THE IMPORTANCE OF EDUCATING THE PUBLIC REGARDING NOAA WEATHER RADIO RECEPTION AND PLACEMENT WITHIN A STRUCTURE

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Abstract

The recent expansion of NOAA Weather Radio (NWR) transmitter locations across the U.S. has resulted in increased NWR signal coverage to previously unserved areas. A recent study completed by the Division of Florida Emergency Management is discussed with suggestions to improve NWR reception in homes and buildings. The signal reception tests were completed for a manufactured home and a home built with metal wall studs with reception results presented. This paper shows that a recently developed external antenna developed from the test results will effectively improve NWR reception in metal buildings and manufactured homes. The importance of effectively educating the public involving correct NWR placement and the use of an external antenna are discussed. It is hoped that the results from this study will aid in the proper public education regarding NWR placement in homes and metal buildings.

1. Introduction

Following the 27 March 1994 Palm Sunday tornado outbreak in the southeast U.S., (NOAA 1994), Vice President Gore developed an initiative to expand NOAA Weather Radio (NWR) coverage to a goal of 95 percent of the population. As a result of the media and local community interest following this tornado outbreak, around 30 NWR new transmitter sites have been implemented across the southeast U.S. The majority of the new transmitter sites were cooperative type projects that were funded by local and state governments and grant money. The increased use of weather radios resulting from these additional transmitters revealed signal reception problems, especially in mobile home parks and metal structures. This paper will highlight recent tests involving NWR signal strength in metal buildings and mobile homes, and suggest methods to improve broadcast availability in these areas. It also highlights new NWR public education efforts aimed at increasing awareness of reception problems and appropriate corrective measures.

2. NWR Signal Attenuation Factors

The acceptable NWR receiver reception standard is five microvolts. This level of reception is needed to ensure automatic activation of the receiver upon receipt of a 1050 Hz tone or valid NWR-SAME-coded message. From an engineering perspective, regardless of how strong a NWR transmitter signal may be, any one of the following types of interference may block its reception in a given residence or commercial building (Kandell 2000):

- Reflection of the signal off of the building's structural elements, causing out-of-phase multipath signal cancellation.
- Signal interference from a secondary radiating source, such as cable TV or electrical service to the building.
- Signal blockage due to the construction features, such as metal wall studs, metallic sunscreen tinting on windows and the receiver location with respect to those features.
- Distance and topographical (line-of-sight) limitations from NWR transmitters.

a. Conventional-home NWR signal test

In order to verify that signal attenuation (reduction in strength) might be caused by home construction, two series of tests were recently completed by the Florida Division of Emergency Management on the basis of several complaints received from residents in the state. One test examined NWR reception in a home, the second in a mobile home. Measurements were taken with a calibrated Motorola Model R-2600 service monitor, an IC-8500 receiver used for the project field radial measurements, and a Radio Shack 12-249 NWR receiver.

The first series of tests were completed in the Broward County community of Coral Springs, Florida, near the home where reception complaints had originated. The home was located 21 miles from the 1000 watt Miami NWR transmitter site, well within the NWR coverage area. The initial step was to monitor the Miami NWR transmitter site to determine the signal strength in the immediate vicinity of that residence. The tests were completed mainly during the afternoon hours, and in all cases, the signal was found to be strong (greater than 5 microvolts), with no evidence of fading or blockage.

Evaluators from the Florida Division of Emergency Management visited the 4,500-square foot residence and found similar sized homes nearby. No unusual structures existed in the neighborhood which would cause local blockage of the NWR signal to the home. It was discovered that the weather radio used at the residence was mounted on a patio wall close to the home's swimming pool. Findings from the site's signal test indicated that the NWR signal was lost directly under the radio's location. The signal reappeared at 5 microvolts approximately six inches on either side of the location of the NWR. As the signal test continued in either direction, 16 inches right or left of the radio, the signal was again lost.

It was concluded from the signal test that metal wall studs grounded through the home's construction design likely blocked the entire signal to the NWR receiver. The homeowner had actually solved his reception problem in the time since he filed the complaint with the National Weather Service by attaching a marine-type mobile whip antenna to the external antenna port of the NWR and mounted it outside on top of the metal screen enclosure surrounding the swimming pool. This test demonstrates how microenvironments within a structure can drastically affect NWR reception.

b. Manufactured-home NWR signal test

Because a large segment of the Florida population lives in manufactured or "mobile" homes, Florida's Division of Emergency Management completed a second NWR signal test to determine what type of signal reception a NWR receiver exhibited inside a manufactured home with aluminum or vinyl siding. Kandel (2000) indicated that a geometric structure built of solid metal or metal mesh and attached to the ground, has the ability to block almost all radio signals from penetrating the structure. This is known as a "Faraday shield." Electronics manufacturing firms use Faraday shields, called screen rooms, to adjust sensitive communications equipment, thereby, eliminating interference from outside electrical sources. A manufactured home with aluminum siding will contain many of the physical characteristics of a Faraday shield, with the exception of windows and flooring. This type of shield may limit a NWR receiver from receiving an accurate signal, especially if the receiver is improperly placed in a manufactured home.

