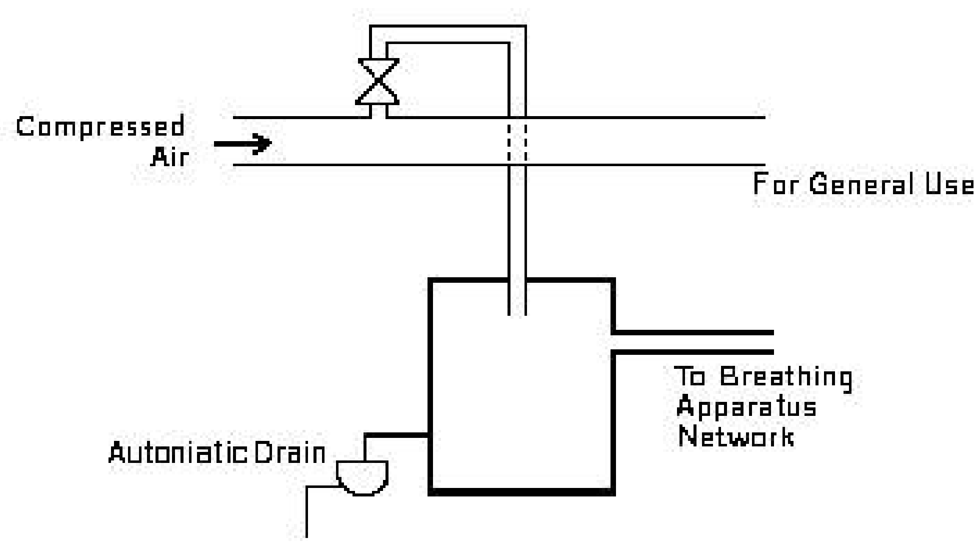
IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No 49

49/1 AFTER 30 YEARS SAFE OPERATION, A PLANT IS ALTERED AND AN ACCIDENT OCCURS

When alterations are made to a plant it is very easy to change something and create a hazard because everyone has forgotten why the 'something' is there.

Thirty years ago a special network of air lines was installed for use with breathing apparatus only. A special branch was taken off the top of the compressed air main as it entered the Works.



For thirty years this system was used without any complaint

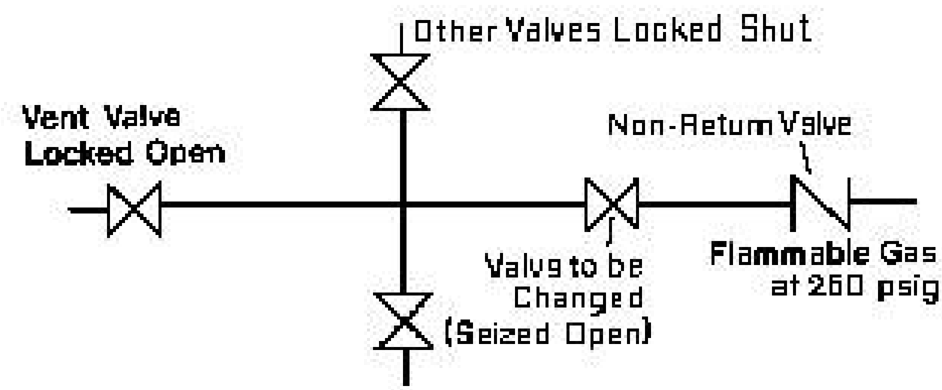
Then one day a man got a face full of water while wearing a face mask inside a vessel. Fortunately, he was able to signal to the anti-gas man that something was wrong and he was rescued before he suffered any harm.

On investigation it was found that a number of alterations had to be made to the system and the branch to the breathing apparatus network had been moved to the bottom of the main. When a slug of water got into the main, it all went into the catchpot which filled up more quickly than it could empty. Unfortunately, everyone had forgotten why the branch came off the top of the main and nobody realised that this was important.

There is no easy way to prevent these incidents. Perhaps it would help if we tried to remember that the men who did our jobs 30 years ago were as clever as we are and if they did something, there was a good reason for it -

49/2 A JOB IS DONE USING A NON-RETURN VALVE AS THE ONLY ISOLATION

A shut-down was avoided by changing a valve on a 1 inch line which was separated from flammable gas at 260 psig by a single non-return valve.



The precautions taken before the job was done are described below for the benefit of anyone else who wishes to use the technique.

1. *Before the job was done the precautions to be taken were described in detail in writing, using a line diagram, and the procedure was scrutinised and approved by the technical safety manager and the assistant works manager.* -

   This is important. Accidents rarely occur because after careful consideration an error of judgement has been made. Accidents occur because well-known precautions are allowed to lapse or because people rush into something without sufficient thought.

