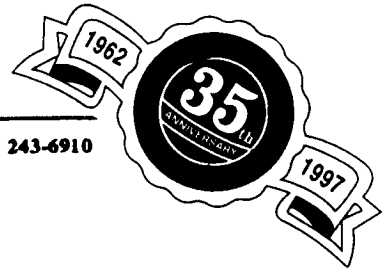




United States Naval Sea Cadet Corps

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February 9, 1998

Naval Sea Cadet Corps Information Letter 2-98

From: Executive Director, Naval Sea Cadet Corps
To: Distribution

Subj: **RESCUE FOR THE NEXT CENTURY**

Encl: (1) "Rescue for the Next Century"
(2) Overview of Search and Rescue in the United States

1. **Purpose.** To advise units of an Interagency Committee Search and Rescue study of "Rescue for the Next Century", and solicit inputs from NSCC units.
2. **Background.** Coast Guard Rear Admiral J. D. Hull has invited NSCC Cadets to participate in a project that encourages input from young people to help the government's Interagency Committee on Search and Rescue develop a new vision for future rescue efforts. RADM Hull chairs the committee that includes representatives of the Departments of Defense, Interior, Commerce and Transportation, the FCC, NASA and FEMA. Enclosure (1), outlines the Committee's current vision statement as background for Cadets. Enclosure (2) provides a list of related WEB sites that can help provide various search and rescue viewpoints. Unit Commanding Officers are recommended to bring this important project to the attention of appropriate Cadets to encourage them to initiate a review of available information, to visit appropriate local search and rescue organizations and to develop their own visions of future search and rescue programs. Their entries should be sent directly to Mr. Ron Wallace, Search and Rescue Mission Manager, NASA Goddard Space Flight Center, Code 480, Greenbelt, MD 20771.
3. **Cancellation.** This letter is cancelled on 31 December 1998.

M. D. Ford

Distribution
NSCC Regional/Associate Regional Directors
NSCC/NLCC Unit Commanding Officers
NSCC Field Representatives

Copy to:
NSCC National Chairman
NSCC National President

RESCUE FOR THE NEXT CENTURY

**INTERAGENCY COMMITTEE ON SEARCH AND RESCUE
RESEARCH AND DEVELOPMENT WORKING GROUP**

I INTRODUCTION AND PURPOSE

Search and Rescue (SAR), like any other business or endeavor, must capitalize on the evolution of technology to maximum life saving capabilities on a cost effective basis.

The intent of this document is to visualize what technology may be available in the near, mid, and far term to meet the functional requirements of SAR and initial disaster response. The projection of future technology is made for 10, 25, 50 and 100 years.

The purpose of this document is to help exercise the reader's imagination, promote innovative thinking and provide guidance in R&D planning in the various government agencies responsible for SAR.

The reader of this document should consider it as a draft and feel free to offer comments and suggestions to the ICSAR R&D Working Group at any time.

It should be noted that in this document, projected technology in one era is considered to be carried forward to the following era when not replaced by more advanced technology. As such, no mention of the previous technology is made.

II THE FUNCTIONAL REQUIREMENTS:

The following functional requirements have been identified for the search and rescue process. They are addressed in this order when presenting the technology for each era.

- MITIGATION
- TIMELY NOTIFICATION
- ACCURATE LOCATION
- TWO WAY COMMUNICATIONS
- RAPID RESPONSE TO SCENE
- STABILIZATION OF THE SITUATION
- EFFECTIVE ON-SITE MEDICAL TREATMENT
- TIMELY EXTRACTION TO RESCUE VEHICLE
- RAPID TRANSPORTATION TO HOSPITAL

III NEEDS AND ISSUES

Approximately 90% of today's US population lives in or near urban centers where police, fire and other rescue services are readily available. SAR services are needed more for the other 10% of the population, for urban dwellers who venture into remote areas, and in any area in the initial phase of Disaster Response. In the future, it appears that there will continue to be a similar population distribution, with the same implications about the need for SAR. In addition it is expected that search and rescue will take on more of an international flavor with greater global search capabilities.

Some of the Issues involved in considering the direction of SAR in the next 100 years are:

- **More Intensive Efforts in Mitigation of SAR**
- **Demand versus Supply of Volunteers**
- **Commercialization of SAR**
- **Federal, State and Local Government Role in SAR**
- **Internationalization of SAR**
- **Inexpensive Devices for People at Risk**
- **Search and Rescue as a Public Safety Issue**
- **Percent of the Population Needing SAR**
- **SAR as a Moral Issue**

IV. YEAR 2006

MITIGATION

Survival education will be accomplished in elementary schools by instruction and field trips. In high school survival education will be offered as an elective similar to arts or music.

