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NOAA Weather Radio (NWR) – A Coastal Solution to Tsunami Alert and Notification

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Abstract. The Washington State/Local Tsunami Work Group adopted the NOAA Weather Radio "All-Hazards" Warning System to warn citizens quickly and effectively of not only tsunami hazards but also other natural or man-made hazards. In concert with an array of deep ocean tsunami detectors, land-based seismic sensors, and warning messages issued by the tsunami warning centers, NWR provides a means to expeditiously get critical decision-making information to emergency managers, elected officials, and first responders. To implement the NWR strategy effectively, a partnership was developed to add a repeater to the NWR system to provide complete coverage to the coast of Washington and to shipping lanes off the coast. The Work Group also recognized the need to disseminate time critical hazard information on tsunamis to the public on beaches and in high traffic areas, so it developed a new notification system, with the first prototype installed on 2 July 2003 in Ocean Shores, Washington. A public education program also was developed to improve the impacted communities' understanding of the tsunami hazard, the warning system, and actions they should take if a tsunami occurs.

Key words: NOAA Weather Radio, NOAA Weather Radio "All-Hazard" Warning System, NWR Emergency Information Network, All Hazard Alert Broadcasting Radio, Tsunami Warning Messages

Abbreviations: AHAB Radio – All-Hazard Alert Broadcasting Radio, EAS – Emergency Alert System, EOC – State Emergency Operation Centers, NAWAS – National Warning System, NWWS – NOAA Weather Wire Service

1. Introduction

This paper documents development of a tsunami alert and notification system that is integrated into NOAA Weather Radio's "All-Hazards" Warning System. This system minimizes the potential for erroneous information that may be disseminated to the public through other methods by broadcasting watch and warning information directly from the source. It supplements the communities' communications infrastructure by quickly notifying residents and visitors of the impending tsunami, and warning them to take immediate action to head inland and to higher ground.

2. State/Local Tsunami Work Group

The key ingredient of the Washington State Tsunami Program is the State/Local Tsunami Work Group, composed of representatives from coastal communities, and state and federal agencies. This multi-disciplinary group meets quarterly and invites people from various disciplines to discuss tsunami issues and projects. Using hazard assessment, warning guidance, and mitigation tools developed by the National Tsunami Hazard Mitigation Program, the Work Group developed a mitigation strategy based on needs assessments of individual communities. This process allowed the communities to "buy into" the tsunami program and led to rapid implementation of mitigation and preparedness tools. The Work Group realized that injury and loss of life could be minimized if coastal populations are warned early enough to take appropriate action from an approaching tsunami. In response, local leadership decided to use NOAA Weather Radio as the primary means of alert and notification for communities vulnerable to tsunamis.

3. Warning Guidance Delivery Systems

The National Tsunami Hazard Mitigation Program (NTHMP) works to ensure tsunami warning information is as accurate as possible using real-time data through two systems: deep ocean tsunami detection tsunameters and a NTHMP seismic network. (See papers in this issue by Frank González and David Oppenheimer for more details.) Real-time data provides the West Coast/Alaska and Pacific Tsunami Warning Centers with quick and reliable information to determine whether a seismic event has generated a tsunami. If the event is tsunamigenic, the information is sent to decision-makers. Figure 1 shows the tsunami warning/evacuation communications cycle that quickly provides data to help decision makers understand the scope and complexity of the impending tsunami threat and allow them to make sound decisions to reduce the impact of that threat.

4. NWR Emergency Information Network

The State/Local Tsunami Work Group developed a program to supplement the communities' communications infrastructure to improve local access to emergency information. The Work Group established an "Emergency Information Network" Program that installed NOAA Weather Radio receivers at designated Emergency Information Centers, including visitors centers, hotels and motels, marinas, parks, gas stations, and grocery stores. NWR placards (Figure 2) have been visibly posted at those sites and explanatory brochures

distributed through local Chambers of Commerce. Additionally, local emergency managers have encouraged residents to purchase NOAA Weather Radio receivers for their homes, cars, and outdoor activities.