2. The NRV was radiographed and a good picture obtained. It showed the NRV to be sound and sealed.

3. Care was taken that the upstream pressure did not vary between taking the radiograph and doing the job.

4. The vent valve was locked open, thus proving that the N RV was not leaking. The other valves were locked shut.

5. The joint was cracked carefully so that it could be remade if there was any leak

   Further points which should be considered are:

6 A slip-plate was not inserted as the valve could be changed just as quickly. On a larger line it might be safer to insert a slip-plate, change the valve and then remove the slip-plate.

7 A trial run could be carried out on a similar type of NRV using a non-hazardous fluid.

8 As a precaution in case the NRV starts to leak, arrangements could be made to inject water or a heavy oil so that they displace the leaking gas or liquid. (But not water if the leaking gas or liquid is hotter than the boiling point of water at the pressure in the pipe-line).

49/3 WOULD YOU RATHER BE A TRAM DRIVER OR A BUS DRIVER?

Newsletter 46, Item 6 described an unusual way of examining a sphere - by filling it with water and inspecting the interior from an inflatable boat.

This item produced a number of comments:

The idea has been used before.

On a previous occasion the inspecting engineer declared the boat redundant and bought it himself.

What prevented the boat drifting away from the wall? (Answer: a magnetic clamp.)

What precautions were taken to prevent the inspector drowning? (Answer: He wore a life-jacket and a life-line and another man kept watch).

Did the damp walls make inspection difficult? (Answer: The normal method of preparing the sphere for entry was to displace the contents with water so it would be damp anyhow).

Is the sphere strong enough to take the weight of the water? (Answer: This must be checked first).

Many thanks to all those readers who commented.

What I liked about the idea was its novelty and the creative thought that lay behind it. Some people call it 'lateral thinking' which means sideways thinking. Most thinking goes along recognised lines, like trams. Lateral thinkers can go off to the side, like buses.

In safety there are too many tram drivers and not enough bus drivers. Too often we solve our problems the same way as in the past despite the trouble and expense. "It is a safety job", we say, "so we have to do it". We do not ask," How else can we get over the problem?"

Item 49/2 above is another good example of lateral thinking. But note how thoroughly the idea was probed before it was adopted. What other ways have been used to change valves or stop leaks without shutting down? One possible method is injecting water and freezing. If you cannot Inject water, can you use cyclohexane (melting point 5°C)? Another possible method is nipping the pipeline (take metallurgical advice first). The Oil and Gas Journal, 30.10.72, p.47, describes how a stopple plugging machine was used to change a leaking valve on a 6 inch line operating at 335°C and 430 psig. Any other ideas?

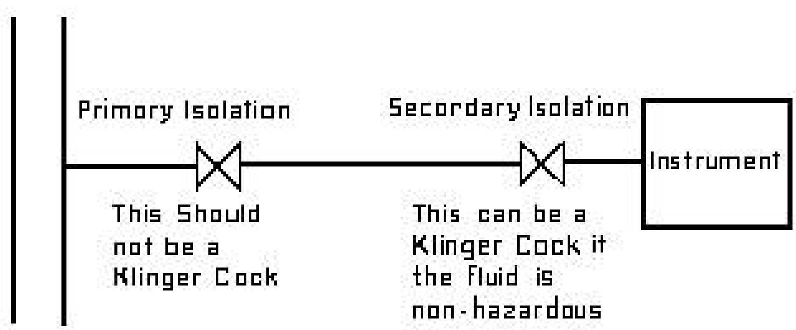
Children are usually better than grown-ups at lateral thinking as they are not put off by the difficulties. A recent Penguin book, "Children Solve Problems", by Edward de Bono, illustrates children's ideas for weighing an elephant, improving the human body, designing a bicycle for postmen and so on. It is well worth reading as a stimulus to our own thoughts.

In designing a machine for weighing an elephant, some of the children paid more attention to ways of persuading the elephant to get onto the machine than to the details of the weighing machine. They realised that software is as important as hardware.

We could do with some child-like ideas for stopping leaks, inspecting vessels or preventing people mixing metric and imperial nuts and bolts (see Item 49/7c below). Any offers?

49/4 KLINGER COCKS

There are hundreds of these in use on our Works, usually on small bore piping leading to instruments. Our current standards do not allow us to use them for primary isolations but if there are two isolations they-can be used for the second, as shown below.



On new plants the first or primary isolation has to be made to the same specification as the main pipeline and cannot be a Klinger cock.

