Beacon Manufacturers Workshop
May 1, 2014
Annapolis, Maryland

MINUTES

NOTE: This document highlights the Workshop presentations; detailed presentations and other information of interest are posted on the NOAA SARSAT website (www.sarsat.noaa.gov) under 'SARSAT Meetings' tab on the left.

Welcome

Mr. Jesse Reich (NOAA/Chair) called the meeting to order.

Mr. Chris O'Connors (NOAA SARSAT Program Manager) welcomed the participants and thanked RTCM for accommodating the Workshop and for sponsoring a 2013 forum for the manufacturers. He emphasized that beacon manufacturers are critical SARSAT partners.

Introductions and Opening Remarks

The Chair also thanked RTCM for hosting the 2014 Workshop and Ms. Lisa Hessler (NOAA/CSC) for providing administrative support. He noted that the development of the Medium Earth Orbit Search and Rescue System (MEOSAR) and second generation beacons (SGBs) represent a critical phase in the life of Cospas-Sarsat.

Enclosure (1) is the list of meeting participants.

Action Items

The Chair reviewed open Action Items from prior Workshops, most of which were able to be closed. The remaining open items are included in (enclosure (2)).

Cospas-Sarsat Update

Mr. Dany St. Pierre (Cospas-Sarsat Secretariat) reported that Cospas-Sarsat, with 43 participating countries and organizations, was improving its system and developing SGBs to more effectively support search and rescue.

The beacon population had reached an estimated 1.4 million and was steadily growing.

1931 persons had been rescued during 2013 in 731 events; personal locator beacons (PLBs) had contributed to 32% of these saves. The system had contributed to over 37,000 rescues in about 10,000 events over its life. On average, Cospas-Sarsat was helping to save about six lives per day.

Cospas-Sarsat had rolled out a revamped website with public and professional sides that enable easier transfer of documents. The International Beacon Registration Database (IBRD) is accessible via the website. The IBRD can be used free of charge and has 41,000 beacons registered from 125 countries.

Mr. St Pierre reviewed MEOSAR's status, plans and advantages. Currently thirteen U.S. S-band Distress Alerting Satellite System (DASS) satellites, one Russian L-band GLONASS satellite and two European L-band Galileo satellites were being used for the MEOSAR demonstration and evaluation (D&E). The number of available L-band satellites would continue to increase past when MEOSAR was expected to become fully operational in 2018. Experimental MEOLUTs were also operating, mostly in the Atlantic.

MEOSAR is expected to:

- Dramatically improve the speed and reliability of detecting and locating beacons and provide improved location accuracy; beacon bursts will be detected and located almost instantly
- Be able to track moving beacons, including in-flight activated emergency locator transmitters (ELTs)
- Provide additional capabilities like return link services (RLS) and false alert cancellations
- Enable improvements in beacon performance and reliability

SGBs were expected to be on the market in 2018.

The Cospas-Sarsat Joint Committee (JC-28), which would meet in June, was expected to finalize plans for MEOSAR implementation.

Mr. St. Pierre showed simulations of the current space segments (six LEO satellites and six GEO satellites); additional GEO satellites would soon be added.

Second Generation Beacons

Mr. George Theodorakos (NASA/ASRC) pointed out that MEOSAR would enable modernization of beacon signals to improve system performance.

SGB operational requirements are in Cospas-Sarsat document G.008 (*Operational Requirements for Cospas-Sarsat Second Generation 406 MHz Beacons*). Cospas-Sarsat document R.017 (*Second Generation 406 MHz Beacon Implementation Plan*) supports development of the new beacons. Cospas-Sarsat had been working on document T.X01, which will provide the SGB specifications.

An expert working group (EWG) had been meeting annually since 2010 to work on SGBs. Narrow band (NB) and wide band (WB) signal specifications were being developed in parallel; WB signals are spread spectrum, while NB signals are more like those used in current beacons.

