

HSE Human Factors Briefing Note No. 9

Alarm Handling

Briefing Note 1 – ‘Introducing Human Factors’ explains the background to these Briefing Notes.

Alarm systems alert operators to plant conditions, such as deviation from normal operating limits and to abnormal events, which require timely action or assessment. Alarms are thus key sources of information to the operator in maintaining safety. It is important that alarm systems are well designed and are used correctly.

Case studies

1. An LPG tanker broke away from its moorings in high winds. It drifted and twice lightly grounded before being manoeuvred into a safe anchorage. The vessel was not damaged in the incident and there were no injuries on board. However the incident illustrated a problem with the alarm systems in the marine terminal that is common in other industries. It was found that operators routinely disabled the wind speed alarm - the reason being that, in gusty weather, the alarm would sound at the peak of a gust, and then reset when the wind speed dropped below the alarm activation limit. In addition, terminal staff did not know whether they should have sounded the site alarm during this emergency.

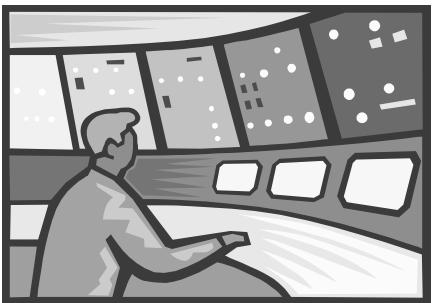
Source: Health and Safety Executive, 'Havkong incident: a joint report of the 'Havkong' incident at Braefoot Bay Terminal by Aberdour Fife on 23 January 1993, 1994.

2. A vapour cloud was released at a Philips chemical complex in Pasadena in 1989. The cloud ignited resulting in several explosions and fires. Twenty three people were killed and up to 300 injured. It was found that the alarm siren was too quiet to be heard by all personnel on the site.

Source: Lees, F.P., 'Loss Prevention in the Process Industries – Hazard Identification, Assessment and Control', Volume 3, Appendix 1, Butterworth Heinemann, ISBN 0 7506 1547 8, 1996.

3. On 13th May 2002, pilot lights on the flare system at a chemical plant were extinguished. This occurred because there were fluctuations in the gas supply to the flare. A large gas cloud formed but, fortunately, did not ignite. The flare gas came from an installation which was being restarted. The restart process produced 3,700 alarms so, not surprisingly, the operators failed to detect the alarm for the flare.

Source: MARS database item 520



HSE Concerns

- Alarm handling (or alarm management) is an issue for any site or process where there is claimed reliance on human response to an alarm in order to control major accident hazards. If there are too many safety critical alarms (i.e. +20) then the balance is likely to be too far towards reliance on the operators.
- There should be a clear link from the site alarm philosophy to major accident hazard risk assessments.
- Alarm systems need continuous management and improvement – in particular, there should be a good link between modification/change processes and alarms.
- Alarm management is primarily a design issue, trying to put matters right later is much more difficult.

If your alarm system is good then:

You will never have a problem noticing alarms because they are:

- well positioned
- bright/loud enough to be seen/heard
- located in frequently manned areas

You will never be 'swamped' by lots of alarms appearing all at once

If several alarms appear, you will know from training and procedures how to deal with them

The system will not produce an alarm for routine conditions – only where there is a problem

You will not receive many 'false' alarms

You will follow strict procedures if you need to suppress or override an alarm

You will not have any long-term 'standing' alarms (permanently lit up or sounding)

Everyone on site, including contractors and visitors, will know what to do if an alarm appears and will know when and how to raise an alarm

Alarm messages on the alarm panel or on screen are helpful (they describe the alarm cause clearly and what you should do)

Learning more about alarm handling

Problems with alarm handling are of two types: problems with the design of the alarm system, and problems with the procedures for handling alarms. The table below is based on modern alarm guidance. It will help you to identify some of the main alarm handling problems you may have in your workplace and suggest what to do about them.

PROBLEM	POSSIBLE SOLUTIONS
DESIGN	
Masking – alarm sound is not heard above typical noise levels; alarm drowns out communications - lit up alarm cannot be seen above typical lighting levels	Raise alarm volume to 10dB(A) above other workplace noise; allow operators to lower the volume of alarms once they've sounded. Make alarm bright enough for all expected conditions; use colour to highlight the alarm; accompany visual alarm with a sound
Flooding – more alarms than the operators can deal with are presented at once	System should be designed to filter out or suppress unnecessary alarms and to present alarms in priority order; operators may need clear procedures and training on how to prioritise their actions
Difficult to tell one alarm from another – sounds or lights are very similar	Use 'coding' (e.g. different sounds; pulsing of sounds; different colours; flashing) to show importance of alarms and group by the safety function to which they relate
Nuisance alarms - false alarms, 'fleeting' or standing alarms	Change set points, hysteresis or dead bands to make the system less sensitive to short duration unimportant fluctuations. When alarms are expected (e.g. during testing and maintenance) and these cannot be overridden, use tags to indicate they are being tested
ORGANISATION/PROCEDURES	
Operators do not have enough time after the alarm commences to take the right action	Set the alarm levels to show the progress of an alarm situation e.g. a tank overfill alarm sounds at 'high' level then again at 'high high' level
Alarms are missed because the area where they appear is not constantly manned	Install 'repeater' alarms in several places; enforce manning of key operating areas
Operators experience other problems with alarms such as irrelevant and unimportant information being given or poor alarm names being used	Include operators in making suggestions about alarm problems and in suggesting solutions; check solutions against recommended guidance (see references)
Alarms are produced when a warning signal would do (alarm is attached to an event that is safety critical)	Alarms are designed against a risk assessment that identifies what plant conditions should produce an alarm
Alarms are in place because it's too difficult to automate the process – puts the responsibility on the operator to act	Design alarms according to good practice principles (see references) – beware not to overload the operator

Solving alarm problems will require persistence and patience. You will need to collect information on what the problem is – by asking people! – then you will need to persuade management to make improvements. You can change some things easily – others may take a long time.

References

1. 'Better Alarm Handling', Chemical Information Sheet 6 (2000), HSE Books (available free via HSE Books website www.hsebooks.co.uk)
2. 'Alarm systems, a guide to design, management and procurement', Engineering Equipment & Materials Users Association publication No 191. ISBN 0 8593 1076 0.
3. Bransby, M L and Jenkinson, J, 'The management of alarm systems' (Contract Research Report 166), HSE Books 1998, ISBN 0 7176 1515 4.