

COMBAT SURVIVOR EVADER LOCATOR (CSEL) SYSTEM



Air Force ACAT III Program

Total Number of Systems:	52,202
Total Program Cost (TY\$):	\$220M
Average Unit Cost (TY\$):	\$5K per radio
Full-rate production:	3QFY02

Prime Contractor

The Boeing Company

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The Combat Survivor Evader Locator (CSEL) is the next generation, survival radio/personnel locator system designed to ensure that isolated personnel are quickly and efficiently located, tracked, rescued and returned to friendly hands. This system includes the hand-held radio (HHR), unattended Ultra High Frequency (UHF) base stations (UBS) for over-the-horizon (OTH) communication and tracking, and ground support segment software for the Joint Search and Rescue Centers (JSRCs). CSEL contributes to the warfighters ability to ensure *dominant maneuver* of forces by extracting downed combat crews/ground teams. The combat commanders and their maneuver forces' ability to assure rapid location and recovery of isolated personnel directly contribute to comprehensive *force protection*.

The HHR incorporates UHF(Ultra High Frequency)/VHF (Very High Frequency) line-of-sight (LOS) voice beacon, precise Global Positioning System (GPS), and three OTH data modes to provide worldwide communications. The OTH data modes include two-way secure data on Ultra High Frequency Satellite Communications (UHF SATCOM), one-way secure data on National Assets, and one-way non-secure data on Search and Rescue Satellite System (SARSAT) for polar coverage. The precise GPS position is included in OTH data communications. The support equipment consists of the unit-level CSEL Planning Computer, radio set adapter, and associated software that performs radio built-in-test (BIT) and loads specific mission data/crypto keys prior to a mission.

The over the horizon segment includes four UBSs, which control two-way worldwide UHF SATCOM secure data communications with multiple HHRs, interface with National Assets, interface with the civil SARSAT system and interface with multiple JSRCs using SIPRNET. The ground segment consists of the segmented software application, which receives and transmits messages from/to the HHR through the UBS. This software can currently be hosted only on SUN workstations but will ultimately run on any SUN or Hewlett Packard Defense Information Infrastructure Common Operating Environment

(DII COE) workstation. This connectivity allows the command elements and search and rescue forces to locate and maintain communication with CSEL-equipped survivors.

BACKGROUND INFORMATION

The interest in a robust, CSEL-type capability began with a Commander-in-Chief, Pacific Command Mission Need Statement and a Joint Requirements Oversight Council validation in 1992. This interest was rejuvenated by the O'Grady shutdown in Bosnia. The Air Force, as the DoD executive agent for combat search and rescue, initiated the CSEL Program as an Acquisition Reform accelerated program to field deploy the capability as rapidly as possible. The CSEL system is intended to replace the current PRC-90 and PRC-112/112B survival radios.

The program was placed under DOT&E oversight in spring 1998 in acknowledgment of the importance of the program to the joint warfighting communities, congressional interests, and potential impact of CSEL integration into DoD C4I systems. Additionally, there were concerns raised during the Joint Combat Search and Rescue (JCSAR) Joint Test and Evaluation (JT&E) regarding system performance and OT&E adequacy.

AFOTEC developed a robust plan to provide an independent system assessment in 1998. This early operations assessment (OA1) was conducted from April-July 1998. The assessment included data and observations from combined testing at Ft. Huachuca, AZ; shipboard operations on the USS Essex; participation in JREX (a joint rescue exercise in conjunction with the JCSAR JT&E); Cope Thunder exercises; and water and cold weather testing in Alaska. DOT&E observed CSEL activity in JREX, Cope Thunder, and Alaska. The initial OA1 on 25 EMD radios/support equipment, a developmental UBS, and developmental JSRC software supported a proposed Air Force decision to buy 891 production radios. As a result of OA1, the production radios were not purchased.

As a result of deficiencies found in the 1998 OA1, the CSEL program was restructured in 1999. A second operational assessment (OA2) is planned for 4QFY00, and IOT&E is scheduled for 1QFY02. One Hundred Option 1 radios were produced and tested fixes to the deficiencies found in OA1. Ninety additional radios, which will include upgrades, will be produced to support OA2. The losses of the F-117 and the F-16 during Operation Allied Force have increased DoD focus on the CSEL program. The Commanders in Chief, U.S. Central Command and U.S. Special Operations Command have requested acceleration of operational fielding.