NASA and CNES (France) had been working on direct sequence spread spectrum beacon technology to improve system performance, meet all of the G.008 requirements, and reduce the cost and complexity of beacons; hopefully, this would help keep Cospas-Sarsat the ‘gold standard’ for distress alerting and location. This work required substantial collaboration with beacon manufactures.

Beacon messages will use a fixed message portion with rotating fields so more capability can be added in the future. The Type Approval Certification (TAC) database will provide some of the required data so some of the data will not need to be transmitted. The message would also include a single BCH forward error correction code to improve efficiency. RF modulation Offset Quadrature Phase Shift Keying (OQPSK) would provide industry standard capabilities.

WB signals are easy to implement and could relax some beacon component requirements, especially frequency stability. WB use of only one center frequency rather than frequency division could enable use of codes for test protocols, beacon types, etc.

NASA had developed a proof of concept including a programmable beacon and real time receiver, was working on a compliant waveform, and planned to develop a prototype marketable beacon using simple inexpensive components. CNES had been running similar tests independently.

Preliminary results using the NASA MEOLUT and beacon prototype showed that the WB beacon could meet or exceed G.008 requirements, with locations always within 3.8 km, and within one km 99.6% of the time. NASA was focused on achieving 100 meter accuracy 95% of the time. Detection probability on single Galileo passes was above 95%, and location errors were reduced substantially with processing time.

Related areas of NASA research included: development of a 406 MHz signal for homing and local detection; ELT crash survivability; and location processing for moving beacons.

NASA would be working with manufacturers on a 406 MHz signal dedicated to local detection and homing to decouple homing functions from the alert signal; this low power signal would eliminate the need for a 121.5 MHz homing signal that cannot now meet G.008 requirements. Homing performance would improve and the homing signal would be less detrimental to the beacon.

NASA was involved in an ELT crash survivability working group that is taking a system approach studying survivability, building on prior testing done by NASA Langley. The group was working with RTCA's SC-229 (406 MHz ELTs).

MEOSAR Demonstration and Evaluation

Mr. Theodorakos explained that the MEOSAR D&E was based on Cospas-Sarsat document R.018 (*Demonstration and Evaluation Plan for the 406 MHz MEOSAR System*) that was expected to be updated in October.

Phase 1 of the three D&E phases was complete; it was conducted using a mixture of satellites mainly to test system performance. Technical tests had been run, the procedures refined, and the test rerun.

Phase 2 includes operational tests, such as assessment of data flowing through the system to compare MEOSAR to LEOSAR and GEOSAR.

Phase 3 was intended to verify system performance using L-band only since S-band satellites were not intended to be used operationally.

Seven countries had been participating in the D&E with MEOLUTs and/or MEO mission control centers (MCCs), and others were expected to join. The U.S. and France had been providing beacon simulators. Six technical tests had been performed and a MEOLUT networking test would occur once the configuration was in place; networking would allow a MEOLUT to use data from other MEOLUTs. Data exchange would be part of the operational tests.

The Cospas-Sarsat Secretariat will report on Phase 1 tests, but final analysis and conclusions might not be available until 2015.

Phase 2, which had begun in March, would include two periods of operational tests with some technical tests in between. JC-28 would review the Phase 2 schedule which would be influenced by satellite launch schedules.

Phase 3 entrance and exit criteria had been under discussion with no decisions on them so far. R.018 specifies the need for 14 L-band satellites for Phase 3 to ensure sufficient data, but this number was being re-evaluated.

The U.S. was supporting the D&E with three MEOLUTs (Hawaii (6 antennas), Maryland (4 antennas) and Florida (6 antennas)).

Detection rates during Phase 1 had been quite good due to the large number of available antennas, and would improve with more satellites. Location (obtaining and accuracy) was hard to assess due to sub-optimal satellite geometry, but was expected to improve substantially.

