Association of Minnesota Emergency Managers (AMEM) Outdoor Warning Siren Best Practices Recommendation

Background

Overview. Outdoor warning sirens are an important tool used by emergency officials to warn people outside of an immediate threat to life safety. The essential warning message of outdoor warning sirens in Minnesota to those who hear them is: 1) **get to shelter**, and then 2) **get information** about the warning using the many other warning tools available to the public. Sirens are the only warning tool completely under direct local infrastructure and control.

The effectiveness of outdoor warning sirens depends on three vital and interrelated factors.

1. First are the technical qualities of the siren itself, its location, and the support structure that keeps sirens functioning. This structure includes as power supply, communications, control and maintenance.
2. Next are the policies and procedures that shape emergency authorities use of the sirens. These include types of authorized uses, testing protocols, and the degree of discretion authorized to activate sirens.
3. Finally, is the level of trust and confidence that the public has in the urgency and accuracy of warning provided by the outdoor warning sirens. To a considerable degree, public trust is raised or lowered based on the first two factors.

Purpose. This policy recommendation document aims to foster increased public trust in outdoor warning sirens through the adoption of policies and standards that are clear, consistent and understandable throughout the state of Minnesota.

History of Outdoor Warning Sirens. Originally designed to warn residents of large cities to take shelter because of incoming enemy bombers during World War II, these “air raid” siren systems were later upgraded and expanded with Federal funding during the Cold War to warn of incoming Soviet missiles. Despite their civil defense purpose, Minnesota outdoor warning sirens were used for the first time to warn people of an unprecedented outbreak of powerful tornadoes that struck the Twin Cities on May 6, 1965. Since then, sirens in Minnesota have warned people of many types of dangers and have grown in coverage and capability as a key element of the wider public warning system.

History of AMEM Siren Recommendations. Research in the years following the Joplin, Missouri tornado (2011) and the Southeast US Tornado Super Outbreak (2011) showed that despite significant advances in weather technology, public understanding and confidence in outdoor warning sirens had decreased among a sizable portion of tornado victims, which had resulted in delayed or incorrect protective action decisions. The research pointed to a wide variance in siren policies and procedures across local jurisdictions which degraded understanding their meaning by the public. Reports also described a phenomenon of "siren fatigue" which was produced by frequent siren drills, use of sirens for things other than warning, and use of sirens for non-life-threatening weather events. The overuse of sirens resulted in people 'tuning out' sirens and ignoring them when sounded.

In 2014, to address the potential for siren confusion and fatigue in Minnesota, AMEM formed a group of emergency managers along with a National Weather Service representative to study the issue and develop a recommendation. AMEM approved and issued their Outdoor Warning Best Practices Recommendation in February of 2015. It was one of the first efforts to advocate for statewide outdoor warning siren standards in the United States.

The Public Warning System. Outdoor warning sirens are just one element in an integrated public warning system that uses many methods to provide immediate, life-saving warning to the public as quickly as possible. Other elements of this integrated public warning system include the National Oceanic and Atmospheric Administration's NOAA Weather Radio (NWR); broadcast radio, television, and cable providers that use the Emergency Alert System (EAS); Wireless Emergency Alert (WEA) systems; telephonic notification services; and digital message boards along highways. No single piece of public warning technology can alert all people all the time. People engage in various activities throughout the day and these warning tools may or may not be effective at reaching an individual at any moment. Having a lot of warning tools also provides redundancy and resilience against failure of key systems such as cell phone towers, the internet, or the power grid which happens often when disaster strikes.

Siren Coordination. Outdoor warning sirens in Minnesota are a wide array of separate devices and systems. They are not part of a coordinated statewide structure. Siren site selection, equipment choice, installation, maintenance and upgrades are typically the responsibility of cities or counties. In some cases, special jurisdictions, such as parks, airports, or private industries, own and operate sirens. Siren activation policy responsibility ranges from operators that own a single siren, to city-centric policies, to county-centric policies, which are the largest jurisdictions responsible for siren policy.

Due to the variety of siren equipment used, as well as differences in technical capabilities between jurisdictions, siren activation methods vary. Some sirens must be manually activated at each location. Other siren networks are automated and can be activated from a single control point which is often a Public Safety Alerting Point (PSAP) or dispatch center. Others have redundant activation points at multiple locations. Also adding more variability are the age and types of sirens used. Some are only capable of a single tone. Others are capable of two or more tones. Still others also are capable of broadcasting human voice messages. The result of the wide diversity of siren capability and control is that siren policy across Minnesota can be quite different.

Siren Capabilities.

Outdoor warning sirens are quite simply tools to warn people who are outdoors to take immediate, potentially life-saving action by finding shelter from an imminent deadly threat. Though some people who are very close to an outdoor warning siren may hear it while they are inside a building, the sirens are really supposed to warn those people who may be outside of a dangerous threat. Most old siren systems are mechanical, while many newer varieties are electronic. Either type works well to provide outdoor warning. The planning range for hearing most outdoor sirens is ½ to 1 mile from the siren location. In addition to differences in sirens models, many other factors may increase or decrease the distance over which the sound may carry, including wind, vegetation, hills, and other noise in the area. Human voice capable sirens have a significantly reduced range while in voice mode because the intelligibility of voice messages drops rapidly with distance.

