

# Effective Evacuation from ferries using Sound Beacons.

Professor Deborah Withington, School of Biomedical Sciences, University of Leeds, LS2 9NQ, UK.  
Tel:0113 233 4263 FAX: 0113 233 4299

Fire is one of nature's most uncontrollable forces, and to be caught in a fire situation is one of the most frightening experiences a person can face. However, although the fire itself is deadly, most casualties die from smoke inhalation which firstly blinds those trapped in its path, making it impossible to see the emergency exits, before being choked and suffocated.

Modern ships and ferries are complex structures whose very design and layout can hinder speedy evacuation. Familiar thoroughfares may be hard enough to navigate in the unfamiliar conditions of an emergency evacuation but add an unfamiliar emergency route to the situation and the difficulties are compounded. Even worse add smoke to the passageway, making it difficult or impossible to see, and the situation can rapidly escalate.

Behavioural studies have shown repeatedly that one of the most natural instincts in the event of a fire is for people to evacuate a structure by the way in which it was entered. This is rarely by the quickest or most appropriate route, with many people failing to spot nearby exits and in some cases walk past visible fire exits. Ultimately, circulation routes that are used for normal, everyday movement become overcrowded, slowing down the evacuation process.

In April 1990 a fire raged through the Scandinavian Star ferry as it coursed through Norwegian waters on an overnight voyage from Oslo to Copenhagen. Of the 500 passengers and crew on board, 158 died including 29 children. Bodies were found below deck piled up in the corridors close to emergency exits, in cabins and even in the showers. Part of the investigation concentrated on the issue of why people died even though some were so close to emergency exits. Many survivors claimed that it was impossible to see the emergency exits in the corridors when these were full of smoke.

In an attempt to understand what went so tragically wrong on board the Scandinavian Star, the Norwegian Fire Research Laboratory performed a series of evacuation trials on a reconstructed section of the Scandinavian Star. Using existing emergency signage provision, it was found that 40% (of their test subjects) could not find the emergency exit. They either passed it, or tried to get out through the wrong door, and some turned round on the way out. In their summary the Norwegian researchers stated "We do know that emergency lighting and marking signs do not help to distribute people among the evacuation routes available."

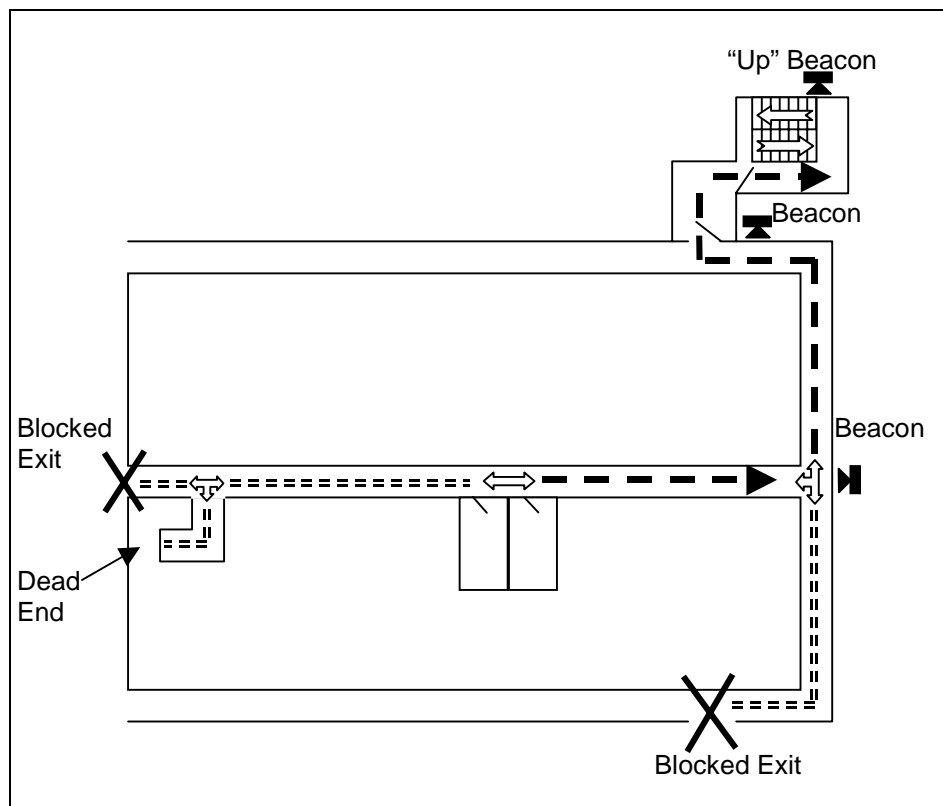
So is there a better way to evacuate people, removing our total reliance on visual signage? Although we are, primarily, visual animals, we are also extremely good at pinpointing sound. The sound must, however, be broadband (i.e. multi-frequency) to ensure our ears and brain compute sound direction accurately. Scientists from Leeds University, in conjunction with a Leeds-based company Sound Alert, have researched and developed sound beacons for use in evacuation scenarios. The beacons emit a pulse of broadband noise that we can pinpoint instantly. The pulse rate of successive beacons gets faster and faster as the final exit is approached. Additionally, rising or falling melodic complexes directing "up" or "down", can instruct on the direction of travel at a stairwell.

In January this year we were able to put the beacons to a rigorous test on board a ferry in dry dock. Twenty volunteers were used in the experiments. They were led by different routes to two cabins in the centre corridor of an accommodation section comprising three parallel corridors.

Each cabin was filled with people who had entered it using different routes. The ship's normal lighting remained on throughout the experiment. Both groups were told that there was going to be one safe route that they could follow to escape from the smoke that would shortly fill the corridors. Some of the potential exit routes would be "non-viable" (i.e. blocked) due to the location of the simulated fire.

After filling the corridors with smoke the first group was let out of their cabin in pairs, at five-second intervals. As you would expect, about half went each way - left and right. Those who turned left found a blind alley and a blocked exit and had to retrace their steps, potentially fatal in a real fire. Those that went right reached a T-junction and had to choose left or right. Again, about half turned

each way; those turning right found a blocked exit and had to retrace their route. Eventually, due to the fact that it was theatrical as opposed to real smoke, all got out.



More smoke was laid down in the corridor before the second part of the experiment began. The Localizer™ sound beacons were then activated. The remaining group in the cabin were briefed that the beacons were located on the exit route and then released in the same way as before, i.e. pairs at five-second intervals. All turned immediately right and then immediately left at the T-junction and were out in about one third of the time it had taken the first group. No one went the wrong way.

There was considerable excitement amongst the volunteers afterwards with volunteers who did not have the beacons to guide them expressing how disorientating and confusing their experience had been. Conversely, those who had used the Localizer™ beacons made comments like "I couldn't believe how clear and obvious the sound beacons were - I had no doubt which way to go."

The trials showed the huge potential for the Localizer™ beacons in the worst-case scenario of a smoke-filled environment. It is, however, believed that even without smoke the beacons would identify clearly exits that may be ignored during non-smoke evacuations. For example drawing people's attention to the nearest exit, which may be out of a direct line of sight.

The ferry evacuation trials were filmed to be shown on television in May on Channel 5 for a programme entitled "Into the Flames - Fire at Sea".

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