8 to 10 years). The long advance notice is a definite advantage from the point of view of

regulatory Administrations, but may not be practical for the reliable forecast of space segment availability which must form the basis of a decision in respect of the termination date. Therefore, a strategy has been developed which:

- builds upon the planned level of service available in future, based on the decision already made to launch future satellites without the 121.5 MHz search and rescue repeater;

- takes into consideration the minimum level of service acceptable to SAR services; and

- defines a planned termination date when the remaining payloads in orbit would be disabled.

In the context of the minimum level of service strategy, the driving factor for determining the termination date of the 121.5 MHz satellite alerting service is the level of service which can be guaranteed by Cospas-Sarsat and remains acceptable to SAR services. The level of service provided by Cospas-Sarsat can be characterised by:

- the 121.5 MHz system coverage; and

- the average waiting times for obtaining the first alert and its confirmation by a second satellite pass for ambiguity resolution.

The impact of the Ground Segment availability (i.e. LEOLUTs capable of processing 121.5 MHz beacon transmissions) and Space Segment availability on these two aspects of the 121.5 MHz system performance is analysed below.

2.4.1 Ground Segment Availability

System coverage and waiting times are both dependent on Ground Segment capabilities. There is currently significant redundancy in the Ground Segment 121.5 MHz processing capability in some areas of the world, while other areas are not covered. The termination of 121.5 MHz processing by some LUTs in Europe would not significantly affect the availability of the service because of the existing redundancy. The impact of the termination of 121.5 MHz processing by some LUTs in the Americas, in Africa or in Asia would be much more significant.

Therefore, a simple, reliable prediction in respect of a reduction of the availability of 121.5 MHz processing in the Ground Segment cannot be made on a global basis. For the above reasons, although the actual availability of 121.5 MHz processing in the Ground Segment should be monitored and reported to users and Administration, such availability cannot be easily forecast with sufficient advance notice, and used as a reliable criteria for deciding on the termination date of the 121.5 MHz satellite service.

2.4.2 Space Segment Availability

The availability of 121.5 MHz instruments in orbit has a direct and global impact on one aspect of the 121.5 MHz satellite alerting service: the waiting times for obtaining the first alert and its confirmation by a second satellite pass for ambiguity resolution.

The International Cospas-Sarsat Programme Agreement (ICSPA) calls for a minimum of four satellites in operation under nominal conditions which defines the performance expected from the 121.5 MHz system in terms of waiting times. This assumes an adequate Ground Segment is available to ensure the appropriate coverage.

With four satellites in operation, the 121.5 MHz system waiting time for the first alert can exceed one hour at mid-latitudes and several hours at the equator. The confirmation of the 121.5 MHz beacon location is received on average 90 minutes after the first alert, but can take many hours. These waiting times are also highly dependent on the distance of the beacon to the LEOLUT.

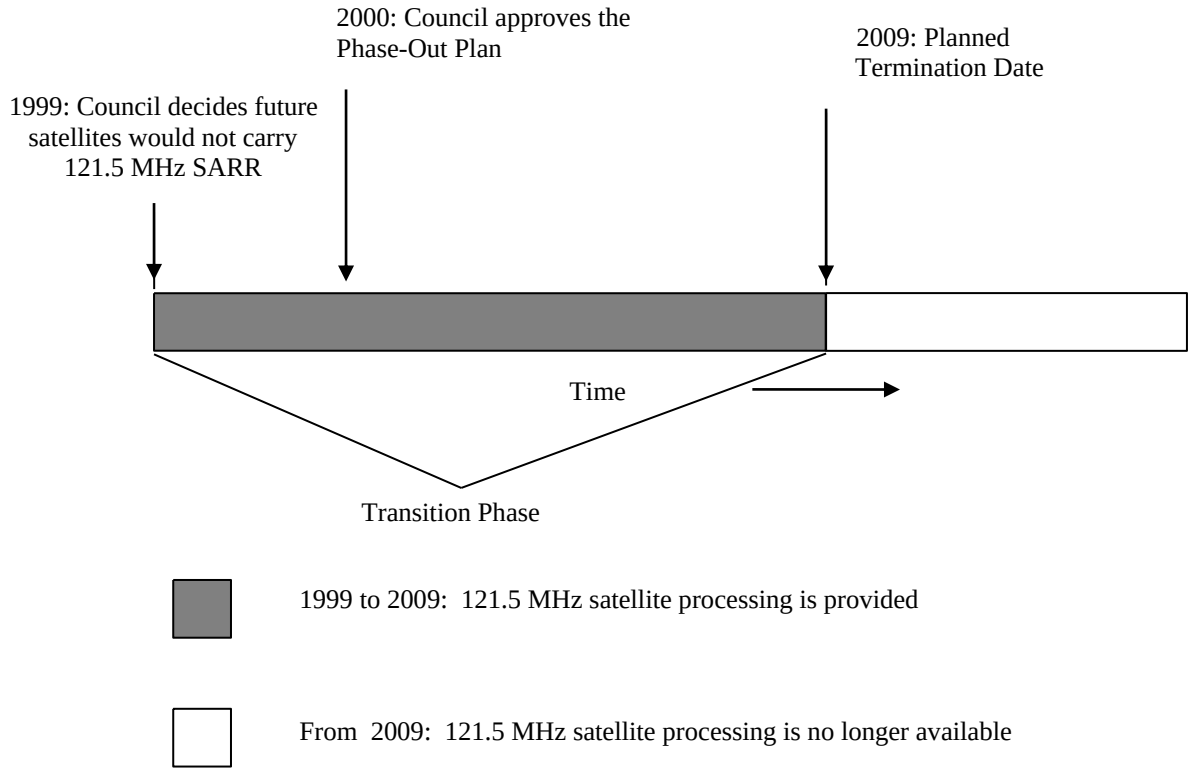
With fewer than four operational satellites, the average waiting times increase significantly, and occasionally reach unacceptable levels which would raise concerns from Administrations as well as users.

The calculation of the projected availability of satellites with 121.5 MHz instruments is detailed in section 3.1.3 and at Annex B to this Phase-out Plan. According to this projection, the number of available satellites would permanently fall below the nominal four satellite constellation by 2009.

2.4.3 Timeline of the Minimum Level of Service Strategy for 121.5 MHz Satellite Alerting Phase-Out

In view of the above determination, the date 1 February 2009 has been selected as the planned termination date for 121.5 MHz satellite alerting service, as illustrated in Figure 2.3. This date should be used by Cospas-Sarsat Participants, Administrations and users to prepare for the termination of this satellite service.

Figure 2.3: Time-Line of the Minimum Level of Service Strategy for 121.5 MHz Satellite Alerting Phase-Out



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3. SPACE SEGMENT ISSUES

In respect of the management of the Cospas-Sarsat Space Segment, three issues need to be addressed in view of the termination of 121.5 MHz satellites services:

a) the availability of 121.5 MHz repeaters;

b) the impact of the 121.5 MHz service termination on the design of future satellites and SAR payloads; and

c) the impact on the LEOSAR and GEOSAR systems capacity requirements of an increase in the number of 406 MHz beacons which will probably result from the elimination of 121.5 MHz satellite processing.

3.1 Projected Availability of 121.5 MHz Repeaters

A number of Cospas and Sarsat satellites with 121.5 MHz instruments will probably be on orbit up to and after 2009 (see Annex B).

In respect of Cospas satellites, it is anticipated that all satellites up to and including Cospas-12 will carry 121.5 MHz instruments. Assuming an average operational life of 5 years, and that the launch date for Cospas-12 will be 2005, the Cospas 121.5 MHz capability could remain available until 2010.

In respect of Sarsat satellites, the 121.5 MHz capability will be provided for up to and including Sarsat 12 (to be launched on NOAA N') and Sarsat-13 (to be launched on METOP-2). Assuming the proposed launch schedule presented at Annex B and the design life of three years for NOAA satellites and five years for METOP satellites, the potential exists for the instruments to be operational until 2013.

3.1.1 Technical Aspects

In light of existing obligations, it is not practical to modify the design of the satellite payloads to remove the 121.5 MHz capability until Sarsat-14 and Cospas-13. Therefore, a number of 121.5 MHz instruments will still be in orbit after the planned termination date of 1 February 2009. Their number will progressively decline until the satellites are decommissioned.

A technical analysis is required to ensure that the disabling of the 121.5 MHz payloads would not cause any adverse effects on the spacecraft or the other satellite instruments and the remaining functions of the SAR payload.

Action Item 3.1: *Russia, Canada and the USA, conducted an analysis to determine whether 121.5 MHz instruments could be disabled without adversely affecting Cospas-Sarsat or other satellite operations. The results of this technical analysis confirming the feasibility of turning off 121.5 MHz instruments without affecting Cospas-Sarsat or*

other satellite operations were adopted by the CSC-23 Session of the Council in October 1999.

3.1.2 Chart of 121.5 MHz Satellite Processing Availability

Although it is expected that Cospas-Sarsat will be able to provide a minimum level of service until 2009, the availability of the 121.5 MHz satellite alerting service needs to be reviewed periodically so that users and Administrations are kept informed of the operational status of the Space Segment.

