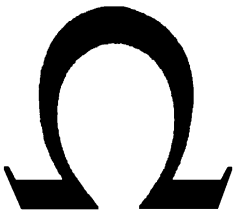
U.S. COAST GUARD

RADIONAVIGATION BULLETIN

Fall/Winter Issue 1997, Number 33



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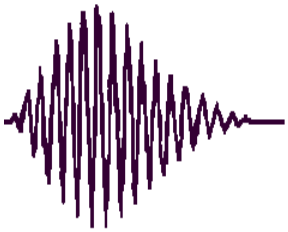

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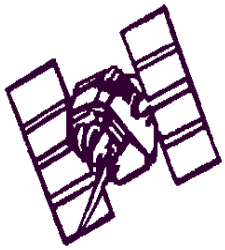

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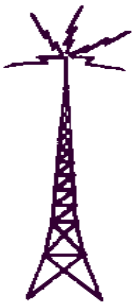

RADIOBEACONS

From the Commanding Officer...

We are fortunate to live in interesting times …. an intriguing statement. Such a statement usually implies its author is extremely busy, generally in challenging situations. Those who work in radionavigation systems today do indeed find themselves so fortunate, for there are challenges and many opportunities within this profession. As you review this issue of the Radionavigation Bulletin, you will certainly read articles that describe our interesting times.

First, and on a bittersweet note, we report the end of Omega. Omega was the first, and to date only, worldwide, internationally operated, radionavigation system. It did its job extremely well for a quarter century, and its operations ended proudly. The eight Omega transmitting stations ceased their signals in unison, precisely at 0300Z 30 September 1997, ending the best operational year of the system. The Commandant of the Coast Guard commended all involved with the system—our partner nations received Public Service Commendations and Coast Guard personnel received the Meritorious Unit Commendation, with operational "O" distinguishing device. The stations commemorated their successful operations with appropriate ceremony; most were small, local events. However, NAVCEN was privileged to participate in the ceremonies at OMSTAs Hawaii, North Dakota, and Argentina. NAVCEN struck a commemorative Omega coin and presented it to Omega's final crewmembers worldwide. Although it was the end of an era—and that always makes us sad—it was indeed a time to celebrate the great success of the Omega Radionavigation System. See our back cover for a poem written by a member of the final Omega crew—this poem was read by the Commanding Officer during the decommissioning of OMSTA North Dakota.

On the other hand, there has been a lot of growth activity in GPS, Differential GPS, Loran, Navigation Information Services, and other radionavigation areas—and those areas are topics in this issue of the Bulletin. Highlighting the success of its unique organizational placement and structure, the Coast Guard Navigation Center has been a significant contributor in virtually all these activities.

Clearly GPS has become part of the worldwide infrastructure. Navigators, surveyors, timing users, and others—with new categories of users added daily—have embedded GPS technology into their equipment, their products, and their jobs. The Interagency GPS Executive Board (IGEB), jointly chaired by DOD and DOT, has been established. The State Department has formed a GPS International Working Group, and formal international consultations are underway to assist in harmonizing the use of GPS technology worldwide.

GPS augmentations, specifically the U.S. Coast Guard's Maritime DGPS Service, are contributing more and more to the quality of life of our users. You'll see articles in this edition of the Bulletin about the National Oceanic and Atmospheric Administration's (NOAA) plans to update harbor survey data and charts, to incorporate water vapor and other sensors at DGPS sites, and to use data on "GPS observables" from all the DGPS reference stations as part of our nation's geodetic reference system. As a Coast Guard officer, you might guess that I am most excited about the harbor survey work. Together with the updated nautical charts that will result and the USCG buoytenders' use of DGPS for positioning buoys, mariners who use electronic charts and rely on DGPS as a primary navigation aid should be able to more safely and efficiently transit our waterways. Indeed, the Maritime DGPS is rapidly becoming a part of the infrastructure of our nation. Our work in developing and promulgating standards for DGPS has assured that ocean-going mariners will also find functionally equivalent navigation aids in most ports throughout the world. And, as you can see, the Department of Transportation is moving out smartly with expansion of DGPS service to meet nationwide transportation safety needs in the interior of our nation.

We have also had a lot of activity in Loran operations. Specifically, the six Loran chains in the continental United States are now operated directly by watchstanders at the Navigation Center. A new computer system, dubbed the Loran Consolidated Control System (LCCS), has enabled a significant

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RADIONAVIGATION BULLETIN

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Omega Silent After 25 Years of Int'l Service

It's official! At 0300Z on 30 September 1997 all stations worldwide ceased transmission of the OMEGA signals, ending a 25-year world-wide navigation partnership.

For more than two decades, the United States Government, led by the U.S. Coast Guard, was in partnership with 6 nations to ensure the safety of navigation of ships and airplanes around the globe by means of OMEGA. The world-wide Omega Navigation System was the only multi-country cooperative navigation system ever and it spanned the globe from Argentina, Norway, Australia, France, Japan, Liberia and two U.S. OMEGA stations, one in Hawaii and one in the heartland of the U.S., North Dakota. Despite the distances and the cultures that separated each of these nations and the vast expanse between these stations, the OMEGA signal remained on air, reliably and accurately, guiding mariners and aviators alike, in trans-continental and trans-oceanic journeys.

Each nation staffed and operated its own station with funding and technical support provided by the current USCG Navigation Center and formerly the OMEGA Navigation System Center. The stations world-wide were crewed by devoted personnel, ensuring that no matter the situation or the political climate in their respective countries, the signals would be broadcast. Their professionalism and devotion to duty was tested on several occasions, such as civil wars and international conflicts, and during less extreme, but just as dangerous events such as life-threatening floods, record-breaking snow fall, and hurricanes. Despite these international crises and hazardous weather situations, the stations remained on air and in tolerance. Truly a testament to the type of people worldwide who served to ensure the safety of life of others.

OMEGA, although still a useful means of navigation, had been superseded by newer technologies, particularly Global Positioning System (GPS) and Differential Global Positioning System (DGPS). GPS provides accuracy to within a few meters, worldwide timing to nanoseconds, improved reliability, and in combination with DGPS, system integrity to degrees unimaginable when OMEGA was first conceived over 40 years ago. Rear Admiral Timothy W. Josiah, nicely summed up the change when he stated at the closure ceremony in North Dakota, "It's time to say goodbye to the past and embrace new technology."

The closure of OMEGA met with fanfare and ceremonies marking the event in most of the partner nations. In the United States, our two stations celebrated the occasion by conducting formal Decommissioning Ceremonies.

OMSTA Hawaii, Kaneohe, HI

OMSTA Hawaii was originally constructed by the U.S. Navy as a Very Low Frequency (VLF) Fleet Communications Station. It was built during World War II to ensure communications with the Allied Forces in the Pacific Theatre. This OMEGA station was unique because of the need to construct a valley span antenna instead of a vertical antenna tower. A valley span antenna design was necessary because a vertical tower would have had to exceed 2000 feet to accomplish the same function. Throughout the years, this station was committed to accomplishing its mission and more. Examples of this are shown in station improvements such as "self-help" projects including: painting of the Omega Transmitters, minimizing the accumulation of water within the fuel oil storage tanks, and building access stairs to the station's storage building. In November of 1996 following a potentially devastating antenna lightning strike, the station's personnel responded professionally and expertly. Their teamwork with NAVCEN and CEU Honolulu resulted in the transmitting signal back on air in 22 days. This was an amazing accomplishment—one that the station personnel can be proud of for years to come.

The OMSTA crew was also involved with the local community taking part in the "neighborhood watch program" and attending local governing board and committee meetings. These efforts ensured increased police presence and improved response in the local community resulting in reduced vandalism and petty crimes.

It is always difficult to say goodbye to any CG

unit, but especially one that has such a rich history and made itself part of its community. On 19 September, Captain James Doherty, Commanding Officer of the Navigation Center, attended the Decommissioning Ceremony to recognize the accomplishments of this fine Station and to witness the CG Ensign hauled down for the last time. The 14th District recognized the Commanding Officer, CWO Zerbe, with a Commendation Medal for his outstanding achievements and the Commandant awarded the crew a Meritorious Unit Commendation recognizing the achievements of the OMEGA Navigation System. A special moment in the ceremony was when members of the original VLF communication station construction crew of 1942 were introduced and recognized for their heroic efforts building the original valley span antenna.