The Red Cross and other organizations will sponsor survival courses much like swimming qualifications and CPR training. Survival education programs will be carried on public service TV and public service announcements.

Mitigation of communications problems for the general public will be enhanced by design of the power and communications infrastructure to withstand earthquake and hurricane forces. The Internet will have an emergency lane that will expand and contract according to the demand placed by rescue operations. Associated universal translators will allow for data communications from any terminal and in any language.

Building codes for new commercial buildings will require reinforcement and stress relieving features. Floor plans of all multi-story buildings along with structural details will be deposited in a central data base file that can be accessed immediately by urban rescue teams.

TIMELY NOTIFICATION AND ACCURATE LOCATION

In the aeronautical community 406 MHz ELTs will be required on all general aviation (GA) aircraft and on commercial airliners. Commercial Mobile Satellite Services (MSS) equivalent emergency beacons will also be available; however, the COSPAS-SARSAT system will still be the major capability for distress alerting. Commercial airliner ELTs will be required to have GPS location capability (either integral to the unit or remotely coupled). In GA aircraft GPS will be optional. In the maritime area the carriage requirements for EPIRBs will be expanded to include all vessels going beyond 10 km from shore, including pleasure vessels. Phasing out of 121.5 MHz ELTs and EPIRBs will have begun and a date set for removing this capability from the COSPAS-SARSAT satellites.

406 MHz Personal Locator Beacons (PLBs) will be authorized and in wide use in national and state parks where visitors to the park will have to register and sign out a PLB. Other organizations and businesses will adopt the PLB as a last ditch means of distress alerting. These will include hiking and skiing organizations, power company workers, pipeline workers, police and fire personnel. PLBs will be made in various forms, including within a wrist watch, and will employ GPS data for positioning.

TWO WAY COMMUNICATIONS

The commercial ELT/EPIRB/PLB equivalents will provide 2-way communications which will allow RCCs to verify distress situations and help to mitigate the false alarm problem.

RAPID RESPONSE TO SCENE

Rescue aircraft will consist of a mixture of advanced helicopters and tilt rotor aircraft that incorporate night vision technology. The tilt rotor aircraft, flying at a speed twice that of a helicopter, will enable rescue forces to arrive on scene faster and rapidly transport survivors to medical facilities. En-route monitoring of patient status by the hospital will be accomplished via a satellite link.

OPERATIONS

Communications support of SAR and Disaster operations will be primarily provided by the various MSS providers with seamless interoperability between various systems and the public telephone network. Extensive use of the Internet will be made for emergency operations with priority access for SAR and Disaster Response operations. Fire fighters and other personnel operating in similar situations (e.g., cave rescues) will have communications equipment that will be attached to the fireman's helmet or the Self Contained Breathing Apparatus (SCBA) with the antenna sewn into the fireman's clothing. This system will be capable of communications from inside burning buildings or collapsed structures using low frequency signals that will provide penetration. This system will also provide location data accurate to one meter through the use of GPS-like systems deployed at the site.

EXTRACTION OF SURVIVORS

Various size robots will be available for utilization in different circumstances. Air, water and food will be fed to trapped individuals through a tube which can be snaked into the structure or delivered by a miniature robot. This tube could also contain medication applicable to the trapped person.

Sophisticated life rafts will be employed in the maritime environment that will contain water purification equipment, generation of food from sea life, satellite communications equipment and propulsion capability. These rafts will be capable of dropping from aircraft at night or day with strobe lights to aid visibility by survivors and rescuers alike. Audible signals will also help survivors find the life raft.

V. YEAR 2021

MITIGATION

Earthquake detection and warning equipment will provide some advance notice of most major earthquakes. Building codes for “earthquake protection” will mitigate many of the problems seen today as they will require retrofit of some features in existing structures and full protection in new structures.

Improved meteorological analysis will provide more advance warning time and more accurate predictions of the storm’s path. Cloud seeding techniques will be more advanced and will allow dispersion of storms in the early stages. In areas subject to hurricanes, building codes will require shutters on all windows.

Wireless communication will be available to most of the general population in an urban area with cell site hardening and redundancy of locations. These improvements in the general communications will greatly ease the problems of disaster assessment and victim location.