Action Item 3.2: *The Cospas-Sarsat Secretariat should maintain and update as necessary the chart provided at Annex B indicating the expected launch dates and possible period of operation for all satellites with the 121.5 MHz SARR. This chart should be updated on an ongoing basis and periodically reviewed by the Cospas-Sarsat Council for inclusion of any revisions in the Phase-Out Plan.*

3.2. Future Satellite Design

Cospas and Sarsat satellites will not include a 121.5 MHz capability starting with Cospas-13 and Sarsat-14, respectively.

This decision allows a redesign of the SAR payloads which offers potential benefits in terms of payload performance, reliability, redundancy, satellite power requirements, weight requirements, payload downlink, and payload production which are detailed below.

From a strictly technical perspective the 243 MHz instruments could be retained on the Sarsat payloads even if the 121.5 MHz instruments are removed. However, this would not be practical since the current design uses some of the 121.5 MHz components to provide the 243 MHz capability, and, consequently, there would be minimal gain in eliminating the 121.5 MHz capability if the 243 MHz capability was retained. Furthermore, maintaining the 243 MHz service would eliminate the potential for simplifying the LUT design. Therefore, the redesign of the SAR payloads and the satellite platforms will involve the elimination of both the 121.5 MHz and the 243 MHz satellite processing capabilities.

3.2.1 Technical Aspects

The elimination of the 121.5 MHz instruments will require a redesign of the Cospas and Sarsat payloads, and a concomitant review and possible redesign of the host satellite platforms. From the perspective of the satellite provider and the SARR payload provider this redesign is highly desirable because:

a) there will be no requirement for a 121.5/243 MHz antenna and associated antenna deployment mechanism;

b) the corresponding requirements placed on the satellite bus in terms of weight, power, thermal control, and space can be reduced;

c) the complexity of the Search and Rescue Repeater (SARR) can be reduced and the production simplified, leading to reduced recurring cost; and

d) the satellite downlink could be optimised.

A modification to the satellite downlink would require modifications to the LEOLUT receiver subsystem. During any transition period when "old satellites" and "new satellites" would be in operational service simultaneously, the LEOLUT would have to provide the capability for handling both types of satellite downlink. New LEOLUT requirements may have to be developed to ensure Ground Segment/Space Segment compatibility (see section 4).

Action Item 3.3: *Space Segment Providers should develop amendments to System document C/S T.003 (LEOSAR Space Segment Description) as soon as any design changes have been frozen.*

3.2.2 Operational Aspects

No operational aspects have been identified in respect of this issue.

3.2.3 Legal/Regulatory Aspects

3.2.3.1 ITU

Space Segment Providers are responsible for registering the satellite network operating frequencies with the International Telecommunication Union (ITU).

Action Item 3.4: *Spacecraft providers will have to amend the declaration to the ITU of the Kospas and SAR network frequencies (i.e. respectively Russia and the USA) to account for the elimination of 121.5/243 MHz services. However, this is only required after the planned termination date.*

3.2.3.2 International Cospas-Sarsat Programme Agreement

The International Cospas-Sarsat Programme Agreement does not make reference to the provision of 243 MHz satellite services. However, it does refer to the 121.5 MHz system and will have to be modified to formalise the decision to remove the 121.5 MHz capabilities of the space segment.

Such modification could possibly be implemented by a declaration of the satellite providers to the Depositaries of the International Programme Agreement. However, the elimination of the 121.5/243 MHz satellite processing capabilities is a significant evolution of the Cospas-Sarsat Programme. Therefore, it might be preferable to consider a formal amendment of the Agreement to better reflect the evolution of the System and of the Parties' responsibilities.

Action Item 3.5: *Although an amendment to the International Cospas-Sarsat Programme Agreement would not be required prior to the elimination of the 121.5 MHz satellite services, the Cospas-Sarsat Parties should investigate this issue as soon as possible.*

3.3 Management of 406 MHz Satellite Processing Capacity

The decision by the Cospas-Sarsat Council to terminate 121.5 MHz satellite services in future will accelerate the transition from 121.5 MHz ELTs/EPIRBs to 406 MHz or other alerting systems. However, the significant growth of the number of 406 MHz beacons is likely to occur in the years immediately preceding the termination date. This aspect will need to be considered in the model of traffic forecast and addressed as part of the 406 MHz Frequency Management Plan for providing adequate GEOSAR capacity.

The forecast growth of the 406 MHz beacon population during the transition phase and the corresponding increase of 406 MHz alert traffic are analysed in sections 5 and 4 of this Phase-Out Plan, respectively. The impact of increased 406 MHz beacon transmissions on the capacity requirements of the LEOSAR system and the GEOSAR system is analysed below.

3.3.1 LEOSAR System Capacity

A preliminary analysis indicated that the LEOSAR system will have sufficient capacity to handle the increase of 406 MHz beacon population, even if all existing 121.5 MHz beacons were to be replaced with 406 MHz beacons.

3.3.2 GEOSAR System Capacity

Capacity limitations in the GEOSAR system are due to collisions between beacon transmissions which are not affected by Doppler, as in the LEOSAR system, and the fact that the visibility area of geostationary satellites is considerably larger than the field of view of LEOSAR satellites. The response to the GEOSAR capacity limitation is to "spread" the 406 MHz beacon carrier frequency over the available bandwidth.

The carrier frequency of operational beacons is centred on the frequency 406.025 MHz, with almost no frequency spreading. As a first step, CSC-21 decided in October 1998 that the carrier frequency of new beacon models could be centred on 406.028 MHz from 1 January 2000, and all models submitted for type approval after 1 January 2002 must use the 406.028 MHz frequency channel.

The preliminary analysis of the consequences of the 121.5 MHz phase-out further indicated that immediate consideration would be required in respect of additional spreading of the beacon carrier frequencies in order to address potential GEOSAR capacity limitations.

Action Item 3.6: *The actual capacity of the GEOSAR system should be re-assessed by completing the outstanding tests from the GEOSAR Demonstration and Evaluation. This work should be completed by 2003.*

Action Item 3.7: *Procedures should be developed and documented in the System monitoring document (C/S A.003) for regularly assessing the required GEOSAR system capacity. This action should be completed by 2003.*

Action Item 3.8: *The plan for changing the carrier frequency of orbitography and reference/test beacons from 406.025 to 406.022 MHz should be implemented as a priority. The migration of test and orbitography beacons from 406.025 MHz to 406.022 MHz should be completed by 2002. Additionally, during this time period all*

existing reference/test beacons should be declared to Cospas-Sarsat and their transmit frequency changed to 406.022 MHz.

Action Item 3.9: *Routinely occurring / transient interference should be evaluated in terms of its effect upon GEOSAR capacity.*

The optimisation of GEOLUT processing in relation to beacon frequency spreading should be considered as a possible method for dealing with potential GEOSAR capacity problems (see also section 4.3.2). A long term plan for the use of the available bandwidth (i.e. 406-406.1 MHz) should be developed by Cospas-Sarsat and updated as appropriate on the basis of the evolution of capacity requirements.

Action Item 3.10: *Participants should conduct studies to determine the optimum spreading method of the beacon carrier frequency in respect of the GEOLUT processing capacity. These studies should be completed by 2002. A long term plan for the use of the available bandwidth (i.e. 406-406.1 MHz) should be developed by Cospas-Sarsat and updated as appropriate on the basis of the evolution of capacity requirements.*

Action Item 3.11: *Cospas-Sarsat Participants should develop and agree a model of the 406 MHz GEOSAR system processing capacity for use in the management of the available 406 MHz bandwidth.*

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4. GROUND SEGMENT ISSUES

The termination of 121.5/243 MHz satellite processing services will have an impact on several aspects of the Cospas-Sarsat Ground Segment management and operation:

a) the LEOLUT design can be significantly optimised to provide savings in terms of maintenance, equipment renewal policy and operation, by eliminating the requirement for 121.5 MHz processing;

b) LEOLUT specifications may have to be amended if the satellite downlink format is changed as a result of the satellite/payload redesign;

c) the LEOLUT, GEOLUT and/or MCC processing capacity may have to be increased to cope with the expected growth of the 406 MHz beacon population; and

d) the number of LEOLUTs providing 121.5 MHz processing may decrease prior to the planned termination date if Ground Segment Providers choose not to renew/maintain the corresponding equipment in anticipation of the 121.5 MHz termination.

4.1 Revised LEOLUT Requirements

The complexity of the 121.5 MHz processing impacts upon LEOLUT requirements, the LEOLUT design, the choice of hardware and software components, and the cost of the LEOLUT. The elimination of such requirements would allow for a possible redesign of the equipment with potential savings for Ground Segment Operators. However, to provide for these potential gains, revised LEOLUT requirements should be developed by Cospas-Sarsat at the earliest opportunity to give manufacturers appropriate notice of the evolution.

