IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No. 86

CONTENTS

Most of the items in this Newsletter are concerned with human error. There is a common theme running through them. Every man will make occasional mistakes even though he is well-trained, well-motivated and physically and mentally capable of doing the job; he will make more mistakes if he is distracted or under stress. We must therefore expect occasional mistakes. Sometimes they do not matter, but if their consequences are serious it is no use telling people to be more careful; we have to redesign the work situation.

Safety Note 74/7A (summarised in Newsletter 75/6) gives some estimates of the frequency at which mistakes will be made by the average man.

Every man is different and we cannot predict the errors he will make or even the probability that he will make an error. But if we consider a large number of people, we can be reasonably certain that errors will occur and we can, in many cases, make a rough estimate of the number.

Newsletters 66/3 and 74/3 described accidents which occurred because someone pressed the wrong button.

Newsletter 68/2 described two fatal accidents which occurred because operators opened equipment under pressure before blowing off the pressure. Every day equipment which has been under pressure is opened up but this is normally done under clearance — one man prepares the job and another opens up the vessel. The two fatal accidents happened under unusual circumstances — when one man does the whole job — and uses quick release fittings instead of nuts and bolts.

Whenever this happens it is inevitable that sooner or later, through oversight or neglect, an attempt will be made to open the equipment while it is under pressure. Devices are therefore needed to prevent anyone doing so. See Newsletter 68/2 for more detail.

86/1 AN OPERATOR CLOSES A VALVE AND CAUSES AN EXPLOSION

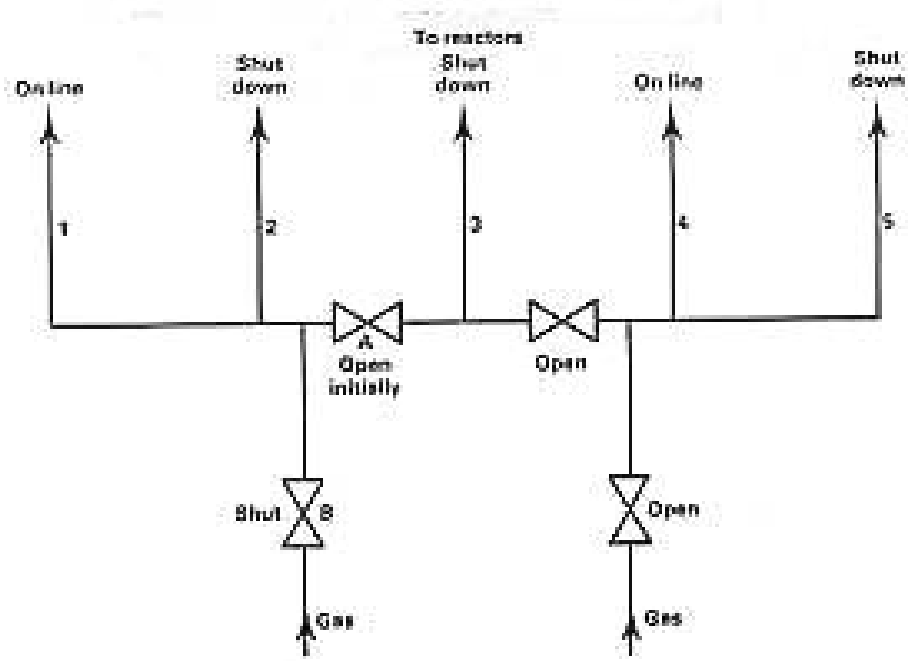
The diagram shows part of a plant, in another company, in which there are five reactors in parallel. There are two gas feed lines with cross connections between them. Oxygen is also fed to the reactors, but the oxygen lines are not shown. At the time of the incident only two reactors, Nos 1 and 4, were on line.

The operator thought valve B was open so he shut valve A. This stopped the flow of gas to No 1 reactor. The oxygen flow was controlled by a ratio controller, but it was out of zero and a small flow of oxygen continued.

When the operator realised his mistake and restored the gas flow the reactor contained excess oxygen and an explosion occurred, not actually in the reactor but in the downstream waste heat boiler. Four men were killed.

Here we have a situation where simple error by an operator produced serious consequences. The explosion was not however the operator's fault but the result of bad design and lack of protective equipment.

We would never knowingly tolerate a situation in which accidental closing of a valve resulted in the overpressuring of a vessel; we would install a relief valve. In the same way accidental operation of a valve should not be allowed to result in an explosion or runaway reaction.