Future Plans

The disposition of the land and the station buildings is still pending. There are a few options being considered for the 698 acres of lush rain forest. The first step in resolving what will be done with the land entails screening the area—making it available to other federal agencies. If no bids are received from a federal agency then there appear to be serious plans to preserve the grounds as a park and recreation area for the people of Kaneohe to enjoy.

OMSTA LaMoure, North Dakota

On a blustery but sunny day in North Dakota, the Decommissioning Ceremony to mark the end of OMEGA in the continental U.S. was held. October 1, 1997 marked the end of an era and the beginning of a new mission for OMSTA LaMoure. The Decommissioning Ceremony was officiated by Admiral Josiah, 8th District Commander, the Station's Administrative Commander. Captain James Doherty, Commanding Officer, Navigation Center, Operational Commander for OMEGA, LaMoure's Mayor, the Honorable Greg Pedersen and Major General Keith Bjerke, Adjutant General of the North Dakota National Guard also participated. The crew was recognized with a Meritorious Unit Commendation for their outstanding contribution to the performance of the OMEGA Navigation System.

The decommissioning ceremony was a sad event for the town. Since 1972, OMSTA LaMoure has been a major influence and contributor to the community. The people embraced the crewmembers that served at LaMoure as their own, and the crew had become an integral part of the town. The Coast Guardsmen were committed to the town's Partnership in Education Program, serving the local elementary school, helping the children with basic studies, and they even set up a computer network for the school. Coasties also manned the local fire and ambulance station, where they volunteered their off duty time to help their neighbors. During the floods in the spring of 1997, the personnel of the station put their lives on the line when they volunteered to assist in flood victim rescue efforts. Their efforts resulted in recovering numerous people stranded by the rising waters. Throughout that devastating period the OMSTA signal remained on air—due to the teamwork and vigilance of the station personnel.

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(Continued from page 5)
The bond between the town and the Coast Guard was strong and both will miss the opportunities this OMSTA offered.

Future Plans

There is a bright side of the decommissioning of Station LaMoure. Following the Coast Guard ceremony, the U.S. Navy began moving into the Station. The facility was officially turned over to the U.S. Navy which is converting the OMSTA into a communications station. This is certainly a twist of fate since in October 1972 the Navy originally turned the facility over to the Coast Guard, the first of eight operational OMEGA stations world-wide.

The U.S. Navy plans to augment their VLF communication network by installing a 500 KW solid state transmitter at LaMoure. The transmitter is being designed by Rockwell, and the goal is to have it installed by summer 1998. This facility will actually serve two purposes; first it will serve as a test site for the engineering of the solid state transmitters and secondly, it will act as a back-up site to mitigate the effects of broadcast outages at other VLF stations. It will be used to broadcast traffic for any station which is off air.

The facility will fall under the auspices of Commander, Navy Computer and Telecommunication Office (CNCTC), Washington DC. Present plans are to have the station operated by contracted personal.

Around the Globe

In recognition for their decades of dedicated service, each of the partner nation Agencies, which oversaw the OMEGA stations' activities, were awarded the Coast Guard Public Service Commendation. These awards specifically recognized each Agency for their devotion and commitment to keeping the OMEGA signal on air.

In addition to recognizing the Agencies, each of the personnel serving at the international OMEGA Stations received a U.S. Coast Guard Certificate of Merit, accompanied by a Department of Transportation Lapel Pin.

It was particularly satisfying to Captain Doherty to have the opportunity to travel to Argentina and personally present the Public Service Commendation to the "Servicio de Hydrographic Naval, Argentina" as well as distribute the awards to the crewmembers at the decommissioning ceremony. Besides the Certificates of Appreciation, two people in Argentina were recognized individually. A Public Service Commendation was awarded to NAVCEN's OMEGA Logistics Advisor, Mr. Carmen Stigliano, who served in that post for almost twenty years. His efforts were instrumental in keeping lines of communication open between the station and the U.S. as well as ensuring timely receipt of spare and replacement parts from the U.S. to Argentina. A U.S. Coast Guard Commendation Medal was presented to the Commanding Officer of OMSTA Argentina, CDR Walter Aleman. He was recognized for his personal contributions over the previous 15 years of his command of Station Golfo Nuevo.

A combined USCG and U.S. Navy team will go to Argentina in mid-December to meet local contractors and arrange for the complete removal of OMEGA related equipment and finalize dismantling of the 1200' antenna. The team is currently arranging to dismantle the station and turn the land back to the Argentine government.

A second international closure ceremony that the U.S. Coast Guard was able to attend was in Norway.

Personnel of the Japanese Transmitting and Control Station displaying their USCG Certificates of Merit.

Mr. Stewart Shoulta, representing Commandant (G-OPN) traveled to Norway to recognize the end of an era there. He presented the Maritime Radio Services Agency with a Public Service Commendation and presented all the crew members with Certificates of Appreciation on behalf of the U.S. Coast Guard.

A facsimile transmission received by the Navigation Center from the Japanese Maritime Safety Agency truly summarized the 25 year relationship between the U.S. and Japan. The fax received just days before the signal was terminated stated,

…"(The final status message) will shine brilliantly, footmarking the world wide radio navigation history cooperatively linking OMEGA with six partner nations. We can't say enough in praise of your excellent duties. In Japan, both the Station and the Analysis Office employees amount to nearly three hundred persons since opening time. They have a favorable impression of the system. Your friendship and kind support with us over the years has been deeply appreciated. It will stay with me as a rewarding memory of the valuable experience received from OMEGA. I hope that the OMEGA community members will continue to have a successful and enjoyable life."

Toshiichiro Kawamura, Director of JMSA, expressed these kind words.

These words reflect the overall feelings between all the personnel associated with OMEGA. Captain Doherty and all the members of the Navigation Center, wish all those who were part of the OMEGA community, a bright and successful future!

LCDR Lori Mathieu
LT Kyle Smith
Mr. Vinicio Vannicola

Civil GPS Service Interface Committee 30th Meeting Summary

The Department of Transportation's Civil GPS Service Interface Committee met in Kansas City, MO 10-12 September 1997. Mr. Joseph Canny, Chairman of the Committee and Deputy Assistant Secretary for Transportation Policy, opened the meeting, welcoming the 200 attendees. CAPT Doherty, Co-Chairman, followed with a presentation of the issues raised by the Committee since the last meeting in March.

The Department of Defense organized a session addressing DOD Policy, GPS Constellation Sustainment and Performance, Satellite Production, and Problem Reporting. DOD and DOT reviewed the efforts so far in GPS Modernization.

Additional presentations included the Maritime DGPS Service and DOT's plans for its nationwide expansion, and the FAA's WAAS and LAAS programs. The international subcommittee coordinated presentations from Daimler-Benz and Satel Conseil on European activities along with presentations from member countries on their GPS activities. Australia gave a presentation on "RAIM holes" observed recently, particularly in the southern hemisphere. The Timing Subcommittee met on Sunday afternoon to discuss advances in International Timing followed by the third meeting of the U.S. States and Localities Subcommittee.

Recent concerns on the protection of GPS spectrum were addressed concluding with a firm resolution by the attendees to discourage encroachment on GPS frequencies.

Copies of the slides presented at the meeting are posted on the Navigation Information Service CGSIC Web Page (www.navcen.uscg.mil). Summaries of the presentations and the open discussions will be posted as they become available.

The next plenary meeting of the CGSIC will be held in Washington 7-9 April 1998. The location will be posted when arrangements are finalized in the next few weeks.

CGSIC Plans Warsaw Meeting

CGSIC International Subcommittee 6th European Meeting
Palac Staszica, ul. Nowy Swiat 72
Warsaw, Poland
Preliminary Agenda

Thursday, December 11

9:15 - 10:45	Opening Session
11:00 - 13:00	GPS Policy and Organization
14:30 - 15:30	GNSS and GLONASS
15:45 - 17:30	Workshop - Policy and Information Exchange
19:30 -	Reception

Friday, 12 December

9:00 - 10:45	Transport and Mobile Services
11:00 - 13:00	Timing, Geodesy and Geodynamics
14:00 - 15:15	Industry Aspects
15:30 - 17:15	GPS Application in Different Countries
17:15 - 18:00	Summary and Conclusions. Closing of the Meeting.