Siren Education.

> **IMPORTANT NOTE**: *Human factors are the most important elements in the public warning system. The scientific, technical and engineering aspects of warning are important to produce and distribute fast and accurate warning, but it is the way the public receives, understands and acts on warnings that matters most. Sirens are but one, important, element in the public warning system.*

People need to know what to do when they hear a siren tone without any further explanation – especially the sirens in their home area. Public education is an essential component of a successful outdoor warning siren capability. If people are unaware of what action to take when a siren sounds, some will seek shelter, others will run, and still others will hang around to find out what other people are doing. If sirens sound, but people have not been provided clear education on what they should do, then almost any response will happen, including non-

response. Education must be clear that emergency managers in Minnesota want the public to immediately move to shelter when outdoor warning sirens are heard, and then get information from a reliable source about the threat. People should always think "***Get inside and get information***" when sirens go off. Education about sirens and other warning methods reduces public confusion, which is a major contributor to fatal decisions when disaster strikes.

Emergency managers should also provide the public with education and materials describing how sirens fit in to the larger public warning effort. The public has access to an ever-expanding range of information sources, many of which speak to hazards and warn about them. A number of these sources, however, are of questionable accuracy. The response by many people to sort out all the available information is to delay action, and instead seek varying degrees of warning confirmation from other sources, both official and unofficial before acting. The public should be reminded that sirens are the only warning system that is fully under the control of local authorities and provides warning directly from emergency officials to them.

Forewarning. Another important part of public warning, especially with outdoor warning sirens, is forewarning. Forewarning is different than education and knowing what to do when a siren sounds. Forewarning is when people are aware of the increase and decrease in hazard potential hazards over hours and days. This is especially important during severe weather season. Advances in technology and the skills of National Weather Service meteorologists mean that typically there are days of indications that severe weather will form (*Hazardous Weather Outlook*). There are often hours of alert that the development of dangerous weather is imminent (*Tornado Watch*). Finally, there are usually only minutes of warning to take shelter (*Tornado Warning*).

> **IMPORTANT NOTE: *Sirens are the last link in the warning chain, not the first***. *A small investment of a few minutes of time each day can ensure proper forewarning and better decision-making for the safety of families, groups and businesses. People should take a moment to check weather forecasts daily for any mention of severe weather. Then, extra attention should be paid days with severe weather potential. Forewarning prevents surprise. Surprise often causes unnecessary delay in taking appropriate life-saving action – sometimes with tragic results.*

Problem, Intent and Siren Use Principles

Problem: Sirens can be made much more effective without added cost. Clear and simple policy changes among siren operators statewide could make sirens more trusted as a warning tool and measurably improve public safety. Many people continue to be confused and mistrust sirens. Therefore, they do not take shelter when they hear them. These studies also show that overuse of sirens leads people to ignore them. Overuse includes testing them too often. It also includes using outdoor warning sirens for non-warning reasons, such as for lunch sirens, dinner sirens, curfew sirens, and fire hall sirens. People have difficulty sorting out all the sirens they hear and then instead, tune them out from frustration. Another problem has been sounding sirens in too large an area so people far from an actual threat have sirens activate near them. These so called 'blue sky warnings' do not match the smaller polygon warnings that are now possible. This produces a lack of confidence in outdoor warning sirens and results in a lack of urgency when they are heard. There is a solution to these problems. Siren standards.

AMEM Intent: The reason the Association of Minnesota Emergency Managers (AMEM) issues best practice recommendations for outdoor warning sirens is to improve public warning effectiveness in Minnesota by encouraging statewide adoption of one simple, clear, consistent and credible outdoor warning siren policy. The policy fosters statewide understanding of the purpose of outdoor warning sirens. Credibility and confidence in outdoor sirens can be developed by adopting a standard way to employ them across Minnesota. Reducing confusion and siren fatigue should lead to increased confidence and trust in outdoor warning sirens. These recommendations are offered for the use of emergency managers as a tool to guide and influence local siren policy decisions.

AMEM is not interested in standardizing practices and policies as they are now. Instead, AMEM aims to develop and promote a siren policy as we believe it should become in the future to promote a safer and more resilient Minnesota. These best practice recommendations are goals that AMEM encourages jurisdictions to work towards. These recommendations are not mandatory. AMEM cannot enforce rules. Rather, these ideas represent the professional judgment and advice of emergency managers gathered from every region of Minnesota, together with senior meteorologists from national and local agencies. Together, we believe that this is the best way ahead for outdoor warning siren effectiveness.

Siren Use Principles: To move toward *one* simple, clear, consistent and credible outdoor warning siren policy in Minnesota, the following overarching principles are recommended as best practice.