TIMELY NOTIFICATION AND ACCURATE LOCATION

An international constellation of low orbiting microsatellites (SARSAT II) owned by commercial interests will provide near real time alerting and location from any point on the globe. Most aircraft, marine vessels and other vehicles will be routinely tracked by satellite which will localize the search area. A worldwide search and rescue (SAR) web will tie in Rescue Control Centers (RCCs) from all cooperating nations. Commercial satellite services will provide much of the distress alerting and locating function for the general public using voice communications handled by 911 PSAPs. Mandated users (maritime and aeronautical) will use either the SARSAT II system or a commercial equivalent that would meet all of the environmental requirements and automatic activation features of ELTs and EPIRBs.

TWO WAY COMMUNICATIONS

The SARSAT II system will provide distress alerting and locating with 2-way data communications and GPS location accuracy. The 2-way communications will allow validation of the distress call and evaluation of the distress situation. False alarms will be mostly eliminated due to this validation, the beacon ID, and accurate location data. Stiff fines and/or jail terms will be imposed on fraudulent use and lower fines will be applied to all parties originating a false alarm (whether or not intentional).

RAPID RESPONSE TO SCENE

Extensive use of hovercraft type vehicles will be used in most types of rescues with the ability to traverse rough terrain or high seas to reach the distressed party quickly. The vehicle will be a hybrid between a VTOL aircraft and the hovercraft capability so that long distances can be traveled at high speeds and the final rescue phase can use the hovercraft capability.

OPERATIONS

Communications capability for SAR and Disaster Response personnel will include equipment that will have the capability of operating in any frequency band in a seamless manner with any other band. Communications equipment will consist mostly of shirt pocket communicators with antenna equipment built into the responders clothing. Capacitive coupling to the antenna will eliminate the need for connectors.

SAR forces will be a mixture of volunteers and paid professional personnel. Local, state or federal organizations having jurisdiction will contract with Commercial SAR firms and then be reimbursed by the distressed party according to means.

For maritime and aeronautical distresses where no distress transmitter is operating, SAR forces will utilize synthetic aperture radar and laser detection to find the distress. Surveillance satellites will do an initial search to determine possible target areas for aircraft search.

EXTRACTION OF SURVIVORS

Urban rescue teams will have advanced sensors able to detect life forms anywhere within a collapsed structure and provide location within one meter. High power lasers will be used by urban rescue teams that will be able to cut through reinforced concrete and steel in a matter of minutes. They will incorporate feedback sensors that will reduce the power near the end of a cut and shut the laser off as soon as the cut is made to reduce the possibility of harming the survivors.

The use of the hovercraft in wilderness and maritime environments will provide a stable platform from which paramedics can jump to the distress site and prepare survivors for hoisting to the rescue craft.

In the maritime area, an autonomous marine vehicle would be deployed to the scene and, with its sensor capability, find the people and pick them up out of the water. The vehicle would provide heat, food and shelter and actually transport the persons in distress back to shore.

VI YEAR 2046

MITIGATION

Mitigation in the wilderness area will consist of extensive education at all levels of primary and secondary education. Survival education will be combined with biology with the realization that in the modern world people living in an urban environment will be at risk in almost any wilderness situation.

Strict building codes will require earthquake resistant structures. The foundation of buildings will support the structure while being resilient to earthquake forces to minimize collapse. Extraction of persons from collapsed structures will be performed by powerful robots which will clear the rubble and proceed into the building as the rubble is cleared.

Ground communications systems will be "hardened" to minimize failures from earthquakes and other disasters. All power and communications lines will be underground with stress absorption techniques applied to minimize outages. Communications and power systems will be designed to allow alternate routing much like what is done in the long lines telephone systems. Satellite communications will be available on a backup basis to everyone, with priority given to distress responders. Underground gas and water pipelines will be protected from rupture by stress absorption construction and ease of repair will be enhanced by routing of these pipelines above the surface, working them into the architectural design of the streets and buildings.

TIMELY NOTIFICATION AND ACCURATE LOCATION

A monitor/communicator (MONCOM) will be offered to each individual at little or no cost. Individuals will be able to monitor their own vital signs and indications when they are out of limit. The communicator will transmit over cellular towers (voice mode) or in remote regions by satellite using a data mode. The MONCOM will be provided in various forms, i.e., as a wrist worn device, as a pendant or as a pocket device. Non-distress transmissions will be billed by the carrier of choice. Distress transmissions will be at no cost. The distress transmission will provide the name address and communications number (one number for all locations) and a location with an accuracy of one meter. Two-way voice transmission (compressed and recreated) will be possible concurrent with data transmission when in the cellular mode. Whereas the device will be capable of being polled, the individual may turn this feature off.

