HUMAN FACTORS

BRIEFING NOTE No. 6

Safety critical procedures

Procedure: written instruction describing how to carry out a job of work. May be on paper, including diagrams, flowcharts etc, or be presented on a computer screen – this briefing note focuses on safety critical procedures but the principles apply to all procedures.
Safety critical procedure: describes a procedure for a task which, if carried out incorrectly or not at all, could lead to serious plant damage, loss of containment, injury or fatality.

Why procedures?

"There have been numerous recorded incidents where failings by operators have been the major contributing cause of major accidents. Provision of clear, concise and accurate operating procedures is the most effective measure to prevent, control and mitigate such events…Adequate training should be provided to ensure that operators are fully conversant with written procedures." Source: HSE COMAH web pages http://www.hse.gov.uk/comah

Documented procedures are required as part of a safety management system. If they are difficult to use or if there are other problems with them as described in this briefing note, then it's likely that the system for producing procedures is at fault and needs to be overhauled. Procedures are not required for all tasks but are most useful for difficult or infrequently performed tasks (start-up/shutdown, emergency, key maintenance tasks) they provide a consistent and safe means of performing tasks, and they are useful in training.

Failure to comply with procedures typically arises not because of their users' attitudes or ignorance but because of faults with procedures themselves, for example: they are poorly-written, difficult to find, not logically structured, contain assumptions (e.g. 're-assembly of the device is simply the reverse of dis-assembly'), or they do not cover unusual circumstances. Briefing note 12 is on the subject of human errors and violations – otherwise known as non-compliance with procedures or rules – and includes some useful further information and references on this subject.

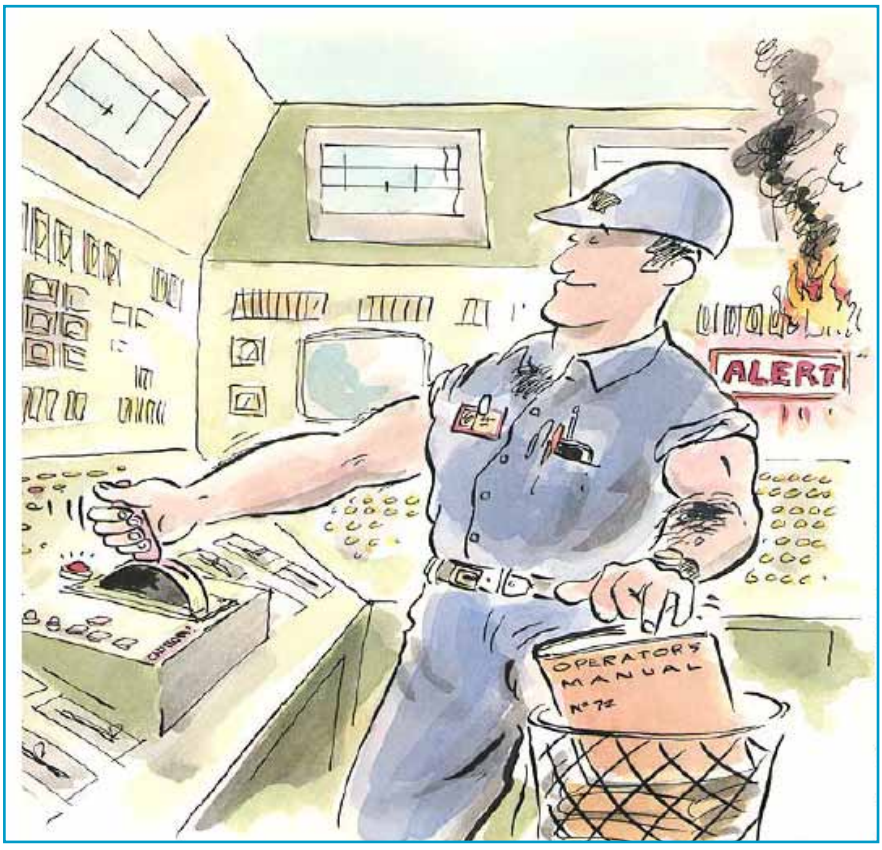
Has anyone who uses written procedures for a job found the following problems?