1. **<u>Protection of Life</u>. The sole purpose of outdoor warning sirens is for the protection of life.**

   Sirens should be used to warn of immediate threats to human life and limb, not for principally property damage threats. They also should not be used for any non-life safety purpose such as time-of-day notification ("noon siren" or "curfew siren" for instance).

2. **<u>Public Warning</u>. To reduce public confusion, outdoor warning sirens should be sounded for public warning purposes only.**
   Using outdoor warning sirens for calling firefighters to the station results in significant public confusion because these messages are not aimed at the public. People have no way of knowing if the siren alarm is for them or just to firefighters. While using sirens to alert volunteer firefighters is traditional and it does have a life-safety objective, technology improvements make siren alerts to firefighters less and less effective. Use of sirens for non-public warning purposes should be phased out.

3. **<u>Call to Take Shelter</u>. The public should know that hearing an outdoor warning siren is a call to *take shelter***.
   Shelter does not just mean going inside any structure or vehicle. It means finding a sturdy, permanent building in a place that offers the best possible protection. The phrase "*Get inside then get information*" are memorable words recommended to describe the essential actions that people should take when they hear an outdoor warning siren. Public education must also go further to give people tools to identify the most protective areas in buildings.

4. **<u>Sirens Used for All Hazards</u>. Sirens may be used for any type of hazard when emergency officials want people in a threatened area to take shelter.**
   Besides severe weather, other situations such as the release of hazardous materials or an immediate security threat may require that sirens be used to tell people take shelter. Outdoor warning sirens are also an important part of the National Alert and Warning System (NAWAS) that warns of imminent attack and other national security emergencies. These are not "tornado sirens."

5. **<u>Sirens Part of Multi-Mode Warning</u>. Sirens are just one element in a larger public warning system made up of many tools – called the Integrated Public Alert and Warning (IPAWS) system**.
   No single warning element is effective for all people, always, and in all circumstances. Many different tools must be used simultaneously to make sure that as many people as possible get proper timely warning to take shelter. Outdoor warning sirens are the premier tool to warn those people who are outside.

IMPORTANT NOTE: *The best warning method is not a matter of favorites or preferences, rather it is a function of the activity a person is doing at the time of the warning. Sirens warn those outside. Television screen crawlers (EAS) warn those watching TV. Digital message boards and radios warn those driving. Weather alert radios (NOAA) awaken those who are asleep or warn those at work or inside a home. Wireless emergency alerts (WEA) warn those with mobile service and those outside of their local area. Reverse notification systems warn local subscribers. People must have several warning systems available to them as they go about their day. It is a fact that most people seek confirmation of one warning source by seeking another before acting. Sirens are an important part of that process.*

Siren Operations - Activations

Operational Standards: Specific recommended operating standards and best practices for outdoor warning siren use in Minnesota…

1. **Siren Tones**. Some sirens can sound several kinds of sounds, however AMEM recommends the use of no more than two siren tones.

   a. **The ALERT tone is a steady 'wail' tone.** It is the basic siren tone used for civilian emergencies (such as for tornadoes or other urgent community incidents) where *local* officials are indicating that people immediately go to shelter and get further information. All sirens in Minnesota should be capable of sounding the alert tone.

   b. **The ATTACK tone is a rising and falling 'wavering' tone.** This tone is used for civil defense purposes only. It is used under the authority of *national* defense officials to indicate to people that an attack is imminent or in progress and that they should seek shelter and then await broadcast instructions from authorities regarding further action. Not all sirens in Minnesota need to have this second attack tone. Generally, this tone should be operational in Minnesota's largest metropolitan areas (such as the Twin Cities, Duluth, Fargo-Moorhead, and Rochester areas).

   These two long-established tones are part of a national standard established by the Federal Government during the Cold War and it continues to be used in the present day. Across Minnesota, the public should only have to understand the meaning of two separate siren sounds. Any other tones used are only for very specific circumstances inside small and often restricted areas (discussed later). People should also understand that most jurisdictions outside of Minnesota's metro areas will usually restrict their sirens to a single tone – ALERT – used for local emergencies.

Best practice recommendation: *All Minnesota jurisdictions that operate outdoor warning sirens should use the ALERT tone for public warning during localized emergency situations. Jurisdictions in metro areas may also have the ATTACK tone available, however use of that tone is restricted to national defense warning upon triggering by national defense authorities. In case national authorities wish to activate sirens for an attack that may impact smaller cities in Minnesota, local warning officers should sound the ALERT tone if their sirens are only single tone capable. The 'wavering' attack tone should*

never be used for any other emergency (such as fire calls). According to the National Warning System Operations Manual (FEMA Manual 1550.2, 2001), the attack signal "… will have no other meaning and will be used for no other purpose." See ***National Defense Warnings*** *later in this section for more information.*

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8. **Year-round Capability**. Outdoor warning is not a seasonal capability, rather sirens should be a continuously available for public warning all year long. Sirens are not intended to be used exclusively for seasonal hazards such as tornadoes but instead should be available for any type of emergency where local officials wish to alert people to take immediately take shelter and get further information. In addition, significant changes in climate have left only two months in Minnesota without a recent record of tornadoes – January and February. Climate trends may eventually lead to a year-round tornado threat as months previously thought to be immune from tornadoes begin to see activity.

