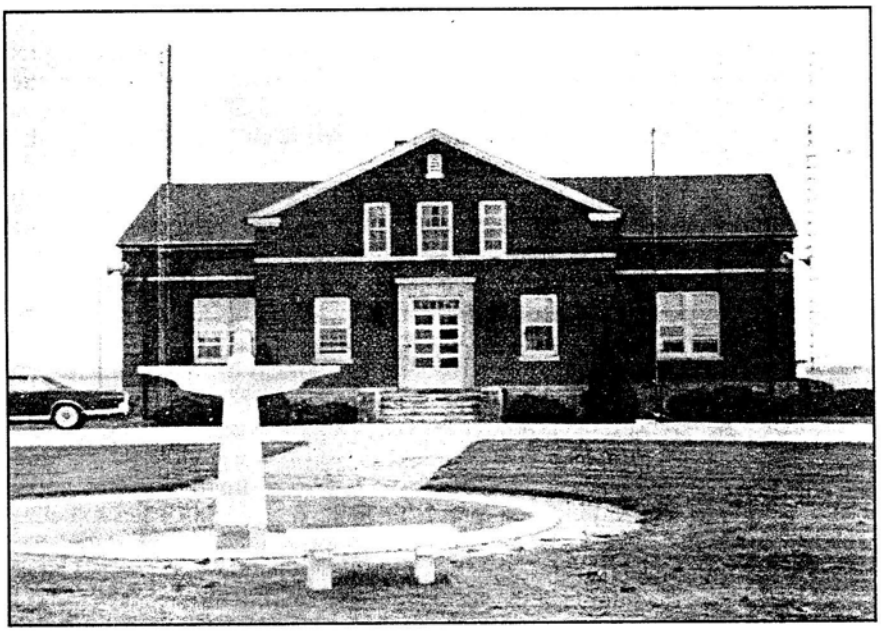
An Historical Sketch of the Grand Island Monitoring Station

by John McKinney, WØAP, Engineer in Charge 1968-1978
P.O. Box 186
Dannebrog, NE 68831



Grand Island Monitoring Station in 1970.

Two old-timers in radio certain place names stood out: Arlington, Virginia; Chatham, Massachusetts; Rocky Point, Long Island; Bolinas, California; Grand Island, Nebraska. These were locations for powerful transmitting facilities; all but the latter which was known for its unique ability to receive radio signals, much to the chagrin of commercial and amateur operators alike. The establishment, in 1929, by the Radio Division of the US Department of Commerce, of its first radio monitoring station was soon to spread the name of Grand Island, Nebraska around the globe.

The phenomenal growth of radio broadcasting (AM radio), from its inception in a Pittsburgh, Pennsylvania basement (1921 - KDKA) was cause for concern in the regulatory agency and the new industry itself. New stations, licensed and unlicensed, were springing up almost daily and if order was to be preserved it was conceded that a monitoring facility was needed. Although the growth of broadcasting was no doubt responsible for the construction of the Grand Island Monitoring Station and the choice of a location in the approximate center of the United States, the regulatory functions of the establishment encompassed all radio licensees. There were comparatively few radio services prior to 1930, the primary users being ships and coastal stations, point to point telegraph, AM broadcasting and radio amateurs, with the amateurs far outnumbering other facilities. Police and aviation radio were in their infancy and the principal means of radio communication was telegraph. Low and medium frequencies (10-3,000 kHz) were widely used and the short waves (200 meters or less) were relegated to the amateurs for whatever use they might make of them. The heart of the new monitoring station was to be a Primary Standard of Frequency, a means whereby engineers at the station could measure the frequency of received signals to determine the compliance of licensees with their frequency assignments. Prior to this time frequency measurements were made at the transmitter site, usually with a calibrated wavemeter or decrameter. Such a system had its drawbacks and a search was made for a suitable means of "off-the-air" measurements of frequency. First consideration was the purchase of equipment utilizing an oscillating pendulum. Such a device was under study by the Westinghouse Electric and Manufacturing Company and consideration for purchase was made. In a letter to Mr. S.W. Edwards, U.S. Supervisor of Radio, Detroit, Michigan dated May 10, 1928, U.S. Radio Inspector James C. McNary wrote of his visit to the plant:

"We found the primary standard apparatus much the same as it was on a visit to the E. Pittsburgh works a month or so ago. The system apparently has not changed. The system, as will be recalled, consists of an electronically driven pendulum which is supposed to control a 5000 cycle tuning fork. The driving amplifier of the tuning fork is supposed to furnish power for the harmonic amplifiers of the frequency multiplying system which in turn is used in the actual measurement of the received signals."