Saturday, 13 December

9:00 - 15:00 Technical Excursions:

1. Visit to the Space Research Centre, Dept. of Planetary Geodesy
2. Visit to the Institute of Geodesy and Cartography, Geodetic Observatory, Borowa Góra.
3. Lunch.

Navigation Information Service Update

The Navigation Information Service (NIS) has been providing Radionavigation information since March 1990. The NIS public information service is manned 24 hours a day, seven days a week. Since its inception, the NIS has experienced rapid growth. The NIS mission is to gather, process and disseminate timely GPS, DGPS, Loran-C status and navigation related information to users of these systems. Specifically, the NIS provides users the following information:

- Operational Advisory Broadcast service (OAB).
- Tutorial, instructional and other relevant handbooks and material for distribution to users.
- Historical records of GPS, DGPS, LORAN-C and broadcast information, in addition to data bases and other relevant data references.
- Answers to maritime related questions via all available means.
- The text of the Federal Radionavigation Plan.
- USAF/NOAA Solar and Geophysical Activity Reports.
- Marine Communication Notices.
- Recreational Boating Safety information.
- National Pollution Funds Center information.
- Coast Guard Public Affairs releases.
- Marine Safety, Security and Environmental Protection information.
- Search and Rescue information.
- Items that may be of interest to the maritime and radionavigation community.

The NIS is able to provide real time information by maintaining state of the art computer technology coupled with highly trained watchstanders. During the course of a 24 day, the NIS watchstander will answer numerous maritime related questions received via phone, fax, e-mail, and letters. The NIS watchstander also updates NGS precise ephemeris data, Differential Global Positioning status, Geophysical activity reports, Broadcast Notice to Mariners, Local Notice to Mariners, forested Almanac information and Global Positioning System satellite status on a daily basis.

The NIS currently receives over 600K "hits" or visits to its Internet website per month. To better handle this flow of information, the NIS is implementing new technology to better serve customer needs. The NIS anticipates introducing a newly revised web site by Spring of 1998. The new web site will include a user friendly search engine, searchable data bases, and an expansion of information to include two years worth of archived data. In addition, the NIS is striving to answer all questions within three working days and is implementing a new watchstander interface to serve as a quality control measure for the information disseminated by the NIS.

QM1 Eugene Diotalevi, NAVCEN

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Telephone: (703) 313-5931/5932

GPS Status Recording:
Telephone: (703) 313-5907

WWV/WWVH Radio Broadcast:
WWV broadcasts by telephone or radio at 14-15 minutes past the hour and WWVH at 43-44 minutes past the hour. Radio frequencies: 2.5, 5, 10, 15, & 20 MHz.
Telephone: (303) 499-7111

Coast Guard Customer Infoline:
Call Infoline operators for information on boating safety recalls, to report possible defects in boats, to comment on USCG boarding procedures, for answers to boating safety questions, or for boating safety literature.
Telephone: (800) 368-5647

Write or Call:
Commanding Officer (NIS)
U.S. Coast Guard Navigation Center
7323 Telegraph Rd
Alexandria, VA 22315-3998
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Fax: (703) 313-5920

The Loran Consolidated Control System: "Positioning" Loran Radionavigation for the Year 2000

Statistics tell us that only 14% of software engineering projects are completed by their deadline. The Loran Consolidated Control System (LCCS) project, a $1.2M Commandant (G-CCS) sponsored and (G-SCE) managed effort, is one such project that can be counted in that 14th percentile bracket. Faced with rigid deadlines, a short timetable, a limited budget, and high contractor turnover, the Loran Support Unit (LSU), formerly the Electronics Engineering Center (EECEN) Loran-C Branch, "LORANimals" met the challenges head-on to produce a superb product within budget and "on time." As Commandant (G-SCE) stated, "This is a project where we were given fewer personnel than required, less $$$ than necessary, and less time to make it all come together---but even with all of these obstacles, the loranimals made this another success story."

The LCCS project was first introduced in FY90 with the Loran-C Electronic Equipment Replacement Plan (EERP). This report presented five major redesign efforts to move the Loran-C Radionavigation System into the 21st century, essentially preparing the Loran-C System for automation and unmanning. One of these efforts was Consolidated Control. After many years of starting and stopping this Consolidated Control initiative, it wasn't until November, 1994, when the Chief of Staff approved G-N's "Consolidated Control of Domestic Loran-C Chains" Productivity Project Proposal (PPP) that work resumed. The EECEN Loran-C Branch received the first two of six engineers and technicians allotted for the project in February, 1995, and that's when the "real" planning and execution began.

The purpose of the LCCS project has been to develop and implement a domestic Loran system to reduce required manning, logistics support, personnel, and training necessary to operate the Loran-C control system. A major component of this multi-year project has been the replacement of certain suites of Loran chain control equipment: the Remote Site Operating Set (RSOS), the Calculator Assisted Loran Controller (CALOC), the Chain Recorder Set (CRS), and the Teletype (TTY). Another major component of LCCS has been the reduction and automation of the data collection and decision making functions at the Loran Control Stations. This has allowed for the functions and responsibilities to be relocated and consolidated at central control sites, namely NAVCEN, Alexandria, VA, and NAVCEN Detachment, Petaluma, CA. The bottom line is an annual savings to the Coast Guard of over $1.3M and the reprogramming of 36 billets, thus assisting with the Commandant's streamlining efforts.

From it's inception, LCCS has been on the forefront of technology. LCCS uses state-of-the-art computer hardware and software to accomplish its mission. LCCS engineers and technicians designed and developed all aspects of LCCS including hardware configuration, application development, and coding. LCCS uses the Hewlett Packard UNIX 10.10 Operating System, Informix 7.13 Online database, X.25 communications interface software, and various other software components in interacting with the LCCS code. The LCCS code itself consists of over 189,000 lines of C, C++, and X/Motif code written with the help of WRSystems, Ltd. and various other contract personnel. The LCCS was designed from the start to be extremely user-friendly and intuitive. LCCS engineers used the latest in Graphical User Interface (GUI) software and worked with NAVCEN and Loran Station personnel to produce a product that requires minimal training and no knowledge of the underlying Operating System or code. LCCS support was designed to minimize support requirements and associated costs. With a few minor exceptions, all LCCS hardware and software was purchased off the Navy's Tactical Advanced Computer generation four (TAC-4) contract with Hewlett Packard and various other subcontractors. This takes advantage of Non-Development Item (NDI)/ Commercial-Off-The-Shelf (COTS) equipment and

ET3 Burgess handles an alarm on the NEUS LCCS Console.

software, thus allowing better allocation of resources. LCCS also takes advantage of the extended warranty of the TAC-4 contract, thus eliminating the need for a depot repair facility.

The first major milestone of LCCS came June 10, 1997 when the control functions for the U.S. West Coast (USWC) and North Central U.S. (NOCUS) Loran-C chains were shifted from Control Station (CONSTA) Middletown, CA, to NAVCEN Detachment, Petaluma, CA. The Southeastern U.S. (SEUS) and South Central U.S. (SOCUS) chains followed when their control functions were shifted from CONSTA Malone, FL, to NAVCEN Alexandria, VA, on July 16. The Great Lakes (GLKS) and Northeastern U.S. (NEUS) chains were the last to be shifted when the control functions were moved from CONSTA Seneca, NY, to NAVCEN, Alexandria, VA. Following the consolidation to NAVCEN and NAVCENDet, all three CONSTA's were converted to "standard" remotely operated Loran Transmitting Stations.