Best practice recommendation: *Siren operators should attempt to keep their siren capabilities operating all year round. Lessons from jurisdictions that operate sirens in cold weather may help other jurisdictions make modifications or enhancements to their system which will make their sirens more resilient.*

IMPORTANT NOTE 1 – Expanding Severe Weather/Tornado Threat: *The severe weather season of Minnesota is expanding into months previously thought to be immune from severe weather due to cold temperatures. The December 15, 2022, southeastern Minnesota derecho and tornado outbreak is a clear example of this trend. The event obliterated the record of the previous latest seasonal tornado from November 16, 1931, in Hennepin County. The 2022 event produced 22 tornadoes across Fillmore, Freeborn, Goodhue, Houston, Mower, Wabasha and Winona Counties, including an EF-2 that severely damaged the town of Hartland in Freeborn County. In addition, the storm spawned a derecho that produced more wind gust reports over 75 mph than any other derecho in the U.S. at any time of year since modern derecho record keeping began in 2004.* https://www.dnr.state.mn.us/climate/journal/mid-december-tornadoes-derecho-and-damaging-cold-front-december-15-16-2021.html

IMPORTANT NOTE 2 – Operability of Sirens in Winter: *At 1:37 am, January 18, 2002, a train carrying anhydrous ammonia derailed ½ mile west of the city of Minot, ND leaving 31 cars of the track and five tank cars loaded with anhydrous catastrophically ruptured leading to a vapor plume. Local authorities wanted residents to shelter in place and activated their outdoor warning sirens. Temperatures at the time were -6F with light winds of 7 mph from the southwest. The sirens operated without problems in winter conditions. However, since the derailment had knocked out power to many homes, and because local broadcasters had gone home and shifted to automatic programming after midnight, local officials had difficulty reaching residents with further information through broadcast media. Integration between outdoor warning sirens use and IPAWS tool use must be regularly practiced.*
https://www.ntsb.gov/investigations/AccidentReports/Reports/RAR0401.pdf

1. **Use in Local Emergencies**. Local emergencies that may require siren activation include (but are not limited to) dangerous weather events such as tornadoes or extreme winds; deadly chemical or hazardous material releases; or certain active security situations. The message that emergency officials want to tell the public by using outdoor warning sirens is to find protective shelter, using the catch phrase "get inside then get information."

Best Practice Recommendation: *When used for a public warning of local emergency, outdoor warning sirens should sound the alert tone only. During an actual warning (as opposed to a drill), the duration of the alert tone should be at least four (4) minutes. There is strong evidence that people take siren warning more seriously if the siren is sounded for a noticeably longer duration than during a monthly drill. When possible, during an exceptionally serious situation (a confirmed large tornado causing damage, etc.), the tone should be continuously sounded or rapidly repeated.*

2. **Weather Triggers**. There are several types of extreme weather that should trigger activation of outdoor warning sirens (and many types that should not). Quick and effective use of sirens is especially important during violent weather events since sirens are designed to warn people engaged in outdoor activities. People outside are the most vulnerable to dangerous weather. Use of sirens for weather warning should be for a clear and present danger to life-safety, not for conditions that mostly threaten property. Of course, almost any stormy weather can increase safety risks that result in death or injuries. Slippery roads, standing water, lightning and other dangers are often part of storms. People should adjust their activities and come inside. But siren activation for public warning is not used for routine storms.

> **IMPORTANT NOTE**: *Siren activation should not be used for routine storms (such as severe thunderstorms as defined by the NWS – winds <58 mph / hail <1.00 inch). Siren activation should be taken only in cases when it is likely that the effects of dangerous weather would likely kill or injure unprotected people outdoors or hurt people in* lightly *constructed structures such as mobile homes, campers, or tents.*

***Best Practice Recommendation One**: Three types of violent weather events should trigger siren activation using the alert tone. These include tornadoes, destructive winds and destructive hail. The National Weather Service recently developed a three- tier description of hazardous thunderstorms across the nation. The highest threat category is called "destructive" and automatically generates a wireless emergency alert (WEA) from the NWS. Therefore, the baseline/fail safe weather criteria for siren activation in Minnesota (in the absence of other guidance or analysis) are:*

- **Tornadoes (NWS tornado warnings and/or trained spotter reported)**
- **Destructive Winds (Measured or imminent at or above 80 MPH)**
- **Destructive Hail (measured or indicated at 2.75 inch or above)**