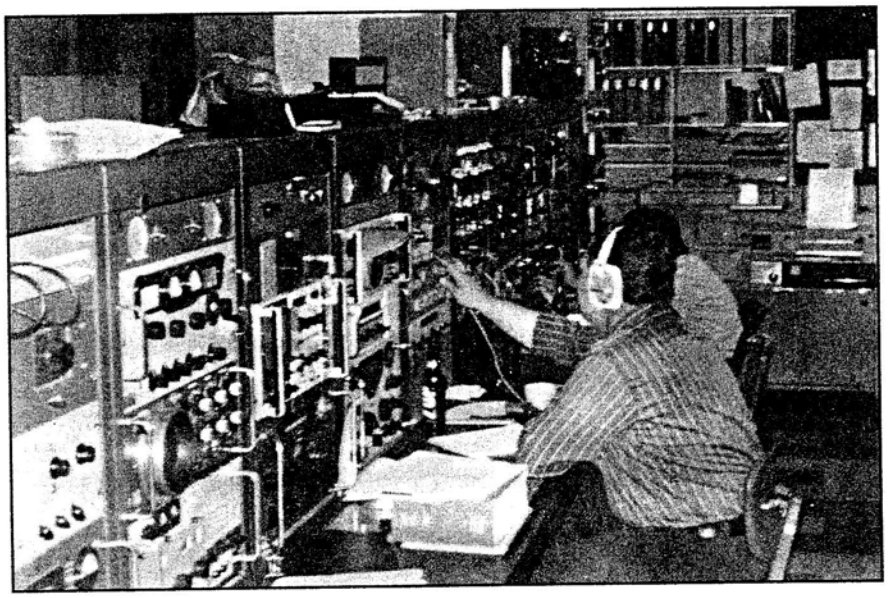
Mr. McNary goes on to describe the apparatus, pointing out alleged discrepancies in the accuracy of the system and its unsuitability for use by the government.

By way of explanation the described apparatus was to drive a clock which was to be compared daily with Naval Observatory time signals and corrected to produce an accuracy of measurement of one part in 200,000 (an accuracy of 5 cyclesat 1000 kilocycles (kHZ). Considering the broadcast tolerance of + or- 50 cycles (Hertz) then in effect this was considered sufficient accuracy. The contract to purchase the pendulum standard was abandoned due to the inability of the contractor to satisfy all requirements but not before a large concrete pedestal for the machine had been poured in the basement of the new monitoring station. It stands there today, never used.

About this same time, Westinghouse was busily engaged in design of a quartz crystal frequency standard and a contract was awarded for purchase of two such standards. These were massive devices and with their associated equipment occupied hundreds of square feet of floor space in the building. Powered by batteries charged by motor generator sets, these standards continued to function and provide accurate measurement standards at this station until the mid 1950's when they were finally discarded in favor of smaller units with slightly better accuracy. The instruction book (2 inches thick) for one of the Westinghouse standards begins as follows:

Station Description

"The location for the Central Frequency Monitoring Station was chosen at Grand Island, Nebraska after an extensive search had indicated the flat prairie regions of central Nebraska to be most suitable. It is situated approximately 6 miles from Grand Island, Nebraska and about one-half mile north of the Lincoln Highway. Telephone, telegraph and power sup-



Two engineers at work inside the station.

ply are brought into the station through a half mile of underground lead covered cable. Figure 1 is an exterior view of the buildings. From left to right we see the building housing the diesel engines for the emergency power supply and the garage. Next we have the main station building and to the right of this a line of poles supporting RF transmission lines. The airways beacon tower appears at the right of the picture. This tower supports a rotating red beacon and a fixed white beacon points to the nearest airport. Figure 2 is an interior view of the main operating room showing three of the receivers. The two on the left are for intermediate frequency bands and the one to the right is used for low frequency reception. Figure 3 is another interior view of the main operating room showing one high and one intermediate frequency receiver in the foreground. To the left of the high frequency receiver is located the main standard cabinet and on either side of this are the screened rooms. The left one houses the measuring equipment and the one to the right contains the timing equipment.