TEST & EVALUATION ACTIVITY

There was no OT&E of CSEL in FY99. However, Boeing conducted a contractor field test with Service support in September 1999. AFOTEC, TEXCOM, and Special Operations Forces participated in Boeing's testing at Hurlburt Field, FL, which DOT&E and all three Service OTAs observed. The CSEL system, including the JSRC software application, UBS, and Option 1 HHR was tested.

TEST & EVALUATION ASSESSMENT

DOT&E found that the CSEL EMD configuration tested in OA1 was neither effective nor suitable. DOT&E is aware of the developer's effort to identify and implement fixes for many of the

problems found in the OA. These fixes were demonstrated during the Boeing Field Test in September 1999; however, the operational impact of those fixes will not be assessed until OA2.

The deficiencies observed by DOT&E in OA1 are detailed below as well as a description of the efforts to correct them.

- The HHR user interface was poor. Boeing demonstrated a new screen and keypad that improved HHR's usability during the Boeing Field Test. In addition, Boeing added status and help screens and is developing a new, simplified menu structure for HHR, which will be available for OA2.
- The HHR was unreliable. Boeing is correcting software deficiencies. Additionally, the VHF/UHF Module, GPS Module, and Controller Module are being redesigned and will be tested in OA2.
- The HHR GPS did not work consistently in foliage. Boeing changed the location of the GPS antenna and improved the GPS acquisition algorithms, which provided much better GPS performance during the Boeing Field Test. However, a new GPS Module, which will integrate the Selective Availability Anti-Spoofing Module, will replace the current module before OA2.
- The HRR LOS voice was inadequate. Boeing has installed a new speaker and added shielding and filtering which resulted in clearer LOS voice communications during the Boeing Field Test. Additionally, the VHF/UHF Module is being redesigned and will be tested in OA2.
- The HHR support equipment, which includes the CSEL Planning Computer and the Radio Set Adapter, was inadequate and unreliable. Numerous software changes have been made to improve the usability and reliability of the HHR support equipment and were demonstrated during the Boeing Field Test.
- The unattended UBS performance was unreliable and had to be manned. Three of the four Category I deficiencies from OA1 will be corrected and tested in OA2. The remaining Category I deficiency, UBS time jump, will be fixed as part of subsequent developmental efforts and evaluated during IOT&E.
- The batteries used by HHR are expensive and its performance has resulted in radio brownouts. An operational workaround exists to prevent battery brownouts in the Option 1 radio, but it reduces the battery's capacity, which may effect the battery lifetime requirement. New radio modules are in development and are expected to lower power requirements, thereby eliminating the brownout problem and possibly extending battery life. These modules will be tested in OA2. The developer is also investigating different battery chemistries in an effort to lower the life cycle cost of the batteries.

The operational impact of these fixes cannot be evaluated until OA2. Also, efforts to correct some deficiencies are being delayed for incorporation into the planned Demand Assigned Multiple Access (DAMA) compatibility and Defense Information Infrastructure Common Operating Environment (DII COE) interoperability development effort. Consequently, correction of these deficiencies will not be operationally tested until FY02 IOT&E.

During OA1, over-the-horizon messages did not often make it from the JSRC to the survivor. UHF Base Station and HHR software have been modified to improve system message delivery performance, which was demonstrated during the Boeing Field Test. Further improvements are anticipated as part of the DAMA and DII COE effort. However, the fundamental architecture of the CSEL system, which requires that the evader stop evading at scheduled times so that the radio can receive messages, is not expected to change. As a result, this design will be examined closely by DOT&E when testing in an operational environment.

CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

The CSEL Program has consistently pushed for an aggressive schedule of concurrent developmental and field test activity to try and field equipment to meet urgent user need. As a result, the hardware and software solutions have been too immature for the service users to field. Early OT involvement in the rapid development cycle and combined DT/OT have allowed the Joint Services to field-test and evaluate the system, as well as identify significant issues early in development.

CSEL is not just a hand-held radio. It is a system that includes a hand-held radio, support equipment to program the HHR, an unmanned base station, and a software application for the rescue center. The system relies on many other systems including UHF SATCOM, SIPRNET, National Systems, and GPS to perform its mission. It is crucial for test and acquisition personnel to consider the system, not just the radio.