***Best Practice Recommendation Two**: The NWS "destructive" category is an extremely high bar for public warning in several scenarios. Many factors can decrease the wind speeds needed to produce tragedy. Rain saturated soils can cause healthy trees to topple and kill and injure people with winds only in the 60- mph range. Urban terrain, mass outdoor events, large campgrounds, significant boating activity, all could be reasons to activate outdoor warning devices in winds below 80 mph. AMEM encourages local emergency managers or other warning officials to assess their local conditions including soil moisture, tree canopy leaf out, outdoor activities, urban terrain, and other factors and decide whether to depart from the baseline warning criteria for winds speed. 70 mph is a very prudent wind speed to trigger siren activation and was used in the previous AMEM recommendation for example.*

> **IMPORTANT NOTE**: *Siren activation should not occur without activating other public warning tools. For instance, if local emergency officials decide to activate sirens due to risks from winds over 70 mph, they should also issue a civil emergency message for the threatened area using wireless emergency alert (WEA). The Integrated Public Alert and Warning System (IPAWS) is ideal for coordinating multiple warning systems.*

3. National Defense Emergencies. There are several scenarios where national authorities may decide to warn the public directly through the National Alert and Warning System (NAWAS). Attack warning was the original purpose of the nation's siren system. In the event of an imminent attack State and County Warning Points will be notified on the special NAWAS Line to sound the "attack" warning under the four specified circumstances (below) as well as other circumstances of national interest. These procedures are included in FEMA Manual 1550.2 published in 2001.

1) **Enemy Attack**. The Attack Warning will be disseminated over NAWAS when the Commander, North American Aerospace Defense Command (NORAD) declares Air Defense Emergency (ADE) Warning RED. ADE RED signifies that an attack upon the United States is imminent or taking place. Only NORAD is authorized to declare

ADEs. Additionally, there are limited threat scenarios by which terrorists or countries of concern may attempt to harm U.S. interests. These scenarios may require an announcement of a limited Attack Warning to a specific area or region of the United States. Warnings are based on tactical and strategic intelligence data gathered and evaluated by NORAD under its responsibility for the aerospace defense of North America.

2) **Accidental Missile Launch**. An agreement between the United States and Russia exists to reduce the risk of nuclear war because of an accidental, unauthorized, or any other unexplained incident involving a possible nuclear weapon detonation. In the unlikely event of such an incident (e.g., an accidental missile launch) that would threaten the United States or a particular area within the country with a possible nuclear detonation, an accidental launch-warning message will be transmitted over the NAWAS. The attack warning tone would be used.

3) **Radioactive Fallout**. NAWAS would be used to convey fallout information to the affected State(s). The State(s) would then pass this information on to local governments, which would issue fallout warnings and instructions to the public based on local observations and information received from the State. The attack warning tone would be used.

4) **Domestic Errant Missile Launch**. The United States space program launches a variety of missiles (military, government and civilian) from several launch locations within its borders. There is potential for these missiles to go errant and not reach proper altitude in outer space but instead fall back to Earth. The rocket launch facility, in conference with NORAD, which monitors all orbital activity, would issue a warning via NAWAS to the threatened area's State Warning Point(s). States would then pass this information to affected local governments, which would sound the attack tone and issue instructions via media and other sources.

***Best Practice Recommendation**: AMEM recommends that counties and siren owner/operators participate in and support the NAWAS system by maintaining the capability to sound attack warnings for public safety in case of national defense emergency. While national defense emergencies are low probability, most carry high consequences and would result in many more casualties if the public did not get adequate advance warning.*

IMPORTANT NOTE: *Civil defense is an ongoing responsibility of emergency management. Threats of attacks by hostile nations are no longer limited to one massive strike by a single superpower opponent. The ability to launch nuclear-capable intercontinental ballistic missiles continues to spread into smaller and sometimes erratic nations such as North Korea. The proliferation of weapons of mass destruction technology to hostile nations and terrorist groups makes civil defense measures such as public warning important capabilities for the security of the United States.*

4. Smallest Warning Area Possible. Siren control technology in use in some places in Minnesota is unable to sound sirens in areas smaller than the entire county. This results in so-called 'blue sky warnings." A blue-sky warning happens when the public warning area where sirens sound is much larger than the actual area under threat. This results in people losing trust in siren accuracy and ignoring siren warnings.

***Best Practice Recommendation**: When repaired or replaced, siren controls should be upgraded with technology to allow only sirens within a specified NWS warning polygon to sound. Additional technology advancements that allow automatic siren activation upon receipt of an NWS tornado or wind message for pre-set conditions should also be considered.*

5. Siren Resilience. Severe weather can quickly make an outdoor warning siren system fail if it depends on the local power grid as its only power source. Power failures can happen well before a storm hits an area. Lightning or fallen trees can cut power and make critical outdoor warning sirens silent just when a town needs it most. Severe weather often comes in waves over the course of hours, or even days. If the first storm knocks power and therefore warning sirens off-line, the public is at risk when new lines of storms approach.

