REQUEST FOR RECORDS DISPOSITION AUTHORITY	LEAVE BLANK (NARA use only)
	JOB NUMBER N1-N2-06-3
To: NATIONAL ARCHIVES & RECORDS ADMINISTRATION 8601 ADELPHI ROAD COLLEGE PARK, MD 20740-6001	Date received 5-3-2006
1 FROM (Agency or establishment) **Department of the Navy**	NOTIFICATION TO AGENCY
2 MAJOR SUBDIVISION **Space and Naval Warfare (SPAWAR)**	In accordance with the provisions of 44 U S C 3303a, the disposition request, including amendments, is approved except for items that may be marked "disposition not approved" or "withdrawn" in column 10
3 MINOR SUBDIVISION **SPAWAR Systems Center**	
4 NAME OF PERSON WITH WHOM TO CONFER **Carl P. Kugel** / 5 TELEPHONE NUMBER **619 553-3066**	DATE 9/13/2006 / ARCHIVIST OF THE UNITED STATES WITHDRAWN

6. AGENCY CERTIFICATION

I hereby certify that I am authorized to act for this agency in matters pertaining to the disposition of its records and that the records proposed for disposal on the attached 7 page(s) are not needed now for the business for this agency or will not be needed after the retention periods specified; and that written concurrence from the General Accounting Office, under the provisions of Title 8 of the GAO Manual for Guidance of Federal Agencies,

☐ is not required; ☐ is attached; or ☐ has been requested.

DATE	SIGNATURE OF AGENCY REPRESENTATIVE	TITLE
4-3-06	Charley Barth	Navy Records Officer

7 ITEM NO	8 DESCRIPTION OF ITEM AND PROPOSED DISPOSITION	9 GRS OR SUPERSEDED JOB CITATION	10 ACTION TAKEN (NARA USE ONLY)
1.	**BACKGROUND** **Starting in the late 1950's, the Navy Electronics Laboratory in San Diego, CA was involved in operating the Omega Navigation System which used Very Low Frequency(VLF) radio signals from time-synchronized world-wide transmitters to provide global navigation coverage for surface, air and undersea usage. Although responsibility for this NAVAID was given to the US Coast Guard in the early 1970's, NEL and it's successor organizations continued to be involved in various aspects of the program until it was phased out in 1997. One major involvement was the acquisition of vast amounts of signal-phase reception data from dozens of world-wide monitoring sites. This data – together with the application of theoretical physics and real-world modeling – led to the development of a computer-based phase prediction model which permitted the Omega System to be used as a NAVAID.** **Data were recorded as continuous tracks on single or multi-track strip chart rolls. Measurements were either the relative phase of 2 remote signals or 1 remote signal and a stable local reference. The bulk of the overall data was obtained at the local monitor**		WITHDRAWN 9/13/2006 cc Agency, NR, NWMD, NWME, NWMW, NWCS, NWCT

sites associated with each of the 8 Omega Stations and typically consists of the phase of 4 remote stations at 3 different frequencies relative to the corresponding stable local transmitter signal. A second large volume of data was obtained at major observatories around the world (NBS, USNAVOBSY, Buenos Aires, Rio De Janeiro) and consists of the phase of various remote signals relative to stable local frequency standards. The remainder of the data was obtained at both short and long-term sites which typically recorded the relative phase of up to 4 pairs of remote stations on 2 frequencies but may also have some single-station measurements versus a local source.

Note that the Omega broadcast format consisted of 8 approximately 1-second segments repeating every 10 seconds. Each station broadcast 4 common frequencies and 4 instances of 1 unique frequency in the 8-segment pattern. At any given time, all stations would be broadcasting on a different frequency with each station being designated by the letters A-H representing the position of their lowest frequency in the 8-segment code. Omega Station data was always for 10.2,13.6 and 11.33 kHz. Observatories used these as well as some unique frequencies plus USNAVOBSY also observed several VLF Communications Stations. Remaining site measurements were usually only at 10.2 and 13.6 kHz.

