The SARSAT Beacon

Volume 1, Issue 1

Taking the "Search" Out of Search and Rescue

September 21, 2011

A Message From the NOAA SARSAT Program Manager

Welcome to our newsletter written specifically for Rescue Coordination Center personnel. The SARSAT Program has developed this newsletter in response to comments you made during the annual RCC Satisfaction Survey.

Our objective is to provide you with information that both answers your survey comments and provides you additional knowledge on how the SARSAT system works, as well as some of our internal processes and procedures. I know that search and rescue may not be your only mission and SARSAT is not your only tool for prosecuting search and rescue missions. The SARSAT system has continuously improved over the years, so it is important to educate yourself on the latest changes. I hope that this newsletter will assist in that process and you find the information contained in this newsletter to be of benefit to you. We look forward to improving our service to you so that you can continue your extremely important mission of saving lives.

Chris O'Connors

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Incident History and Feedback Comment & Reply

"Request a test page sent out to all RCC's at 0001 everyday to update day folders."

This was implemented on 3 August 2001. The timer that sends the message runs at 0010 instead of at 0001 as requested because an existing timer that does similar functions was used.

"It would be helpful if we could see a history of this beacons activations and any case numbers associated with it right on the registration sheet as it comes over SARSAT."

It is possible to fully or partially implement this suggestion and SARSAT will look into it, however, we must weigh the workload to implement this suggestion against other requirements and the benefit derived. One thing we would not be able to do is provide case numbers with previous activations because this information is kept in two dissimilar databases. In the meantime, don't forget that you can access the Incident History Database to determine the history of any beacon's activation record.

"I think it would be a big help if the feedbacks were available to populate right away instead of having to wait until a site closes out."

While an RCC Controller may be able to complete a minimal amount of information if the feedback form was immediately available, most of the information on the form is provided by the USMCC and changes with every satellite pass. Making the form immediately available would then require the RCC Controller to continuously refresh the form. This introduces the possibility of old information being updated over more current information. Currently, the RCC Controller can get an IHDB record to update by asking the USMCC Controller to close the alert site as soon as the site/case/mission is closed and the beacon is turned off. In the case where the beacon is still operating but inaccessible by SAR personnel the site can be closed and the site that reopens can be linked to the first site.

Inside this issue:

Doppler Location Processing

What do the A and B Doppler probabilities mean? How can the RCC Controller use the Doppler probability in working SAR cases ?

The Local User Terminal or LUT performs Doppler location processing to compute two locations, one real and one image (incorrect). Doppler processing is not able to ascertain which location is real from a pair of Doppler locations. However, the LUT assigns a probability to each location in a pair of Doppler locations, where the location with a higher probability of being real is deemed the "A" side (with possible values between 50 – 99) and the other location is deemed the "B" side (with possible values between 1 – 50). While the solution with the higher probability is more likely to be the real position, even the highest reported probability (99) ***does not guarantee that the associated position is the real position.*** An "A" side location with a higher probability tends to be more accurate; for example, an "A" side location with a 95% probability is likely to be more accurate than an "A" side location with a 55% probability

Prior to ambiguity resolution (which uses independent data to determine the real position of the beacon), the USMCC will send a "LOCATION FIRST ALERT UPDATE (SIT 162)" message when the "A" side probability in the new solution is at least 30% higher than the "A" side probability in the old solution for the same satellite pass. The receipt of this message indicates:

a) the same location previously reported as the "A" side is now reported with a much higher probability (e.g., the "A" side probability increased from 55% to 90%), or

b) the location previously reported as the "B" side is now reported with a much higher probability than the previous "A" side (e.g., the previous "B" side probability was 40% and the same location is now reported as the "A" side with a 70% probability).

Unreliable 406 MHz Beacon Messages

What causes a 406 MHz beacon message to be unreliable? And, should alerts with an unreliable beacon message be treated as distress alerts?