Most of the antennas for short wave reception are directional and are located away from the receivers, in some cases as far as 800 feet, with transmission line lead-ins. One array receives from east or west and another from the south. For long wave reception, two large loops have been set up, at right angles, crossing at the center. A goniometer arrangement in connection with a single wire antenna permits unidirectional reception over 360 degrees. Other antennas of the half wave, single doublet type provide for reception of the intermediate wave lengths constituting the balance of the band covered."

What better description of the first monitoring station could be found! We are truly indebted to the author of this instruction book for leaving us with this picture. Speaking of pictures, the book is profusely illustrated with photographs of the equipment and its placement in our building, the instructions having been compiled after installation was competed.

The Federal Radio Commission Era

Full scale operation of the station began in 1932. No record of the first citation (Official Notice of Violation) is available but it was probably mailed out in July of 1932 and countersigned by Benjamin Wolf "Manager". (This title has since been changed to "Engineer in Charge".)

Records on hand show the names, addresses and positions of all personnel ever employed at this facility. The July 21, 1932 roster lists eighteen employees plus one Westinghouse Engineer, a Mr. S.G. Ellis, probably putting the finishing touches on the new frequency standard installation. Curiously there are three diesel engineers listed. These can be explained by the fact that originally this station was equipped to generate its own power, there being no commercial power available. This was corrected in 1932 and the diesel plants relegated to stand-by use. By comparison, the August 1933 roster lists but ten persons including but one diesel engineer/custodian, a Mr. Lewis S. Anderson who remained with us until the 1950's when he retired. The complement of ten persons remained unchanged throughout the thirties except for replacements and transfers. By 1940, five of the original employees were still at the station, being Benjamin Wolf, Manager; George Jensen, Radio Inspector; Maxine Grey, Clerk; Lewis Anderson, Diesel Engineer and George Harr, Janitor.

The Communications Act of 1934 saw the birth of the Federal Communications Commission and an expansion of the powers of the regulatory agency. The high frequencies (short wave) were now in full use with new radio services being established and licensed each year. The VHF (very high frequency) spectrum was put to use first by the amateurs and then by a myriad of mobile services such as Public Safety, Industrial and Land Transportation.

A major project carried out at Grand Island and at a few other select locations and one that lasted for some 20 years was the study of the effect of sunspots on radio propagation. For this purpose a recorder house with numerous receivers and ink-line recorders was located on the property. Tuned to selected clear-channel broadcast stations throughout the United States these instruments recorded the received field strength of these stations year after year. Analysis of the charts from the various receiving locations enabled the Commission and the National Bureau of Standards to predict propagation characteristics of radio signals. Engineers of the station were required to service and calibrate this equipment several times each day and to extract the data from the completed charts and submit in tabular form to Headquarters.

At a later point, with the advent of early television and FM broadcasting a similar project was set up to record the field intensity of distant FM and TV broadcasters. The data so obtained was utilized by the Commission to prepare the present tables of channel assignments for these services. By having empirical knowledge of VHF propagation it was possible to provide geographical spacing of co-channel and adjacent channel assignments for maximum spectrum utilization with minimum mutual interference between stations. In the late forties and early fifties these projects overlapped for several years.