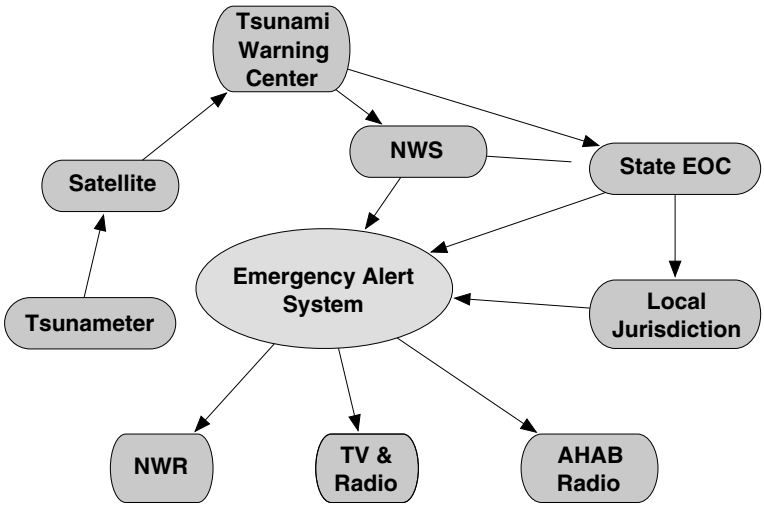

Figure 1. Tsunami Warning/Evacuation Communications Cycle that interfaces with tsunameters, the Tsunami Warning Centers, National Weather Service, and State Communication Systems.

Figure 2. Window sticker that identifies locations with a NOAA Weather Radio receiver.

5. NOAA Weather Radio

The State/Local Tsunami Workgroup supports use of NOAA Weather Radio as an effective and primary all-hazard alert and notification system in tsunami-threatened coastal communities. Inexpensive weather radio receivers can warn listeners about a hazard before the mass media and county alerting systems can do so, giving people additional time to react before danger hits their area. (See paper in this issue by Mark Darienzo *et al.* for more details.)

5.1. MOUNT OCTOPUS WEATHER RADIO TRANSMITTER PROJECT

To effectively implement the NOAA Weather Radio Emergency Information Network Program and placing of weather radio receivers in tsunami threatened communities, the State/Local Tsunami Work Group had to ensure complete coverage along the Washington Coast and offshore shipping lanes. Parts of the coast had little or no service. To do this, the Work Group developed a partnership with the National Weather Service, the U.S. Navy, coastal counties, tribal nations, and the private sector to install a new NWR repeater site on the central coast's Mount Octopus. The new transmitter site became operational in late 2000. This kind of partnership was the first in the nation to establish complete coastal NWR coverage (Figure 3).

6. All Hazard Alert Broadcasting (AHAB) Radio System

NOAA Weather Radio is gaining popularity in the coastal communities. While the state has been successful in deploying weather radio receivers throughout these communities, it lacked a notification system that could be placed on remote beachheads and other highly trafficked areas. The Work Group decided to utilize the capabilities of NWR to quickly disseminate warning messages to those in remote coastal locations. In a brainstorming session, the concept of the AHAB Radio was developed. The first prototype system was installed in Ocean Shores, Washington on 2 July 2003 (Figure 4).