Note that sometimes the primary isolation has to be a "double-block and bleed" (see Engineering Specification PR 0310) and if so all three valves in the double block and bleed have to be made to the same standard as the main pipeline.

The secondary isolation can be a Klinger cock, but only if the material in the pipeline is not toxic, is not irritant and is below its normal boiling point. Needle valves or globe valves should be used for these materials (see Engineering Specification IN 0112 for details).

On older plants there are, of course, many more Klinger cocks in use, and it is impossible to replace them all. Some of them contain asbestos packing and others Fluon packing. Asbestos packing is better when there is a high fire risk but it is more likely to leak in normal use; it is also better when the liquid contains abrasive solids and for ammonia. With clean fluids and a low fire risk, Fluon packing is better but in a fire it disappears and the weight of the handle may open the cock. To decide what packing to use for clean liquids with a high fire risk we have to balance the greater risk in a fire against the increased risk of leakage in normal use and the decision will depend on the location of the cock and the lay-out of the plant —sometimes the right decision is to use asbestos, sometimes Fluon (with the cock placed so that the weight of the handle will not open it) and sometimes the best solution is to replace the cock by a needle or globe valve.

49/5 UNUSUAL ACCIDENT No. 19

In Missouri a woman taking a driving test turned a corner and crashed into a parked car belonging

to the tester.

She failed!

From “Family Safety”, Spring 1972.

49/6 MR S A LAMB

Sidney Lamb retires at the end of February after 38 years service with ICI. He has been a member of Safety & Loss Prevention Group for 4½ years, his particular concern being new legislation, actual and proposed. His quiet, unobtrusive work has had some influence on the Highly Flammable Liquids Regulations and on the Robens Report. Among other activities he has prepared our Codes for benzene and ethylene oxide.

We wish him a long and happy retirement.

49/7 RECENT PUBLICATIONS

(a) During the last few years a lot of data has been collected on the reliability of equipment, particularly instruments. We know how often a pressure switch or a motor valve will fail to operate when required. The next step is to ask ourselves how often a man will fail to take the action we want him to take. Safety Note 72/22 describes the quantitative information that is available on human reliability (there is not very much) and shows how it can be used in plant design.

(b) Safety Note 72/28 summarises the causes of 16 furnace tube failures and the recommendations made in the reports. It replaces the draft note mentioned in Newsletter 46/12d.

(c) A note dated 11 January 73 describes three accidents which occurred as the result of mixing metric and imperial nuts and bolts.

(d) A reprint of a paper which appears in Loss Prevention Vol. 6 describes the ways in which hazard analysis can be used in specifying and designing protective systems.

(e) Have you ever wondered how accident rates vary with age, time of day, shift, temperature, noise, speed of working or anything else? A summary of published work, "A Review of the Industrial Accident Research Literature" was prepared for the Robens Committee and has been published by HMSO, price 57p. It is not very readable but is useful for reference.

For copies of (a)-(d) or for more information on any other item in this Newsletter please write to Miss M.N., Organic House, Billingham or ring B.3927. If you do not see this Newsletter regularly and would like your own copy please ask Miss N to add your name to the circulation list.

February 1973

SUPPLEMENT TO SAFETY NEWSLETTER No 49

The following article has been prepared for readers who have heard of “Area classification” but are not quite sure what it means.

HAZARDOUS AREAS IN PETROCHEMICALS PLANTS

In the petrochemicals industry we handle many highly flammable gases, liquids and powdered solids. To prevent these materials catching fire, we try to make sure that they are kept inside the plant equipment

Occasionally, because of maloperation of the plant or the failure of a component, flammable material will escape and mix with the air and an explosive mixture will be formed. Most fires and explosions start in this way. To prevent fires and explosions we design and operate our plants so that the chance of a leak is small. We also try to make sure that any leaks that do occur are not ignited. It is impossible to get rid of all sources of ignition but we do what we can. In particular, we use electrical equipment that will not ignite leaks of flammable gas, vapour or dust

In order to choose the right sort of electrical equipment we have to decide where leaks are liable to occur, how often they are likely to occur and how far the leaking gas, vapour or dust will spread. We classify every area of the plant according to the chance that there will be a flammable atmosphere in the area. This is called an area classification study and is carried out jointly by members of process, electrical and safety sections.

Those parts of the plant where explosive atmospheres are likely to exist are divided into Division 0, 1 and 2 areas in accordance with British Standard Code of Practice CP 1003. It has now been agreed, both internationally and in the UK, that the term, ‘Zone’ will be used in future instead of ‘Division’. The definitions of Zones 0. 1 and 2 are:-

Zone 0 A zone in which a flammable atmosphere is continuously present or is present for long periods.

