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COSPAS-SARSAT SATELLITE DISTRESS ALERTING SYSTEM

*2001 DOD Personnel Recovery Conference
Technology and Space Support Workshop*

**LCDR PAUL STEWARD
UNITED STATES COAST GUARD
OFFICE OF SEARCH AND RESCUE**

23 January 2001



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OVERVIEW



- ⇒ **UNITED STATES SAR PROGRAM SNAPSHOT**
- ⇒ **COSPAS-SARSAT SYSTEM**
 - **Overview**
 - **History**
 - **Operation**
 - **U.S. SARSAT Program**
- ⇒ **COSPAS-SARSAT ALERTING - 121.5 & 406 MHz**
 - **Critical Comparison**
 - **Operational Impact**
- ⇒ **TERMINATION OF 121.5 MHz ALERTING**
 - **International**
 - **United States**



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UNITED STATES OPERATIONAL SAR ASSETS



- ⇒ **12 RCCs/RSCs - 10 USCG and 2 USAF**
- ⇒ **USCG - 200 Aircraft, 185 Stations, 1500 Small Craft, 85 Patrol Boats, 70 Cutters**
- ⇒ **Federally sponsored volunteer organizations:**
 - **Civil Air Patrol (CAP) - responds to 90% of USAF's 3,000 civil SAR missions annually**
 - **USCG Auxiliary - Responds to 10% of USCG's 40,000 SAR cases annually**
- ⇒ **AMVER - Automated Mutual-assistance Vessel Rescue system**
- ⇒ **Other Federal, Regional and Local resources:**
 - **NOAA - SARSAT Program Lead Agency**
 - **DOD - Ships, planes, personnel, others assets on a cases-by-case basis**
 - **NPS - National Park Service conducts SAR on federal parks**
- ⇒ **NSARC - National Search and Rescue Committee**



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NATIONAL SEARCH AND RESCUE COMMITTEE



DOC

*Satellite Services,
Environmental Information*



DOD

SAR Facilities



FCC

*Regulations for Radio
Facilities*



SAR Services



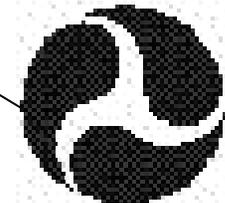
DOI

**Research and
Development**



NASA

SAR Facilities



DOT
4



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UNITED STATES MARITIME SAR REGIONS



COLOR KEY: U.S. MARITIME REGION (USCG)

U.S. INLAND REGION (USAF)

CANADIAN SRR



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COSPAS-SARSAT SYSTEM

**Cospas COsmicheskaya Systyema Poiska Aariynyich Sudov
which translates loosely into “Space System for the Search of Vessels
in Distress”**

Sarsat Search and Rescue Satellite Aided Tracking

**Cospas-Sarsat provides distress alert and location information to
search and rescue authorities anywhere in the world for maritime,
aviation and land users in distress.**

Cospas-Sarsat is made up of three interconnected segments:

- Space Segment 7 polar orbiting(LEO) / 3 geostationary satellites(GEO)**
- Ground Segment 39 LEOLUTs, 6 GEOLUTs, 22 MCCs**
- User Segment 600K 121.5 MHz / 250K 406 MHz beacons
250K 121.5 MHz / 68K 406 MHz beacons (U.S.)**



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COSPAS-SARSAT SYSTEM

Cospas-Sarsat is comprised of 4 parties:

Canada

France

Russia

United States

25 participating countries:

Algeria

Australia

Brazil

Chile

China (P.R.)

Denmark

Germany

Greece

India

Indonesia

Italy

Japan

Korea (Rep. of)

Madagascar

Netherlands

New Zealand

Norway

Pakistan

Peru

Singapore

Spain

Sweden

Switzerland

Tunisia

United Kingdom

2 participating organizations:

International Telecommunication Development Corporation

The Marine Department of Hong Kong, China



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COSPAS-SARSAT HISTORY

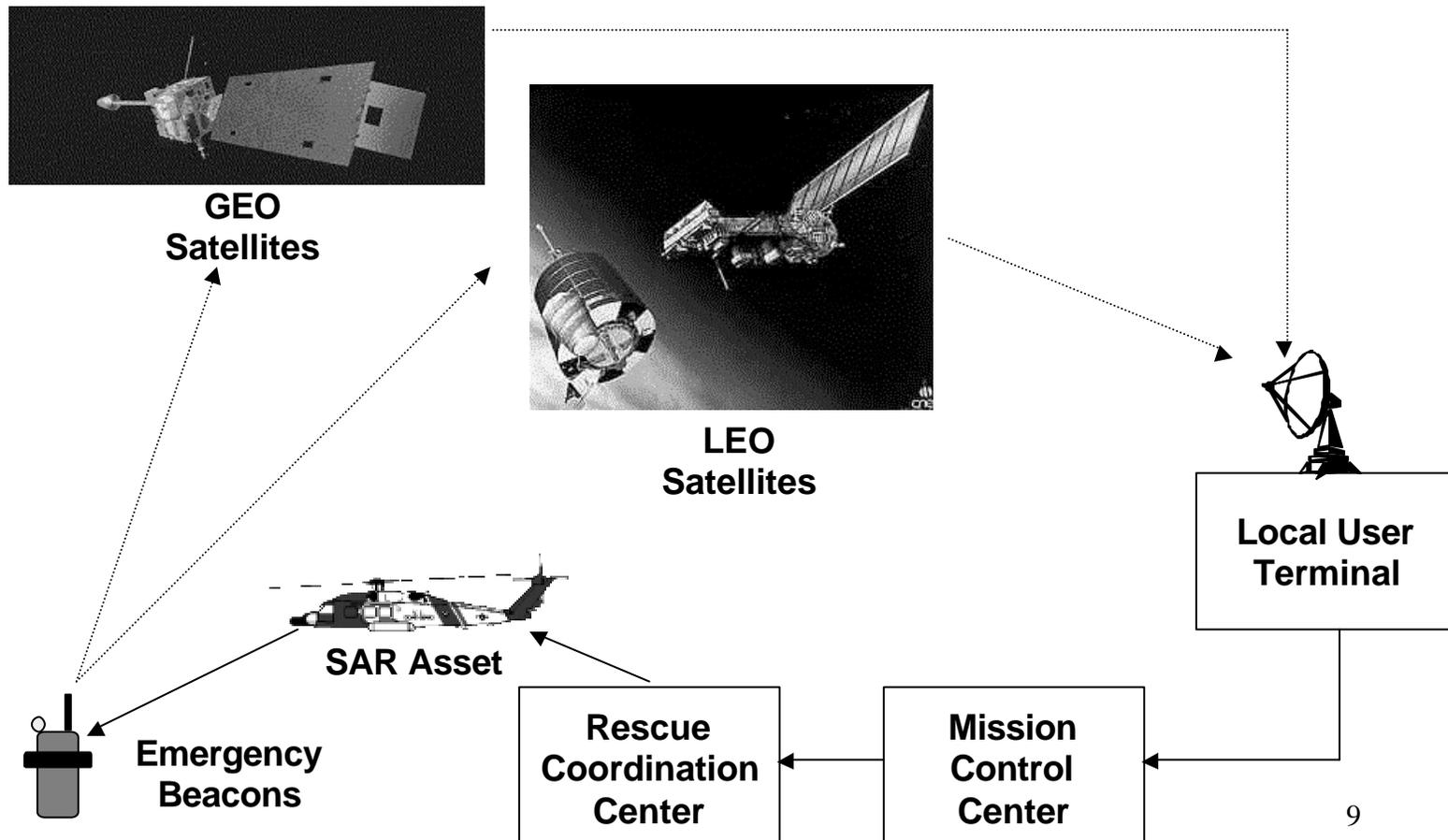
- 1979** Initiated with Memorandum of Understanding among agencies in Canada, France, the USA and former USSR
- 1982** Launch of Cospas-1
- 1983** Launch of Sarsat-1; first save in Canada from Cospas-1
- 1985** Cospas-Sarsat declared operational
- 1988** International Cospas-Sarsat Program Agreement signed
- 1992** Russia assumes the responsibilities of the former USSR
- 1999** Cospas-Sarsat reaches 10,000 rescue mark
- 2000** Cospas-Sarsat announces termination of 121.5 MHz satellite alert processing as of February 1, 2009



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COSPAS-SARSAT SYSTEM OPERATION