Future plans include the incorporation of LCCS in Alaska (FY98) and Canada. LCCS will be installed at CONSTA Kodiak, AK, and will assume control functions for the Gulf Of Alaska (GOA) and Northern Pacific (NORPAC) Loran-C chains helping the Coast Guard realize further savings. The Coast Guard's excellent relations with the Canadians are giving us the opportunity to install LCCS and share in the benefits of this modern-day system. LCCS is to be installed at CONSITE Williams Lake, British Columbia where it will assume control functions for the Canadian West Coast (CWC) chain and at St. Anthony, Newfoundland, where it will take over control functions for the Canadian East Coast (CEC) and Newfoundland East Coast (NEC) Loran-C chains.

Through the hard work, tireless efforts, and dedication of many organizations and individuals, the Coast Guard has turned adversary into asset in beating the odds and producing an outstanding, cutting-edge technology, engineering product used to control the entire Loran-C Radionavigation System in the "lower 48." LCCS will soon be adding Alaska and Canada, giving it control not only over the entire Continental U.S. (CONUS) Loran-C Radionavigation System, but also the entire North American Loran-C System. As the G-CPA-1 Reviewer for G-S stated, "The LCCS project demonstrates the type of cross-programmatic initiatives that must continue in order to meet future budget targets. The LCCS project should be touted as the model of how G-S leveraging technology initiatives enables operational programs to provide same level of service at reduced cost." LCCS truly has met it's original goal proposed back in FY90; moving Loran Radionavigation out of 20th century technology and positioning it for the needs of the community in the 21st century.

LT Christopher Stout, LSU

Loran Stations Out of Control

Now that I have your attention! Loran Stations Middletown, CA, Seneca, NY, and Malone, FL are out of control, but this time it's a good thing. On 10 June 1997, a new era began as control of the North Central U.S. and U.S. West Coast Loran Chains was transferred from Middletown to NAVCEN Western Operations Division Petaluma CA. One month later control of the South East U.S. and South Central U.S. Loran Chains was transferred from Malone to NAVCEN Eastern Operations Division Alexandria VA. Consolidation of Loran control for the continental U.S. was completed on 18 July 1997 with the transfer of control for the North East U.S. and Great Lakes Loran Chains from Seneca to NAVCEN. Implementation of the Loran Consolidated Control System at NAVCEN and NAVCEN Detachment ends a 19 year reign for Loran Stations Middletown, Seneca, and Malone.

The change has been met with mixed emotion. With the shift of control, personnel compliments at each of the former control stations has dropped from approximately twenty-one to four or five. "It's pretty quiet around here these days", explained ETC Masters, who became Middletown's first OIC in June. Instead of stocking the refrigerators for the long 24 hour watches, station personnel find themselves locking the doors and departing the station after the day's work, letting Petaluma keep watch over the Loran signals at night. Personnel remaining at the former control stations are now focused on the responsibilities of a transmitting station. One can detect their enthusiasm as beepers and cell phones have replaced the long hours of live watches they experienced in the past.

LT Lee Putnam, NAVCEN

A Day in The Life of an LCCS Watchstander

Imagine eleven of the most powerful radio stations in the country. They are scattered from Jupiter Inlet, Florida, to Gillette, Wyoming, to Las Cruces, New Mexico, and points in between. Your mission, should you decide to accept, is to monitor these radio transmitters as they fire in sequence, and ensure they fire at the proper time - right down to the nanosecond (that's a decimal, eight zeros, and a one, to you and me). You have fifty-nine seconds to interpret the alarm data presented to you on your multi-windowed computer monitor. This data may be spurious, it may be intermittent: you must decide if the problem is real or imagined. And just to make everything a little more important, there are thousands of people out there depending on you for their safety. Still want the job? We do.

Welcome to the LORAN Consolidated Control System at NAVCEN Alexandria, Virginia. Come on in, have a seat at the controls. Now you're controlling SEUS & SOCUS, our most complex LORAN chains. Two monitors display information from seven LORAN receivers strategically placed throughout North America. These monitors also display current operating conditions at eleven transmitting stations. The information is shown as charts, graphs, tables, and text. How do they pack so much information onto an admittedly large computer screen? Well, if you touch the icon on the screen for a transmitting station, the data for that transmitter will appear. You will see the transmitted power level, RF pulse shape, and a lot of other useful information. From this screen you can also switch from a faulty transmitter to a redundant transmitter. If things get out of control, you can even shut the station down.

"Trust me, the user will know not to rely on a signal if his LORAN receiver tells him the transmitter is blinking."

Touch the icon for a LORAN receiver and more data will appear. This data is from a receiving site far from the transmitting station. The purpose of this site is to monitor the transmitted signal under conditions similar to those the actual LORAN user will see. These primary LORAN receivers tell you three important pieces of information. First, how strong is the transmitted signal? Second, is the LORAN pulse still the same shape after traveling all those miles? Last, and most important, is the pulse being transmitted at precisely the right time? All this information can be displayed in graph or table form. If any of these readings are not within set parameters, you will be alerted by an audible alarm and a text message. What should you do? Your first priority is to protect the user from an inaccurate signal. You do this by modifying the transmitted signal with a method known as "Blink". That's right, you blink. Trust me, the user will know not to rely on a signal if his LORAN receiver tells him the transmitter is blinking. This has to be done within fifty-nine seconds from the first indication of a problem. But not so fast: what if the primary receiver is malfunctioning? Jump on over to the next screen and we'll have a look at another receiver monitoring the same station. Yep, this one says there's a problem too. You've confirmed that the problem is real and not weather or computer related. Time to blink. Jump back to the screen with all the station controls and touch the icon that says "START BLINK". O.K., now what? Let's look at the text alarms that the station is reporting, maybe that will give us a clue as to what the problem is. The alarms tell you that the cesium frequency standard has failed at the transmitting station. The cesium oscillator drives the timer which develop the signals necessary for proper signal transmission. No problem, just switch over to the standby cesium and timer (they come as a pair) if you'll just touch that icon marked "SWITCH TIMER". O.K., lets go back to the screen with the primary receiver data and see if the solution worked. Great! You're back in tolerance. Now go back to the transmitter screen, and touch the "STOP BLINK" icon. Congratulations. You just survived your first LORAN casualty.

What's that? The guy to your right? Oh, he's the other watchstander. He's doing the same thing you are with just as many stations. We do this in eight hour shifts, twenty-four hours a day, three-hundred sixty-five days a year. Stop by and see us some time. We'll be here.

ET1 Phillip R. Hill, NAVCEN

DOT LORAN-C USER SURVEY

The Department of Transportation (DOT) is undertaking a congressionally mandated review of the decision to decommission the Loran-C navigation system in the year 2000, as outlined in the 1996 Federal Radionavigation Plan. To assist them in this effort, DOT has retained the contracting firm Booz-Allen & Hamilton, Inc., to assess the technical merits of extending Loran beyond the year 2000, and to conduct a cost/benefit analysis of such an action. Early in the review effort, Booz-Allen & Hamilton hosted a September 1997 Loran-C Users conference in Washington, D.C., where representatives of various users of Loran-C presented information related to the Loran system and its present and future use.

The Government is also soliciting written input from individuals and organizations who were unable to attend this Loran-C Users conference. Booz-Allen & Hamilton has developed a Loran-C Input Form/Questionnaire to gather Loran-C user input. These inputs may be mailed to:

DOT Loran-C Study Comments
c/o Joseph R. Davis
Booz-Allen & Hamilton, Inc.
8251 Greensboro Drive, McLean, VA 22102

Telephone comments cannot be accepted. E-mail comments may be directed to a dedicated account called **loranc@bah.com** . Comments may be sent **FAX to (703) 917-3023**. Both accounts are available 24 hours a day. Comments are being solicited on any technical, operational or economic issue(s) associated with the proposed action. Comments should be factual, and if possible provide verifiable reference to the source of any data cited. Interested parties may call (703) 902-4671 during normal business hours (8:00AM-5:00PM *EST*) if they wish to confirm receipt. All comments should identify the originator and provide some means (mail, telephone or E-mail) to allow return contact with the originator. You should identify the specific Loran-C user community/communities (maritime, aviation, weather, timing and synchronization, etc.) they represent, and the specific use made (type of aircraft, vessel or other platform, where used, what other navigation systems are used, and typical navigation activity). In addition, comments should address reliability and other system performance issues. Inputs will be accepted until approximately 15 December 1997; however, early submission will ensure time for Booz-Allen & Hamilton staff and the Government to address key issues in the cost/benefit analysis and other technical reports.