The redesign of LEOSAR payloads and satellite platforms may lead to an optimisation of the satellite downlink format which will need to be taken into account in revised LEOLUT requirements (see section 3.2.1).

The processing of the 121.5/243 MHz channels is not a mandatory requirement of the LEOLUT specification and design guidelines (C/S T.002). Therefore, the absence of such capability in a new LEOLUT design would not impact on the commissioning of new equipment. However, in the longer term the System document C/S T.005 (LEOLUT Commissioning Standard) will also have to be amended.

Action Item 4.1: *Cospas-Sarsat should develop modified LEOLUT requirements and:*

a) *amend System document C/S T.002, LEOLUT Specification and Design Guidelines, to provide for a possible optimisation of the LEOLUT design, changes in the satellite downlink format, and increased capacity for 406 MHz beacon transmissions; and*

b) *amend System document C/S T.005, LEOLUT Commissioning Standard.*

This action should be initiated as soon as possible. It is expected to take one year to complete.

4.2 Availability of 121.5/243 MHz Local Mode Coverage to Termination Date

As noted in 4.1 above, the processing of the 121.5 MHz channels is not a mandatory requirement of the LEOLUT specification and design guidelines (C/S T.002). Therefore, the absence of such capability in a LEOLUT would not impact on the commissioning of new equipment, or of an existing LEOLUT if this capability is not maintained.

There is a possibility that some Ground Segment operators would consider the option of not renewing/maintaining the equipment required to provide the 121.5 MHz processing capability in their existing Ground Segment, in anticipation of the 121.5 MHz termination. This could lead to a reduction of the operational availability of 121.5 MHz processing in the Ground Segment several years prior to the termination date.

However, Cospas-Sarsat must ensure that such processing will be provided by an adequate number of LEOLUTs until the termination date. The implication of a gradual reduction of the LEOLUT 121.5 MHz processing capability prior to the termination date will need to be assessed, and may require a revision of existing 121.5 MHz alert distribution procedures.

Users and Administrations must be kept informed of the operational status of the Ground Segment and the resulting availability, reliability and quality of the 121.5 MHz satellite service. The corresponding legal liability issues may need to be further assessed.

Action Item 4.2: *Cospas-Sarsat should:*

a) request Ground Segment Providers/Operators to advise the Council of their plans in respect of maintaining 121.5/243 MHz processing capabilities at their LEOLUT(s) up to the planned termination date;

b) monitor the continued availability of 121.5 MHz LEOLUT processing capability during the transition phase, assess the quality and reliability of 121.5 MHz services taking into account the number of satellites with a 121.5 MHz capability and the number of LEOLUTs which have opted to continue processing this channel, and provide adequate information on the availability of 121.5/243 MHz local mode coverage to Administrations, international organizations and users; and

c) develop as appropriate revised procedures to ensure an adequate distribution of 121.5 MHz alert data by MCCs.

These activities should be updated on an ongoing basis as circumstances change.

4.3 406 MHz Ground Segment Capacity Requirements

The expected growth of the number of 406 MHz beacons analysed in section 5 will generate an increase in 406 MHz beacon transmissions, either from genuine distress situations or from false alerts, which will affect LEOLUTs as well as GEOLUTs. This growth will also result in an increase of the 406 MHz alert message traffic in the Cospas-Sarsat MCC network.

In parallel with the growth of the 406 MHz processing requirements, there should be a decrease in the number of 121.5 MHz beacon transmissions, if 121.5 MHz beacons are gradually replaced by 406 MHz ELTs/EPIRBs or other types of equipment. However, taking into account that the majority of 121.5 MHz alerts processed by Cospas-Sarsat are not related to genuine distresses, it is unclear whether the gradual decrease in the number of 121.5 MHz beacons will translate into a significant reduction of 121.5 MHz alert message traffic. In particular, since the vast majority of 406 MHz ELTs and EPIRBs also include a 121.5 MHz homing device, each 406 MHz transmission could also generate a 121.5 MHz Doppler position, to be treated as an independent alert message unless modifications are made to the current Cospas-Sarsat data distribution procedures.

4.3.1 LEOLUT 406 MHz Processing Capacity Requirements

From experience, the processing of the 406 MHz SARP and SARR data at LEOLUTs is not a determining factor of the LEOLUT processing power requirements. However, if the decrease in 121.5 MHz alerts is not significant, an increase of the number of 406 MHz beacon transmissions may require additional file storage capacity in some installations, and possibly a verification that the capacity of the communication link to the associated MCC is adequate.

Action Item 4.3: *Ground Segment Providers/Operators should carry-out verifications of their LEOLUT data storage capacity and communication links, as soon as a better estimate of the 406 MHz beacon message traffic increase becomes available and new LEOLUT requirements have been defined.*

4.3.2 GEOLUT 406 MHz Processing Capacity Requirements

Capacity limitations of the GEOSAR system are linked to the bandwidth available for "spreading" the 406 MHz beacon carrier frequency, i.e. distributing the carrier frequencies of operational beacons amongst an adequate number of channels to avoid collisions between beacon transmissions (see section 3.3.1).

The following carrier frequency channels have already been adopted by the Cospas-Sarsat Council to meet requirements, taking into account the current growth of the 406 MHz beacon population:

a) existing operational beacons: 406.025 MHz;

b) orbitography/reference beacons: 406.022 MHz; and

c) new models of operational beacons (from 2000): 406.028 MHz.

The preliminary analysis of the consequences of the 121.5 MHz phase-out and the corresponding growth of the number of 406 MHz beacons indicated that immediate consideration would be required in respect of additional spreading of the beacon carrier frequencies in order to address potential GEOSAR capacity limitations. Technical studies should be initiated as soon as possible and completed by year 2001 to determine the optimum beacon spreading frequency method in respect of the GEOLUT processing capacity (see Action Item 3.11, section 3.3.2).

4.3.3 MCCs and Communication Networks Capacity Requirements

MCCs' processing and communication requirements will be affected by the growth of the 406 MHz alert traffic, although the constraint on MCCs may be eased by some reduction in the 121.5 MHz alert traffic. However, 406 MHz alerts will be processed by all LEOLUTs and by the GEOLUTs in a given GEOSAR coverage area, while 121.5 MHz alerts are essentially processed in the local mode LEOSAR coverage only.

Action Item 4.4: *Using the forecast of the 406 MHz beacon population and beacon message traffic as an input (see section 5.1), Cospas-Sarsat should develop a model of 406 MHz alert message traffic in the Ground Segment. The model should be validated by the year 2003, and reassessed on an annual basis thereafter.*

Action Item 4.5: *Based on the results of the analysis of 406 MHz alert message traffic in the Ground Segment, and taking into account the possible decrease of 121.5 MHz alert message traffic, Ground Segment Operators should take necessary actions to ensure any required enhancement to the communication network and Ground Segment processing capabilities are implemented in a timely manner.*

It should be noted that this assessment may also lead to a review of the Cospas-Sarsat MCC network and of the need for additional nodal MCCs.

5. 406 MHz BEACON ISSUES

The ICAO requirement for 406 MHz/121.5 MHz ELTs and the planned termination of processing of the 121.5 MHz satellite channel will result in a significant increase in the 406 MHz beacon population.

This increase of the beacon population, the corresponding increase in 406 MHz alert traffic and the new capacity requirements for the LEOSAR and GEOSAR systems need to be assessed. A preliminary assessment of the 406 MHz traffic forecast shows that, in order to cope with the expected growth, the capacity of the GEOSAR space segment will have to be carefully managed through:

- the close monitoring of the beacon population;
- specific actions by Cospas-Sarsat and Administrations to eliminate as far as possible faulty beacons that could reduce the system capacity; and
- the development of a plan for spreading 406 MHz beacon carrier frequencies, as required, over the available bandwidth.

The impact of the increase of the 406 MHz beacon population on the Space Segment and the Ground Segment are addressed in sections 3 and 4, respectively. This section addresses more specifically:

- the forecast of the beacon population and 406 MHz beacon message traffic;
- required updates to 406 MHz beacon specifications;
- the impact on registration databases; and
- the availability of 406 MHz beacons and beacon installation capacity.

5.1 Forecast of the 406 MHz Beacon Population and Beacon Message Traffic

In order to assess the alert message traffic, the required capacity of the Space Segment components and the required capacity of the Ground Segment communication links, an appropriate alert message traffic model should be developed and validated. However, the first input for this analysis is an updated forecast of the 406 MHz beacon population growth.

In addition, the 406 MHz beacon message traffic is affected by the actual performance and the operation of 406 MHz beacons, e.g. faulty beacons and beacon test procedures can significantly impact on the system capacity. A close monitoring of 406 MHz beacon performance and use is required to maintain, and update as necessary, a reliable assessment of the 406 MHz beacon message traffic.