406 MHz beacons transmit 144 bits every 50 seconds ± 2.5 seconds. The first 24 bits are used by receiving equipment at the satellite and the LUT to identify the signal as coming from a 406 MHz beacon. The remaining 120 bits, also known as the "beacon message", are normally represented by 30 hexadecimal characters and identify the beacon in LUT-to-MCC and MCC-to-MCC communications.

A 406 MHz beacon message is determined to be unreliable when it fails a validation check specified in document C/S A.001 (Cospas-Sarsat Data Distribution Plan); for example, if the country code or error detection code encoded in the beacon message is invalid. When the 406 MHz beacon message is unreliable, no processing is based on the message and it is distributed based only on the Doppler location. An alert message with an unreliable beacon message is not distributed if there is no Doppler location.

An unreliable beacon message may be caused by a problem with the beacon, the satellite, the LUT, the MCC or communications to the MCC. An unreliable beacon message may also be caused by a miscoded beacon. ***Whatever the cause, the absence of a reliable (i.e., usable) beacon message does not imply that the Doppler location is unreliable or that the 406 MHz alert was not transmitted in a distress situation.***

Alerts with an unreliable beacon message and a reported Doppler location in the U.S. Search and Rescue region are sent to a U.S. RCC based on the location. In addition, these alerts are sent to the US Coast Guard Atlantic Area, the US Competent Authority for Ship Security Alert System (SSAS) alerts, because the associated beacon message may have been transmitted by a SSAS beacon.

Alerts with an unreliable beacon message are sent to U.S. RCCs in the same format as other RCC messages, except that a header line saying "UNKNOWN BEACON TYPE" is included. In addition, no fields within the 406 MHz beacon message are decoded in the RCC message when the beacon message is unreliable.

Receipt of Image & Incorrect Doppler Positions

Doppler location processing generates two locations, one real and one image (incorrect). The two locations are the same distance from and perpendicular to the satellite's path over the ground. To determine the real position (that is, to resolve ambiguity) independent location is required, either Doppler location from another satellite pass or encoded position in the 406 MHz beacon message.

For example, during the first 6 months of 2011, the USMCC resolved ambiguity for 46 sites with a location reported in the Guam SRR (MARSEC). The real position was in the Guam SRR for only 3 of these sites and in the coastal regions of eastern Asia (Hong Kong, Indonesia and Singapore, in particular) for most of the other sites.

Sector Guam receives image positions for many beacons activated in eastern Asia due to its proximity to these areas and the nature of Doppler location processing. When a beacon activated in eastern Asia is detected by a polar orbiting satellite passing to the east of the beacon location, an image position is often generated in the Sector Guam SRR.

Why do RCCs receive SAR alerts that resolve outside the RCCs Search and Rescue Region (SRR)?

Position Conflict Messages for the Same Satellite Pass

Doppler locations are generated by LUTs (ground stations) based on beacon data from a single satellite pass. Different LUTs may generate significantly different Doppler locations because they do not receive the same data for the same beacon. This typically happens when one LUT receives partial data in real time, because the beacon was turned on during the pass or the LUT has a limited view of the satellite, and the other LUT receives the full data set from the satellite's memory.

When the RCC receives a Position Conflict message they can use the reported A and B probabilities to help determine which is the real position. The location with the highest probability is more likely to be the real location however, ***even the highest reported probability (99) does not guarantee that the associated position is the real position.***

How can we get two alert messages with two different sets of A and B positions from the same satellite pass?

What Can (and can't) the USMCC Controller Do For You?

The USMCC Controller ***can*** assist the RCC controller:

- Close sites so the IHDB record will be created
- Change communication paths when requested
- Relay messages to appropriate USMCC personal
- Answer alert questions from RCCs and /or forwards calls to Operations Supervisor when needed.
- Send test messages
- Assist in retrieving registration information for foreign beacons
- Change SRRs for sites
- Site queries (O-plots) by position
  - ◊ Point radius
  - ◊ Corner points
  - ◊ Track boundaries by way points

But they ***can't...***

- Advise the RCC Controller on their SAR activities such as whether to launch assets for an alert.
- Advise the RCC Controller on which position (A or B) of a first alert is most likely to be the "actual" position of a beacon.
- Assure the RCC that alerts were sent to RCCs outside of the US service area.
- Assure the RCC that a foreign RCC is actively prosecuting an alert for a US-coded beacon.