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U.S. COSPAS-SARSAT PROGRAM



**Inland
SAR**



**Maritime
SAR**



**Satellite
Integration /
Post Launch
Testing**

**Research &
Development**



**Space
Hardware**

**Ground
Segment**

**System
Operation**



**Representative to
Cospas-Sarsat Program**



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U.S. SARSAT SPECIAL PROGRAMS

A number of U.S. government agencies and military service organizations, state and local agencies have established a 406 MHz 'Special Program' with the SARSAT Program Manager:

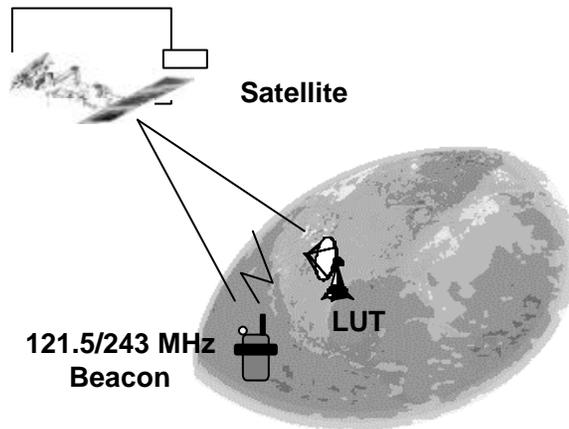
- USCG**
- U.S. Navy**
- DEA**
- State of Alaska**
- Special Forces**
- USDAO Lima, Peru**
- Civil Air Patrol**



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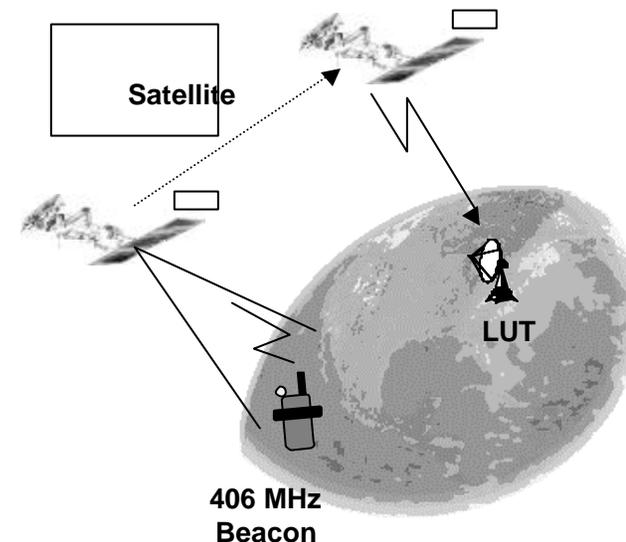


COSPAS-SARSAT SATELLITE ALERTING



Detection of a 121.5/243 MHz beacon requires mutual visibility between beacon, satellite and ground station (LUT)