- Survey Form on Reverse Page -

LSU Team Receives Secretary's Award

Congratulations to the LCCS Project Team, who received the DOT Secretary's Team Award for their role in implementing the LCCS system.

LCDR Charles Schue, III
LT Alan Arsenault
LT Stephen Bartlett
LT Jim Koermer
LT Christopher Stout
CWO Kirk Montgomery
CPO Brian Bensen
ET1 Mike Luna
ET2 Stephen Pearson
ET3 William Sage
Mr. Dave Hartley

DOT LORAN-C USER SURVEY FORM

(Return address or business card)

Date: _____

Phone: _____

FAX: _____

To: Loran-C Study Comments
c/o Joseph R. Davis
Booz·Allen & Hamilton, Inc.
8251 Greensboro Drive
McLean, VA 22102

The following information is provided for use in the Department of Transportation study of the proposed decommissioning of the Loran-C system:

Boat(s) Type(s)
_____

Length _____

Documentation _____

Type of use/Number of Passengers _____

License _____ Number of years under license____

Area(s) of operation_____ Typical distance offshore _____

Electronic equipment installed/used _____

_____

Comments regarding use and proposed termination of Loran-C (safety, accuracy, cost, etc.):

(Signature)
_____

1.Mail survey form to Booz-Allen at above address; or
2.Email survey to loranc@bah.com; or
3.Fax survey form using (703) 917-3023

Differential GPS Update: FOC in '98

As reported in the last issue, the Coast Guard's maritime Differential GPS (DGPS) Service continues operation under Initial Operational Capability (IOC) phase, providing signals which meet the system's accuracy and integrity requirements. Currently 54 sites are providing DGPS corrections to mariners; the 54th site was added in May 1997. We continue efforts to complete the system upgrades necessary for the Service to achieve Full Operational Capability (FOC) by the end of calendar year 1998.

The most recent DGPS site added to the network is located in Appleton, WA. Based on a navigation requirement (on the Snake and Columbia Rivers) from the Commander, Thirteenth Coast Guard District in Seattle, the Coast Guard Radionavigation Program Office readily agreed to cooperate with the Federal Railroad Administration (FRA) to transmit DGPS corrections for their Positive Train Separation prototype demonstration. The FRA is interested in this project because it will provide DGPS signals to the railroad tracks that run through the natural canyon of the Columbia River Gorge. The site, which is part of the Air Force's Ground Wave Emergency Network (GWEN), occupies roughly 11 acres, has a 300' top-loaded monopole with a 600' ground plane (providing roughly 50% efficiency), and hardened equipment and generator shelters. The Coast Guard's Electronic Engineering Center provided extensive advice and assembled a suite of differential equipment from CG inventories. The FRA provided funding for the conversion and contracting oversight, and purchased a radiobeacon transmitter. The CG Navigation Center monitors site operations and a contractor provides maintenance; operations from this site have been exceptional. Since the USAF plans to replace the ground-based emergency communications system (GWEN) system with a satellite based system, this conversion also presents an excellent opportunity to reuse government investment.

In order for the maritime DGPS Service to achieve FOC, the Service must meet the specifications in the following categories: accuracy, integrity, coverage, availability, and reliability. Where signals are available, those signals currently have accuracy and integrity. The NAVCEN continues its coverage verification efforts. These verification efforts are not complete; coverage deficiencies detected to date are in southeast Alaska and southeast Puerto Rico/US Virgin Islands. Funding is approved to construct two new sites in southeast Alaska in FY98. Additional funding has been requested for FY99 to correct remaining signal coverage deficiencies.

The two primary equipment sources of signal outages (failure to meet availability and reliability requirements) under IOC have been weather-related affects on some transmit antennas and outages due to power disruption. CG civil engineers have focused on replacement of the troublesome antennas with a more weather-resistant top-loaded monopole design. Sixteen antennas have been replaced, and thirteen more are scheduled.

While DGPS System Maintenance & Engineering Facility (SMEF) responsibilities transferred to the Command and Control Center (C2CEN) in Portsmouth with the closure of EECEN in May, the DGPS transmitter procurement continued to receive excellent attention – the first delivery of transmitters and couplers arrived at the Engineering Logistics Center in October. These transmitters incorporate the control interface capabilities, permit remote monitoring of transmitter performance, and provide the charge/control circuits for a battery backup system capable of powering the beacon for up to 22-hours. C2CEN has developed a field change to support installation by local technicians. These replacements should be completed by September 1998. Together with the new antennas, the new transmitters - and battery backup power - should improve signal availability and reliability.

NAVCEN teams have performed initial site certifications at over 70% of the sites. This has assured that sites are operationally ready to meet system requirements. Site recertification is required when new transmitters are installed; all sites will be revisited again in the next year.

Demand for, and capabilities of, DGPS technology continue to increase. One measure, recently approved by the Radionavigation Program Manager, involves a cooperative effort with the National Oceanic and Atmospheric Administration. The NOAA has developed a procedure to use CG reference stations to improve weather forecasting accuracy (see related article on page 15).

Congress unexpectedly provided initial funding to expand the CG-style, radiobeacon-based datalink DGPS corrections to terrestrial users in the U.S. This is a major Department of Transportation public safety initiative, dubbed Nationwide DGPS Expansion, and will span several funding cycles. Major players leading the expansion initiative include the Federal Railroad Administration and the Federal Highway Administration; the Coast Guard will continue to assist with technical expertise and provide control infrastructure.

NOAA & USCG Collaborate for CORS

NOAA provides a National Spatial Reference System (NSRS) to support surveying, mapping, engineering, and navigation applications by allowing users to relate their positioning to a common coordinate system. In modernizing the NSRS to meet the needs of the GPS era NOAA has implemented a Continuously Operating Reference Station (CORS) System to provide GPS observations to support positioning and other post-processing GPS applications. The U. S. Coast Guard Differential GPS Stations make up nearly half of the network of stations providing observations to the CORS System. To support NOAA applications the CORS stations are initially positioned with an accuracy of 1 to 2 cm and monitored on a daily basis.

In addition to supporting the NSRS, the Coast Guard stations are supporting other applications. Scientists are using the data to study crustal motion. NOAA has begun to use the data to monitor changes in the electron content of the ionosphere, an application that will have increasing importance as we approach maximum Sun Spot activity in the next few years. In the near future the Coast Guard stations that are a part of CORS will also be used by NOAA for improved weather forecasting and climate monitoring.

In the past five years, the use of surface-based GPS observations for atmospheric remote sensing has emerged as a promising new application of GPS technology. NOAA is now using the data provided by GPS receivers to calculate the total quantity of precipitable water vapor in the atmosphere with millimeter-level accuracy, under all weather conditions, and at very low cost. This is significant because water vapor is the source of clouds and precipitation, and the means by which moisture and latent heat are transported to cause "weather". It is also a greenhouse gas with a critical role in the global climate system. Despite its importance in atmospheric processes, water vapor is one of the least understood and poorly described components of the Earth's atmosphere.

By equipping USCG DGPS sites with low cost meteorological sensors, and acquiring these data along with the GPS observables, NOAA can start to develop the backbone of an operational GPS water vapor observing system for the United States, and do so at a small fraction of the cost required to build a dedicated system.

Mr. Seth Gutman,
NOAA
Mr. Bill Strange, NOAA

USCG on Delegation for International GPS Talks

Over the past eighteen months the Department of State's Bureau of Oceans, International Environmental and Scientific Affairs has lead a U.S. delegation to bilateral consultations on the Global Positioning System (GPS). The discussions have concentrated on mutual GPS cooperation with several of our international trading partners. As of this writing, formal discussion rounds have been conducted with delegations from Japan, the European Commission, and Russia. The U.S. Coast Guard is providing a delegation member, the Commanding Officer of the Navigation Center, to provide expertise on maritime and civil GPS issues.