6.1. AHAB RADIO CONCEPT

Coastal communities needed a reliable outdoor alert and notification system that is capable of providing all-hazard warning messages, one that is economical, reliable, and easy to understand and use, and hardy enough to withstand gale-force winds and salt corrosion, require little to no maintenance, and could be placed in areas without electrical power service. Capabilities of the pole-mounted system included (Figures 5 and 6):

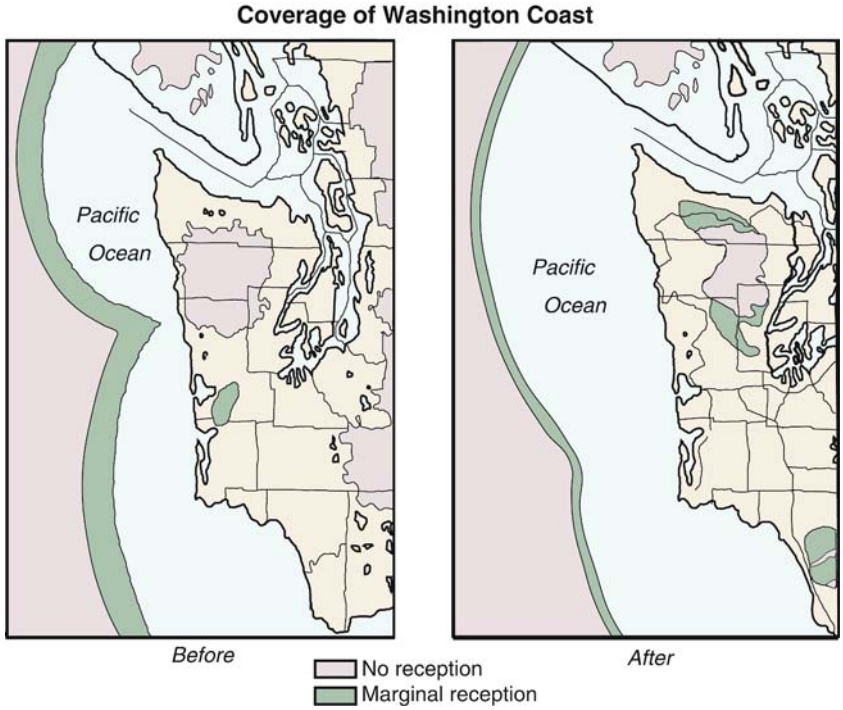

Figure 3. NOAA Weather Radio reception before and after installation of the new NOAA Weather Radio transmitter at Mount Octopus.

- A bright blue strobe light – the same type used by the Coast Guard to cut through fog and be seen from a long distance
- Modulator speaker – with 360° coverage to provide a voice message and coverage to a small community
- Battery operated – charged by wind, and solar, or commercial power
- Triggered by:
  - Hazard Event Code – example: NWS Tsunami Warning Message
  - A Specific Location Code – example: County or city law enforcement and emergency managers

7. Alert and Notification Communications Flow

When data indicates a tsunami has been generated, the Tsunami Warning Centers transmit the appropriate message (Information statement, Advisory, Watch, or Warning) on the NOAA Weather Wire Service (NWWS). The National Weather Service offices, newswires, and state teletype system receive the message. The Tsunami Warning Centers also transmit an oral notification

Figure 4. AHAB Radio prototype installed at Ocean Shores, Washington on 2 July 2003.

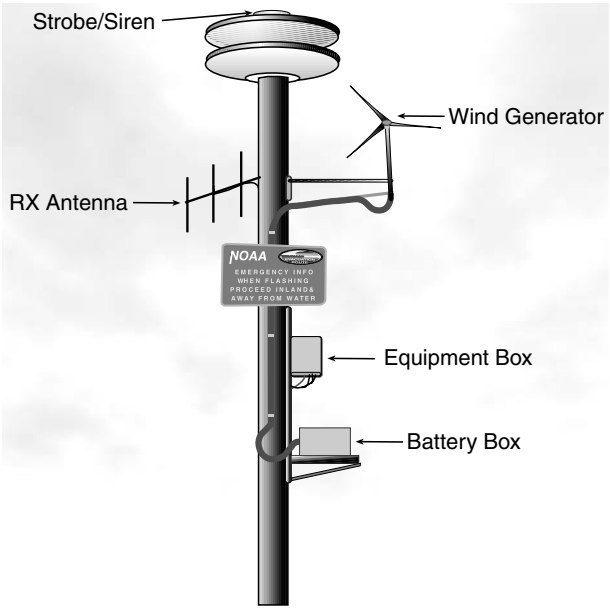

Figure 5. Conceptual drawing of AHAB Radio developed by George Crawford and Michael Namchek, Washington Emergency Management Division in partnership with Federal Signal.

