The following information is compiled to provide an overview of distress radio beacons and avalanche beacons. It is important for any user to thoroughly understand all the requirements and proper use of these devices. Practice and training for proper use is required.

Distress Radio Beacons

The basic purpose of distress radio beacons is to get people rescued within the first 24 hours following a traumatic event during which the majority of survivors can usually be saved.

All the systems work something like this: A beacon is activated by a crash, a sinking, or manually by survivors. The beacon's transmission is picked up by one or more satellites. The satellite transmits the beacon's signal to its ground control station. The satellite's ground station processes the signals and forwards the data, including approximate location, to a national authority. The national authority forwards the data to a rescuing authority. The rescuing authority uses its own receiving equipment to locate the beacon and makes the rescue or recovery. Once the satellite data is in, it takes less than a minute to forward the data.

Distress radio beacons, also known as emergency beacons, ELT or EPIRB, are tracking transmitters which aid in the detection and location of boats, aircraft, and people in distress. Strictly, they are radio beacons that interface with worldwide offered service of Cospas-Sarsat, the international satellite system for search and rescue (SAR).

There are three types of distress radio beacons compatible with the Cospas-Sarsat system:

EPIRBs (emergency position-indicating radio beacons) signal maritime distress.
ELTs (emergency locator transmitters) signal aircraft distress.
PLBs (personal locator beacons) are for personal use and are intended to indicate a person in distress who is away from normal emergency services; e.g., 9-1-1.

PLB sub-classification
There are two kinds of PLB:

- PLB with GPS input (internal or external)
- PLB with no GPS input

All PLBs transmit in digital mode on 406 MHz.

All PLBs must have a Hex Code on the body. Persons must register this Hex Code with their national SAR agency, in the United States the agency that monitors them is NOAA.

In the case of 406 MHz beacons which transmit digital signals, the beacons can be uniquely identified almost instantly (via GEOSAR), and furthermore a GPS or GLONASS position can be encoded into the signal, which provides instantaneous identification of the registered user and its location. Frequently, by using the initial position provided via the satellite system, SAR aircraft and ground search parties can home in on the distress signals from the beacons and come to the aid of the concerned boat, aircraft, or people.

In the United States, PLBs are now authorized for nationwide use. This authorization was granted by the FCC beginning July 1st, 2003. Prior to July 1st, 2003 only residents of Alaska had been able to use PLBs. The Alaska PLB Program was set up to test the capabilities of PLBs and their potential impact on SAR resources.

Avalanche Beacons

Avalanche transceivers are a class of radio transceivers specialized to the purpose of finding people or equipment buried under snow. They are variously called Trackers, Pieps, or Arva's in a reference to some of the popular brands, "avalanche beacons" or "avalanche transceivers". When transmitting, the device emits a pulsed signal which another transceiver can receive. Due to the nature of the radio pulse, a person holding the receiving beacon can orient it, and home in on the location of the transmitting beacon using techniques similar to radio direction finding.

Early avalanche beacons transmitted at 2.275 kHz (2275 Hz/Hertz). In 1986 the international standard of 457 kHz, a higher radio frequency, was adopted and remains the standard today.

An avalanche beacon is not considered a preventative measure for possible avalanche burial, but rather it is a way to reduce the amount of time buried.

Types of beacons
There are two types of avalanche beacons: digital and analog. They both adhere to the international standard as described above, and only differ in the method(s) used to indicate to the user where the buried beacon is located.

Analog: The original avalanche beacon was an analog beacon which transmitted the pulsed signal as an audible tone to the user. The tone gets louder when the user is closer to the transmitting beacon. These beacons have also been augmented with LEDs that provide a visual indication of signal strength, and earpieces to increase the ability of the listener to hear the tone.

Digital: Digital beacons take the strength of the signal and the emitted dipole flux pattern and compute distance and direction to the buried transceiver. Digital beacons usually combine a visual distance and directional display with an audio "beep" that increases in frequency as you move closer (along the flux line) to the transmitting beacon.