Test T-5 obtained results using actual real beacons that had been donated, scattered around the world and activated for three days. T-5 data was still under review. The U.S. was looking at data from beacons within 3,000 miles of a MEOLUT. Better results came when satellites happened to be in more optimal positions. NASA greatly appreciated beacons that had been donated by manufacturers for T-5.

Mr. Mickey Fitzmaurice (NOAA) stated that the Hawaii and Florida MEOLUTs had been networked, and this had greatly increased the available data. Stand-alone vs network results would be reported to JC-28. MEOSAR had contributed data successfully in a few actual SAR cases where LEO and GEO had been unable to provide data.

SGB Direction Finding and Homing

Mr. Al Knox (USAF) pointed out that in 2010 Cospas-Sarsat EWG on SGBs had begun looking to the SAR community for needed and attainable homing requirements, and that these had since been codified in G.008, Section 3.14. The advantages of a low power 406 MHz homing signal apart from the low duty cycle alert signal came under consideration during 2012, with the possibility that it might replace 121.5 MHz signals for homing. JC-26 had proposed changes to G.008 with the advantages of 406 MHz homing in mind.

Meanwhile, the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO), both have beacon performance standards that specify 121.5 MHz homing signals, decided not to consider changing those specifications until the accuracy of MEOSAR locations was better known.

In 2014, a Cospas-Sarsat Task Group (TG) on SGB specifications had formed a correspondence group (CG) led by the U.S. to clarify the G.008 homing requirements. The CG had been working closely with manufacturers of direction finding equipment on what 406 MHz signal characteristics their equipment could handle. Mr. Knox, a co-chair of the CG, **invited** beacon manufacturers to participate in the CG.

Within the U.S., the Coast Guard and Civil Air Patrol had successful experience homing on 406 MHz. The manufacturer ROTHETA had produced a paper on signal requirements, and RTCM had produced a paper on 406 MHz homing battery considerations. The battery power requirement for homing signals is a key consideration. JC-28 was expected to clarify G.008 without specifying a homing solution.

The U.S. Coast Guard and Air Force were both advocating use of 406 MHz, but the ICAO-IMO reservations posed a key concern. Also, the International Telecommunications Union (ITU) International Radio Regulations might have to be amended to clearly permit a 406 MHz signal solely for homing; views differed on this matter. The timeline for getting ITU to allow 406 MHz for homing was discussed. The issue should be raised in time for WRC-15 to allow for a decision by WRC-18.

Mr. Knox emphasized that the homing characteristics should not be permitted to unduly affect the SGB development.

RTCM Sub-Committees

Mr. Chris Hoffman (RTCM) opened a presentation with a brief overview of RTCM's history and main activities.

RTCM's Special Committee for emergency position-indicating radio beacons (EPIRBs) and PLBs (SC-110) had published an EPIRB standard approved in 2012; Mr. Hoffman pointed out the differences between this standard and a comparable one of the International Electrotechnical Commission (IEC).

The U.S. Federal Communications Commission (FCC) has just issued proposed rules that would, among other things, adopt the RTCM EPIRB standard into the Code of Federal Regulations (46 CFR Part 80). The FCC had similarly proposed rules to adopt the RTCM PLB standard into 46 CFR Part 95. RTCM was working on a further update to address mandatory internal global navigation satellite system (GNSS) capability, an altitude test, and a wet test.

RTCM has published a standard for satellite emergency notification devices (SENDs) in 2011, and the FCC had published proposed rules to authorize use of devices that comply with this standard. The standard would be updated by RTCM SC-128 to provide suitable message formats.

RTCM SC-119 handles the standard on maritime survivor locator devices (MSLDs) that had been published in 2012. MSLDs operate locally on 121.5 MHz VHF DSC Channel 70 or VHF automatic identification system (AIS) frequencies. The FCC had also issued proposed rules for these devices.

