Ground Wave Emergency Network (GWEN) - Archived 9/96

Outlook

- Canceled after extensive production
- Little prospect of resumption

Orientation

Description. The Ground Wave Emergency Network (GWEN) is a series of low frequency (150-175 kHz), EMP-hardened, unmanned radio relay stations located across the US.

Sponsor
US Air Force
Electronic Systems Center
Hanscom AFB, MA

Contractors
Lockheed Martin Corp
Government Electronic Systems
Camden, NJ
(Prime)

Boeing Co
Seattle, WA
(Site installation)

Contel Federal Systems
Chantilly, VA
(Maintenance support)

TRW Inc
Cleveland, OH
(Software support)

Watkins-Johnson Co
CEI Division
Gaithersburg, MD
(WJ-8790-1 receivers)

Status. Canceled after extensive production.

Total Produced. Approximately 185 receive-only terminals, 107 relay nodes, and 38 input/output terminals were produced as of 1993.

Application. Interservice emergency communications that remain operational after a nuclear attack. GWEN forms part of the Minimum Essential Emergency Communication Network or MEECN. (See separate report).

Price Range. Receive-only terminal - US$600,000; relay node - US$1.2 million; input/output terminal - $2.2 million.

Technical Data

Design Specifications. GWEN is made up of three types of stations:

- The input/output terminals both transmit and receive messages. These stations use 50-watt transmitters (usually on 150-foot towers) that broadcast at UHF frequency (225-400 MHz). These are located on existing military installations.
- The receive-only terminals cannot transmit messages. These stations are also located on existing military installations, usually on the roofs of communications buildings, and receive low-frequency (150-175 kHz) signals.
- The third type of station is an unmanned, VLF radio relay node that is intended to form a nationwide network to distribute messages throughout the GWEN system by means of computerized traffic controllers. A relay node is similar to a small commercial AM radio station and were designed to be located at 150-200-mile intervals throughout the US. The relay node uses a 300-foot-high, two-foot-wide stick antenna and a ground screen of copper wires that are buried 18 inches below the ground's surface, in a bicycle wheel spoke pattern radiating 330 feet away from the hub tower. Three EMP-hardened shelters are included. These house the antenna tuner, the radio/signal processing equipment, and the back-up power generator. Each relay node uses about 700 square feet of land, located either on government land or on private land leased or purchased by the government.

Ground mobile and airborne input/output and receive-only terminals were also slated to use GWEN. Input/output terminals are connected to tower relay nodes via line-of-sight, UHF radio links. Peak broadcast power for each GWEN tower is from 2,000 to 3,000 watts.

Peculiar Support Equipment. In May 1988, the USAF ESD issued eight solicitations for GWEN peculiar support equipment as follows: uninterruptable power supplies - MTBF of at least 20,000 hours, AC source of 120 VAC, 60 Hz, 3299 volt-amps, and a resistive load capable of dissipating the full rated KVA or the line replaceable unit; LF receivers - 120 VAC power requirement (+ or - 10 percent), 15-watt power consumption rate; EMP pin drive testERS (three types of waveforms, amplitude selectable from 0-2,000 volts peak output, capable of generating electronically the fast risetime of a nuclear EMP and injecting this pulse across the Terminal Protection Device or Penetration Protection Device under test); portable memory programmers capable of fault isolation and EPROM burn-in at both the chip and board level; shielded enclosure test sets (portable, battery operated, operating frequency of 450 MHz); power amplifiers with a 500 ohm input impedance, 50 kHz to 200 kHz, 50 ohm output impedance, 100 watt minimum power output, 45 dB gain; loop antennas with a 50 ohm input impedance, used for 100 kHz frequency; and helium leak detectors with a sensitivity of 2 x 10.10 atm cc/sec for helium, cycle time of six seconds, response time of less than two seconds for helium.

Operational Characteristics. The GWEN system was designed to work as follows: GWEN's relay nodes were to use low data rate (75 bits/sec) packet-switching techniques to relay messages. The packet-switching concept stems from Advanced Research Projects Agency (ARPA) work going back a decade, and was designed to ensure that GWEN would be able to deliver vital messages even if many of the relay nodes were destroyed. The packet-switching network would send messages in a series of small packets (each with about 1,000 bits of data) that include the intended recipient's identity. The packet would then be dispatched to several relay stations, all of which then retransmit it; the sequence continuing until the message packet reached its destination, where it would be stored until the rest of the packets for a typical message were received. All relay nodes would include temporary (buffer) storage should a packet be received when the node is transmitting a message packet received earlier.