Action Item 5.1: *Cospas-Sarsat should develop a model to estimate the growth of the 406 MHz beacon population. This model should be validated, and updated on an annual basis. Since this model will be the foundation for all analyses in respect of System capacity issues, its development should be completed no later than 2000.*

Action Item 5.2: *Participants should validate the existing model of 406 MHz beacon message traffic forecast using the data provided by Ground Segment Providers (specifically USA and France). In addition, the model should be modified to account for the impact of self-test mode transmissions and faulty beacons. The modified model should be validated in 2000, and updated on an annual basis.*

Action Item 5.3: *GEOLUT Operators should collect and provide GEOLUT data to the Secretariat for analysis to confirm/evaluate the impact of self-test mode transmissions and faulty beacons.*

5.2 406 MHz Beacon Specification Updates

To cope with the 406 MHz beacon population growth and provide sufficient GEOSAR space segment capacity, the 406 MHz beacon carrier frequencies need to be spread over the available bandwidth as noted in sections 3.3.2 and 4.3.2.

Action Item 5.4: *Cospas-Sarsat should undertake co-ordination with relevant organizations (e.g. ICAO, IMO, ITU, RTCM, RTCA) to ensure that any change of the beacon carrier frequency specification is disseminated and incorporated into the documentation of the organizations as appropriate.*

5.3 Impact on 406 MHz Registration Databases

The termination of 121.5/243 MHz satellite services may cause an increase in the number of 406 MHz beacons registered in national databases. In particular, Administrations may have to prepare for a significant increase in 406 MHz beacon registrations during the period immediately prior to the termination date. This may require an increase in staffing to handle technical and operational aspects associated with the registration process.

5.3.1 Technical Aspects

National databases may have to be created, or structured to handle the increase in the number of 406 MHz beacons (EPIRBs, PLBs, and ELTs) in use, as expected at a national level. Handling of registration information at a national level may have to be automated (e.g. it may be necessary to eliminate labour-intensive manual entry of registrations into a database).

5.3.2 Operational Aspects

Systems to update beacon registration information should be implemented by Administrations. Staffing, at a national level, may have to be increased to handle maintenance and operation of registration issues (e.g., confirmation of registration information, or survey of beacon population, according to national and international guidelines).

In conjunction with maintenance and operations of registration databases, national Administrations may have to be prepared to provide guidance on coding issues.

Greater 406 MHz beacon use will cause a corresponding increase of the number of requests for beacon registration information between MCCs, and from RCCs/SPOCs. Data from registration databases should be available 24 hours a day to SAR services.

An increase in the number of 406 MHz ELTs may cause greater use of the 24-bit aircraft address. The use of the 24- bit aircraft address leads to a number of problems:

- some registration databases may not allow a search using the 24-bit address; and

- the 24-bit address can be reported in Cospas-Sarsat alert messages to RCCs either as a string of 6 hexadecimal characters or as a 24-bit string.

A standard should be established by Cospas-Sarsat so as to ensure that this information is meaningful to RCCs and allows access to the aircraft registration data. Additional guidance on registration aspects of the 24-bit aircraft address will have to be developed by Cospas-Sarsat and promulgated by ICAO.

5.3.3 Legal/Regulatory/Educational Aspects

It is essential for national Administrations to evaluate the requirement for mandatory registration of 406 MHz beacons.

The benefits and criticality of registration information should be publicised.

5.3.4 Actions and Recommendations

Action Item 5.5: *Ground Segment Operators should review the current data distribution procedures for the exchange of registration information (via the SIT 925) to determine if improvements are necessary. As the increase in 406 MHz beacon population could take place soon after the announcement of the decision to terminate 121.5 MHz satellite alerting services, Ground Segment Operators should initiate the review as soon as possible and complete the analysis by 2001.*

Action Item 5.6: *Cospas-Sarsat should develop guidance on the use of 24-bit aircraft addresses to access aircraft registration data and request ICAO to promulgate advice on this issue.*

Action Item 5.7: *The Cospas-Sarsat Secretariat should convey to ICAO a request that ICAO develop and circulate to all member States guidelines on the establishment and maintenance of 406 MHz ELT registration databases.*

Recommendation I: *Administrations may wish to analyse potential increases in 406 MHz beacon registrations and ensure that national databases can accommodate the increase. The analysis should be completed as soon as possible.*

Recommendation II: *Administrations may wish to promote point-of-sale registration to ensure compliance with mandatory, or voluntary guidelines.*

5.4 Availability of 406 MHz Beacons and Beacon Installation Capacity

As of June 1999 there were over 600,000 beacons operating at 121.5 MHz. Cospas-Sarsat and Administrations should make efforts to ensure that 406 MHz beacons are made available to 121.5 MHz beacon users throughout the transition phase.

5.4.1 Manufacturing Capability

If a large number of 121.5 MHz beacon users wait until the final years of 121.5 MHz satellite processing to replace their beacon with 406 MHz beacons, the potential exists for a shortage of 406 MHz beacons and long lead times for installation work. If there were a shortage of 406 MHz beacons or installation capacity at the time 121.5 MHz satellite processing is to be terminated, Administrations and/or organizations may request Cospas-Sarsat to delay the date for terminating the 121.5 MHz satellite service. To avoid this situation, an educational programme and communication plan should be implemented to inform users and Administrations of the need to transition to 406 MHz beacons (or another substitute for 121.5 MHz beacons) during a suitable time frame.

Action Item 5.8: *Cospas-Sarsat should implement an information campaign to advise users, Administrations, international organizations and manufacturers of the requirement to transition from 121.5 MHz beacons as soon as possible.*

Recommendation III: *Administrations may wish to consider mandating the transition from 121.5 MHz beacons well in advance of the termination date determined by Cospas-Sarsat.*

5.4.2 406 MHz Beacon Cost

The requirements imposed on 406 MHz beacons result in higher costs as compared to 121.5 MHz beacons. Many of the existing 121.5 MHz beacons are used by recreational boaters and aviators who may not be willing to purchase the more expensive 406 MHz beacons. Additionally, Administrations may not be willing to impose carriage requirements for 406 MHz beacons due to the present high cost.

It is anticipated that the future sales volume will lead to some decrease in the cost of 406 MHz beacons. However, Cospas-Sarsat should also review existing design specifications to determine if changes could be introduced to lower the cost. A new design or modifications to beacon specifications should not impact existing mandated users that operate under the provisions of IMO and ICAO. Instead, a new class of beacons should be introduced if necessary.

Action Item 5.9: *Cospas-Sarsat should review System documents C/S T.001 and C/S T.007 to determine if a new beacon design, or modifications to the existing specifications could significantly lower the cost of 406 MHz beacons.*

Recommendation IV: *Administrations may wish to promote beacon technologies (i.e. batteries, oscillators and manufacturing processes) to further reduce the cost of 406 MHz beacons.*

The cost of 406 MHz beacons is also driven by the operating requirements set by Administrations and/or international organizations. These requirements are not part of

the Cospas-Sarsat specifications and, therefore, are not under the responsibility of Cospas-Sarsat.

When considering the replacement of 121.5 MHz ELTs/EPIRBs with equivalent 406 MHz equipment, Administrations should also take into account the impact of these operational requirements on the cost of the 406 MHz replacement beacon.

Recommendation V: *Administrations may wish to review their existing operational requirements for 406 MHz ELTs/EPIRBs with the objective of reducing the impact of additional features/requirements on the cost of 406 MHz beacons intended for replacement of existing 121.5 MHz ELTs/EPIRBs.*

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6. OPERATIONAL ISSUES

The termination of 121.5/243 MHz satellite services and the expected resulting increase in the number of 406 MHz beacons will lead to an increase in the number of 406 MHz processing anomalies which may also lead to an increase in the number of 406 MHz false alerts. Last minute installations and transition to 406 MHz ELTs/EPIRBs during the period immediately prior to the planned termination date could also cause a significant increase in the number of 406 MHz false alerts.

Some modifications to the Cospas-Sarsat alert data distribution procedures may be required during the transition phase.

6.1 406 MHz Processing Anomalies

A processing anomaly is defined as an alert message produced by the Cospas-Sarsat System, which either should not have been generated or provided incorrect information. The majority of 406 MHz processing anomalies are generated from beacon activations. Consequently an increase in the 406 MHz beacon population will result in an increased number of 406 MHz processing anomalies.

6.1.1 Technical Aspects

The technical causes of 406 MHz processing anomalies should be fully determined in order to develop methods of eliminating or mitigating them.

6.1.2 Operational Aspects

An increase in the number of 406 MHz processing anomalies might require additional resources at the MCC to conduct investigations to resolve them. Any increase in the number of 406 MHz processing anomalies may be mitigated by a reduction in the number of 121.5/243 MHz processing anomalies. However, in view of the fact that, in most parts of the world, the majority of 121.5/243 MHz processing anomalies are caused by background noise in the channel (and not beacons), there may only be a minimal reduction in the number of 121.5/243 MHz processing anomalies until the processing of these satellite channels is terminated.