Mr. Hoffman highlighted some of the accomplishments and benefits of RTCM over the years, including: providing a foundation for the robust EPIRB and PLB industries that provide effective beacons at reasonable costs; providing key support for Cospas-Sarsat's technical work; and contributing indirectly to the rescues of thousands of persons in distress. RTCM was actively involved in development of SGBs.

Mr. Hoffman emphasized that RTCM needs the support of beacon manufacturers to accomplish all that it does.

RTCA Special Committee on ELTs

Mr. Tom Pack (Co-chair, RTCA SC-229) stated that RTCA functions similarly to RTCM, except that its committees are typically established based on need and are commissioned by the Federal Aviation Administration (FAA) with a sunset date for completion of their work.

70 people had signed up for SC-229; in March 2014, 45 people had attended its first and only meeting to date.

SC-229 was commissioned mainly to update RTCA's document DO-204 A, *Minimum Operational Performance Standards for 406 MHz Emergency Locator Transmitters*, that would become the basis for a revised FAA Technical Standard Order (TSO C-126x).

EUROCAE had already begun similar work via its Working Group 98 (WG-98), so SC-229 and WG-98 were working as a joint committee.

The terms of reference for the two bodies were being harmonized, but in addition to developing ELT MOPS, WG-98 had also been tasked to develop minimum aviation system performance specifications (MASPS) to cover in-flight ELT activations and ELT interfaces.

SC-229 would be updating specifications for first generation ELTs while developing specifications for second generation ELTs. A major challenge would be to keep up with the Cospas-Sarsat SGB development timeline.

The table below shows how SC-229 intends to address specifications for automatic fixed, automatic portable, automatic deployable, and survivor ELTs.

	1st Generation Beacons					2nd Generation Beacons			
	AF	AP	AD	S		AF	AP	AD	S
Crash Safety	M	M	N/A	N/A		M	M	N/A	N/A
Antenna and Cable	M	M	N	N		M	M	N	N
Integral GNSS	O	O	O	O		T	T	T	T
GNSS Interface	O	O	O	O		T	T	T	T
406 Homing (other than std homing)	N	N	N	N		O	O	O	O
121.5 homing	M	M	M	M		O	O	O	O
243 homing	O	O	O	O		O	O	O	O
Triggered in flight	T	T	T	N		O	O	O	N
Return Link Service	O	O	O	O		O	O	O	O
Rechargable Battery	N	N	N	N		N	N	N	N
Antenna and Cable In Flight Activation	T	T	T	N		O	O	O	N
Non rechargeable Battery	M	M	M	M		M	M	M	M

M = Mandatory
O = Optional
N = Not Permitted
N/A = Not Applicable
T = TBD by working Group

SC-229/WG-98 had decided not to provide for use of ELTs with rechargeable batteries, and had established the following working groups to facilitate some aspects of its work (some of which were already operating under different prior incentives outside RTCA):

Standards Documentation
In-Flight Activation
Crash Survivability
2nd Generation Homing

The joint group planned to address certain topics such as GNSS, return link services (RLS) and power sources within its plenary sessions.

RTCA had established a web workspace for all the committee documents and schedules.

SC-229 planned to submit a paper to JC-28 on inflight ELT triggering for first generation ELTs operating through MEOSAR to call for investigation and performance analysis, and would also be coordinating its work with relevant ICAO meetings.

The next SC-229/WG-98 meeting had been scheduled for 3-5 September 2014 in Toulouse, France. SC-229 intends to finish its work in 2015, after which the FAA was expected to need about 18 months to update TSO C-126a and decide when to disallow use of older ELTs.

Beacon Use and Issues

False Alerts

Mr. Eric Foster (NOAA/ERT) informed the Workshop that ELTs were not only still producing the largest number of false alerts in 2013 by a big margin, but were also the only type of beacon with the number of false alerts still increasing. ELTs accounted for 18% of registered beacons, but 57% of the false alerts. The main cause of false activations had been improper testing and maintenance.