The War Years

In 1939 Congress passed the National Defense Act and the complexion of the monitoring station began a change. By this time additional monitoring stations were already in operation or rapidly being constructed across the nation. Stations came into being at Millis, Massachusetts; Marietta, Georgia; Laurel, Maryland; Allegan, Michigan; Kingsville, Texas; Santa Ana, California; San Leandro, California and Portland, Oregon to

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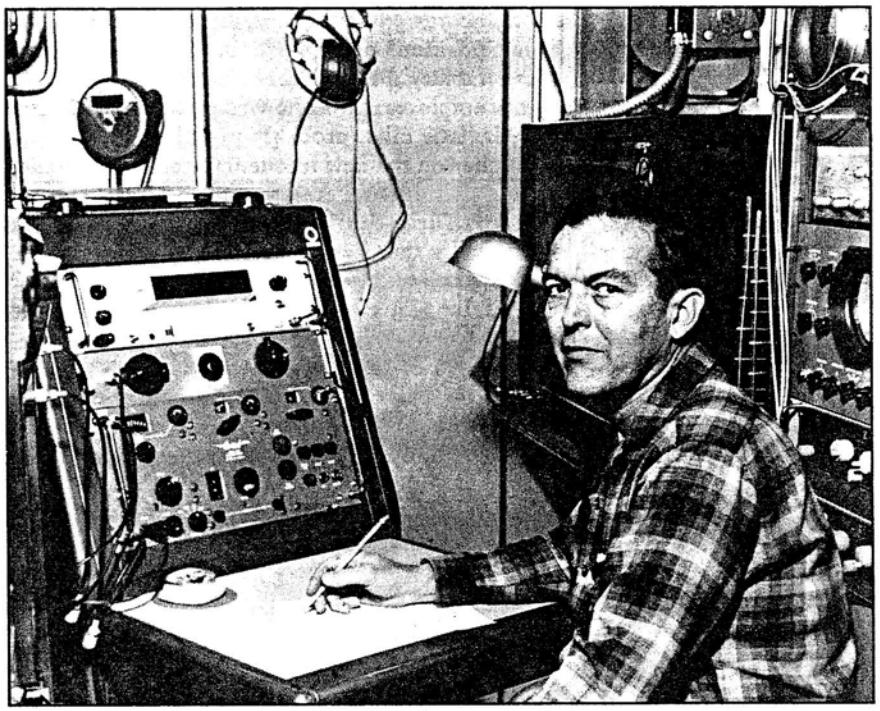


The author inside a mobile TV monitoring unit he designed and operated.

name a few. From these, and others designated as primary monitoring stations, crews were sent out to establish small secondary stations in rented buildings and farm houses. The chief difference between a primary and secondary station was the size of the installation and the staff necessary to operate it. Primary stations were equipped with long range high frequency direction finders, whereas the secondary stations had loop DF's in mobile units for close-in direction finding.

As our entrance into World War II became imminent, recruitment of personnel to man the newly formed network of radio monitoring stations began. Announcements of Radio Operator and Monitoring Officer positions appeared in radio trade journals and amateur publications. Applicants were required to have an entrance code speed of 25 WPM, preferably with commercial as well as amateur radio operator's licenses. Training centers were set up at the primary monitoring stations with Grand Island in the forefront. Key personnel from the "Routine" division of the FCC staff were elevated to supervisory position sin the NDO (National Defense Operations) and in 1940 alone 84 trainees arrived at Grand Island in four different classes spaced about 3 months apart. After a training period of from 3 to 4 months most of these were transfered to other locations. In all, 247 persons received training here by July 1, 1946 when the Radio Intelligence Division (formerly NDO) was again merged with the Field Division.

Through the war there were two distinct operations at the monitoring station. The Field Division personnel, known as "Routine", continued in their role of routine enforcement and the newly-formed and much larger Radio Intelligence Division surveyed the spectrum for clandestine and espionage activities. For this operation equipment facilities were greatly expanded and operational techniques devised that made it virtually impossible for any radio transmission to go undetected for even a short period of time. By wars end the RID had handled and solved nearly 200 cases of radio espionage or suspected espionage activity.

In 1941 acquisition of an additional 80 acres of land opposite the front of the station property provided space for nine new rhombic antennas arranged in a semicircle and spaced 20 degrees apart. Eighteen transmission lines supported on H frames crossed the front lawn to the main building. These rhombics were the "ears" of the RID.