If the answer to any of the following questions is 'Yes', then you should take action!	Yes	No
1. Some jobs that should have a written procedure don't have one?		
2. It's easier to do some jobs without the procedure?		
3. Some procedures are out-of-date (or just out of step with how the job is actually done)?		
4. The words or diagrams used in some procedures are too small, too faint, complicated, too detailed or not detailed enough, or badly laid out?		
5. There are often problems finding the right procedure?		
6. The available procedures are often dirty or damaged?		
7. It's very difficult to use emergency procedures in an actual emergency (judging by training or experience)?		
8. If a list of tasks in a job had to be ticked off as each one is completed, this is sometimes skipped or the ticks filled in all at once?		
9. Training in the use of procedures is poor (infrequent, not done at all or done badly)?		
10. Procedures have been developed without any input from the user?		

What should my company do about it?

There follows some guidance on the design and use of procedures. Procedures should be:

- Easy to obtain when needed (and it should be obvious when one is needed and which is the right one).
- Fit for purpose – a laminated pocket guide or a large manual? Flowcharts and checksheets, or text etc.
- Complete – contain just the right amount of information (including pictures and diagrams).
- Accurate and up-to-date (signed and dated to show who authorised them and when they need to be reviewed).
- Written based on a formal task analysis and risk assessment of the task to be done – and the people who actually carry out those tasks should be involved in the analysis and writing process.
- Tested, where possible, on the plant before being used 'live'.
- Clear about what happens next – if an instruction is given (e.g. 'start pump NW16') it should then make it clear what the effect will be ('pressure on gauge EB5 will begin to rise'), unless it's obvious.
- Realistic – it should be feasible to carry out the actions in the procedure given the equipment, people and amount of time available.
- Easy to 'navigate' – with a short description of the whole job at the front, a good contents page and index, flowcharts, and clear cross-references where needed in the main body of the procedure.



Courtesy of Human Reliability Associates©

CASE STUDY 1

On 20 April 2005 BNFL discovered a serious leak from a pipe that held radioactive material at their THORP plant in Sellafield. Incident investigators found decisions had been made to change operating procedures and that these had introduced added stress on the pipe and caused a rupture. Investigators could find no procedure for auditing how these decisions were made; in addition, the procedures for approval of design changes were not followed. Investigators recommended a review of change control processes and steps to ensure compliance with audit procedures.

Source: *Report of the investigation into the leak of dissolver product liquor at THORP, Sellafield*. HSE 2005.

There are also many guidelines on language and layout of procedures. The most important are that procedures should:

- Use terms that the user will know, but avoiding slang or terms used only locally.
- Contain a glossary of terms and abbreviations (use abbreviations in full the first time they are used in any procedure).
- Use short sentences.
- Write 'actively' (e.g. 'remove the access cover' rather than, 'the access cover should be removed').
- Be as precise about actions as possible (e.g. 'open valve XP1 half a turn only' rather than 'crack open valve XP1' and 'hold the button down for 10 seconds' rather than, 'for a short time').
- Set out actions in the right order – e.g. 'isolate the 75 kV supply. Carry out step 5', rather than, 'perform step 5 above after isolating the 75 kV supply'.
- Emphasise any hazards and precautions, personal protective equipment (PPE) requirements and warnings with capital letters, bold text, or other highlighting.
- Avoid negatives where possible (e.g. 'wait until the pipe has fully depressurised: then start drilling', rather than 'do not start drilling if the pipe has not been fully depressurised').
- If long, have aids for keeping track of which step has been reached (tick boxes, markers etc.)
- Avoid complicated or ambiguous language.
- Avoid using different terms for the same thing.