Want more information on the NOAA/SARSAT Program?
Visit us on the web at: www.sarsat.noaa.gov

The USMCC Duty Controller Functions and Responsibilities

It's important to realize that we all have our areas of expertise. USMCC personnel assume the RCC Controller is the SAR expert. Likewise, we want you to realize that the USMCC Controller may know little to nothing about prosecuting a SAR mission but has specific duties that are essential to the efficient functioning of the SARSAT system.

The USMCC Duty Controller monitors the USMCC system and is responsible for the USMCC phone traffic during his 12-hour shift. Receipt, merging, matching, filtering, and distribution of alert messages through the USMCC system is a ***fully automated process*** and the USMCC Duty Controllers never see an individual message unless a specific request for information comes from an RCC. ***On a typical day the USMCC processes over 1,000 messages***. Many actions taken by the Controllers are prompted by alarms that indicate an interruption in one of the automated processes, such as re-transmission of failed messages or failure of a LUT (ground station) to send expected data.

One of the most important duties of the Controller is to ensure all expected data is received from the ten LEOLUTs located in FL, CA, AK, HI and Guam as well as the GEOLUTs located at the NOAA Satellite Operations Facility in Suitland, MD. The Controller is also responsible for processing of satellite orbital data received daily from the NAVNETWARCOM OPS in Dahlgren, VA to ensure our LUTs produce the most accurate Doppler positions possible.

During the Controller's shift they accomplish a variety of administrative reporting tasks for NOAA as well. These tasks include database reports, changing out of backup tapes, building the draft of the morning brief document and support to the Registration Database staff.

NOAA, USCG and AFRCC count on the USMCC Controllers to make sure the Incident History Database (IHDB) is populated as accurately as possible. The Controller makes sure the appropriate RCC has provided feedback on the beacon activation outcome. They send reminders through the system and call RCCs for clarification of information provided if needed. They also collect additional information from RCCs for distress cases and write the first draft of these distress cases for NOAA.

Their administrative tasks also include sending messages to COSPAS-SARSAT partners concerning the quality of data coming into the system and sending test messages to ensure communication links are up and operational. This international data distribution system depends on all partners to contribute data to the system and alarms are set up to ensure the USMCC is doing its part as a Mission Control Center as well as our duties in the role as the Nodal MCC for the Western Data Distribution Region responsible for all of North and South America.

When SARSAT hits are extremely broad, or vary dramatically, I would like for USMCC to take a proactive, not reactive role. More specifically, I would like for USMCC to notice these and try to troubleshoot or explain to us what their interpretation is before we have to call. I feel like we always have to call them when it happens, and there is no awareness of a SARSAT alert with a 3000+ mile difference, or knowledge of one that is moving aggressively around the globe.

We received some comments from you concerning the quality of customer service provided by the Controllers in the USMCC. Rest assured we have taken steps to improve those areas you mentioned. In the future, if you feel you have not received the assistance you needed and/or in a manner you thought was unprofessional please provide an email describing the issue to the Lead USMCC Controller, Beth Creamer at:

elizabeth.creamer@noaa.gov

Additional Resources

- Our SARSAT website has been updated but additional suggestions are always welcome. Please visit the SARSAT website at www.sarsat.noaa.gov and if you have ideas for improving the website please submit your suggestions to sarsat.Webmaster@noaa.gov

- Several Cospas-Sarsat documents have been cited in this newsletter. You can find those publications and much more information at the Cospas-Sarsat website at www.cospas-sarsat.org

- Alert messages from the USMCC contain "next pass" information but if you would like to see the SAR satellite's location and movement in real time you can do so at www.n2yo.com/satellites/?c=7

- Title 47 of the Code of Federal Regulations (CFR) referenced in this newsletter can be found at ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=ef8423070606ecbaa51f4e7e1448c032&c=ecfr&tpl=/ecfrbrowse/Title47/47tab_02.tpl . Information for EPIRBs can be found in Part 80, Subpart V. For ELTs in Part 87, Subpart F; and for PLBs in Part 95, Subpart K.