An experimental Adcock type high frequency direction finder was fabricated in 1939, the first of many to follow. Resembling a small plywood shack on stilts with a hand-wheel rotated pipe boom supporting two vertical shortened dipoles the original affair was crude by today's standards but provided remarkable results. All equipment in the Adcock was self-maintained including batteries for receiver power. When it was necessary to take a bearing on a signal the operator ran to the structure, located in the center of a clear area, climbed a ladder, tuned in the signal and rotated the hand wheel to obtain his bearing.

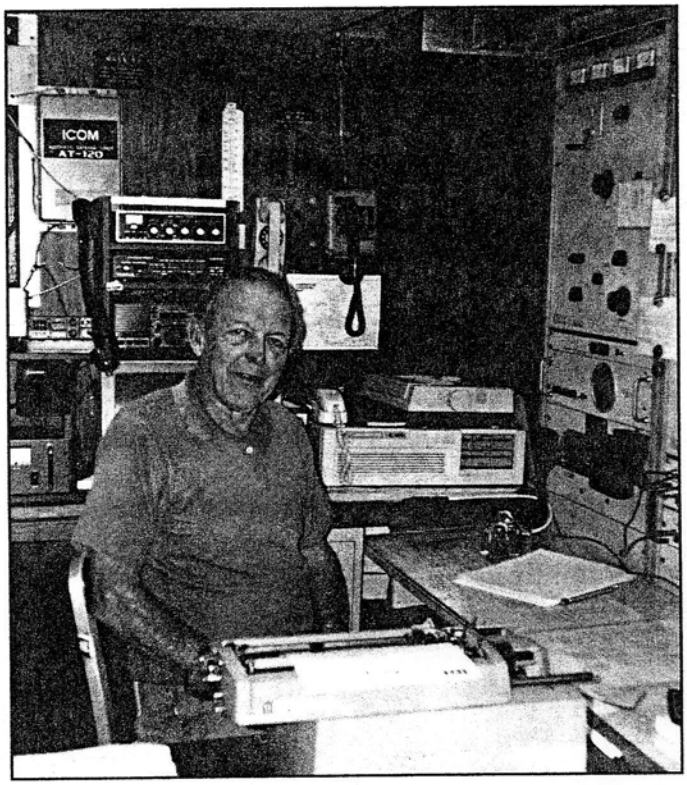
A more sophisticated but still manually operated model dubbed the Type A Adcock followed. On busy watches these were manned full time and a VHF transceiver employed for a talk line to the station. The next step was the Type B. This was a Type A modified for remote control by means of a prop-pitch motor and magnetic clutch arrangement. By this time power had been brought into the Adcock building and battery operation eliminated. This improvement came after the war. Later improvements led to the Type C, still in use and the Wullenwebber DF, a different concept in direction finding.

Communications

Until the advent of World War II there was little need for a system of rapid communications between Commission offices. With the growth of the monitoring system and the introduction of direction finding facilities a means was required for coordinating operations and transmitting bearings to a plotting center for triangulation. Message traffic was handled between Washington and the primary monitoring stations by TWX. This took care of volume traffic but was unsuited for rapid exchange of information. RID established a CW network between all of its offices and monitoring stations. Using tactical call letters, a wide range of frequency assignments and encoded alert procedures, monitoring personnel manned what was probably the most elaborate radiotelegraph network ever assembled. Net control facilities were located at Laurel, Maryland and San Leandro, California, handling the European War or Pacific War traffic separately or jointly as the needs demanded. By this time monitoring stations had been set up in the Hawaiian Islands, Alaska, and Puerto Rico.

By war's end a leased private line Teletype circuit (land line) connected the primary stations with monitoring control in Washington, DC and the radio circuits extended this facility to the secondary stations as well as providing for back up in case of line failure.

With the closing of the secondary stations after the war the remaining stations were all connected by private line Teletype (PLT) and the radio facilities used solely for standby purposes, except for extension of communications to overseas points. Grand Island was designated as the new net control facility. Soon the use of CW was abandoned in favor of radio Teletype and all stations so equipped. At the present time GI



In 1989, at the age of 71, the author went back to sea as a radio operator.

maintains the radio Teletype communications between our overseas stations and monitoring control and provides a center for emergency RTTY communications between all stations in the event of line failure.