86/2 PRESSING THE WRONG BUTTON AGAIN

Newsletters 66/3 and 74/3 described incidents which occurred because somebody pressed the wrong button. The Supplement to *Occupational Safety and Health*, October 1975, described an incident which occurred in a pipe-coating plant. Two men were fixing blades to the equipment in No 2 unit. A third man wanted to start up another unit. For some reason he pressed the wrong button and No 2 unit started to move. One of the men was killed.

The cause of the accident was not, of course, the third man's error, but the lack of a proper permit-to-work system. The equipment on which the men were working should have been electrically isolated by defusing or locking-off.

86/3 HOW OFTEN IS THE WRONG VALVE OPERATED IN ERROR?

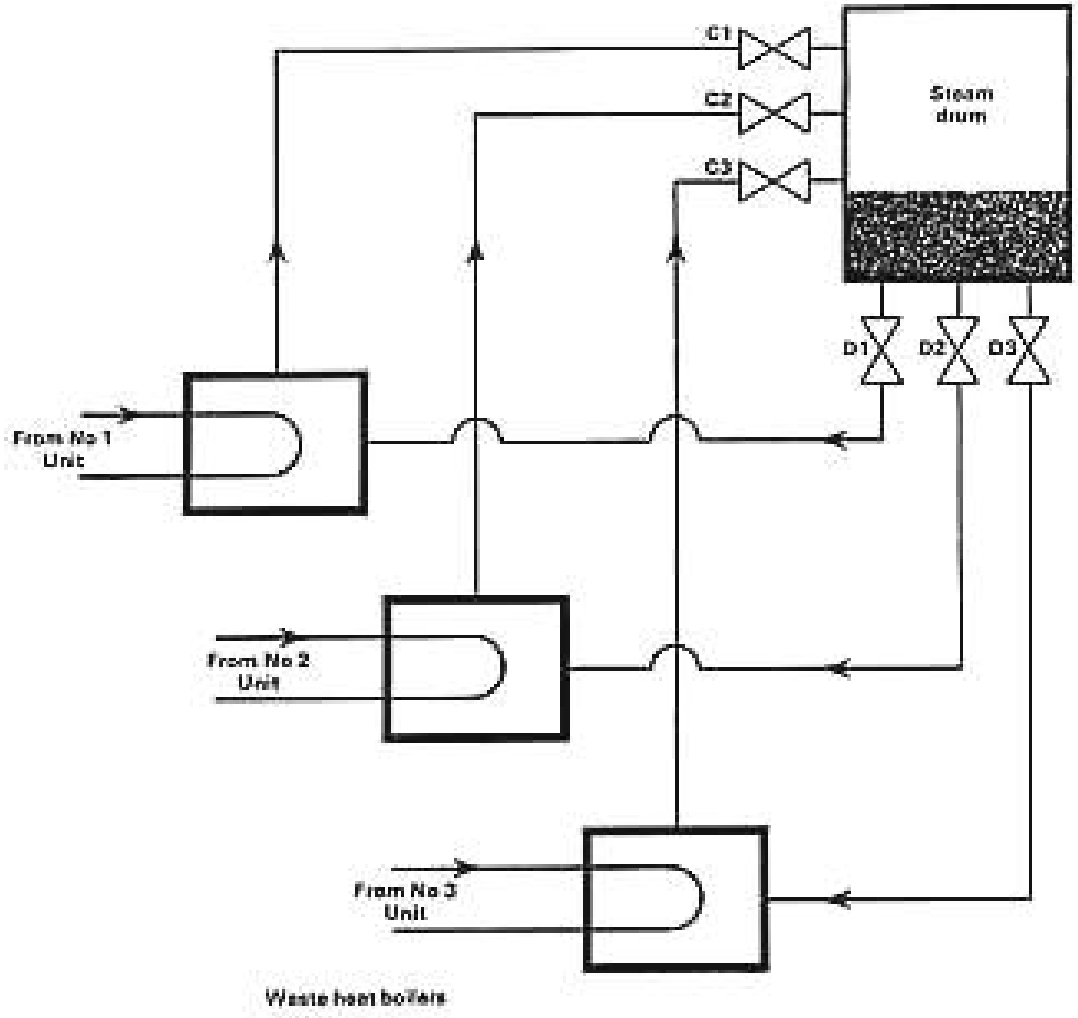
In a plant in one of our overseas companies a hot process stream is used to raise steam. Three waste heat boilers in parallel share a common steam drum.

No 2 unit had been shut-down and Nos 1 and 3 units continued on line. An operator was asked to close valves C2 and D2. Instead of closing D2 he closed D3; the two valves are close together.