6.1.3 Actions and Recommendations

Action Item 6.1: *Cospas-Sarsat Participants should conduct analyses to determine the technical causes of 406 MHz processing anomalies and actions implemented to eliminate their occurrence. These analyses should be conducted on an ongoing basis.*

Action Item 6.2: *Cospas-Sarsat Participants should conduct an analysis to determine the anticipated increase of 406 MHz processing anomalies and the reduction of 121.5/243 MHz processing anomalies, with a view to determining the required resources to effectively handle them. This analysis should be performed for each MCC*

since the extent of investigations for resolving 406 MHz and 121.5/243 MHz differs for each administration. This analysis should be completed before year 2004.

6.2 406 MHz False Alerts

Although most 406 MHz processing anomalies are filtered-out before transmission to RCCs, the possible increase in processing anomalies (see above) could result in a corresponding increase in the number of 406 MHz false alerts.

The consequences of an increase in 406 MHz operational false alerts may be mitigated by the expected decrease in the number of 121.5 MHz false alerts, and the presence of identification and registration information for 406 MHz beacons. However, the decrease of 121.5 MHz false alerts may not be significant during the transition phase, as the majority of 121.5/243 MHz processing anomalies are caused by background noise in the channel (and not beacons).

The 1999 Cospas-Sarsat Task Group on False Alerts (TG-3/99) identified a number of actions which should be carried-out to monitor and reduce the number of 406 MHz false alerts, and mitigate their impact on SAR services.

Recommendation VI: *Cospas-Sarsat Participants should continue to implement the actions identified by TG-3/99, and monitor and report on the causes of 406 MHz false alerts with a goal to minimising their number.*

6.3 Alert Data Distribution Procedures

Before the termination date, an increase in 406 MHz alerts is expected, including 406 MHz alerts generated by the GEOSAR system.

The impact on existing data distribution procedures will need to be analysed.

Action Item 6.3: *Cospas-Sarsat Participants should review the Cospas-Sarsat alert data distribution procedures to ensure they will be appropriate for distribution of 406 MHz data only.*

Action Item 6.4: *Cospas-Sarsat Participants should determine if data distribution procedures are appropriate for the possible increase in 406 MHz GEOSAR detections.*

The analysis of the Cospas-Sarsat alert data distribution procedures should be completed within two years after the beginning of the transition phase.

7. CO-ORDINATION OF PHASE-OUT ACTIVITIES

The large number of inter-related activities in the preparation for terminating Cospas-Sarsat 121.5 MHz services require that a specific co-ordination effort be accomplished internally within the Cospas-Sarsat Programme, and externally with a number of organizations and Administrations including:

- international organizations and national Administrations or organizations responsible for SAR activities, regulatory matters and beacon registration;
- manufacturers of Cospas-Sarsat equipment (i.e. 406 MHz beacons, LUTs and MCCs);
- user organizations representing the various categories of users (e.g. IFALPA, ICS).

7.1 Internal Co-ordination of Activities Regarding the 121.5 MHz Satellite Services Phase-Out

The co-ordination of phase-out activities by Cospas-Sarsat Participants can be accomplished as part of the normal co-ordination of Cospas-Sarsat activities, i.e. at Joint Committee (JC) meetings and during the Cospas-Sarsat Council (CSC) sessions. The CSC may also decide to convene task groups of experts as appropriate to address particular issues concerning the preparation for phasing-out 121.5 MHz satellite services.

7.1.1 Phase-Out Plan

The Phase-Out Plan describes the major actions to be implemented by Participants and the Cospas-Sarsat Secretariat in preparation for the phasing-out. Therefore, it provides the main vehicle for co-ordinating Cospas-Sarsat activities.

Action Item 7.1: *The Secretariat should update the Phase-Out Plan as necessary for its review at each regular meeting of the Programme to reflect the status of preparation by Cospas-Sarsat.*

7.1.2 Cospas-Sarsat System Documentation

The result of Cospas-Sarsat activities will be reflected in the amendment to the System documents. The termination of 121.5/243 MHz satellite services will necessitate modifications in almost all Cospas-Sarsat System documents. This task will require significant work from Participants and the Cospas-Sarsat Secretariat. Some documents, for example the Introduction to the Cospas-Sarsat System (C/S G.003) and the Guidelines for Participation in the Cospas-Sarsat System (C/S P.007) will have to be modified relatively soon. Other documents may be modified at a date closer to the actual termination.

Action Item 7.2: *The Secretariat should develop and update as necessary the list of System documents to be updated prior to the termination of 121.5 MHz satellite services (Annex D to the Phase-Out Plan) and prepare amendments to System*

documents, as directed by the Council, for review by Participants at Joint Committee meetings and approval by the Cospas-Sarsat Council.

7.2 External Co-ordination Regarding the 121.5 MHz Satellite Services Phase-Out

In addition to the Phase-Out Plan and the updating of Cospas-Sarsat System documentation, specific efforts will have to be made to publicise the phase-out activities and time-line, and provide international organizations, Administrations, user organizations and beacon manufacturers and agents with relevant information on actions and decisions taken by Cospas-Sarsat in respect of phasing-out 121.5/243 MHz satellite alerting services.

Multiple means should be explored for the distribution of information to include periodic regional meetings, use of web sites, user organization conventions, etc.

Information provided by Cospas-Sarsat and Administrations should include:

- the rationale for the Cospas-Sarsat Council decision to terminate the 121.5 MHz satellite alerting service;
- the rationale for, and the description of the strategy adopted for terminating 121.5 MHz services;
- the time frame of the 121.5 MHz satellite service phase-out; and
- guidelines on the actions that should be taken by the targeted audience to prepare for the termination of 121.5 MHz satellite services.

Cospas-Sarsat will also need to ensure that amendments made to Cospas-Sarsat 406 MHz beacon specifications and type approval procedures (see section 5) are reflected as appropriate in the 406 MHz beacon specifications published by other organizations (e.g. ITU, IMO, RTCA, RTCM, EUROCAE, IEC).

Action Item 7.3: *The Secretariat should continue to provide periodic statements of System status to the appropriate international organizations and co-operate with these international organizations to ensure that the information on the termination of 121.5 MHz satellite services is publicised and made available to all Administrations.*

Recommendation VII: *Cospas-Sarsat should develop periodic statements of status and progress on the plans to phase-out 121.5 MHz satellite services that can be used by others to develop presentations and information bulletins for education and information distribution.*

Recommendation VIII: *Administrations may wish to develop information campaigns and establish distribution lists to ensure that all appropriate user, regulatory bodies, and manufacturing concerns are kept informed of the progress of the phase-out.*

Recommendation IX: *Cospas-Sarsat should continue promoting the advantages of the 406 MHz system and recommend to users and Administrations an early transition from 121.5 MHz ELTs/EPIRBs to 406 MHz beacons.*

The distribution of information should begin as soon as such information is available and continue periodically until the termination of satellite services.

8. NATIONAL REGULATORY MATTERS

If Administrations authorising the use of 121.5 MHz beacons choose to transition to the use of 406 MHz beacons, changes to the national requirements for carriage of emergency beacons will probably be required. In addition, Administrations should consider various legal, regulatory and educational aspects of the introduction of 406 MHz beacons, as described below.

8.1 Legal and Regulatory Aspects

States should consider legislating for the carriage of 406 MHz ELTs (as necessary) on the various types and categories of aircraft (if such legislation does not already exist), i.e. airline, business jet, helicopter, general aviation, leisure craft, and of 406 MHz EPIRBs on fishing vessels and pleasure craft not subject to the provisions of the SOLAS Convention.

Administrations may also wish to co-ordinate at a national level to modify legislation concerning the type approval, sale, and use of 121.5 MHz beacons. Such actions would require advanced planning to ensure that the impact to beacon manufacturers and owners is minimised.

Administrations should ensure that an appropriate 406 MHz beacon registration database is in place and is of sufficient capacity to accommodate an increase in 406 MHz registrations. In the case of the 406 MHz ELT, any legislation should lay down the rules for mandatory registration of necessary beacon details.

Guidelines for coding requirements may need to be devised. Regulatory authorities must be actively involved as they will have to deal with manufacturers and users on certification issues and agree suitable ELT equipment and time-scale for implementation.

8.2 Policy and Educational Aspects

A 406 MHz ELT policy may be required, together with an implementation plan to be developed with a panel of experts/representatives drawn from the civil aviation authority, military, regulatory authorities, manufacturers, airlines, equivalent maritime agencies (such as SAR authorities, maritime safety agencies etc.). Frequent meetings may be necessary in order to steer the transition. A policy for the use of personal locator beacons (PLBs) for land use may also have to be considered.

Publicity material may need to be produced to promote, throughout the aviation industry, the carriage of the new type of ELT. Presentations might have to be given at national meetings associated with flight safety and SAR. Articles could be written for magazines and other publications and may be placed on the Internet. Beacon manufacturers and aviators should be specifically targeted.