Post War Era

As previously stated 1946 saw the merger of the Radio Intelligence and the Field Division. Personnel with career aspirations and potential were absorbed by the various field offices and remaining monitoring stations, others left for private industry or more lucrative fields. Hiring was at a standstill until early in the fifties. Surveillance type monitoring persisted throughout the "cold war" but a gradual transition to enforcement monitoring took form.

Mr. Wolf retired in 1947 and was replaced by Arthur A. Johnson, a veteran FCC engineer with expertise in DF location and construction. Mr. Johnson served as Engineer in Charge for 20 years, retiring in 1967.

The post-war years created a new dimension for our direction finding network: the locating of ships and planes in distress. As most craft were then equipped with high frequency transmitting apparatus it followed that the FCC network was in a position to fix the location of lost aircraft and vessels. The peak of such assistance was probably reached in the early 1950's when as many as 3 or 4 such assists might occur in a week's time. With the transition to VHF communications and the introduction of sophisticated electronic navigation devices the need for FCC assistance declined but on occasion we render such assistance today.

Balloon Tracking

An interesting project involving our DF network took place in the 1950's. In cooperation with other governmental agencies the Field Engineering Bureau contracted to provide "location fixes" on high altitude free floating balloons. These balloons, measuring a hundred or more feet in diameter, were being launched from various points in the country in a study of the high altitude air currents (jet streams). Each balloon carried a small radio transmitter that transmitted temperature and altitude information in coded data form. Constant tracking of the course of the balloon and copying of the code groups was accomplished by our organization. Many of these craft traveled in excess of 100 MPH and from coast to coast. The retrieval of the "package" at the end of flight was of utmost importance and when the balloon was "shot down" by a command radio signal our fixes became increasingly important.

Mobile Monitoring

The post-war era saw a boom in VHF/UHF frequency usage. In the broadcast field TV and FM were new words on everyone's lips. Aviation and marine radio moved, at least in part, to the very high frequencies. Virtually every taxicab in America acquired a radio. Police, contractors, veterinarians, railroads, telephone companies and hosts of others were assigned portions of the VHF/UHF spectrum. Due to the limited range of the higher frequencies a new approach to monitoring enforcement took place.

As a preliminary program the FCC began operation of a mobile TV-FM enforcement vehicle. The first such vehicle was based at Laurel, Maryland at the Commission's laboratory. When a second vehicle was added it went to the west coast. The third such vehicle operated from Grand Island. Equipped to make the many engineering measurements required for enforcement of the TV and FM regulations these vehicles travel thousands of miles each year monitoring and inspecting the television and FM broadcast stations in their area.

A similar approach was initiated for monitoring the mobile VHF/UHF services. First underway in the mid 1960's the program has expanded to the present day. Due to the overwhelming numbers of licensees in the VHF services the major portion of our work is now devoted toward this end. Grand Island has two such mobile monitoring vans covering a ten-state area comprising roughly one fourth of the contiguous 48 states.

A third type of mobile monitoring is conducted from here - microwave monitoring. A vehicle equipped with receivers, dish-type antennas and spectrum analysis equipment covers an eight-state area driving from microwave tower to microwave tower measuring frequencies, bandwidth and making base line analysis of microwave systems.

Due to its unique geographical location in the center of the US one of the first Citizen Band enforcement units was established in Grand Island in 1973. From here a team of specially trained engineers in DF equipped vehicles travel throughout mid-America tracking down violators of the Citizen Band rules and locating unlicensed operators.

Conclusion

The present area of the Grand Island station comprises 200 acres of land, 160 acres dedicated to monitoring purposes and 40 acres used for antennas and buildings for the transmitting complex (RTTY). Buildings are essentially the same as originally planned with the addition of a transmitter house and an office building for the Special Enforcement Facility (CB). Total staffing is about 18 persons as follows: 8 engineers, 6 technicians, 3 clerical and 1 custodial.

On January 16, 1973 the Grand Island Monitoring Station was entered in the National Register of Historic Places, the first FCC property so designated and indeed a distinct honor.

It will close down in June, 1996. WØAP