Search Techniques
No matter what type of avalanche beacon you've got, a flux line search is the fastest way to locate a transmitting beacon. Given that fact, flux line signal transmission is an important concept to understand. The antenna in a transmitting beacon sends out an electromagnetic signal. Because this signal is in the form of an electromagnetic field, it does not simply radiate outward in all directions at equal strength. This signal actually transmits in a "flux line" pattern in all three dimensions.

Beacons in "search" mode receive this signal from the transmitting beacon. The strength of the signal received is dependent on the searcher's location along the flux line of that signal. Signal strength increases along the flux line path, moving toward the transmitting beacon. Beacons that use digital processing to give distance and direction information DO NOT point the user directly at the transmitting beacon. These beacons actually give distance and direction info along the flux line. The search technique that follows increasing signal strength along the flux line is known as the "flux line search"

Difference between Avalanche Beacons, PLBs, and SPOTs

Avalanche Beacons: An avalanche beacon does not transmit to satellites. Avalanche beacons transmit and receive on a frequency of 457 KHz, which transmits well through snow. Typically, the signals from avalanche beacons are received by similar units less than 100 meters away. Avalanche beacons come in three types: analog, digital and hybrid analog/digital. No registration required.

Personal Locator Beacons: PLBs are designed for an individual to carry and can only be activated manually. Although these beacons operate exclusively on 406 MHz, they also have a homing beacon that transmits on 121.5 MHz. This homing beacon lets rescue teams home in on a signal after the 406 MHz satellite system has led them to within about two to three miles of the signal. You need to register your PLB with NOAA.

SPOTs: Another type of beacon for personal use is the SPOT system, which operates on the Globalstar (GEOS) satellite network, rather than the Cospas-Sarsat system that PLBs operate on. SPOTs use a higher frequency of 1610 MHz. The SPOT has a GPS, but does not transmit a 121.5 MHz homing signal. Unlike the PLB that can lead rescuers to within two to three miles of a signal, the SPOTs do not provide an approximate position and reply on the GPS for transmitting location information. There is no way for searchers to pinpoint a SPOT's exact location, for example inside an unmarked snow cave. One nice feature of the SPOT is if Google Map tracking is being used, friends at home can tell something is amiss if the same location is repeated for an extended period.

The unit has to be out in the open and it can take up to 20 minutes to get connected and send a message. The device is easy to use, bright safety orange and uses two AA batteries. SPOT sells for about $150.00 and costs $99 per year to be a subscriber.

Additional Resources:

International Cospas-Sarsat Program http://cospas-sarsat.org/index.php

The International Cospas-Sarsat Program (the Program) is an intergovernmental organization established in 1988 under the International Cospas-Sarsat Program Agreement (the Agreement) signed by Canada, France, the former USSR, and the USA. The Russian Federation replaced the USSR as Party to the Agreement in January 1992.

The System is available to maritime and aviation users and to persons in distress situations. Access is provided to all States on a non-discriminatory basis, and is free of charge for the end-user in distress. On average, about 5 persons are rescued every day with the assistance of Cospas-Sarsat alert and location data.

NOAA Search and Rescue Satellite Aided Tracking http://www.sarsat.noaa.gov/index.html

The Search and Recuse Satellite Aided Tracking (SARSAT) system uses National Oceanic and Atmospheric Administration (NOAA) satellites in low-earth and geostationary orbits to detect and locate aviators, mariners, and land-based users in distress. The satellites relay distress signals from emergency beacons to a network of ground stations and ultimately to the U.S. Mission Control Center (USMCC) in Suitland, Maryland. The USMCC processes the distress signal and alerts the appropriate search and rescue authorities to who is in distress and, more importantly, where they are located.

NOAA-SARSAT is a part of the international Cospas-Sarsat Program to which 41 nations and two independent SAR organizations belong to. All U.S. coded beacons must be registered with NOAA. Read or download their registration brochure to learn more.