8.3 Recommendation

Recommendation X: *If required, Administrations may wish to develop a plan for the transition from 121.5 MHz to 406 MHz beacons. The plan should include the efforts necessary to modify the national regulations to accommodate new carriage requirements, and the time line necessary to accomplish the appropriate actions to ensure proper compliance by the time of phase-out of the satellite services. The plan should also include guidance on the disposal of old beacons to prevent an unwanted increase in false alerts due to beacon mishandling and improper disposal. Planning the transition from 121.5 MHz emergency beacons should begin as soon as possible.*

ANNEXES

TO DOCUMENT C/S R.010

LIST OF ANNEXES:

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ANNEX A

LIST OF ACRONYMS

BPO	Beginning of Phase-Out date
CSC	Cospas-Sarsat Council
ELT	Emergency Locator Transmitter (aircraft)
EPIRB	Emergency Position Indicating Radio Beacon (ships)
EUMETSAT	European meteorological satellite organization
EUROCAE	The European Organisation for Civil Aviation Equipment
FTD	firm termination date
GEO	geostationary Earth orbit
GEOLUT	ground receiving station in the GEOSAR system
GEOSAR	GEO satellite system for SAR
GMDSS	Global Maritime Distress and Safety System
ICAO	International Civil Aviation Organization
ICSPA	International Cospas-Sarsat Programme Agreement
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
ITU	International Telecommunication Union
JC	Joint Committee
LEO	low Earth orbit
LEOLUT	ground receiving station in the LEOSAR system
LEOSAR	LEO satellite system for SAR
LUT	Local User Terminal (Cospas-Sarsat ground receiving station)
MCC	Mission Control Centre (Cospas-Sarsat communication centre)
METOP	LEO meteorological operational satellite of the European meteorological organization (EUMETSAT)
MHz	megahertz
NOAA	National Oceanic and Atmospheric Administration (USA)
NPOESS	National Polar-orbiting Operational Environmental Satellite System (USA)
PLB	Personal Locator Beacon

RCC	rescue co-ordination centre
RTCA	Radio Technical Commission for Aeronautical Services (USA)
RTCM	Radio Technical Commission for Maritime Services (USA)
SAR	search and rescue
SARP	Search and Rescue Processor (satellite on-board instrument)
SARR	Search and Rescue Repeater (satellite on-board instrument)
SIT	Subject Indicator Type (Cospas-Sarsat alert message type)
SOLAS	Safety of Life at Sea (Convention)
SPOC	SAR point of contact
TG	task group

ANNEX B

121.5 MHz SATELLITE PROCESSING AVAILABILITY

Satellite/Year	01	02	03	04	05	06	07	08	09
S4 (NOAA-11)				D					Satellite processing at 121.5/243 MHz ceased 1February 2009
C4 (Nadezhda-1)	~~DR~~						D		
S6 (NOAA-14)	▲						D		
S7 (NOAA-15)	▲								
S8 (NOAA-16)			▲					D*	
C9 (Nadezhda-6)					▲		D		
S9 (NOAA-17)					▲				
C10 (Nadezhda-7)				D					
C11 (Sterkh)									
C12 (Sterkh)									
S10 (NOAA-N)								▲	
S11 (Metop-A)									
Year	01	02	03	04	05	06	07	08	09
Maximum Number of Payloads Available	6	8	8	6	6	9	6	4	4

***** Sarsat-8 – no processing capability at 121.5 MHz

X Projected Satellite Launch

D Decommissioned

▲ End of Design Life (Satellites may continue to be available beyond their expected design life, dependent upon satellite health)

R Recommissioned

Figure B.1: Chart of 121.5 MHz Satellite Processing Availability

B.1 121.5 MHz Satellite Processing Availability

The projected launch and end of design life dates for Cospas and Sarsat payloads with 121.5 MHz instruments is provided at Figure B.1. The end of design life planning figure used was 3 years for Sarsat instruments (5 years for the instruments carried aboard Metop satellites) and 5 years for Cospas instruments. Sarsat payloads include both 121.5 and 243 MHz repeaters, whereas Cospas payloads only include 121.5 MHz repeaters.

B.2 Number of 121.5 MHz Payloads in Orbit

The projected number of 121.5 MHz payloads in orbit is provided in the last row of Figure B.1. The number of available 121.5 MHz payloads includes the older satellites currently in orbit (i.e., C-4, S-6, S-7, S-8 and C-9). A satellite was assumed to be operational and available as of the year that it was launched through the year it reached its design life. It should be noted that the Space Segment providers may choose to decommission satellites even if their SAR payloads are still operational.

PLEASE NOTE:

The chart at Figure B.1 was developed using provisional launch dates and the satellite design lifetime. The launch dates are subject to change depending on national requirements of the space segment providers. In addition, the actual satellite life may exceed its design life.

- END OF ANNEX B -

ANNEX C

LIST OF ACTIONS AND RECOMMENDATIONS

C.1 COSPAS-SARSAT ACTIONS FOR PHASING-OUT 121.5 MHz SATELLITE SERVICES

Actions	Status
Action Item 3.1: (section 3.1.1)	
Russia, Canada and the USA conducted an analysis to determine whether 121.5 MHz instruments could be disabled without adversely affecting Cospas-Sarsat or other satellite operations. The results of this technical analysis confirming the feasibility of turning off 121.5 MHz instruments without affecting Cospas-Sarsat or other satellite operations were adopted by the CSC-23 Session of the Council in October 1999.	Action closed at CSC-23 (October 1999)
Action Item 3.2: (section 3.1.2)	
The Cospas-Sarsat Secretariat should maintain and update as necessary the chart provided at Annex B indicating the expected launch dates and possible period of operation for all satellites with the 121.5 MHz SARR. This chart should be updated on an ongoing basis and periodically reviewed by the Cospas-Sarsat Council for inclusion of the revision in the Phase-Out Plan.	Action closed at CSC-43 (October 2009)
Action Item 3.3: (section 3.2.1)	
Space Segment Providers should develop amendments to System document C/S T.003 (LEOSAR Space Segment Description) as soon as any design changes have been frozen.	Action closed at CSC-41
Comments: Canada and Russia provided updates to document C/S T.003 to describe satellite design after elimination of 121.5 MHz processing.	(October 2008)

Actions	Status
Action Item 3.4: (section 3.2.3)	
Spacecraft providers will have to amend the declaration to the ITU of the Kospas and SAR network frequencies (i.e. respectively Russia and the USA) to account for the elimination of 121.5/243 MHz services. This action is only required after the planned termination date.	Action closed at CSC-43 (October 2009)
Comments: At CSC-42 in April 2009, the Council noted that Russia and the USA planned to correspond with the ITU via their national frequency authorities to amend the declarations of the Cospas and Sarsat network frequencies, and would inform CSC-43 of any actions taken	
Action Item 3.5: (section 3.2.3)	
Although an amendment to the International Cospas-Sarsat Programme Agreement would not be required prior to the elimination of the 121.5 MHz satellite services, the Cospas-Sarsat Parties should investigated this issue as soon as possible.	Action closed at CSC-37 (October 2006)
Comments: At CSC-37 in October 2006, the Council noted that there was no need to modify the ICSPA; however the Parties should inform the depositories of the ICSPA (e.g. IMO and ICAO) of the termination of 121.5/243 MHz processing after the termination date. *At CSC-42 in April 2009, the Council decided to invite the Secretariat to prepare draft letters from the Cospas-Sarsat Council Chair to the Secretary General of ICAO and the Secretary General of IMO to inform the Depositories of the ICSPA of the termination of 121.5/243 MHz processing by Cospas-Sarsat and present these letters for consideration at the CSC-43 Session*	
Action Item 3.6: (section 3.3.2)	
The actual capacity of the GEOSAR system should be re-assessed. Cospas-Sarsat should complete the outstanding GEOSAR Demonstration and Evaluation test dealing with GEOSAR capacity by 2003.	Action closed at CSC-37 (October 2006)
Comments: Document C/S R.013, Issue 1, October 2004 provides an assessment of GEOSAR system capacity.	

Actions	Status
Action Item 3.7: (section 3.3.2) Cospas-Sarsat should develop procedures for inclusion in the System monitoring document (C/S A.003) for regularly assessing the required GEOSAR system capacity. This action should be completed by 2003. *Comments: Document C/S A.003 currently does not address the GEOSAR system. Carried forward as a JC-23 action item.*	Action closed at CSC-43 (October 2009)
Action Item 3.8: (section 3.3.2) The plan for changing the carrier frequency of orbitography and reference/ test beacons should be implemented as a priority. The migration of test, orbitography and reference beacons from 406.025 MHz to 406.022 MHz should be completed by 2002. Additionally, all providers of reference/test beacons should declare their beacon to Cospas-Sarsat and change the beacon operating frequency to 406.022 MHz. *Comments: All orbitography and reference beacons changed to new frequency.*	Action closed at CSC-37 (October 2006)
Action Item 3.9: (section 3.3.2) Participants should conduct analysis to determine the effect of routinely occurring / transient interference upon GEOSAR capacity. *Comments: No longer required.*	Action closed at CSC-43 (October 2009)
Action Item 3.10: (section 3.3.2) Participants should conduct studies to determine the optimum spreading method of the beacon carrier frequency in respect of the GEOLUT processing capacity. These studies should be completed by 2002. A long term plan for the use of the available bandwidth (i.e. 406.0 - 406.1 MHz) should be developed by Cospas-Sarsat and updated as appropriate on the basis of the evolution of capacity requirements. *Comments: See the LEOSAR and GEOSAR capacity models in C/S T.012*	Action closed at CSC-31 (October 2003)
Action Item 3.11: (section 3.3.2) Cospas-Sarsat Participants should develop and agree a model of the 406 MHz GEOSAR system processing capacity for use in the management of the available 406 MHz bandwidth. *Comments: See the GEOSAR capacity model in C/S T.012.*	Action closed at CSC-31 (October 2003)