Mr. Foster **asked** that when a U.S. government agency orders beacons, that beacon manufacturers ask the buyer to contact NOAA for education on special coding, alert distribution, proper beacon operation and testing, registration, battery issues and beacon disposal.

ELTs on Unmanned Vehicles

Mr. Knox discussed inappropriate beacon installations on unmanned vehicles, which include remotely piloted aircraft (RPAs), unmanned aerial vehicles (UAVs), unmanned aircraft systems (UASs) and drones. 406 MHz beacons are only allowed to be used by persons in distress and should not be sold for or installed aboard unmanned vehicles.

Beacons are not intended for tracking. SAR responses to beacon alerts can put the lives of responders at risk. Mr. Knox **asked** beacon manufacturers to direct any manufacturer or user of unmanned vehicles to himself or LCDR Aaron Ortenzio (USCG) if further explanations are needed on this matter.

ELT Survivability

Mr. Knox reported that the Air Force Air Combat Command (ACC) and NASA Langley Research Center had formed an interagency working group (WG) to work on, among other things, ELT survivability. The FAA, National Transportation Safety Board (NTSB) and USCG were also participating.

The WG intends to:

- Deliver recommendations to the FAA, specification development agencies, beacon manufacturers, and airframe manufacturers on ways to increase ELT survivability;
- Research historical ELT failures in general aviation (light aircraft) accidents, and gather data to determine reasons for low beacon system survivability (by the end of 2014);
- Study data, perform failure modes analysis, and develop new procedures and processes for beacon system design (beacon, antennae, cabling), installation, etc. as findings dictate;
- Test these procedures on a system level, including use of the Langley Research Center test crash site to crash a plane and analyze results;
- Develop recommendations based on comprehensive test results; and
- Improve ELT survivability on a global level through coordination and information transfer with Cospas-Sarsat, including coordination with RTCA-EUROCAE on MOPS development.

On behalf of NASA, Mr. Knox **invited** beacon manufacturers to:

Share any information on ELT failure modes;

Provide hardware samples to be used for testing, including automatic fixed ELTs with mounting trays, cabling and antennas;

Attend some of the NASA tests; and

Join the WG.

Galileo and Return Link Service

Mr. Xavier Maufroid (EC), representing Galileo, advised that four more Galileo satellite launches had been scheduled for 2014, which would bring the total in service to six. With up to 12 more satellites expected to be launched in 2015, Galileo would be at full operational capability around 2018 and have a total of 30 satellites by 2020.

Besides contributing satellites with repeaters for Cospas-Sarsat, Galileo was providing three MEOLUTs and a Return Link Service Provider (RLS). RLS is intended to provide users of RLS-capable beacons an acknowledgment message that their alert has been detected and located.

Based on test results to date, Galileo was confident that the Cospas-Sarsat accuracy specifications could be met.

Two potential types of acknowledgments were being considered; Type 1 would advise a beacon user that an alert had been detected and located, and Type 2 would advise that an RCC had received the alert. IMO had endorsed use of Type 1, but so far neither ICAO nor IMO was supporting use of Type 2 RLS. The Galileo return link service provider (RLSP) will acknowledge alerts received via the French MCC from RLS-capable beacons within 15 minutes of receipt at the RLSP; the beacon's message would indicate RLS capability.

RLS specifications for beacons (including relevant message elements) and type approval would be considered by JC-28. RLS would have to use the long (160 bit) message for the 22 Hex ID.

Beacon Registration Database

Mr. Apurve Mathur (NOAA/ERT) stated that beacon registration statistics were available on the NOAA SARSAT website for U.S.-registered beacons.

After August 2014, all beacon registrations submitted via the U.S. Postal Service must be sent to:

NOAA
SARSAT Beacon Registration
NSOF E/SPO53
1315 East-West Highway
Silver Spring, MD 20910

Registrations sent by FedEx or UPS must be sent to:

SARSAT Beacon Registration
NOAA
NSOF E/SPO53
4231 Suitland Road
Suitland, MD 20746

However, on-line registration is preferred over submission by the means indicated above.