The first round of international consultation was with the Japanese delegation in Tokyo during August of 1996. Over the following months, the U.S. delegation has met a second time with the Japanese, twice with the European Commission, and once with the Russian delegation. All of these talks have centered on GPS aspects of transportation applications, civil/military use coordination, commercial markets, and economic impacts.. The Department of State initiated the GPS consultations under the guidance of the March, 1996 Presidential Decision Directive (PDD) on GPS. The PDD stated the need for the U.S. government to foster international acceptance of GPS as a standard global utility.

The next scheduled consultations will be during December, 1997; the third round of discussions with the Japanese delegation in Tokyo. The Japanese delegation will be lead by the Ministry of Foreign Affairs and include representatives from the Ministry of Posts and Telecommunications, Ministry of Transport, Ministry of International Trade and Industry, the Japanese Defense Agency, Ministry of Construction, the Science and Technology Agency, and the National Police Agency. The State Department led U.S. delegation will have representatives from the Department of Transportation (including the USCG and the FAA), the Department of Commerce, the Department of Defense, and the White House.

LCDR Gene Schlechte, NAVCEN

DGPS Reduces Hydrographic Costs, Improves Process Accuracy

The National Oceanic and Atmospheric Administration's (NOAA) Office of Coast Survey is the federal agency responsible for producing and maintaining the suite of 1000 nautical charts that encompass the coastal waters of the United States and its territories. A nautical chart shows the depth of water, aids to navigation, dangers, and the outline of adjacent land and other features that are useful to the marine navigator. Hydrographic surveys, conducted primarily by NOAA and its predecessor, the Coast and Geodetic Survey, serve as the basis for navigational information displayed on nautical charts.

The advent of GPS has revolutionized the discipline of hydrographic surveying. The principle elements of a hydrographic survey involve recording depth soundings while simultaneously establishing the survey vessel's position offshore. Most hydrographic surveys are conducted with a sounding vessel running a series of parallel lines at fixed spacing back and forth over a body of water. Precise positioning is required to maintain a constant spacing (e.g. fifty meters) and to position features that are potential dangers to navigation. The position information collected along the vessel track is then correlated to a depth profile that is generated by an echo sounder.

Since 1991, the U.S. Coast Guard has established a series of DGPS radiobeacons along the coast of the United States. Today, hydrographers, as well as the average mariner, can receive differential correctors in most coastal waters of the United States. The effect on hydrographic surveying has been monumental as NOAA ships now utilize DGPS exclusively for hydrographic positioning. The requirements to establish horizontal control and to erect and maintain radio transmitters have disappeared. The availability and accuracy of DGPS has also given the private sector the opportunity to conduct hydrographic surveys for NOAA.

In addition to horizontal positioning, potential exists for GPS to revolutionize vertical measurements in hydrography. Before conducting a hydrographic survey, NOAA field units typically install a series of tide gauges in order to define the sounding datum in the survey area. Raw depth soundings are reduced to the datum (typically Mean Lower Low Water) by applying tide correctors. Tests using kinematic GPS on sounding vessels have demonstrated that in certain circumstances, vertical heights above the ellipsoid can be determined with great precision. While some tide gauges would still be required to establish the datum before the survey, the potential exists to use kinematic GPS on a sounding vessel to reduce the number of gauges required.

The availability of DGPS to the average mariner has raised some interesting issues in nautical charting. Before GPS, hydrographers always conducted surveys with a higher degree of positional accuracy than what was available to the average mariner. Therefore, the information shown on the chart was usually much more accurate than what could be achieved by the mariner. Today, computers can display a raster version of the nautical chart on a monitor. Many ships now have computer software that integrates real time DGPS positions with raster chart information. As a result, mariners can view an icon of their vessel continually updated on the electronic chart. This is a powerful new tool that is playing a positive role to increase safe navigation in the maritime world.

Ironically, with DGPS, the average mariner now has better positional accuracy than what was often available to the hydrographer who conducted the survey. Approximately fifty percent of depths displayed on NOAA charts originate from surveys over 50 years old. Therefore, using an electronic chart, the uninformed mariner may desire to zoom into a chart and expect to navigate with greater precision than the data on the chart can support.

CDR Nicholas Perugini, NOAA

DGPS Slated for Nationwide Expansion

The Department of Transportation is heading the implementation of a navigation system with an unprecedented level of cooperation from other Federal and state agencies.

The Nationwide Differential Global Positioning System (NDGPS) will soon blanket the nation with a navigation service that is the most accurate, most reliable and has the highest degree of integrity of any navigation system the country has ever seen. You might think that a system like that would cost billions to build, but the proven Coast Guard design will only cost between $23 and $27 million. Converting the Air Force's obsolete Ground Wave Emergency Network (GWEN) sites into DGPS reference stations will save the Department of Defense about $6M in GWEN decommissioning costs, and save the Department of Transportation about $10M in NDGPS implementation costs. It's a win-win situation. In fact, a recently completed Nationwide DGPS Report indicates the total life cycle cost will be $78.8M while the total life cycle benefits will be $11 billion, thus yielding a cost benefit ratio of 140 to 1 in favor of benefits.

After some initial research and development in the late 1980's by the Coast Guard's R&D Center, plans for the deployment of the Coast Guard DGPS system began. Currently, the Coast Guard's DGPS Service covers the coast of the United States and navigable waterways of the Mississippi River. The system was designed to be fully compliant with the RTCM SC104 and ITU-R M.823 domestic and international standards. As the Coast Guard was deploying its standard system, other Federal and state agencies began developing non-standard systems which could not be used by other agencies. In a September 1994 report, the General Accounting Office encouraged greater cooperation among Federal agencies in the development of differential systems. This comment was echoed in a December 1994 report entitled, *A Technical Report to the Secretary of Transportation on a National Approach to Augmented GPS Services*, which is more commonly referred to as the Augmentation Study. The Augmentation Study recommended the Department of Transportation plan, install, operate and maintain a nationwide system modeled after the Coast Guard's DGPS. In March of 1996, President Clinton established the GPS strategic goals and management structure, in Presidential Decision Directive NSTC-6 (PDD). The PDD assigned the responsibilities of leadership over civil GPS matters and the development of GPS augmentation systems for transportation applications to the Department of Transportation.

In January 1997, the Department formed an interagency DGPS Executive Steering Group and DGPS Policy and Implementation Team to lead the implementation of the nationwide system. The DGPS Policy and Implementation Team revalidated the findings of the Augmentation Study, documented the requirements across many Federal and state agencies, evaluated alternative methods of providing differential corrections, documented benefits, and developed a cost benefit analysis in accordance with OMB circular A-94. This work is documented in the Nationwide DGPS Report, dated December 3, 1997. Many public safety applications are identified in the report, including saving lives on the railroads and highways.

The use of DGPS in the Positive Train Control system will: (1) prevent accidents saving over $35 million per year, (2) reduce fuel consumption by better pacing trains, and (3) increase rail line capacity through closer train spacing, thus reducing the need for the construction of new lines.

Someday GPS/DGPS receivers will be as common in cars as AM/FM radios are today. An integrated vehicle safety system consisting of a DGPS receiver, map matching, collision sensors and communications links can help prevent accidents and notify emergency personnel when an accident has occurred. A collision sensor, similar to the sensor in an air bag, could automatically send a preformatted message to an emergency center at the instant an accident occurs. The message would contain the exact location of the accident. No longer would an injured person have to wait for another car to drive by and call for help. The notification is instantaneous. Using DGPS aided routing, the emergency response team can more quickly arrive at the scene of the accident. Thus the notifica-

tion time will be completely eliminated and the emergency response time will be greatly reduced. Faster response could save up to three percent (1,230 lives) of the 41,000 people who die on U.S. highways each year.

Similarly, a communications link from the emergency response center to other cars could indicate where accidents are impeding traffic. The DGPS receiver could display this information or an audio warning could alert drivers of an accident ahead. This could prevent multi-car pileups in poor visibility conditions.

The DGPS Policy and Implementation Team (DPIT) identified many other Federal and state public safety requirements. For example, DGPS could be used in search and rescue, fire fighting, oil spill response, monitoring shipment of hazardous material, and mapping contaminated water supplies.

"Faster response could save up to 1,230 lives each year..."