The actual recorded track represents a time-averaged value of several 1-second samples over a 1 to 5-minute time constant typical of most receivers. Normal chart speed was 1 inch/hour but some Observatories often used 2 to 4 inch/hour values. Phase measurements were made using 1-cycle full scale and a resolution of 0.005 to 0.01 cycle depending upon the physical size of the chart. Observatories often converted phase into time units and used full-scale values of about 75 to 100 microseconds. Although breaking the charts at 1 month intervals was common, there was no actual standardization as to duration or whether charts remained rolled or were folded flat. Single-channel Rustrak charts typically lasted for 1 month so the majority of the miscellaneous sites will have 8 or more of these per month. Multi-track rolls used at Station sites could last up to 3 months but actual durations are not always evident on the outer portion of rolled charts.

Note that some data sites were regularly supplying the central processing sites with hourly extracted readings from the charts but, except for special studies or unusual situations, many charts were never accessed again.

Most smaller chart sizes are still in their original boxes which may contain the only outwardly visible labeling as to the rolls' contents. USNAVOBSY used the boxes to record a complete inventory of chart contents but periodic changes, etc. were so numerous that it was beyond the scope of this effort to translate the box notes to an an overall index for this specific site.

SIGNIFICANCE

The scientific importance of these records cannot be overstated. The workability of the Omega System relied upon the highly repeatable response of the ionized region of the earth's atmosphere to daily and seasonal variations in solar and cosmic ray fluxes acting world-wide. When considering a single-station measurement, the recorded signal phase track represents a history of ionosphere response to terrestrial and extra-terrestrial influences along the entire path from transmitter to receiver. The physical parameter being measured is the variation in signal propagation time along the path and this variation can almost always be related to one or more geophysical conditions or events. Data using 2 remote signals is not so straight-forward but still can be interpreted as being descriptive of one path or the other under some circumstances. Path lengths typically are several mega meters and can exceed half the earth's circumference under favorable propagation conditions.

Specifically, all data can be used to detect both short and long-term solar disturbances, variations in ground conductivity and other geophysical phenomena. Solar disturbance warning services routinely quoted VLF phase deviations as signs of solar x-ray flares and/or polar region particle dumps or aurora. Presently, there is interest in determining if unusual VLF behavior can be related to seismic activity and/or possible prediction. Additional uses may include ionosphere response to global warming and periodic shifts in the earth's magnetic field.

An additional importance of this series of records is that they date from a period before satellite surveillance became commonplace and hence may be one of the few if not the only long-term source of this type of information.

To summarize, these data cost millions of dollars to obtain and are invaluable and irreplaceable.

(For following item descriptions, Disposition instructions are found on final page.)

SSIC 3141

IONOSPHERIC DATA: OMEGA /VERY LOW FREQUENCY NAVIGATION SYSTEMS

1. CONTINUOUS RAW PHASE-DIFFERENCE MEASUREMENTS. Strip chart recordings of the relative phase of 2 Omega Station signals observed at various fixed site monitors distributed worldwide. Generally non-textual records with textual notes.

a. Absolute Phase. Measurements of remote Omega signals relative to a stable local reference signal.

(1) Omega Station Monitors. Typically 2 sets of multi-track recordings of 4 remote stations on 3 frequencies relative to the corresponding stable reference signal from the local transmitter (6-track charts). 8-track charts used in latter years added signal quality information for 1 frequency for up to 4 stations. Chart speed is 1 inch/hour and charts may be 1 to 3-month rolls or folded at 12-hour intervals . Although detailed documentation normally is included on each day, rolled charts vary as to the amount of outwardly visible information available for content identification. Time period covered is generally from 1974 to 1988.