System Linkages. GWEN nodes were to interact directly with the Improved Emergency Message Automatic Transmission System (IEMATS), and possibly with the C^3 integration function of the SACDIN equipment in the Missile Launch Control Centers to print out messages received over GWEN. Indirectly, the nodes would also interact (via GWEN transmit/ receive terminals) with sensor sites and with C^2 systems at national command centers, such as NORAD, SAC and NMCC.

GWEN was designed to link the National Command Authority with NORAD, SAC, all strategic bomber and missile wings and the PAVE PAWS coastal radars that watch for submarine-launched ballistic missiles.

Variants/Upgrades

No variants or upgrades identified.

Program Review

Background. The GWEN project was part of the Minimum Essential Emergency Communications Network System (MEECN). (See separate report). In FY82 R&D Associates was awarded a US$13.6 million contract for design, development, integration and testing of one GWEN initial connectivity system. Rockwell Collins and RCA also were awarded contracts for initial GWEN testing. In FY83, a nine-station GWEN network was constructed for proof-of-concept testing: stations are located at Pueblo and Aurora, CO; Omaha and Ainsworth, NB; Manhattan and Colby, KS; Fayetteville, AR; Canton, OK; and Clark, SD. Each relay station has a single 300-ft tower and a ground plane consisting of a copper-wire screen. Shelters house radios, air conditioners, heaters and auxiliary power equipment.

RCA was awarded a US$97.6 million contract in October 1983 for full-scale development of GWEN, and work began on fabrication of a prototype TLCC network providing EMP hardened connectivity be-tween warning sites, major command centers and bomber, tanker and missile control centers. The Air Force funded fabrication and deployment of the prototype TLCC network in FY85.

Implementation of the Thin-Line Connectivity Capability, the prototype network, encountered significant delays, basically because of sometimes-strident local opposition to the location of 300-foot towers in residential areas, as well as a popular misconception that GWEN encourages the idea of a successful nuclear conflict by ensuring survivable communications.

As an electromagnetic pulse (EMP)-resistant communications network, GWEN was meant to carry critical attack warning and force execution data in the nuclear attack phase. It was never intended to be survivable in the sense that its equipment is located in hardened shelters. Rather, the emphasis is on having a sufficient number of stations that operate in a packet switching network that can switch around destroyed stations.

Three Phases. The GWEN development program was divided into three phases. The first, Initial Connectivity Capability, was the concept validation phase completed in April l984. This consisted of a nine-relay-station proof-of-concept network, as well as 11 receive-only terminals and three fixed input/output terminals. The second phase was the Thin-Line Connectivity Capability (TLCC), the prototype GWEN network. Phase IIA consisted of 56 relay stations, eight input/output locations and 30 receiver terminals. The first 56 nodes were for use by the Strategic Air Command, and the remaining stations were scheduled for missile and airborne terminals applications. Survivability for the system was provided by proliferated relay nodes using unmanned EMP-hardened, jam-resistant, low-frequency groundwave radio equipment. Phase III was to add 40 fixed relay nodes, four fixed input/output stations, 107 missile launch control receive-only stations, 30 portable receive-only terminals, 23 airborne input/output terminals, and nine airborne receive-only terminals.

In August 1988 the USAF quietly approved the final construction phase, or Phase III. This encompassed the building of the above indicated 40 additional relay node towers. The contract was awarded to Contel, which was responsible for the installation of 10 of the original nodes. Contel was responsible for network design, installation and integration of the 40 additional towers, with work being preceded by the design of the site plan for locating the new towers. The process of selecting the sites for the 40 new towers proved to be as controversial as the process of picking the sites for the TLCC.

In August 1989 the USAF announced that it was intending to solicit for the production and testing of 22 airborne input/output systems for the GWEN Final Operational Capability. These airborne I/O systems were intended to be installed in EC-135 aircraft and interface with GWEN ground segments. Contract award was tentatively scheduled for March 1990, with first article delivery 15 months after contract award.