Figure 6. Information sign placed on the pole of the Tsunami Notification System. The sign provides information on what to do when the bright blue light at the top of the pole flashes.

to State Emergency Operation Centers (EOC) via the National Warning System (NAWAS). The State EOC then passes the message to 24-hour contact points in affected jurisdictions via NAWAS and the state teletype system. The local jurisdiction's 24-hour contact points then notify emergency management personnel, key responders, and elected officials. If a tsunami warning message is received and evacuation is ordered by the local jurisdiction, an Emergency Alert System (EAS) message is transmitted over the local EAS Relay Network by local authorities. At the request of local authorities, the State EOC also can transmit the EAS message. The EAS message is automatically relayed over coastal NWR transmitters, reaching AHAB Radio, commercial broadcast stations (AM, FM, TV, and cable), and all of those with weather radio receivers programmed to receive the EAS message (Figure 7).

8. Education

The State/Local Tsunami Work Group has developed tsunami brochures to provide information on the tsunami hazard. These brochures include

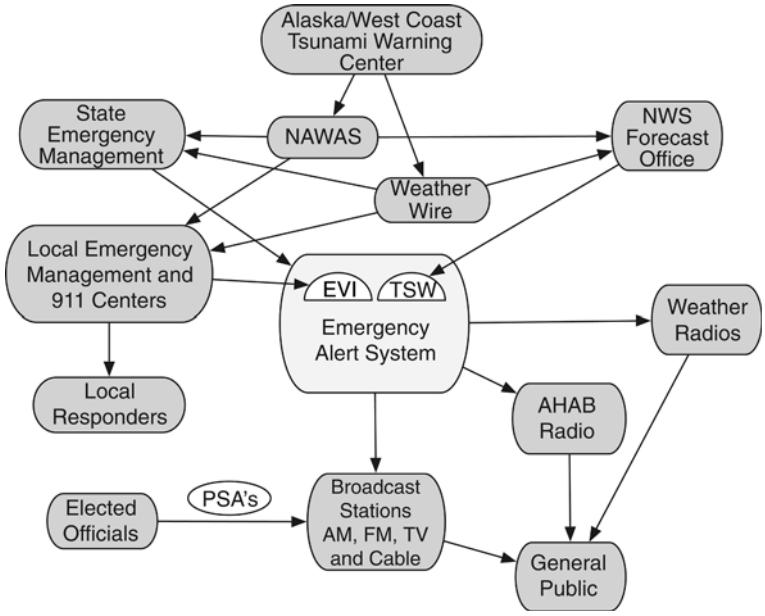

Figure 7. Identifies the communications flow of a tsunami warning message from the Alaska/West Coast Tsunami Warning Center to the general public. It also identifies the routing of EAS messages.

evacuation maps, NOAA Weather Radio information, and tsunami safety tips. The State worked with David Johnston from the Institute of Geological and Nuclear Sciences in New Zealand to examine residents' and visitors' perception of the tsunami hazard. The study also looked at their knowledge of the Washington Warning System and their understanding of what to do if a tsunami were to strike. (See paper in this edition by David Johnston for more details.) Results from Johnston's study were used to revise the booklet "How the Smart Family Survived a Tsunami" (elementary edition—K–6). The booklet now addresses the tsunami warning process, AHAB Radio, and actions people should take when a tsunami warning is received. It also has information on a family disaster plan and disaster supply kit.

With September designated as Weather Radio Awareness Month in Washington, the Work Group's goal is to have NOAA Weather Radio receivers become as common as smoke detectors in homes and businesses statewide to help protect lives and property from natural and technological hazards.

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