(2) National Observatory and Miscellaneous Sites. Sites possessing highly stable frequency standards typically recorded several Omega signals relative to a local reference at 10.2 and/or 13.6 kHz. The US Naval Observatory also observed Omega unique frequencies and several major VLF Communications stations(GBR,NAA,NSS,NLK, etc.). Charts typically were 1-month rolls but chart speeds varied from 1 to 4 inches/hour and could be single or multi-track recordings. Time period covered is generally as above except that USNABOBSY data extends back to 1966.

b. Relative Phase. Measurements of 2 remote Omega signals which, except in the case of potential mis-tracking due to local-oscillator frequency error, are basically independent of the local monitoring arrangement. The majority of these recordings were made at the approximately 2-dozen miscellaneous sites installed throughout the world for varying periods. Many sites were installed specifically to support the Omega System Validation efforts of 1977 to 1987 and may have been active for only a few years. Recordings typically were made on 2-inch wide single-track charts and included up to 6 different stations as 4 pairs on 10.2 and 13.6 kHz. Chart speed was

1 inch/hour and charts could be rolled(most in labeled boxes) or folded flat at 6 to 12-hour intervals. Time period generally covers 1973-1987 but may be less than 1 year at some sites.

2. PERIODIC RAW PHASE-DIFFERENCE MEASUREMENTS. Standard computer text files of hourly extracted phase measurements. Starting in the late 1980's, automated receivers and analog tape-cassette recording systems replaced the older monitoring systems at most sites. Although stripcharts still were maintained at the main Station monitors, sites were no longer required to forward them to a central processing site but instead provided hourly extracted readings on tape. These raw tapes were reformatted from the original 7-line teletype format to a readable columnar version, sorted into monthly blocks and stored on Compact Disk as ASCII text files. All data is for 10.2,11.33 and 13.6 kHz and consist of 7 remote and 1 locally injected antenna calibration signals per frequency all relative to the receiver internal oscillator. Signal quality numbers roughly equivalent to a -40 to +40 Signal-to-Noise Ratio also were recorded.

a. Omega Station Monitors. Reformatting included the subtraction of the local transmitter signal from all remote channels to produce the same Absolute Phase data as in (1a) above.

b. Miscellaneous Sites. Similar to (a) above except that there was no inherently stable local signal and all data was left for the user to combine into specific pairs as desired. For sites that may have been using a stable frequency standard as the local oscillator, data represents the Absolute Phase Variation for remote stations. Time period covered by both (a) and (b) generally is from 1989 to 1997 with the Omega Station Monitor data being the most continuous.

3. PROCESSED PHASE/AMPLITUDE/SNR DATA SUMMARIES. Published or unpublished textual summaries that typically display one or more of the following:

a. 24-hour by 31-day tabulations of observed readings-possibly flagged for the occurrence of ionospheric disturbances,outages,etc.-and various statistics for hourly, day, night or overall behavior.

b. 24-hour plots of weekly, bi-weekly or monthly average behavior plus predicted values when available and appropriate.

Summaries available throughout 1966-1997 period.

4. OMEGA VALIDATION DATA FILES and/or PLOTS. For the years 1977-1990, various forms of Omega signal amplitude data were collected at numerous ground sites and aboard in-flight aircraft throughout the oceanic areas of the world.

a. Signal Amplitude vs. Time and Distance for approximately 200 aircraft flights during the 8 Validation periods. Since most flights were designed to approximate radials to or from one or more transmitters of interest, the data represent an approximate 'snapshot' of the ionosphere during the flight periods. In many cases, multiple frequencies were available from several stations on each flight.

b. Statistical Summary Plots of weekly amplitude behavior at several ground monitors already in or specifically set up for each Validation. These normally include 10.2 and 13.6 kHz and also 11.33 kHz for the later years.

c. Computer Data Files for all data types including Omega/INS/GPS navigation comparisons for the tests of 1986-7.

d. Flight Itineraries and Course Maps

5. SPECIAL TEST DATA.

a. Mostly non-textual records from various tests to investigate near-field behavior, underwater reception and the precise time-dissemination capabilities of Omega, and absolute phase stability of VLF Communications Stations in the arctic.

b. Various published and/or non-published documents related to miscellaneous tests and including data plots or summaries similar to those described in 1 to 4 above.

DISPOSITION. All records to be considered Permanent and intended for immediate transfer to NARA.

Note: Non textural records comprise 95% of total material and amount to approximately 150 to 175 cubic feet. Textural records are about 10 cubic feet.