In 1991, preparation of the GWEN relay sites was put on hold pending completion of a NAS study on GWEN low-frequency health effects, per Congressional direction. An independent review was conducted. The draft report was not seen by anyone outside the NAS. Since GWEN RN stations use a frequency similar to that used by commercial AM radio stations but at considerably lower power levels, the Air Force argued and expected GWEN to be given a clean bill of health. Congress subsequently rescinded the hold order and allowed GWEN to continue with hardware storage and site preparation.

The program was again forced into rough waters when conjecture again generated publicity regarding the safety of the towers. Since each tower is 300 feet tall and comes equipped with a 24-hour flashing beacon, equipment sheds, fuel tanks, and barbed wire fencing, public objection to hosting such an eyesore was easily incensed even during the Cold War. In an increasingly relaxed political climate, that objection - as well as issues of safety and government waste - swelled to such a point that the 1994 defense appropriations bill contained Amendment 160, which effectively canceled the program, having banned construction of GWEN towers throughout FY94. In 1985, the plan originally called for construction of 240 towers. That figure was slashed due to public protest. As of the beginning of FY94, the DoD had built 54 of the 83 planned sites.

Funding

GWEN RDT&E was funded under Program Element #0303131F MEECN, Project #2834 GWEN. There is no further funding reported.

Analysis. Despite scattered support for GWEN, there is the debate over whether there is still a justified need for the GWEN system in light of the collapse of the Soviet Union. The USAF and the DoD maintain that as long as the US continues to deploy nuclear weapons for strategic deterrence, there will be a need to maintain secure and redundant communications links with strategic forces. Others claim that satellite technology will soon be able to perform most of those duties.

The four-year gap that the 1994 congressional directive and other stop-work orders created has prompted focus to shift to alternative radio methods that are cheaper, safer, more aesthetic and more effective (such as satellites).

We believe the interruption will most likely kill any momentum that supporters had hoped would fuel a resurgence of interest in the controversial program.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
GE	6.5	Sept 1990 - FFP contract for an integration support facility and software development facility for GWEN (F19628-84-C-0003/P00084).
Contel	31.5	Dec 1990 - A one-year contract with four one-year options to provide logistic support to test, maintain, and operate GWEN.
Contel	8.3	Sept 1991 - (Estimated) FFP unfunded requirement type services contract for operational and maintenance support services for GWEN (F25606-91-D-0001).

Timetable

Jun	1982	Initial Connectivity Capability (ICC) contract awarded
Feb	1983	Full-scale development began. Thin Line Connectivity Capability design contract awarded
Oct	1983	Competitive design contracts for the prototype Thin Line Connectivity Capability completed. Contract for fabrication and deployment of TLCC prototype network awarded to RCA
	FY84	Installation and contractor testing completed on the ICC (a nine-relay-station proof of concept network). Software protocols, user interfaces, and EMP hardening techniques developed and tested
Apr	1984	ICC testing completed. IOC for Phase I
	FY85	ICC continued demonstration phase. Site preparation and equipment installation for TLCC prototype network began
	FY86	ICC continued demonstration of software protocols, user interfaces, and EMP hardening techniques. The Full Scale Development effort continued fabrication and deployment
Sep	1986	IOC for Phase IIA
	FY87	Installation of prototype TLCC network scheduled to be completed. Initial USAF operational test and evaluation employing no less than 43 relay nodes. Development of EC-135 and E-4B airborne command post aircraft terminal and missile launch control

		center receive-only terminal continued and portable receive-only terminal development began. Additional fixed receive-only terminals procured.
Jan	1988	Development of launch control center receive-only terminals completed
Aug	1988	USAF approved final construction phase
Sep	1988	Contel selected as Phase III contractor
Apr	1989	Development of EC-135 airborne input/output terminals
	FY89	56 relay node configuration deployed. IOC for fixed input/output terminals and portable and fixed receive-only terminals
	FY90	FOC installations began
	FY91	IOC for launch control center receive-only terminals
	FY92	IOC for airborne input/output terminals
	FY94	GWEN put on hold

Worldwide Distribution

GWEN stations are situated only in the continental US.

Forecast Rationale

At this time, we foresee no further production. Unless there is a resurgence in activity over the next 12 months, this report may be deleted.

Ten-Year Outlook

Due to the effective cancellation of the program, the forecast chart has been omitted.

* * *