After an earlier, similar incident high temperature alarms were installed on the waste heat boilers. The alarm on No 3 boiler came in and the supervisor went to investigate but by this time the waste heat boiler had been overheated and three tubes were damaged.

At one time, following an incident like this, it would have been considered sufficient to blame the operator — and hope he would never close the wrong valve again.

However, on the plant concerned they looked at the problem in a different way. They estimated that 135 valve operations on the waste heat boilers are carried out every year. Even if the operators make one mistake in 1000 operations — a very low error rate — this is one error every seven or eight years — a frequency that is too high to be acceptable because of the damage that could result. An interlock system was therefore installed to prevent the wrong valves being closed.



[Note added later: Would it have been sufficient to colour code the valves, one colour for C1 and D1.another for and C2.ano D2 and at third colour for C 3 and D3?]

86/4 SOME QUESTIONS I AM OFTEN ASKED?

20—IN OUR DESIGNS, SHOULD WE ASSUME THAT PEOPLE MAKE MISTAKES?

"We cannot install enough safety devices to correct for improper operation or maintenance of a facility. Safety devices are intended primarily as a protection against unusual conditions which operating personnel cannot cope with rapidly enough through normal procedures."

K FitzPatrick, "Safety in High Pressure Polyethylene Plants," AICh E, 1973, p39.

I suggest that in addition, safety devices should be designed to cope with those errors in operation and maintenance which experience shows are liable to occur, and which can have serious results.

According to the law, a person "is not, of course, bound to anticipate folly in all its forms, but he is not entitled to put out of consideration the teachings of experience as to the form those follies commonly take". (A House of Lords judgement quoted in "The Guardian", 7 February 1966 and originally quoted in Newsletter 40/9).

Folly apart, well-trained and well-motivated men make occasional mistakes, and we should allow for these in our designs.

86/5 A COMMENT FROM A READER

"I asked process personnel what they would do if a specific demand arose. Senior people shared my optimism; 9 out of 10 successful interventions, or even better. But the junior supervisor and panel man had different ideas and their fingers are nearer to the button. They see the existing high integrity protective system (HIPS)as security which allows them more time to keep the job on line.

I conclude that when high integrity protective systems are installed, assessments of probability of successful operator intervention should be pessimistic, say 1 in 4 or worse, because of the sense of security developed in the panel man as soon as he sees the HIPS installed.

If you give a man braces to wear then he is less inclined to grab for his trousers when his belt snaps."

86/6 ERRORS AT SUPERMARKET CHECKOUTS

A survey carried out by a consumer group (*Cleveland Consumer*, No 84, November 1974, page 7) showed that one bill in ten from a supermarket checkout is wrong. A few errors were due to machine faults, but most were due to errors by the girls. The commonest errors were adding an extra item (for example, charging for five identical items instead of four) or misreading a price (for example, reading 21 upside down as 12). Under charging was as common as overcharging. The older women made fewer mistakes than the younger ones.

So this is one case where it is better to choose a mature woman.

86/7 UNUSUAL ACCIDENTS NO 55

At a conference on reliability, a reliability engineer reported that one evening, on going to bed, he threw his dirty socks into the toilet bowl instead of the dirty clothes basket alongside.

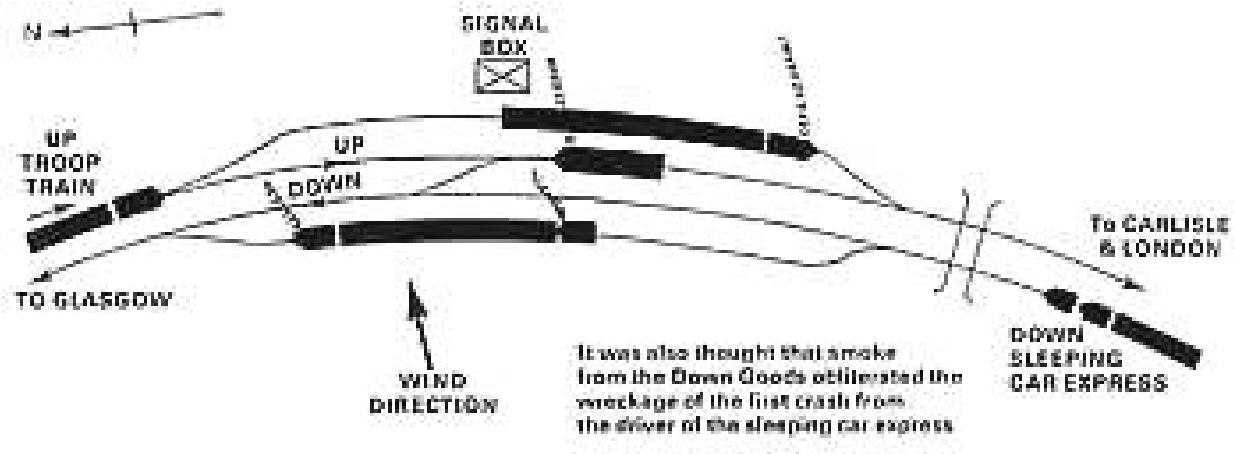
Most of us have made stupid mistakes like this at some time or other.