This second series of signal tests were performed in Palm Beach County's Lake Worth Village mobile-home park. The home selected for the test was a single-wide unit, with aluminum siding and an attached patio/carport. It was located only 9.9 miles southwest of the West Palm Beach NWR transmitter, well within this 500 watt transmitter's service area. Signal tests were completed inside the manufactured home, outside the home in close proximity to the structure on all four sides of the structure, and away from the structure on the adjoining road.

Inside the home, measurements with the Radio Shack NWR receiver were taken along and near outside walls containing two windows separated by 36 inches and near and along interior walls. Signal levels in and near the home are shown in Table 1.

Table 1. Signal strength in various locations in and near mobile home tested.

Location of Receiver/Antenna	Signal Strength (microvolts)
1. Outside of Mobile Home	
a. on road adjacent to mobile home	60-65
b. more than 6" away from outer wall	60-65
c. less than 6" from outer wall, 16" off ground	2 (noisy)
2. Inside Mobile Home	
a. more than 6" near/along outer wall	2-5
b. less than 6" from outer wall	2.5
c. Attached prototype J-Pole external antenna hanging in window	5-8

These tests demonstrated that the manufactured home is indeed a strong attenuator of the NWR radio signal, especially when the NWR receiver is mounted on a wall and when a built-in telescoping antenna is in close proximity to the wall. The test results were found to be very similar to the Coral Springs test that was completed in the home with metal wall studs. This second test also importantly showed that when the NWR receiver was placed near the wall between the two windows and about five feet above the floor, the signal was completely blocked. Complete signal blockage also occurred inside the home when the radio was placed on the floor and the pull-up antenna was on a wall next to the home's main service line. In this situation, a 2.5 microvolt noise level (possibly 60-cycle hum) was indicated. This noise completely prevented any NWR signal from reaching the receiver. However, a very strong signal occurred when the J-Pole antenna was plugged into the NWR receiver and hung in the window only eighteen inches away from the NWR receiver.

3. User Training

Since the acceptable NWR receiver reception sensitivity standard is 5 microvolts, the manufactured home owner must be carefully instructed as to the placement of the NWR receiver. To ensure that the NWR signal can be adequately received, it is recommended that an external antenna, described in section 2b, be hung in a window, preferably facing the direction of the local NWR transmitter site. Public education and user training is crucial to the successful use of NWRs by the general public. A tri-fold pamphlet that explains the pitfalls of improper location and installation of NWRs is being developed by the Florida Division of Emergency Management for distribution across the state.

4. Prototype External Antenna

Based upon the field test findings from Florida's Division of Emergency Management, an external auxiliary antenna was used to determine if NWR coverage at a location could be improved. This particular example of an external antenna (Fig. 1) was developed by MTS electronics from Raleigh-Durham, North Carolina. The

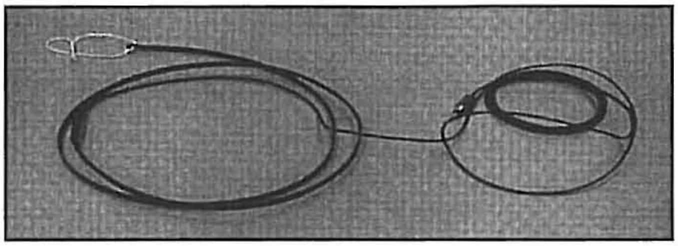

Fig. 1. Photograph of a J-Pole antenna for use in mobile homes and metal structures to increase NWR signal reception.

antenna was designed with both effectiveness and expense in mind. The end result is a 3 dB gain, inexpensive, flexible, light-weight antenna, which can be hung in a window location in an inconspicuous manner to greatly improve NWR signal reception. The external antenna is expected to be distributed to 12,000 schools, businesses and other government agencies as part of the FWIN (Florida Warning and Information Network) project to ensure that these locations receive a reliable NWR signal (Hagan 1999). A tri-fold pamphlet (not shown), is being developed by the NWS and Florida Division of Emergency Management to accompany the external antenna distribution in Florida. Plans are for this tri-fold pamphlet to be distributed by NWR manufacturers within the packaging that accompanies each NWR receiver.

5. Conclusion

Tests involving NWR were completed in response to complaints from the public regarding limited NWR reception in Florida. Results from these tests completed by the Florida Division of Emergency Management showed that the NWR signal was being attenuated by metal used in the construction of the buildings and homes in question. Signal attenuation tests identified locations within the structures where the greatest amount of attenuation occurred (and where lesser attenuation was experienced). The tests further showed that using a simple J-pole external antenna mounted on a window alleviated the attenuation problem. It is hoped that this study's preliminary results will alert the public, emergency managers, and other local officials to the potential for poor NWR reception in mobile homes and metal buildings, as well as what corrective measures to take. The use of lightweight external antennas and the correct placement of NWRs should be stressed during NWS outreach activities and public education efforts. Obviously it is very important for residents to purchase a NWR, but they must be educated about proper unit placement and antenna availability. These education efforts should inform customers, reduce complaints regarding NWR reception, and increase public safety.

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