406 MHz beacon detections can be stored on board the satellite and re-broadcast later



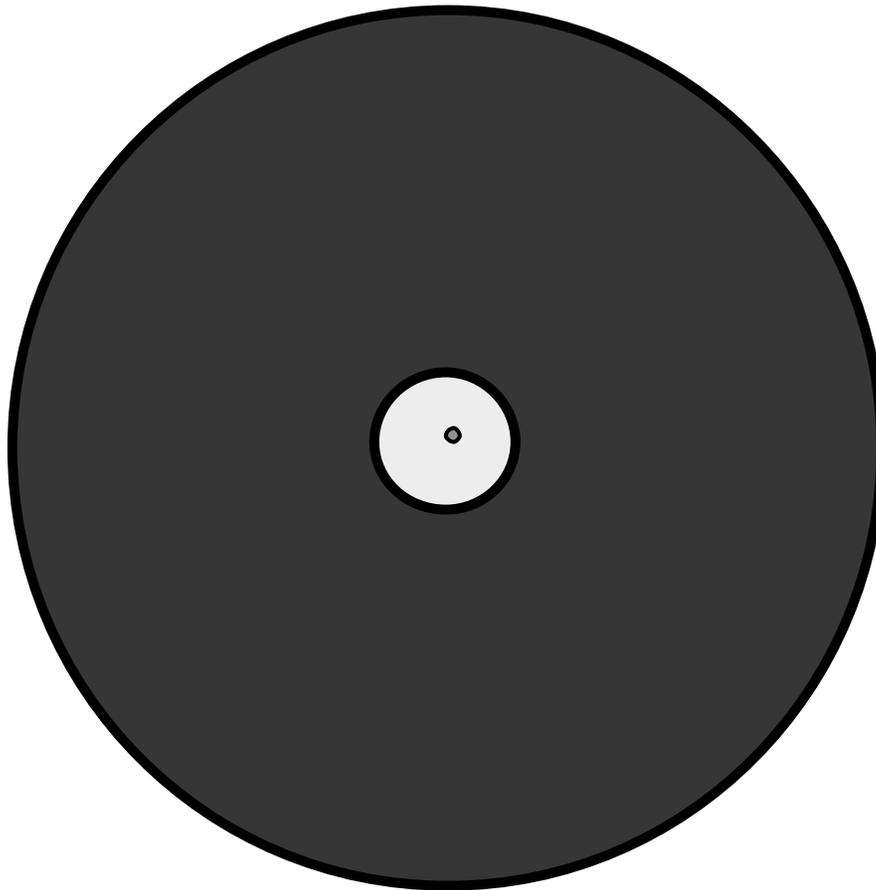
- 121.5/243 MHz is an analog signal with no data capability
- 406 MHz is a digital signal with embedded data capability



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POSITION ACCURACY FOR SAR RESPONSE



- **121.5 MHz Beacon**
12-16 NM radius
450 SQ NM search area
avg 6 hours to initial response
- **406 MHz Beacon**
1-3 NM radius
12.5 SQ NM search area
avg 1 hour to initial response
- **406 MHz Beacon w/ GPS**
0.05 NM radius
0.008 SQ NM search area
avg 25 minutes to initial response



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SUMMARY
UNITED STATES COSPAS-SARSAT ALERTS 1996-1999



121.5 MHz ALERTING SYSTEM

<u>YEAR</u>	<u>1ST ALERTS</u>	<u>COMPOSITES</u>	<u>DISTRESS</u>	<u>SAVES</u>
1996	132,160	14,235	325	99
1997	122,641	13,827	294	143
1998	104,557	10,860	196	36
1999	117,243	13,125	237	24

406 MHz ALERTING SYSTEM

<u>YEAR</u>	<u>1ST ALERTS</u>	<u>COMPOSITES</u>	<u>DISTRESS</u>	<u>SAVES</u>
1996	2,968	781	234	311
1997	3,255	887	224	390
1998	3,208	857	220	272
1999	3,362	823	199	297



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121.5 MHz FALSE ALERT IMPACT

- ⇒ **110,000+ 121.5 MHz FALSE ALERTS PER YEAR EQUALS**
- ⇒ **300+ 121.5 MHz FALSE ALERTS EACH DAY TO U.S. RCCs**
 - **13,000+ 121.5 MHz COMPOSITE FALSE ALERTS / YEAR EQUALS**
 - **35+ 121.5 MHz FALSE ALERTS EACH DAY TO U.S. RCCs**
- ⇒ **END RESULT: U.S. SAR SYSTEM IS OVERTAXED**
 - **OVERBURDENED RCCs**
 - **OVERTASKED SAR AIRCRAFT/VESSELS/PERSONNEL**
- ⇒ **MAIN IMPACT: THE BIG THREE**
 - **DELAYED RESPONSE TO PRIMARY “CUSTOMER” - LIVES AT RISK**
 - **SAR PERSONNEL PLACED AT UNDUE RISK**
 - **SAR BUDGET IMPACTED**



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DELAYED RESPONSE TO 121.5 MHz ALERTS

- ⇒ **“GOLDEN HOUR” RESPONSE CRITERIA IMPACTED**
- ⇒ **DUE TO THE UNRELIABILITY OF 121.5 MHz ALERTING SYSTEM, USCG POLICY IS TO RESPOND TO 121.5 MHz ALERTS ONLY AFTER THE 2ND COMPOSITE - UNLESS THERE ARE OTHER DISTRESS INDICATORS**
 - **AVERAGE TIME TO INITIAL LAUNCH OF SAR ASSETS - 4 HOURS**
 - **AVERAGE TIME TO USCG ASSETS LOCATING TARGET - 6.5 HOURS**
- ⇒ **USAF / CAP HAVE SIMILAR 121.5 MHz RESPONSE POLICY**
- ⇒ **FALSE ALERTS DETRACT FROM TRUE DISTRESS RESPONSE**



