

SPECIFIC TOPICS

Specific topic 1: Alarm handling

Introduction

Alarm handling (or alarm management) is an issue for any site or process where there is claimed reliance on human response to an alarm to control major accident hazards. This can range from sites with a small number of alarms (e.g. small storage sites) up to sites with a central control room and a fully distributed control system (DCS). The principle is the same though – assuring the human response to alarms through e.g. good interface and system design, monitoring and review; competency arrangements; procedures.

The Engineering Equipment and Materials Users Association (EEMUA) has produced guidance on the design and optimisation of alarm systems for industrial processes such as chemical plant. The aim of this guidance is to help engineers develop alarm systems that are more useable and which result in safer and more cost effective operation.

Alarm management is primarily a design issue, for example, it is one key issue for control room design. Wider control room design issues (from **ISO11064 ‘Ergonomic design of control centres’**) are based on seven principles for human-centred design & consist of: ergonomic design framework; control suite arrangements; control room layout; workstations layout; displays, controls & interactions (includes alarms); and environmental ergonomics.

Trying to put matters right later is much more difficult and so the EEMUA review process is time and resource-intensive; therefore companies need to manage such reviews as a major project. Alarm systems need continuous management and improvement

The overall control philosophy is crucial – can the balance of manual versus automatic control be justified (What is automated and why? Beware – what is hardest to automate is often what gets left for operators to do!)

Do companies recognise that even fully-automated trip/ESD systems can fail or part-fail? Check how they assure operator decision making in or after a major upset and on restart and if competence assurance arrangements cover all foreseeable operating conditions (**NB** role of simulators/simulation for upset or abnormal conditions).

Key principles

- **Usability** – does the system meet user needs & operate within their capabilities;
- **Safety** – identify the safety contribution of the system; human performance / reliability claims should be soundly based;
- **Performance monitoring** – initial design, commissioning then audit – commitment to review / continuous improvement;

- **Engineering investment** – structured design method – justify & engineer all alarms – there should be a justification for each alarm documented (in effect this is what a later alarm review does but at a later and more difficult stage).

General

Very often, older systems will be likely to have been designed better for normal state operation than for upset/emergency.

Management of change (including organisational change impacting directly or indirectly on the control room operation/operators): is there a good link between modification/change processes and modifications to, or introduction of, new alarms?

Balance of control/allocation of function: is this right for the hazards/risks and system as whole? For example 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.

Is there a clear link from the site alarm philosophy to MAH risk assessments? Is any review or prioritisation programme based on the priorities – and the claimed reliability of operator/ESD arrangements – in the assessment?

The Human Factors Team have developed and published an information sheet on alarm handling.

Specific documents

In addition to the general documents that should be requested prior to the visit (see chapter 'Aim of the Guidance') it is recommended that the following documents, which are specific to this topic, should also be requested:

- Details of alarm handling philosophy;
- Documents relating to any alarm review – e.g. list of alarms, their purpose and the required operator response.

Enforcement and advice

Alarm handling has been the subject of two major interventions at refinery sites and raised as an issue at many other visits. It's vital that significant (i.e. more than 300 alarms) new DCS systems going in are designed to EEMUA principles and we should enforce on this. For existing systems enforcement to carry out a review is appropriate where there is evidence of problems (e.g. large numbers of standing alarms on the system). HF and process safety support is likely to be needed for both.

A more detailed question set than the one below is available if needed. Please contact the Human Factors Team for a copy.

Major intervention at BP Grangemouth including examination of alarm handling.

Guidance

- **The explosion and fires at the Texaco Refinery, Milford Haven, 24 July 1994**

- **Alarm systems, a guide to design, management and procurement**, EEMUA Publication No 191, detailed guidance for designers and essential for alarm system managers/engineers
- **Better alarm handling**, Chemicals Sheet No. 6
- **Training on alarms management**, EEMUA & 4-sight Consulting
- **The management of alarm systems**, Contract Research Report 166/1998, detailed guidance for designers

Question set: Alarm handling

	Question	Site response	Inspectors view	Improvements needed
1	What size of alarm system is involved? How many installed alarms per operator?			
2	Is there a site strategy or philosophy (and a site version of any corporate one)?			
3	Is there a commitment to continuous improvement?			
4	How are alarm modifications handled?			
5	What is the process for new projects?			
6	Have the current alarm systems been reviewed? <ul style="list-style-type: none"> • What was the outcome of the review? • Is it being implemented? 			
7	Is the system 'context sensitive'? <ul style="list-style-type: none"> • Does it recognise different operational states and the different operator needs e.g. normal/upset/emergency & what has and hasn't occurred? 			
8	How is the competence of all those involved assured (e.g. designers and users)?			
9	Are safety-critical alarms clearly distinguished and separately displayed (and hard-wired)? <ul style="list-style-type: none"> • In design the target number for critical alarms is 20. 			
10	How are the alarms prioritised? <ul style="list-style-type: none"> • Do operators find the categorisation appropriate? • Targets: high priority 5%, medium 15% and low 80% • Target alarm occurrence rates: safety-critical - very infrequently; high priority – less than 5 			

	Question	Site response	Inspectors view	Improvements needed
	per shift; medium priority – less than 2 per hour; low priority – less than 10 per hour			
11	Does the system work currently (discuss with the Operators)? Are key performance measures for the system (e.g. alarm rates) recorded and tracked?			
12	<p>Are there repeating (nuisance) alarms in normal or upset conditions?</p> <ul style="list-style-type: none"> • Targets: normal/steady state: <1 per 10 minutes (1 per 5 minutes is manageable); upset: max of 10 in the ten minutes (20-100 hard to cope with, 100+ excessive). • Is the supporting information adequate (i.e. what to do for each safety-critical or safety-related alarm)? • Are any procedures compliance audited? 			
13	<p>Is there an adequate alarm log/history?</p> <ul style="list-style-type: none"> • What information is recorded? • How is the information used? 			
14	<p>Is the alarm list clear and easy to navigate?</p> <ul style="list-style-type: none"> • Are different alarm priorities distinguished on screen e.g. by colour/sound? • Is there a clear process overview (plant detail mimic) with adequate information including alarm details? • Is the alarm list clear? (Best is a page design - like a book, with a font and size that can be read standing back from normal VDU sitting position e.g. to allow conferring with supervisor). • Can the alarm list be filtered e.g. by priority or plant area? • Can alarms be silenced before being studied/accepted? (Essential feature) • Resetting of alarms should only be possible if 			

	Question	Site response	Inspectors view	Improvements needed
	cleared (ie have returned to normal) and accepted by operator			
15	Are emergency arrangements adequate? <ul style="list-style-type: none">• Are there enough people available at all times (especially out of hours) to cover for emergencies?			