***Best Practice Recommendation**: To ensure function during critical situations, outdoor warning sirens should not depend on the normal power grid as their sole source of their power. Backup power sources should be installed, including battery back-up, or connection to a generator that automatically starts when the grid power source shuts off. Other sirens are not connected to the grid at all and are capable of independent power through use of solar charged batteries.*

6. No "All-Clear" Message. A frequent question asked of emergency managers by the public is "what is the all-clear siren tone?" The answer in all cases should be that there is NO "all-clear" tone. Messages telling people that the situation is "all-clear" will come from local commercial broadcasts and other reliable sources while people remain in the sheltered location. People should not have to leave a safe shelter spot trying to hear an all-clear siren tone outside. That makes no sense and is unsafe.

IMPORTANT NOTE: *The mistaken belief that outdoor sirens use an all-clear signal comes from history. An all-clear signal was used to tell people that they could come out of bomb shelters after enemy bombers had departed London and other cities during World War II (1940-1945). Thus, all clear signals were a standard feature of many movies about "the Blitz" seen in the United States. However, the all-clear tone dropped from use in Civil Defense sirens during the Cold War when bombs became nuclear and radioactive contamination and fallout became a concern. Staying inside shelter became much more important during nuclear warfare and "all-clear" tones became dangerous. So, "all-clear" siren signals have not been used since at least the mid-1950s.*

***Best practice recommendation**: Outdoor warning siren policies should never include any form of "all-clear" signal.*

Siren Operations – Tests and Drills

IMPORTANT NOTE: *The way tests and drills are conducted plays a crucial role in determining whether the public will rely on and trust them, or whether they will ignore them or be confused by them. Tests and drills give people their most frequent exposure to outdoor sirens. Standard times and methods are important ways to foster a perception of consistency and siren reliability among the public.*

1. **Purpose of Siren Drills**. Siren drills have several purposes. These include:

   - **Maintenance** to verify that each siren is functioning.
   - **Familiarization** to enable public listeners to learn the tones and acoustical quality of their outdoor warning sirens.
   - **Exercise** by providing a trigger for immediate action drills by people at home, work, school or other sites.

   It is important that the public understand the intent behind monthly siren drills. They should not think that the monthly drills are exclusively for maintenance and testing (therefore it is best not to call them monthly siren tests). In fact, modern siren control systems can conduct silent tests that determine siren function, signal reception, battery strength, and so on. Using these systems, siren readiness can be measured many times each week. Therefore, the public should be reminded that the purpose of monthly siren *drills* is for them to become familiar with their area's siren alert and attack tones in all seasons, and to trigger a brief mental exercise to answer the essential question "*where would I go for shelter right now if this were an actual emergency*?" Some workplaces and institutions may also use the scheduled monthly siren drill as the trigger for an actual sheltering practice or other safety exercise.

   ***Best practice recommendation**: Public education efforts should make it clear that siren drills are provided as a way for people to become familiar with the siren tones that they will hear for warning. They should learn how the sirens in their area sound. They should further listen to how that sound carries to their yards, worksites, parks, playing fields, lakes and other outdoor spaces during all seasonal conditions. In addition, if emergency managers expect the public to report siren outages, they must be provided contact methods to do so.*

2. **Frequency of Siren Drills**. Emergency managers must balance several demands during siren drills. Too many tests and drills, especially when combined with non-public warning uses of outdoor sirens such as time notifications and fire calls, result in siren fatigue among

residents. In siren fatigue, people experience so many siren activations that they become numb to siren sounds and their attention is no longer secured when a siren goes off. Siren drills must be limited to only those needed to meet specific objectives to not produce siren fatigue among the public.

***Best practice recommendation**: A single audible siren drill protocol used across Minnesota will help reduce public confusion and familiarize people with tones they will hear in an emergency. AMEM best practice recommends one monthly audible siren drill. This drill should occur at 13:00 (1:00pm) local time on the first Wednesday of each month. Maintaining this calendar date and time across Minnesota is key to establishing a predictable and reliable pattern. Excessive testing or drills (more than once per month (except for the statewide tornado drill day) are counterproductive. Due to ever present potential threats that are not dictated by seasons, siren drill should not be terminated, reduced or otherwise modified during winter months.*

3. **Siren Tones During Drills**. The goal for outdoor warning siren capability in Minnesota is to offer two separate siren tones to warn populations. Some jurisdictions in the state cannot yet provide warnings using two kinds of tones.

   a. **Two tone siren drill**
   Jurisdictions that have two siren tone capability should follow the following protocol during monthly drills: one (1) minute of the alert ("wail") tone starting at 13:00 local time; followed by one (1) minute of silence; followed by one (1) minute of the attack ("wavering") tone. Drill complete.

   b. **Single tone siren drill**
   Jurisdictions that are not yet capable of signaling two different tones should conduct the following protocol during monthly drills: one minute of the alert ("wail") tone starting at 13:00 local time; followed by one minute of silence, followed by one minute of the alert ("wail") tone. Drill complete.