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RISK TO SAR CREWS / BUDGET IMPACT

SAR CREWS PLACED AT UNDUE RISK

- ⇒ **SAR RESPONSE IS INHERENTLY DANGEROUS**
- ⇒ **2ND COMPOSITE 121.5 MHz RESPONSE HAS 96% FALSE ALERT RATE**
- ⇒ **EVEN WITH 121.5 MHz RESPONSE POLICY, USCG / CAP SAR ASSETS LAUNCH DOZENS OF TIMES EVERY DAY PLACING SAR RESPONDERS LIVES AT RISK**

SAR BUDGET IMPACT

- ⇒ **EVERY LAUNCH OF SAR AIRCRAFT / VESSEL / OTHER ASSETS HAS A FINANCIAL IMPACT**
- ⇒ **FALSE ALERT RESPONSE RESULTS IN “WASTED” FUNDS**



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ACTUAL SAR DAY AT USCG RCC MIAMI

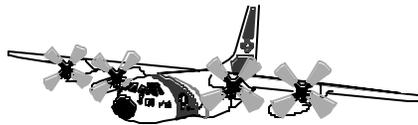
<u>SUBJECT</u>	<u>DISTRESS-LOCATION</u>	<u>RESPONSE</u>	<u>STATUS</u>
M/V ATL. BAY	ELT-INM C IVO FLAGGLER	COMMS LCTD VSL - ACC ACT.	CLOSED
P/C DIE KREUZEN	TOW-IVO PT EVERGLADES	STAFTL DEWATERED VSL	CLOSED
33FT S/V	ODU-IVO SAPELO SND, GA	VSL LCTD SAFE	CLOSED
S/V KEPALI	ELT-UNLOC/UNREG 406	HH-60 LCTD AGR - 3 POB HSTD	CLOSED
F/V AGITATOR	ODU-IVO CHARLESTON, SC	UMIB, VSL LCTD SAFE INPORT	CLOSED
19FT P/C	SNK-IVO FT LAUDERDALE	RECOVERED PIW	CLOSED
02 PIW	PIW-IVO TARPON SPRINGS	VSL LCTD SAFE AT RAMP	CLOSED
M/V CASTILLO(BF)	ELT-406-UNLCTD	TELEX/ACC ACT	CLOSED
P/C MARDI GRAS	ELT-406-UNLCTD	COMMS/ACC ACT/VSL AT PIER	CLOSED
C/S PRINCESSA	MED-IVO MIAMI, FL	STAMIA XFRD PAT TO EMS	CLOSED
18FT P/C	MAY-23NM OFF SANIBEL	C130 LCTD VSL, UTB TOWED	CLOSED
01 ORANGE FLR	FLR-IVO PONTE VEDRA BCH	STAMP/FMP HELO SCHD	SUSPEND
121.5MHZ	ELT-20NM E OF ST LUCIE	HU-25 SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-80NM E OF MIAMI	HH-65 SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-30NM E CANAVERAL	WPB SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-IVO WEST END, BF	HU-25 SCHD W/NEGRES	SUSPEND
121.5MHZ	ELT-35NM W OF CAPE SABEL	HU-25 SCHD W/NEGRES	SUSPEND
121.5MHZ	ELT-IVO BOYNTON BEACH	HH-65 SCHD W/NEGRES	SUSPEND
121.5MHZ	ELT-60NM SW OF FT MYERS	C-130 SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-37NM NE ST LUCIE	HU-25 SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-80NM E OF MIAMI, FL	HH-65 SCHD W/NEGRES	SUSPEND
121.5MHZ	ELT-IVO NAPLES, FL	HU-25 SCHD W/NEGRES 3MP	SUSPEND
121.5MHZ	ELT-3NM SE ISLAMORADA	STAISL SCHD W/NEGRES	SUSPEND
121.5MHZ	ELT-IVO FT LAUDERDALE	HH-65 SCHD W/NEGRES, 3MP	SUSPEND
121.5MHZ	ELT-41NM OFF FT MYERS	C-130 SCHD W/NEGRES, 3MP	SUSPEND