Registration Database — Questions & Comments

Q. I thought beacon registration was required, why do RCCs receive so many alerts for unregistered beacons?

A. Registration of 406 MHz EPIRBs, ELTs, and PLBs is required by Federal regulations (Title 47 of the CFR). NOAA maintains the 406 MHz National Beacon Registration Database (RGDB) however we estimate that only 70% of beacons are ever registered. NOAA is unaware of any penalty for not registering a beacon. The NOAA Registration Database currently holds over 314,000 406 MHZ beacons in its database. Unfortunately, beacon registration is up to the beacon owner and this can mean that some beacons are not registered or not updated when the status changes such as when a beacon is sold or disposed of. The SARSAT Program uses various outreach efforts to encourage beacon registration. When the RCC comes in contact with a beacon owner who has not registered their beacon we ask that you encourage the owner to register their beacon at: www.beaconregistration.noaa.gov.

Q. Does USMCC have any sort of reminder system that is automatically sent to beacon owners asking them to update their registration data every year?

A. Yes, NOAA distributes letters to owners every two years requesting that they review and 'renew' their beacon information. Owners have a choice of updating their information via the website at www.beaconregistration.noaa.gov or sending the updates by mail, email, or fax. In addition, Owners are encouraged to make frequent updates reflecting their latest information .

Q. There should be an explicit warning displayed on the beacon to update the registration whenever it gets moved, sold, or someone's contact info changes. All of these are regulatory changes that can be implemented by manufacturers.

A. Each beacon is required to have an identification plate or label that contains the statement "The owner of this 406.0-406.1 MHz ELT (or EPIRB or PLB) must register the NOAA identification code contained on this label with the National Oceanic and Atmospheric Administration (NOAA), whose address is .....". Title 47 of the CFR also dictates that NOAA be notified upon transfer of ownership or any other change in registration. All of this information and more is also contained in literature that accompanies the purchase of a new beacon. Other information not related to SARSAT is also required to be attached to the outside of beacons and as beacons continue to decrease in size there is less room to add any additional information without decreasing the font size to a point where it is no longer readable.

Additional Information on Beacon Registration

The NOAA Registration Database currently holds over 314,000 406 MHz beacons in its database. It is comprised of Emergency Position Indicating Radiobeacons, or EPIRBs (176, 000), Emergency Locator Transmitters or ELTs (54,000), Personal Locator Beacons, or PLBs (84,892), and Ship Security Alert Systems or SSAS (249).

If an owner submits a beacon registration (by fax/mail), which is coded with a non-USA country code, NOAA sends the registration form with a letter back to the owner. This letter provides contact information for the country of registry to register the beacon. If that country does not have a registry, NOAA provides the website address of the International Beacon Registry in the letter. NOAA, as a courtesy, also sends a copy of this correspondence to the appropriate registry. If the same owner attempts to register a non-USA country coded beacon via the website, a message is displayed with contact information on where to go to register the beacon and the registration is rejected.

Beacon IDs are decoded when received (via fax, postal mail, or phone) to confirm for errors. If there is a discrepancy with the Beacon ID, it is rejected and the owner is formally mailed a notification letter. Decoding software can identify an authentic US country code as well as the tail or serial number of an aircraft. If a beacon is coded with an international code not of the United States, the registration is rejected and a formal letter is mailed to the owner and international registry to notify them of an incorrect country code. US encoded beacons with international addresses are accepted into the registry and mailed information via air mail.

Search and Rescue authorities are the best resource (excluding the owners) to help identify an incorrect ID and provide further guidance to owners when any of their beacons become activated. If the beacon is not registered or incorrectly registered please inform the owner to register the beacon online at www.beaconregistration.noaa.gov.

Contact Info:

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Suitland, MD 20746

Phone USMCC Console:
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Have an idea for a future article in The SARSAT Beacon? Please direct suggestions/comments to: Stephen.Roark@noaa.gov