   Note: The wail tone is used a second time in the case of single tone only sirens, to preserve the standardized format of the drill, and because the alert tone is the one that will be used both for a civil emergency or the event of an attack for single-tone capable sirens.

   c. **Audible language loudspeaker drill**
   Jurisdictions owning or operating sirens with loudspeaker capability can optionally test this feature on the monthly siren drill day. A language message could follow the siren test, with a message such as "This is a drill. This has been the monthly outdoor warning system drill. The drill is complete."

4. **Growl Testing**. Sometimes, siren maintenance requires an audible verification of siren function. Siren maintenance checks requiring actual sound can either be delayed until the monthly siren drill, or a 'growl test' can be used as needed. A growl test is a brief audible activation of an outdoor warning siren that lasts only a few seconds. In a growl test, the siren does not reach full volume or last long enough to generate much notice by the public, and therefore does not risk a false decision by listeners that they need to take any action.

   ***Best Practice Recommendation**: The growl testing method used for siren maintenance does not conflict with the goals and objectives of the AMEM Outdoor Warning Sirens Best Practices. Growl testing is an acceptable audible test method as needed.*

5. **Drill Day Severe Weather Threat**. During severe weather season there is a reasonable chance that a siren drill may occur on a day with actual severe weather risk. Emergency managers do not want to be in a position where a monthly siren test is happening while actual severe weather is building in the same area. This kind of siren purpose conflict would only erode public confidence in the siren system and in emergency management decision-making. Looming severe weather or other developing emergency situations are appropriate reasons to cancel siren drills to reduce public confusion. Cancellation also reassures people that officials are actively monitoring developing situations and making appropriate adjustments when needed.

   ***Best practice recommendation**: If, on the day of the siren drill, the National Weather Service forecasts a threat of actual severe weather in a specific county or counties, to occur within the six (6) hours prior (07:00) and through the six (6) hours following the siren drill (19:00), the drill should be cancelled in the county/counties described in the forecast. The six-hour minus – six-hour plus window allows time for variance in predicted storm development times and for counties with large geographic areas. Local media outlets should be advised that the test is cancelled due to an actual severe weather threat. This not only will notify the public of the cancelled drill but is also another newsworthy method to highlight to the public the increased severe weather risk for that day.*

6. **Annual Statewide Tornado Drill**. The Minnesota Division of Homeland Security and Emergency Management coordinates a Statewide Tornado Drill each year in April as part of Minnesota's Severe Weather Awareness Week. This is a valuable public education effort that gets a lot of concentrated media attention across the state in the weeks just before the onset of severe weather season in Minnesota. The use of outdoor warning sirens during an afternoon and an evening tornado warning scenario is important to the success of the education effort.

***Best practice recommendation**: All jurisdictions and other siren operators should actively participate in Severe Weather Awareness Week and use their outdoor warning sirens for the annual Statewide Tornado Drill.*

7. **Exemptions in Special Circumstances**. Most of Minnesota is NOT within a special circumstance area for sirens. The benefit of standard siren use policies can only be realized if they are implemented and followed across the entire state. However, there are a very few special environments or circumstances when outdoor warning sirens have a public warning value when used in different ways than described in this best practice recommendation. The principal example is in the immediate areas around federally licensed nuclear power generating stations or at military facilities.

   It is the local emergency manager's responsibility to ensure that residents and visitors present within the area of special siren use policy, understand the use and meaning of sirens in these areas – especially the actions that listeners are supposed to take when hearing them. They also should stress that sirens in such special areas are used differently than elsewhere in Minnesota. Again, in order to preserve the benefits of standardized siren activation, testing and drill policies, the number and size of special areas should be kept to an absolute minimum.

Further Reading

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Federal Emergency Management Agency. (2006). *Outdoor Warning Systems, Technical Bulletin (Version 2.0).*

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Document Improvement

Suggestions for improving the AMEM Outdoor Warning Siren Best Practices Recommendation should be sent to the current President of the Association of Minnesota Emergency Managers via contact information found at **http://amemminnesota.org/**

Approval

The AMEM Outdoor Warning Siren Best Practices Recommendation was recommended by the AMEM President and approved by a vote of the AMEM Board on 2/27/2023, while meeting at Virtual Meeting in, Minnesota.

These recommendations remain in force as AMEM recommended best practices until rescinded or modified by subsequent AMEM Board action.