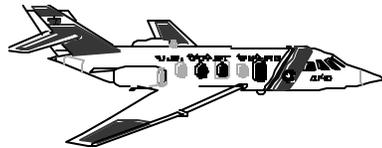
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SAR PERSONNEL / BUDGET IMPACT



C-130
\$9,322/HR
CREW: 4-6



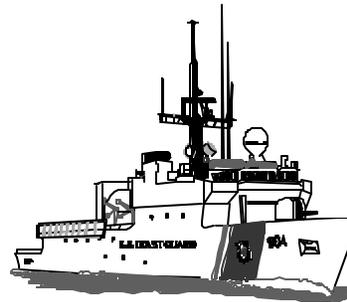
HU-25
\$6,174/HR
CREW: 4



HH-60
\$7,855/HR
CREW: 4



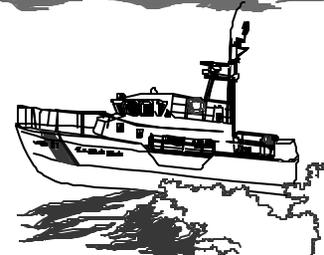
HH-65
\$5,173/HR
CREW: 3-4



CUTTER
\$3,000-7,000/HR
CREW: 60-100



PATROL BOAT
\$1,200/HR
CREW: 10-16



SMALL BOAT
\$500-1,500/HR
CREW: 3-4

IMPACT OF SAR RESPONSE TO COSPAS-SARSAT ALERTS:

406 MHz - 3 CASES, 2 FALSE / \$0.00, 1 DISTRESS / 3 RESCUED / SAR CREW - 4, COST - \$32K
121.5 MHz - 13 CASES, 13 FALSE ALERTS / 0 DISTRESS / SAR CREWS - 62, COST - \$153K



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CRITICAL COMPARISON - 121.5 MHz vs 406 MHz ALERTING

- ⇒ **ALERT RELIABILITY**
- ⇒ **RESPONSE POLICY**

ALERT RELIABILITY

406 MHz

- ⇒ **1 in 12 alerts an actual distress**
- ⇒ **Beacon coding for rapid corroboration**
 - **70% FALSE ALERTS RESOLVED PRIOR TO LAUNCH**

121.5 MHz

- ⇒ **2 in 1000 first alerts are actual distress**
- ⇒ **2 in 100 composite alerts are actual distress**



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SAR RESPONSE POLICY

406 MHz

- ⇒ **First alert warrants launch**
 - **Exception - “B” solutions less than 20%**
- ⇒ **Initial detection near instantaneous - allows for immediate response**
- ⇒ **Beacon coding allows for identification / stand-down & follow-up**
 - **Approximately 70% of false alerts resolved prior to launch of SAR assets**

121.5 MHz

- ⇒ **High false alert makes first alert and composite alert launch unfeasible**
- ⇒ **Second composite requires launch to verify status**
- ⇒ **Analog technology incapable of data encoding - no ability to confirm status without launch of SAR assets**



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TERMINATION OF 121.5 MHz ALERTING & EPIRB USE

- ⇒ **On February 1, 2009 the Cospas-Sarsat System will terminate the satellite processing of distress signals received from 121.5 and 243 MHz emergency beacons world-wide.**
- ⇒ **In response to this, the Federal Communications Commission (FCC), at the request of the U.S. Coast Guard, has published rule-making to end the use of 121.5 EPIRBs in three stages:**
- 1) Upon publication of this rule new 121.5 MHz EPIRB models will no longer be certified by the Commission.**
 - 2) As of February 1, 2003 Class A, B, and S 121.5 MHz EPIRBs shall not be manufactured, imported, or sold in the U.S.**
 - 3) 121.5 MHz EPIRBs installed on board vessels before February 1, 2003 may be used until December 31, 2006 and not thereafter.**



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WEBSITE INFORMATION

SUPPORT SEARCH AND RESCUE



GET LOST!



But before you do...

Register your 406 MHz Emergency Beacon with the United States Mission Control Center 1-888-212-SAVE

www.uscg.mil/hq/g-o/g-opr/sar.htm

www.sarsat.noaa.gov