The registration form includes a checksum field to help verify the hex ID; any questions on checksum could be referred to Mr. Jesse Reich (jesse.reich@noaa.gov; 301 817-4509).

NOAA **asked** all beacon manufacturers to:

Include checksums voluntarily pending promulgation of a regulatory mandate to do so;

Provide NOAA with arithmetic formulas that correlate beacon IDs and serial numbers for the coding protocols that they use;

Notify NOAA whenever they are aware of beacons with duplicate IDs, mislabeling of beacon IDs or beacon recalls; and

Install conspicuous and legible UIN labels to blank registration forms.

NOAA **encouraged** beacon service centers to question beacon owners on whether their registrations are up-to-date.

Regulatory Changes

Mr. Knox reviewed the history of an FCC Third Further Notice of Proposed Rulemaking issued in January 2013 (WT Docket No. 01-289) to prohibit certification, manufacture, importation, sale or use of ELTs that operate solely on 121.5 MHz, and to solicit comments on effective dates; the comment period on this rulemaking had closed.

The National Telecommunications and Information Administration (NTIA) had recommended to the FCC, on behalf of interested federal agencies, that certification of 121.5 MHz ELTs cease on the effective date of the rules, that manufacture and importation cease 12 months after the effective date, and that sale and use end 96 months after the effective date.

The FAA intended to cancel TSO-91a for these beacons, so that the beacons can remain in use but no new ones could be certified.

Mr. Ed Thiedeman (USCG) reported on an FCC Notice of Proposed Rulemaking issued in April 2014 (NPRM 14-36) to amend 46 CFR Parts 80 and 95, with comments due by June 2, 2014, and reply comments due by June 30, 2014. The proposed amendments address comments from RTCM, the Global Maritime Distress and Safety System (GMDSS) Task Force, and NTSB. The proposed rules seek comments on numerous proposed changes, including:

A mandate that EPIRBs transmit encoded locations;

Technical updates to the PLB standard;

Authorization to certify SENDs, MSLDs and AIS-SARTs (search and rescue transponders); and

Adoption of the IMO AIS-SART performance standard (Resolution MSC 246.83), the IEC standard for VHF-DSC equipment (61097-3), and the RTCM standards for EPIRBs (11000.3) and ship security alerting systems (11020.1).

Potential future FAA, FCC or Coast Guard rules might be needed to cover SGBs and carriage of EPIRBs by recreational vessels operating more than three NMs offshore.

Beacon Manufacturers Survey

Mr. Andryey Zhitenev (Cospas-Sarsat Secretariat) reviewed the results of the 2013 annual beacon manufacturer survey and he projected the 2014 beacon production; the survey is used to analyze production trends and forecast beacon populations.

48 manufacturers that had responded to the survey (mostly from Europe) indicated that about 156,000 beacons (69,000 EPIRBs, 23,000 ELTs, and 64,000 PLBs) had been produced during 2013 (a slight reduction from 2012). 105,600 of these were location protocol beacons.

The estimated beacon population increased about 9.5% during 2013 to 1,411,000; the growth in 2014 is projected to be 8.8%, mainly among EPIRBs and PLBs.

The Secretariat planned to distribute the detailed survey results to the survey participants.

The Secretariat estimates the number of beacons removed from service by assuming a ten-year design life.

Review of Action Items

There were no action items from this meeting.

Wrap-Up/Closing Remarks

The Chair expressed appreciation to all who had contributed to a successful meeting, asked the participants to submit their completed meeting evaluations, and adjourned the meeting.