Blain Johnson

AMEM President

AMEM Executive Director

03/08/2023

Date

Summary of Best Practices

Best practice recommendation: *All Minnesota jurisdictions that operate outdoor warning sirens should use the ALERT tone for public warning during localized emergency situations. Jurisdictions in metro areas may also have the ATTACK tone available, however use of that tone is restricted to national defense warning upon triggering by national defense authorities. In case national authorities wish to activate sirens for an attack that may impact smaller cities in Minnesota, local warning officers should sound the ALERT tone if their sirens are only single tone capable. The 'wavering' attack tone should never be used for any other emergency (such as fire calls). According to the National Warning System Operations Manual (FEMA Manual 1550.2, 2001), the attack signal "… will have no other meaning and will be used for no other purpose." See* ***National Defense Warnings*** *later in this section for more information.*

Best practice recommendation: *Siren operators should attempt to keep their siren capabilities operating all year round. Lessons from jurisdictions that operate sirens in cold weather may help other jurisdictions make modifications or enhancements to their system which will make their sirens more resilient.*

Best Practice Recommendation: *When used for a public warning of local emergency, outdoor warning sirens should sound the alert tone only. During an actual warning (as opposed to a drill), the duration of the alert tone should be at least four (4) minutes. There is strong evidence that people take siren warning more seriously if the siren is sounded for a noticeably longer duration than during a monthly drill. When possible, during an exceptionally serious situation (a confirmed large tornado causing damage, etc.), the tone should be continuously sounded or rapidly repeated.*

Best practice recommendation one*: Three types of violent weather events should trigger siren activation using the alert tone. These include tornadoes, destructive winds and destructive hail. The National Weather Service recently developed a three- tier description of hazardous thunderstorms across the nation. The highest threat category is called "destructive" and automatically generates a wireless emergency alert (WEA) from the NWS. Therefore, the baseline/fail safe weather criteria for siren activation in Minnesota (in the absence of other guidance or analysis) are:*

Best Practice Recommendation Two*: The NWS "destructive" category is an extremely high bar for public warning in several scenarios. Many factors can decrease the wind speeds needed to produce tragedy. Rain saturated soils can cause healthy trees to topple and kill and injure people with winds only in the 60- mph range. Urban terrain, mass outdoor events, large campgrounds, significant boating activity, all could be reasons to activate outdoor warning devices in winds below 80 mph. AMEM encourages local emergency managers or other warning officials to assess their local conditions including soil moisture, tree canopy leaf out, outdoor activities, urban terrain, and other factors and decide whether to depart from the baseline warning criteria for winds speed. 70 mph is a very prudent wind speed to trigger siren activation and was used in the previous AMEM recommendation for example.*

***Best Practice Recommendation**: AMEM recommends that counties and siren owner/operators participate in and support the NAWAS system by maintaining the capability to sound attack warnings for public safety in case of national defense emergency. While national defense emergencies are low probability, most carry high consequences and would result in many more casualties if the public did not get adequate advance warning.*

***Best Practice Recommendation**: When repaired or replaced, siren controls should be upgraded with technology to allow only sirens within a specified NWS warning polygon to sound. Additional technology advancements that allow automatic siren activation upon receipt of an NWS tornado or wind message for pre-set conditions should also be considered.*

***Best Practice Recommendation**: To ensure function during critical situations, outdoor warning sirens should not depend on the normal power grid as their sole source of their power. Backup power sources should be installed, including battery back-up, or connection to a generator that automatically starts when the grid power source shuts off. Other sirens are not connected to the grid at all and are capable of independent power through use of solar charged batteries.*

***Best practice recommendation**: Outdoor warning siren policies should never include any form of "all-clear" signal.*

***Best practice recommendation**: Public education efforts should make it clear that siren drills are provided as a way for people to become familiar with the siren tones that they will hear for warning. They should learn how the sirens in their area sound. They should further listen to how that sound carries to their yards, worksites, parks, playing fields, lakes and other outdoor spaces during all seasonal conditions. In addition, if emergency managers expect the public to report siren outages, they must be provided contact methods to do so.*

***Best practice recommendation**: A single audible siren drill protocol used across Minnesota will help reduce public confusion and familiarize people with tones they will hear in an emergency. AMEM best practice recommends one monthly audible siren drill. This drill should occur at 13:00 (1:00pm) local time on the first Wednesday of each month. Maintaining this calendar date and time across Minnesota is key to establishing a predictable and reliable pattern. Excessive testing or drills (more than once per month (except for the statewide tornado drill day) are counterproductive. Due to ever present potential threats that are not dictated by seasons, siren drill should not be terminated, reduced or otherwise modified during winter months.*

***Best Practice Recommendation**: The growl testing method used for siren maintenance does not conflict with the goals and objectives of the AMEM Outdoor Warning Sirens Best Practices. Growl testing is an acceptable audible test method as needed.*

***Best practice recommendation**: If, on the day of the siren drill, the National Weather Service forecasts a*

threat of actual severe weather in a specific county or counties, to occur within the six (6) hours prior (07:00) and through the six (6) hours following the siren drill (19:00), the drill should be cancelled in the county/counties described in the forecast. The six-hour minus – six-hour plus window allows time for variance in predicted storm development times and for counties with large geographic areas. Local media outlets should be advised that the test is cancelled due to an actual severe weather threat. This not only will notify the public of the cancelled drill but is also another newsworthy method to highlight to the public the increased severe weather risk for that day.

***Best practice recommendation**: All jurisdictions and other siren operators should actively participate in Severe Weather Awareness Week and use their outdoor warning sirens for the annual Statewide Tornado Drill.*