During the developmental stages of the nationwide DGPS report, the DPIT learned about U.S. Air Force plans to replace the Ground Wave Emergency Network (GWEN) with more recent technology. In the process, the USAF would have to decommission their existing GWEN sites and restore the property to pristine conditions. Since the GWEN sites have a 300' antenna which would provide high-efficiency for the medium frequency broadcasts and therefore greater range than a small tower, the DPIT recognized the opportunity and approached the USAF.

Since our plan is to reuse the Air Force's GWEN sites as they are decommissioned, we asked the Air Force if we could remove one site from the network to convert it into a DGPS site as a proof of concept. They agreed and we converted the GWEN site in Appleton, WA in May 1997. The site has been transmitting flawlessly since then. As a bonus, the antenna efficiency exceeded expectations. We anticipated an antenna efficiency of about 35 percent but we are getting over 50 percent. So instead of radiating 350 watts the site is putting out over 500 watts. As a point of reference, the other Coast Guard antennas operate between 5 and 20 percent efficiency. The range of the Appleton site is about what the DPIT expected, 200 to 250 miles, depending on the terrain and ground conductivity.

The Appleton site is also being used as a proof of concept for the use of NDGPS in the Positive Train Control system. We ran tests on trains along both sides of the Columbia River Gorge and the signals were received the entire length. As you might imagine, the electromechanical noise on the locomotives is very high. So we are looking into reduction techniques to lower the noise level in the receiver, thus effectively extending the usable range of all reference stations.

In July, Senators Daschle and Johnson from South Dakota attached an amendment to the Department of Transportation's fiscal year 1998 appropriation bill, which would authorize the NDGPS program and provide first year funding. The amendment was incorporated into the bill. Despite some initial opposition from the Office of Management and Budget (OMB), President Clinton signed the bill into law on October 27, 1997, as Public Law 105-66. Section 346 of this Public Law outlines the requirements and establishes the authority for NDGPS. The law also provides $2.4 million, in fiscal year 1998, to begin the installation of the NDGPS.

Per the 1996 Federal Radionavigation Plan, the accuracy of the USCG's DGPS Service is expected to be better than 10 meters (2drms). Fielded operations are now achieving accuracies on the order of 1 meter. The NDGPS will provide dual differential beacon coverage nationwide. That means anywhere in the country you should be able to receive corrections from at least two reference stations. Dual coverage increases the availability of the NDGPS signal. Since a single reference station provides an availability of 99.7%, dual coverage will provide an availability of 99.999% as illustrated below:

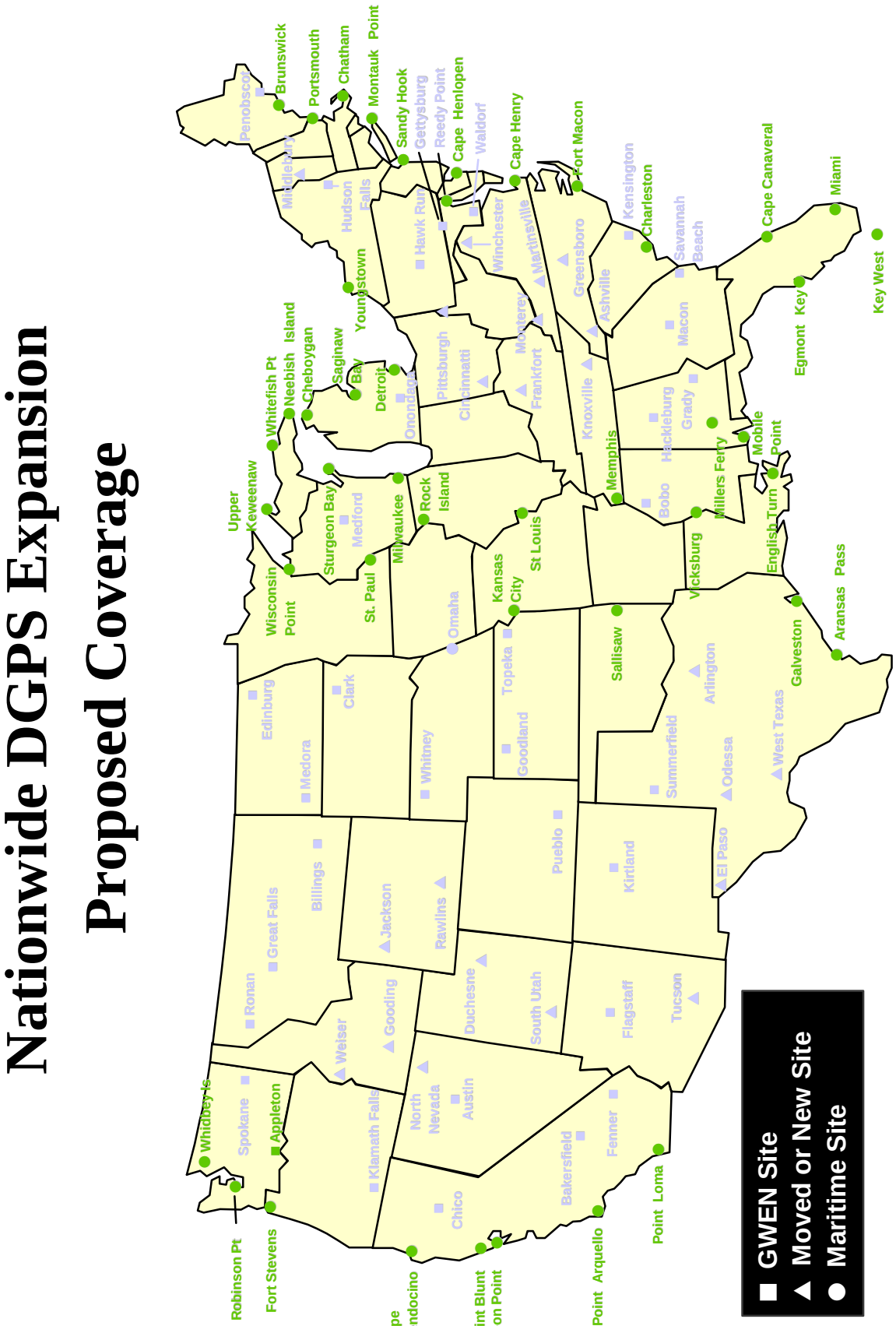
$$A_o = (RS1_{Ao} + RS2_{Ao}) - (RS1_{Ao} \times RS2_{Ao})$$

$$A_o = (.997 + .997) - (.997 \times .997)$$

Where: A_o is the Operational Availability
$RS1_{Ao}$ is the availability of reference station number one
$RS2_{Ao}$ is the availability for reference station number two

The NDGPS system will be installed using commercial products and services and will be maintained through commercial service contracts. Thus, we are meeting the requirements of both the PDD and Public Law 105-66, Section 346 to maximize the use of commercially available products and services.

As mentioned earlier, the NDGPS will reuse


Nationwide DGPS Expansion
Proposed Coverage
GWEN Site
Moved or New Site
Maritime Site
Whidbey Is
Spokane
Appleton
Robinson Pt
Fort Stevens
Ronan
Great Falls
Billings
Klamath Falls
Weiser
Gooding
Jackson
Rawlins
Cape Mendocino
North Nevada
Austin
Chico
Duchesne
South Utah
Point Blunt
Pigeon Point
Bakersfield
Fenner
Point Arquello
Flagstaff
Kirtland
Pueblo
Point Loma
Tucson
El Paso
Odessa
Summerfield
Sallisaw
Arlington
West Texas
Galveston
Aransas Pass
Edinburg
Medora
Clark
Whitney
Goodland
Topeka
Omaha
Kansas City
Vicksburg
English Turn
Millers Ferry
Bobo
Hackleburg
Grady
Mobile Point
Memphis
Knoxville
Ashville
Greensboro
Martinsville
Winchester
Waldorf
Cape Henlopen
Reedy Point
Gettysburg
Hawk Run
Hudson Falls
Middlebury
Penobscot
Brunswick
Portsmouth
Chatham
Montauk Point
Sandy Hook
Cape Henry
Fort Macon
Kensington
Charleston
Savannah Beach
Macon
Cape Canaveral
Egmont Key
Miami
Key West
Upper Keweenaw
Whitefish Pt
Neebish Island
Cheboygan
Saginaw Bay
Youngstown
Detroit
Onondaga
Pittsburgh
Cincinnatti
Monterey
Frankfort
Wisconsin Point
Sturgeon Bay
Medford
St. Paul
Milwaukee
Rock Island
St Louis

Ground Wave Emergency Network (GWEN) sites which the Air Force no longer need. The Air Force has 53 operational sites and 6 "complete" spare systems. We will reuse the 300-foot broadcast antenna, two equipment shelters and a 25KW generator at each site. Since our NDGPS coverage model predicts that we will need 66 sites for dual coverage, we will have to purchase some additional antennas and equipment shelters.