All commercial vehicles will be tracked on a world wide basis so that their position will be known to five meters. Most rescues will be accomplished by commercial firms who will bill the person's medical insurance carrier. (Everyone will be covered by medical insurance of one form or another.)

TWO-WAY COMMUNICATIONS

Distress transmitters (MONCOM) will provide 2-way voice transmission (compressed and recreated) with voice capability when in the cellular mode. Two-way data communications will be provided when out of range of cellular and in the satellite mode.

RAPID RESPONSE TO SCENE

Atomic powered vehicles (APVs) will be capable of high speed response to the rescue scene. These vehicles will be capable of hovering over the distress site for an unlimited period of time due to the lack of fuel limitations. Many of the rescue vehicles will have essential living conditions to sustain rescuers for days without returning to base. Three axis gyroscopes coupled with reaction wheels and jets will provide a stability in the hover mode almost equal to a fixed structure.

OPERATIONS

An International Organization will be formed to provide rapid response to disasters. The organization will be enabled by a treaty signed by all participating nations so that formal invitations will not have to be issued for the response teams to be assembled. The organization will be staffed with a permanent staff capable of immediate response for assessing the extent of the disaster.

EXTRACTION OF SURVIVORS

Extraction of survivors from wilderness and maritime distresses will be accomplished using manned APVs capable of hovering within arms reach of the distressed party or by use of a small elevator which could be lowered to the ground.

Extraction of survivors from collapsed structures will be accomplished mainly by the use of very strong robots. The rescue robots will have the capability of contracting and expanding so that they can make their way into confined spaces and then expand to support portions of the structure to allow rescue of trapped survivors. These robots will have all types of sensors so that rescue personnel can guide their every move. In addition they will have some capability to cut through obstacles. They will be capable in every way to act much as a person would do in freeing a survivor and bringing them out to safety.

VII YEAR 2096

MITIGATION

Building codes will employ all previous efforts as well as a resonance resistant approach. Using an extensive file of typical frequency forces the design will incorporate means to avoid these resonant frequencies in the structure.

Sensors will be installed on all gas and water lines so that instant notification can be given to a central monitoring facility. An urban area will be divided into sections with each area having a network of piping which will allow cutoff and rerouting of gas and water. The entire urban area will likewise have these cutoff and rerouting features so that several failures will not have a devastating effect on services in a greater metropolitan area.

Problems from various disasters with communications and utility services will be greatly mitigated by design and installation of these systems. All communications systems will rely primarily on wireless communications. Relay points will be installed in a protected environment (earthquake proofed) and will provide multiple paths in the event of one or more outages. Large buildings will have their own communications net which will be tied to two or more relay points. Satellite links will provide backup to ground relay links and, when more economical, will provide point to point communications (e.g., long distance) Sensors will be installed on all gas and water lines so that instant notification of problems can be given to a central monitoring facility. An urban area will be divided into sections with each area having a network of piping which will allow cutoff and rerouting of gas and water. The entire urban area will likewise have these cutoff and rerouting features so that several failures will not have a devastating effect on services in a greater metropolitan area.

TIMELY NOTIFICATION AND ACCURATE LOCATION

Routinely carried or worn communications devices, controlled by voice recognition, will be offered to all persons on a voluntary basis. These will be provided at no cost to the individual. The main function of these devices will be to communicate with other people and data bases as well as monitor the medical condition of the individual (remotely or by the individual.). In a distress situation the person will trigger a distress message and location (accurate to 30 cm) through a constellation of low orbiting satellites.

A major issue will be privacy if the person's location can be polled (e.g., in cases where a person has disappeared and no alert is received). This might be solved by allowing the individual to turn off his or her remote monitor capability on a timed out basis capable of reset. This will ensure location of the individual if he or she is disabled.

TWO-WAY COMMUNICATIONS

All distress alerting will be accomplished using 2-way communications links. These links will be used to query the distressed party to verify the emergency and obtain specific information vital

to the rescue. In addition the return link will be used by SAR forces to ascertain the physical status of the distressed party. The return link will also be used to mitigate the extensive reporting of a disaster by persons in the vicinity by automatically notifying incoming callers when a distress has already been reported.