Many of the above principles apply equally to labels on equipment, wording on visual display unit (VDU) screens, posters, signs and other types of written material.

Management responsibility

Management should make sure they are familiar with modern standards for designing procedures and should actively champion work to improve existing procedures. They should also regularly check that procedures are being used and be prepared to make changes if the procedures or related systems, such as training, are at fault. Procedures and training should be integrated i.e. training should complement procedures used for the job. Management should ensure that procedures and job aids are being used as a supplement to and not a substitute for other means for reducing task failure, such as thorough training and raising risk awareness, and should avoid simply writing another procedure in response to an incident. Management must be clear on which of their safety critical tasks require procedures, identified using (for example) risk assessments.

CASE STUDY 2

An interlock system on a pig launcher could be defeated, allowing valves to be operated out of sequence. The report on this states that "this latent defect came to light when the operational procedure was reviewed by a fresh pair of eyes," and recommends: "Where there is reliance on procedural control to supplement interlocks, this should be made clear in operating instructions and operator training – and consideration should be given to improving the interlocking arrangements. Operators should be encouraged to review and challenge the detail of routine operational procedures, with a view to identifying and eliminating latent risks and failure modes."

Source: Step Change in Safety incident alert 163 (http://www.stepchangeinsafety.net).

Measuring performance

Below is a sample of performance indicators that could potentially be used to monitor how effectively safety critical procedures are being managed, divided into leading indicators (showing that a problem may occur in future) and lagging indicators (showing that there is currently a problem). See Briefing note 17 *Performance indicators* for more information on using performance indicators.

Leading indicators	Lagging indicators
Number or percentage of procedures documented/up-to-date/ within scheduled review date, or as compared with total number of procedures. Percentage of procedures meeting quality criteria/number of errors found in procedures (based on procedural walkthroughs undertaken by managers and operators to confirm appropriateness). Backlog of procedures updates. Number or percentage of safety critical tasks for which appropriate procedures are in place. Percentage of permits to work (PtWs) reviewed and considered fit-for-purpose.	Number of violations of procedures. Number of incidents/accidents citing problems with procedures.

CASE STUDY 3

Following a series of errors during process isolations prior to maintenance, an offshore oil and gas platform management team conducted a study to identify common error sources, and any factors which made errors more likely. This included a review of the permit to work system and isolation procedures, to ensure they were tolerant of human error. After implementation of the study's recommendations, the error rate declined by 66%, and potential consequences also reduced.

Source: Maitland, J et al (2008) Presentation at Ergonomics Society Oil and Gas Conference, Manchester, October 2008.

Further reading

- HFRG/HSE (1995), *Improving Compliance with Safety Critical Procedures: Reducing Industrial Violations*, Human Factors in Reliability Group. HSE Books.
- HSE, *COMAH safety report assessment guidance - operating procedures* http://www.hse.gov.uk/comah/sragtech/techmeasoperatio.htm.
- Hartley, J (1981), *Designing instructional text*, Kogan Page.
- Zimmerman, CM and Campbell JJ (1988), *Fundamentals of procedure writing*, Kogan Page.
- HSE (1999), *Reducing error and influencing behaviour*, HSG48 HSE Books.
- HSE, Briefing Note 4 *Procedures* http://www.hse.gov.uk/humanfactors/majorhazard/index.htm.
- HSE, COMAH Core Topic 4 – *Reliability and usability of procedures* http://www.hse.gov.uk/humanfactors/comah/core4.pdf.
- HSE, *Revitalising procedures* http://www.hse.gov.uk/humanfactors/comah/procinfo.pdf.
- Indicator (2008), *Safety procedures that work*, http://plus.indicator.co.uk/healthandsafety.
- AIChE, Centre for Chemical Process Safety (1996), *Guidelines for writing effective operating and maintenance procedures*.

For background information on this resource pack, please see Briefing note 1 *Introduction*.