Actions	Status
Action Item 4.1: (section 4.1) Cospas-Sarsat should develop modified LEOLUT requirements and: a) amend System document C/S T.002, LEOLUT specification and design guidelines to provide for a possible optimisation of the LEOLUT design, changes in the satellite downlink format, and increased capacity for 406 MHz beacon transmissions; and b) amend System document C/S T.005, LEOLUT commissioning standard. *Comments: Completed in 2009 with deletion of all references to 121.5/243 MHz processing in documents C/S T.002 and C/S T.005, which included a review of document C/S T.002 concerning the performance of the downlink receiver.*	Action closed at CSC-43 (October 2009)
Action Item 4.2: (section 4.2) Cospas-Sarsat should: a) request Ground Segment Providers/Operators to advise the Council of their plans in respect of maintaining 121.5/243 MHz processing capabilities at their LEOLUT(s) up to the planned termination date; b) monitor the continued availability of 121.5 MHz LEOLUT processing capability during the transition phase, assess the quality and reliability of 121.5 MHz services taking into account the number of satellites with a 121.5 MHz capability and the number of LEOLUTs which have opted to continue processing this channel, and provide adequate information on the availability of 121.5/243 MHz local mode coverage to Administrations, international organizations and users; and c) develop as appropriate revised procedures to ensure an adequate distribution of 121.5 MHz alert data by MCCs.	Action closed at CSC-43 (October 2009)
Action Item 4.3: (section 4.3.1) Ground Segment Providers/Operators should carry-out verifications of their LEOLUT data storage capacity and communication links, as soon as a better estimate of the 406 MHz beacon message traffic increase becomes available and new LEOLUT requirements have been defined. *Comments: Not required in light of current LEOLUT capacity and expected 406 MHz beacon message traffic.*	Action closed at CSC-37 (October 2006)

Actions	Status
Action Item 4.4: (section 4.3.3)	
Using the forecast of the 406 MHz beacon population and beacon message traffic as an input (see Action Items 5.1 and 5.2), Cospas-Sarsat should develop a model of 406 MHz alert message traffic in the Ground Segment. The model should be validated by the year 2003, and reassessed on an annual basis thereafter.	Action closed at CSC-31 (October 2003)
Comments: Per TG-1/2003 recommendation. Volume of traffic is very low in comparison with the capabilities of most communication systems and there is no need for further investigations.	
Action Item 4.5: (section 4.3.3)	
Based on the results of the analysis of 406 MHz alert message traffic in the Ground Segment, and taking into account the possible decrease of 121.5 MHz alert message traffic, Ground Segment Operators should take necessary actions to ensure any required enhancement to the communication network and Ground Segment processing capabilities are implemented in a timely manner.	Action closed at CSC-31 (October 2003)
Comments: Due to forecast low volume of 406 MHz alert message traffic, no modifications to the communication network and Ground Segment processing capabilities required.	
Action Item 5.1: (section 5.1)	
Cospas-Sarsat should develop a model to estimate the growth of the 406 MHz beacon population. This model should be validated, and updated on an annual basis. Since this model will be the foundation for all analyses in respect of System capacity issues, its development should be completed no later than 2000.	Action closed at CSC-43 (October 2009)
Comments: Model agreed and available in document C/S T.012. Validation performed annually.	
Action Item 5.2: (section 5.1)	
Participants should validate the existing model of 406 MHz beacon message traffic forecast using the data provided by Ground Segment Providers (specifically USA and France). In addition, the model should be modified to account for the impact of self-test mode transmissions and faulty beacons. The modified model should be validated in 2000, and updated on an annual basis.	Action closed at CSC-43 (October 2009)
Comments: Model agreed and available in document C/S T.012.	

Actions	Status
Action Item 5.3: (section 5.1) GEOLUT Operators should collect and provide GEOLUT data to the Secretariat for analysis to confirm/evaluate the impact of self-test mode transmissions and faulty beacons. <u>Comments</u>: *JC-19 agreed that monitoring beacon performance was essential for ensuring the health of the System and encouraged Participants to implement beacon monitoring and reporting programmes in accordance with the guidance provided in document C/S A.003.* *Administrations report false alert statistics in their annual Report on System Status and Operations.* *Self-test mode transmissions are addressed annually as part of the 406 MHz traffic evaluation in accordance with the procedure described in document C/S T.012. Faulty beacon issues are addressed on a case-by-case basis, as required.*	Action closed at CSC-43 (October 2009)
Action Item 5.4: (section 5.2) Cospas-Sarsat should undertake co-ordination with relevant organizations (e.g. ICAO, IMO, ITU, RTCM, RTCA) to ensure that any change of the beacon carrier frequency specification is disseminated and incorporated into the documentation of the organizations as appropriate. <u>Comments</u>: *Changes to C/S T.001 and C/S T.007 reflecting the 406 MHz channel assignment plan as outlined in C/S T.012 have been made. The Secretariat proposed appropriate changes to the ITU Recommendation ITU-R M.633-2, which now refers directly to C/S T.001. ICAO Annex 10 was amended to refer to C/S T.012. IMO Assembly Resolution A.810 (19) amended by Resolution MSC.56(66) and Resolution MSC.120(74) make direct reference to C/S T.001.*	Action closed at CSC-37 (October 2006)

Actions	Status
Action Item 5.5: (section 5.3.4) Ground Segment Operators should review the current data distribution procedures for the exchange of registration information (via the SIT 925) to determine if improvements are necessary. As the increase in 406 MHz beacon population could take place soon after the announcement of the decision to terminate 121.5 MHz satellite alerting services, Ground Segment Operators should initiate the review as soon as possible and complete the analysis by 2001. *Comments: TG-2/2000 agreed that a SIT 925 (beacon registration information) was not required to be transmitted automatically on receipt of an NOCR message. However, if MCCs desired they could follow procedure in the DDP to transmit SIT 925 messages concerning beacons in their national registry*.	Action closed at CSC-37 (October 2006)
Action Item 5.6: (section 5.3.4) Cospas-Sarsat should develop guidance on the use of 24-bit aircraft addresses to access aircraft registration data, and request ICAO to promulgate advice on this issue. *Comments: No standard ICAO procedure exists for the assignment of 24-bit address by Administrations.*	Action closed at CSC-37 (October 2006)
Action Item 5.7: (section 5.3.4) The Cospas-Sarsat Secretariat should convey to ICAO a request that ICAO develop and circulate to all member States guidelines on the establishment and maintenance of 406 MHz ELT registration databases. *Comments: Annex 10, Volume III, Part II of the ICAO Convention was modified effective 27 November 2003 to notify states of the requirement for 406 MHz ELT registration databases and provide guidelines on required database fields.*	Action closed at CSC-31 (October 2003)
Action Item 5.8: (section 5.4.1) Cospas-Sarsat should implement an information campaign to advise users, Administrations, international organizations and manufacturers of the requirement to transition from 121.5 MHz beacons as soon as possible.	Action closed at CSC-43 (October 2009)

Actions	Status
Action Item 5.9: (section 5.4.2)	
Cospas-Sarsat should review the documents C/S T.001 and C/S T.007 to determine if a new beacon design or modifications to the existing specifications could significantly lower the cost of 406 MHz beacons.	Action closed at CSC-37 (October 2006)
Comments: At CSC-29 a relaxation of the medium term stability requirement was agreed in principle. A System test was conducted in September/October 2003. CSC-33 approved a revised issue of C/S T.001 which included a change in the beacon medium-term frequency stability requirement to facilitate manufacture of lower cost beacons.	
Action Item 6.1: (section 6.1.3)	
Cospas-Sarsat Participants should conduct analyses to determine the technical causes of 406 MHz processing anomalies and actions implemented to eliminate their occurrence. These analyses should be conducted on an ongoing basis.	Action closed at CSC-43 (October 2009)
Comments: Administrations have reported beacon anomalies to the Secretariat on an ad hoc basis and in two recent cases have resulted in beacon recalls by manufacturers. The Secretariat continues to report status to the Council.	
Procedures are addressed in section 4 of document C/S A.003.	
Action Item 6.2: (section 6.1.3)	
Cospas-Sarsat Participants should conduct an analysis to determine the anticipated increase of 406 MHz processing anomalies and the reduction of 121.5/243 MHz processing anomalies, with a view to determining the required resources to effectively handle them. This analysis should be performed for each MCC since the extent of investigations for resolving 406 MHz and 121.5/243 MHz differs for each administration. This analysis should be completed before year 2004.	Action closed at CSC-37 (October 2006)
Comments: Experience has shown that 406 MHz processing anomalies do not adversely impact the System.	
Action Item 6.3: (section 6.3)	Action closed at CSC-37 (October 2006)
Cospas-Sarsat Participants should review the Cospas-Sarsat alert data distribution procedures to ensure they will be appropriate for distribution of 406 MHz data only.	
Comments: There is no reason to suspect that existing alert distribution procedures would be inadequate.	