RAPID RESPONSE TO SCENE

Short range recovery operations will depend primarily on jet propelled hover aircraft capable of speeds higher than the speed of sound. Long range recovery will utilize rocket powered aircraft which can reach most domestic scenes in minutes and can brake at the distress scene and hover.

OPERATIONS

The concept of a Search and Rescue force will no longer exist. Except in a very few cases the search function will be gone; therefore, what we know as SAR today will only be known as “the R-force.” The R-Force will combine what we know today as police, fire, medical emergency and SAR capabilities. The search for persons in distress will be conducted by an International Consortium of satellite systems augmented by aircraft and ground forces as required. False alarms will be mitigated by the design of the communicator and stiff penalties imposed.

EXTRACTION OF SURVIVORS

Extraction of survivors from wilderness and maritime distresses will be by direct transporting to the rescue vessel. One possible approach might be the use of a column of air to lift people into the rescue vehicle. Most rescue missions will be handled by local responders who will be trained in fire, police and medical emergencies. Rescue vessels will employ momentum wheels and jet forces to travel at high speeds and to hover over the disaster scene.

Extraction of persons from collapsed structures will be at least partially enabled by the design and construction of buildings in a modular fashion to optimize the survival of persons in each location of the building. Extraction will be accomplished by the use of high power lasers to cut through construction materials while being carefully controlled by monitoring devices in each module. As the extraction process continues, collapsible/expandable structures will be put in place to support the overhead debris.

Encl (2)

OVERVIEW OF SEARCH AND RESCUE IN THE UNITED STATES

In the oceans and inland waters in the land area, the US Coast Guard (**Web site: <http://www.navcen.uscg.mil/hotlist.htm>**) has the responsibility for search and rescue (SAR). The US Air Force (**Web site: <http://www.acc.af.mil/afccc/>**) has the responsibility for coordinating SAR in the land areas; however, each state is responsible for executing SAR in its own state. Although federal and state resources are often used in rescue efforts, a large part of the rescue effort is done by volunteer organizations. Many of these volunteers are members of the National Association for Search and Rescue (NASAR) (**Web site: <http://www.nasar.org>**). Additionally, the National Institute for Urban Search and Rescue (NI/USAR) (**Web Site: <http://niusr.org/welcome.html>**) is active in promoting improved technology and procedures to improve urban SAR.

DETECTION OF A DISTRESS

A number of airplanes and ships are required to carry emergency beacons which are detected and located by satellite. In the future, it is expected that individuals in high risk situations will carry Personal Locator Beacons (PLBs) which will also be detected and located by satellite. The National Oceanic and Atmospheric Administration (NOAA) (**Web site: <http://psbngil.nesdis.noaa.gov:8080/SARSAT/homepage.html>**) operates satellite systems which detect, locate and send these distress messages to the Rescue Coordination Centers (RCCs) that have the responsibility to initiate a search according to the location of the distress. The satellite system is an international cooperative program which is described at **Web site: <http://www.worldserver.pipex.com/cospas-sarsat/>**. Other means of distress alerting include eye witnesses, telephone, cellphone or radio calls. In the case of urban disasters, such as floods or earthquakes, detection and notification is usually done over telephone lines.

SEARCHING FOR AND FINDING THE PARTY IN DISTRESS

When the distressed party has an emergency beacon, the rescue party can "home in" on the distress site. Otherwise, visual observation is necessary. This may involve searching hundreds of miles since the distress site may not be known with any accuracy. NASA (**Web site: <http://poes2.gsfc.nasa.gov/sar/sar.htm>**) is developing passive tools such as RADAR to locate a distress. In some cases search parties on foot are required to search an area when visibility and bad weather will not allow aircraft to be used. The Civil Air Patrol (CAP) (**Web site: <http://www.cap.af.mil/>**) conducts most of the searches for downed aircraft in the US. In the case of collapsed structures from an earthquake, a careful removal of rubble is necessary to find and recover survivors. In some cases SAR dogs are used to detect the presence of victims in the rubble. Some use of sensitive sound receiving and vibration detection equipment has also been made.

RECOVERING SURVIVORS

After finding the exact location of survivors, effort must be concentrated on stabilizing any injured or impaired persons. This will require emergency medical personnel at the rescue site. Following stabilization of survivors, transportation to safety and/or medical facilities is required. The difficulty of evacuating survivors is a function of the terrain, weather and other conditions such as the remoteness of the distress site. Helicopters may be limited by wind conditions, or in the ocean area, by the height of the waves.

ENCLOSURE 2