Enclosures:

1. List of Participants
2. Open Action Items

Enclosure (1)

2014 Beacon Manufacturers Workshop
May 1, 2014
Annapolis, MD

List of Participants

	NAME	ORGANIZATION
1.	Angeli, Gerry	ACR Electronics, Inc.
2.	Arnstein, Paul	[Unaffiliated]
3.	Avidor, Dalia	Astronics DME Corporation
4.	Axtell, Lynne	NOAA/CSC
5.	Baker, Sam	NOAA/ERT
6.	Bastiani, Sergio	Astronics DME Corporation
7.	Chen, Jizhong	NASA
8.	Ch’en, Daniel R.	Microwave Monolithics Incorporated
9.	Christo, James	NASA
10.	Eastwood, William	Orolia Ltd
11.	Fitzmaurice, Mickey	NOAA
12.	Forey, Peter	Sartech Engineering Ltd
13.	Foster, Eric	NOAA/ERT
14.	Foster, Tony	NASA
15.	Fuechsel, Jack	GMDSS Task Force
16.	Fuhrmann, Dave	USAF
17.	Griffin, Sean	GME (Standard Communications Pty Ltd)
18.	Hargraves, Joy	NOAA
19.	Hessler, Lisa	NOAA/CSC
20.	Hiner, Eric	Astronics DME Corporation
21.	Hitchcock, Edward	Canadian National SAR Secretariat
22.	Hoffman, Christopher	ACR Electronics, Inc.
23.	Holmes, Kevin	WS Technologies Inc.
24.	Jordan, Neil	McMurdo Group (Orolia Ltd)
25.	Khalek, Ghassan	Federal Communications Commission
26.	Khorrami, Jeff	Techno-Sciences, Inc.
27.	Kissel, Fred	Kissel Engineering
28.	Knox, Allan	USAF/HQ ACC
29.	Landa, Joseph	BriarTek Inc.

30.	Lariviere, George E.	Whiffletree Corporation Inc.
31.	Lemon, Dan	NOAA/2020
32.	Lett, Steven	Cospas-Sarsat Secretariat
33.	Li, Henry	Techno-Sciences, Inc.
34.	Markle, Bob	RTCM
35.	Martin, CAPT Peter	USCG
36.	Mathur, Apurve	NOAA/ERT
37.	Maufroid, Xavier	European Commission
38.	Mazzuca, Dr. Lisa	NASA
39.	McDonald, Mike	Colorado Search and Rescue Board
40.	O'Connors, Chris	NOAA
41.	Oladapo, Kehinde	NASA
42.	Ortenzio, LCDR Aaron	USCG
43.	Pack, Thomas	ACR Electronics
44.	Pearson, Bob	Rakon
45.	Pulgarin, Felipe	Rakon
46.	Reich, Jesse	NOAA
47.	Rissone, Christian	Agence Nationale Des Frequences
48.	Robinson, Michael	Specmat Technologies Inc.
49.	Saliba, Karl	Saliba Strategies
50.	Sinquefield, LT Timothy	NOAA
51.	Steward, Paul	ACR Electronics, Inc.
52.	St-Pierre, Dany	International Cospas-Sarsat Programme
53.	Street, Bill	WS Technologies Inc.
54.	Taylor, Annette	NOAA/CSC
55.	Taylor, Stuart	HR Smith Group of Companies
56.	Theodorakos, George	NASA/ASRC
57.	Thiedeman, Edwin	USCG
58.	Trent, Michael	Maritime Technology Associates, LLC
59.	Wilson-Elswood, Kevan	GME
60.	Yarbrough, Larry	[Unaffiliated]
61.	Zhitenev, Andryey	Cospas-Sarsat Secretariat

Enclosure (2)

SARSAT Beacon Manufacturer's Workshop
Open Action Items from 2014 and Prior Meetings

Action Item #	**Description**	**Status**
BMW-2012-AI.I	RTCM and Cospas-Sarsat to investigate the need to add a test to Cospas-Sarsat document T.007 to identify beacons that could transmit with rapid repetitions that prevent proper processing by SARP-3 satellite instruments.	*RTCM has no update on the status. It will be discussed at the SC-110.*