Zone 1 A zone in which a flammable atmosphere is likely to occur in normal operation.

Zone 2 A zone in which a flammable atmosphere is not likely to occur in normal operation and, if it does occur, will exist for only a short time.

Areas where flammable mixtures do not occur are known as “safe areas”.

An item of equipment which is liable to leak is known as a SOURCE OF HAZARD.

The following ‘rule of thumb’ can be used to classify sources of hazard and hence zones:-

Source of Hazard 0: One from which a release occurs for a total of more than 1000 hours/year.

Source of Hazard 1: One from which a release occurs for a total of between 10 and 1000 hours/year.

Source of Hazard 2: One from which the release occurs for a few instances totalling less than 10 hours/year.

The size of each zone will depend upon the type of material, that is, if it is gas, liquefied gas, liquid or dust, its temperature and pressure and the size of the leak.

At one time whole plants were classified 0, 1 or 2. Nowadays we classify the sources of hazard and the areas around them. Most plants in Petrochemicals Division are mainly Zone 2, with small areas of Zone 1 around items of equipment that are particularly liable to leak. Zone 0 is rare; an example is the vapour space of a fixed roof storage tank that is not blanketed with nitrogen.

When the hazardous areas of the plant have been identified, the presence of ignition sources within these areas must be rigorously controlled. The red permit-to-work, or clearance, is used to control casual operations involving sparks and flames; the control of fixed equipment must be more specific. The equipment most likely to give rise to a spark is, of course, electrical but other sources of ignition such as diesel engines and furnaces must be considered

In order to make the chance of an ignition of a flammable atmosphere by electrical equipment very small, it is necessary to use special equipment such as flameproof, non-sparking, intrinsically safe, pressurised or purged. In selecting the type of electrical apparatus for a particular application, we rely on the fact that for an explosion to occur a flammable concentration of material and an ignition source must occur at the same time. The type used in a particular area will depend, therefore, on the probability that a flammable concentration of the leaking material will occur near the apparatus: that is, it will depend upon the classification of the area and upon the chance that the particular apparatus will mark or give rise to a flame.

ZONE	Apparatus Approved for Gas or Vapour Hazard	Apparatus Approved for Dust Hazard
0	Intrinsically safe (certain types only)	Intrinsically safe (certain types only)
1	Flameproof	Intrinsically safe
	Intrinsically safe	Pressurised or Purged
	Pressurised or Purged	Dust-tight or Totally enclosed
	(depending on dust characteristics)	
2	Any apparatus specified for Zone 1	Intrinsically safe
	"Non-sparking ' and "Division 2 approved"	Pressurised or Purged
	Type N	Totally enclosed

Some other types not used in Petrochemicals Division have been omitted.

Although apparatus specified for Zone 1 can be used in Zone 2, we would not normally use it as it is more expensive.

A flameproof enclosure is one that is strong enough to withstand an internal explosion of the flammable vapour or gas entering it without suffering damage and without the flame igniting any flammable gas or vapour in the surrounding atmosphere.

In intrinsically safe apparatus, the energy release In these parts of the electrical system located in a hazardous area is limited, under both normal and specified fault conditions, to well below the minimum energy which can cause ignition.

"Division 2 approved", "non-sparking" and Type N apparatus do not spark in normal use but can spark if a fault develops. They are used in Zone 2 areas because the chance of a spark coinciding with a leak is so low that it can be accepted.

When we have to use equipment which does spark in normal operation or is at a temperature sufficiently high to ignite a flammable gas which may be present, then the equipment may be pressurised. This means that the equipment is enclosed in a box, which is pressurised with nitrogen or air, so that flammable gas, vapour or dust cannot get inside the box. Purged equipment is similar but the nitrogen or air is at atmospheric pressure and a continuous flow prevents the gas, vapour or dust getting into the box. Small boxes are pressurised, large ones are purged.

This note is intended only as a summary of the subject of hazardous areas and the equipment suitable for installing in them. For further information see the following:-

1. ICI Engineering Codes and Regulations, Electrical Installations in Flammable Atmospheres, Group C (Electrical), Vol. 1.5 — draft To be issued in the Spring of 1973.
2. Petrochemicals Division Engineering Specification, EL 01 10~ Electrical Area Classification.
3. Petrochemical Division Engineering Specification, EL 0111, Electrical Apparatus for use in Hazardous Areas.
4. Safety aspects of Plant layout — Review of Work carried out 1966 — 1971, H G Simpson, Reports File No. O.21,38WB. 18.5 72
5. Report on the Standard of Electrical Maintenance in HOC Division, Reports File No. 0.21,110/B, E H Frank and V F Lord, 23.7.69.

E S Hunt