Unfortunately not all of the GWEN sites are ideally located for our purposes. This means we will have to move some site equipment to new locations. The plan calls for the reuse of 33 GWEN sites in their current locations, 25 moved GWEN sites and 8 new sites. We will probably keep one complete GWEN set as a spare. Reusing the GWEN system will save the Air Force about $6M in GWEN decommissioning costs and the Department of Transportation $10M in NDGPS installation costs. This will be one of the largest defense to civil system conversions in history.

The sites will be installed in two phases. The first phase will provide single coverage to the entire country. The second phase will provide dual coverage.

The broadcast of the differential corrections will be free of direct user fees as required under Public Law 105-66, Section 346. The format of the broadcast will be fully compliant with both RTCM SC-104 and ITU-R M.823 non-proprietary standards. These standards were developed, in a large part, by the United States and are now used in over 22 other countries, leading to a seamless international system. An additional benefit of using an open internationally accepted standard is that it creates a world market for all United States GPS equipment manufacturers and creates lower equipment costs for users through economies of scale and competition. Thus, both the manufacturers and users benefit. Use of the NDGPS in the Positive Train Control system and in Intelligent Transportation Systems helps to promote this U.S. government augmentation system standard in transportation systems, as required in the PDD.

The NDGPS sites will be integrated into three Federal systems: the Coast Guard's DGPS system for continuous integrity monitoring and control, the National Geodetic Survey's Continuously Operated Reference Station (CORS) system for high accuracy (5 centimeter) positioning applications, and the National Oceanic and Atmospheric Administration's Integrated Precipitable Water Vapor System for real-time input of water vapor data into the national weather models (see related article on page 15). From a national security perspective, the system will be operated by government and, thus can be denied to enemies of the United States, if the need arises, as required in Public Law 105-66, Section 346.

The NDGPS Report was developed through the exceptional teamwork of several Federal and state agencies and private contractors; the implementation will be done in a similar fashion. A multi-agency Memorandum of Agreement (MOA) (STILL IN DRAFT), will be the primary document which assigns responsibilities. Under the proposed MOA the DOT is seeking cooperation amongst the agencies involved. Many states could be involved in acquiring and developing sites.

This program will demonstrate that Federal and states agencies can work cooperatively with industry and the international community to accomplish a common goal. As we approach the dawn of the 21st century, this interagency, international team will build the largest, most accurate and reliable navigation system the world has ever seen. NDGPS will provide a seamless system, designed to nonproprietary standards and free of user fees. But most importantly, the Nationwide DGPS will save lives on the seas, on the roads and on the rails.

Mr. Len Allen, DOT OST-P7

New DGPS Transmitter Debuts

On 13 December 1997, the Coast Guard Command and Control Engineering Center (C2CEN) completed the first installation of the new DGPS beacon transmitter manufactured by Southern Avionics Corporation. This transmitter, capable of producing 1KW, incorporates new features such as reporting of forward and reflected power to the control station, provides an uninterruptible power supply for the transmitter and DGPS equipment rack, and consolidates the control station communications interface, RSIM, into one package. Assistance was provided by the local Electronics Support Detachment (ESD) in Portsmouth, VA and technicians from ESD Ft. Macon, NC, ESD Galveston, TX, and Electronic Support Unit Miami, FL.

LCDR Gary Schenk, NAVCEN

(Continued from page 2)
reduction in the number of watchstanders required and a consolidation of the Loran control function from several Loran stations in the field to the Navigation Center. I doubt our Loran users even noticed the change—the Loran system's outstanding performance record simply continued unabated. However, we have better technology—computer displays and databases—which enable our control watchstanders to access information throughout the system instantaneously. We will soon implement LCCS throughout the rest of the North American Loran service areas. Additionally, the Navigation Center has been working with the Loran Support Unit (LSU), Headquarters, and other federal agencies (notably the Federal Aviation Administration) to upgrade older systems and components in the Loran system. In the near future, we expect these efforts to result in implementation of automatic blink (i.e., rapid, autonomous integrity alarms on the Loran signals), improved synchronization of Loran chains to Universal Coordinated Time (UTC), and improved remote and automated control of Loran stations by the Navigation Center's LCCS control watchstanders.

Although not addressed in this edition of the newsletter, I recently had the opportunity to visit with Professor Durk Van Willigen and several of his colleagues and students at Delft University, Netherlands. There I was given an outstanding demonstration of a concept named EUROFIX—the transmission of DGPS corrections on the Loran signal. I was impressed! The concept of communication modulation on the Loran signal has been around, and used successfully, for almost as long as Loran itself. The idea of using the Loran signal to transmit DGPS corrections has been discussed in the technical navigation literature since the late 1980s. However, to actually see the system in operation, over a 400 kilometer baseline, is impressive. From my observations, the system performs about the same as a radiobeacon-based DGPS service operating at 50 baud. Transmitting corrections for nine satellites from a reference station at LORSTA Sylt, Germany, EUROFIX provided positions within a 1.5 by 3 meter ellipse at Delft. Due to construction activity at Delft, portions of the horizon were masked and only five satellites were available for the position solution. The Coast Guard intends to conduct tests of this EUROFIX concept shortly; look for more information in the next edition of the Bulletin.

The Navigation Information Service (NIS), operated at the Navigation Center, is a fully staffed operations center and Internet Website, serving civil needs for information about GPS, DGPS, Loran, and other navigation services and navigation-related information. The NIS website receives more than 600,000 electronic visitors monthly; when the 1996 Federal Radionavigation Plan was approved in August 1997, it was first made available to the public on the website, and some 800 copies were downloaded by users over the first weekend it was available. The other information service of the Navigation Center, the Civil GPS Service Interface Committee (CGSIC) has also been extremely busy. Full Committee meetings and International Information Subcommittee meetings continue to be well subscribed, and the dialogue is always interesting. GPS modernization, second civil frequency, interference/problem reporting, and other topics have filled the agendas. I was particularly pleased that the International Information Subcommittee held its first Asia-Pacific meeting in Canberra, Australia, in June; its next meeting is scheduled for December in Warsaw, Poland. The U.S. States and Localities Subcommittee was formed and elected a chairperson at the September full Committee meeting, and the Timing Information Subcommittee continues to actively address the needs of this unique but ubiquitous user group. Through the NIS and CGSIC, civil users needs and voices continue to be heard "loud and clear" by the U. S. service providers of GPS and its augmentations, and indeed, their needs are being addressed.

So, we continue to live and work in interesting times. Radionavigation services and positioning information are increasingly important in the ways we live, work, and play today—and it is really exciting to be working in this field today. It is also very gratifying to realize that the contributions of our community, the radionavigation specialists, are recognized by our users.

Thank you to all the contributors in this edition of the Radionavigation Bulletin—keep up the good work you are doing and keep on reporting it through YOUR Bulletin!

J. T. Doherty
Captain, U.S. Coast Guard
Commanding Officer, USCG Navigation Center

Omega…Omega in the sky.

Ships and planes use you as their eyes.

You've run so long, Your waves held high.

You cover the world in the blink of an eye.

You sing a song like no other.

Your cycle covers places that no other could cover.

Your lattice…out-stretched like the arms of a mother,

helping so many, no matter what weather.

We bid you farewell, so long and goodbye…

and from all the men, past and present,

we salute you and all who have served under your majestic tower,

here at OMSTA LaMoure, North Dakota…

And Just like your song,

We are gone…In the Blink of an eye

Fireman Adam Powers,
OMSTA LaMoure, North Dakota