Assuming the engineer's wife makes him change his socks every day, he takes them off 10,000 times in 27 years. An error rate of 1 in 10,000 is about the lowest that we can expect for any operation, even when there is no stress or distraction.

If the engineer is not willing to accept an occasional mistake of this nature he must re-design the work situation. He should not keep the clothes basket next to the toilet. [See Newsletter 89/8(a).]

86/8 HUMAN ERROR AND THE RAILWAYS

A signalman's error was responsible for Britain's worst railway disaster — the crash at Quintinshill, just north of Gretna Green on the Carlisle-Glasgow line, in 1915. 226 people were killed, most of them soldiers.



The two loop lines were occupied by goods trains and so a slow north-bound passenger train was backed on to the up-line in order to let a sleeping car express come past. The signalman, who had just come on duty, had had a lift from Gretna Green on the slow train and had jumped off the footplate as it was backing on to the up-line. He could see the slow train through the signalbox window. Nevertheless, he completely forgot about it and accepted a south-bound troop train which ran into the slow train. A minute or so later the north bound express train ran into the wreckage. The wooden coaches of the troop train caught fire and many of those who survived the first impact were burned to death.

There were several irregularities in addition to the one major error. The signalman who had just gone off duty (and was still in the box), had omitted to warn the signalman in the next box that the up-line was blocked and had omitted to put a reminder collar on the signal lever. The signalman who had just come on duty, had come on late by agreement with the other man, and was busy catching up with his paperwork. Nevertheless the primary cause of the incident was the failure of the signalman to remember there was a train on the down line, although he could see it from his window and had just got off it.

Both signalmen were sentenced to several years imprisonment and few voices were raised in their defence. It was wartime and many soldiers had been killed. Nevertheless the signalman who forgot about the train was normally a conscientious man and made the sort of mistake which anybody can make from time to time. These mistakes must be expected and will result in occasional rail accidents unless the presence of a train on the line operates a "Track Circuit" which prevents the signal being cleared.

At the time, track circuiting was just coming into operation and the Board of Trade Inspecting Officer wrote that Quintinshill, because of its simple layout, would be one of the last places where track circuiting would be introduced. It did, in fact, not reach this remote spot until the recent electrification of the London-Glasgow line.

For more details see "Britain's Greatest Rail Disaster", by J A B Hamilton, Allen and Unwin, 1969, a very well-written and readable book.

The soldiers in the troop train were on their way to Liverpool to embark for Gallipoli. The other half of the battalion which was following in another train went on there, and suffered even greater casualties.

Similar errors by signalmen have caused other serious railway accidents. See “Railway Accidents of Great Britain and Europe” by A Schneider and A Masé, David and Charles, 1968, and “Red for Danger” by LT C Rolt, Pan Books, 2nd edition, 1966.

For more information on any item in this Newsletter please ‘phone Mrs E.T. (Ext. P.2845) or write to her at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask Mrs T to add your name to the circulation list.

April 1976

Who's Who in Safety?

No. 3 - T A KLETZ

Trevor Kletz was born in Darlington in 1922 but spent most of his boyhood in Chester which he looks upon as his home town. He studied chemistry at Liverpool University and joined ICI in 1944. His first seven years were spent on research, mainly on infra-red spectroscopy, and then in 1952 he was transferred to Oil Works as manager of the iso-octane plant.

He remained in Oil Works, apart from a two-year spell in Technical Department, until the end of 1967 carrying out various jobs and gradually working his way up to assistant works manager.

In January 1968 he was appointed the Division's first technical safety adviser with particular responsibility for process safety. The appointment followed a number of serious fires in the Division in the mid-sixties and was one of the first of its type in the UK. Trevor has taken a special interest in the application of quantitative methods to safety problems.

Until 1968 Trevor had never set foot outside the UK on company business but since then he has travelled widely, visiting the United States several times, Australia, South Africa and Japan and many European countries.

Trevor is married with two sons, aged fourteen and twelve. His hobbies are reading, railways and country walking.