Actions	Status
Action Item 6.4: (section 6.3) Cospas-Sarsat Participants should determine if data distribution procedures are appropriate for the possible increase in 406 MHz GEOSAR detections. *Comments:* *Experience to date with global GEOSAR coverage shows that this is not a significant issue.*	Action closed at CSC-37 (October 2006)
Action Item 7.1: (section 7.1.1) The Secretariat should update the Phase-Out Plan as necessary for its review at each regular meeting of the Programme to reflect the status of preparation by Cospas-Sarsat.	Action closed at CSC-43 (October 2009)
Action Item 7.2: (section 7.1.2) The Secretariat should develop and update as necessary the list of System documents to be updated prior to the termination of 121.5 MHz satellite services (Annex D to the Phase-Out Plan) and prepare amendments to System documents, as directed by the Council, for review by Participants at Joint Committee meetings and approval by the Cospas-Sarsat Council.	Action closed at CSC-43 (October 2009)
Action Item 7.3: (section 7.2) The Secretariat should continue to provide periodic statements of System status to the appropriate international organizations and co-operate with these international organizations to ensure that the information on the termination of 121.5 MHz satellite services is publicised and made available to all Administrations. *Comments: Regular System status reports are provided to the IMO COMSAR Sub-Committee and the ICAO/IMO JWG on SAR. Reports have also been provided to regional ICAO hosted SAR seminars.*	Action closed at CSC-43 (October 2009)

C.2 RECOMMENDATIONS TO ORGANIZATIONS/ADMINISTRATIONS IN RESPECT OF PHASING-OUT 121.5 MHz SATELLITE SERVICES

Recommendations	Status / Comments
Recommendation I: (section 5.3.4) Administrations may wish to analyse potential increases in 406 MHz beacon registrations and ensure that national databases can accommodate the increase. The analysis should be completed as soon as possible.	
Recommendation II: (section 5.3.4) Administrations may wish to promote point-of-sale registration to ensure compliance with mandatory or voluntary guidelines.	
Recommendation III: (section 5.4.1) Administrations may wish to consider mandating the transition from 121.5 MHz beacons well in advance of the termination date determined by Cospas-Sarsat.	
Recommendation IV: (section 5.4.2) Administrations may wish to promote beacon technologies (i.e. batteries, oscillators and manufacturing processes) to further reduce the cost of 406 MHz beacons.	
Recommendation V: (section 5.4.2) Administrations may wish to review their existing operational requirements for 406 MHz ELTs/EPIRBs with the objective of reducing the impact of additional features/requirements on the cost of 406 MHz beacons intended for replacement of existing 121.5 MHz ELTs/EPIRBs.	
Recommendation VI: (section 6.2) Cospas-Sarsat Participants should continue to implement the actions identified by TG-3/99, and monitor and report on the causes of 406 MHz false alerts with a goal to minimising their number.	
Recommendation VII: (section 7.2) Cospas-Sarsat should develop periodic statements of status and progress on the plans to phase-out 121.5 MHz satellite services that can be used by others to develop presentations and information bulletins for education and information distribution.	

Recommendations	Status / Comments

Recommendation VIII: (section 7.2)

Administrations may wish to develop information campaigns and establish distribution lists to ensure that all appropriate user, regulatory bodies, and manufacturing concerns are kept informed of the progress of the phase-out.

Recommendation IX: (section 7.2)

Cospas-Sarsat should continue promoting the advantages of the 406 MHz system and recommend to users and Administrations an early transition from 121.5 MHz ELTs/EPIRBs to 406 MHz beacons.

Recommendation X: (section 8.3)

If required, Administrations may wish to develop a plan for the transition from 121.5/243 MHz to 406 MHz beacons. The plan should include the efforts necessary to modify the national regulations to accommodate new carriage requirements, and the time line necessary to accomplish the appropriate actions to ensure proper compliance by the time of phase-out of the satellite services. The plan should also include guidance on the disposal of old beacons to prevent an unwanted increase in false alerts due to beacon mishandling and improper disposal. Planning the transition from 121.5/243 MHz emergency beacons should begin as soon as possible.

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ANNEX D

LIST AND STATUS OF COSPAS-SARSAT DOCUMENT UPDATES

The table below identifies System documents and other key Programme documents which should be amended to reflect the phasing-out of 121.5/243 MHz satellite alerting services. The "effective date" indicates when the amended document should take effect, and the status column indicates whether the required amendment has been completed or if the action is still open. If a document has to be amended more than once (e.g. once to address the transition period and once to reflect the situation after the cut-off date) separate entries are identified for each.

Document Title	Target Completion Date	Status
C/S P.001: International Cospas-Sarsat Programme Agreement *Comments: Cospas-Sarsat should notify IMO and ICAO, the depositories of the ICSPA, that the definition of the System has changed.*	April 2009	Action closed at CSC-43 (October 2009)
C/S P.011: Cospas-Sarsat Programme Management Policy *Comments: Some updates required to remove all reference to 121.5 MHz processing and specifications.*	JC-23	Action closed at CSC-43 (October 2009)
C/S G.003: Introduction to the Cospas-Sarsat System Amend C/S G.003 to reflect transition period. Amend C/S G.003 to address status after the cut-off date. *Comments: Document C/S G.003 has not been updated since 1999, yet it remains a very popular and useful document (in April 2008 it was downloaded from the Cospas-Sarsat website over 1000 times). A complete redraft of this document is required and will take considerable effort.*	JC-23	Action closed at CSC-43 (October 2009)
C/S S.011: Cospas-Sarsat Glossary *Comments: Rebuild of document required to address Russian language in Cyrillic font.*	JC-23	Action closed at CSC-43 (October 2009)
C/S T.002: Cospas-Sarsat LEOLUT Performance Specification and Design Guidelines *Comments: See Action Item 4.1. Requires updates to several sections and block diagrams to remove reference to LUT processing at 121.5MHz and 121.5 MHz performance requirements.*	JC-23	Action closed at CSC-43 (October 2009)

Document Title	Target Completion Date	Status
C/S T.003: Description of the Payloads Used in the Cospas-Sarsat LEOSAR System *<u>Comments:</u> Per Action Item 3.3, Canada and Russia should provide updates to document C/S T.003 to describe satellite design after elimination of 121.5 MHz processing.*	CSC-41	Closed
C/S T.004: Cospas-Sarsat LEOSAR Space Segment Commissioning Standard *<u>Comments:</u> Requires extensive modification to remove all reference to 121.5 MHz processing.*	JC-23	Action closed at CSC-43 (October 2009)
C/S T.005: Cospas-Sarsat LEOLUT Commissioning Standard *<u>Comments:</u> See Action Item 4.1. Requires modification to remove all reference to 121.5 MHz test conditions, etc.*	JC-23	Action closed at CSC-43 (October 2009)
C/S A.001: Cospas-Sarsat Data Distribution Plan Delete references to 121.5 MHz alerts	JC-23	Action closed at CSC-43 (October 2009)
C/S A.002: Cospas-Sarsat Mission Control Centres Standard Interface Description *<u>Comments:</u> Requires modification to remove all reference to 121.5 MHz in SIT message descriptors, etc.*	JC-23	Action closed at CSC-43 (October 2009)
C/S A.003: Cospas-Sarsat System Monitoring and Reporting *<u>Comments:</u> Requires extensive modification to incorporate the Quality Management System and remove all reference to 121.5 MHz System monitoring, interference monitoring at 121.5 MHz, changes to the annual Report on System Status and Operations form, etc.*	JC-23	Action closed at CSC-43 (October 2009)
C/S A.004: Cospas-Sarsat System Exercising *<u>Comments:</u> This document dates from 1994 and had only minimal updates in 1998.* *If this document is selected for use in another System exercise, it will require updating*	TBD	Action closed at CSC-43 (October 2009)
C/S A.005: Cospas-Sarsat Mission Control Centre Performance Specification and Design Guidelines *<u>Comments:</u> Requires modification to remove all reference to 121.5 MHz processing in MCCs.*	JC-23	Action closed at CSC-43 (October 2009)

Document Title	Target Completion Date	Status
C/S A.006: Cospas-Sarsat Mission Control Centre Commissioning Standard *<u>Comments:</u> Requires modification to remove all reference to 121.5 MHz processing in MCCs.*	JC-23	Action closed at CSC-43 (October 2009)
C/S S.007: Handbook of Beacon Regulations *<u>Comments:</u> Participants should provide updates to national regulations to remove all reference to 121.5 MHz regulations, once these are updated at the national level.*	JC-23	Action closed at CSC-43 (October 2009)

- END OF ANNEX D -

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