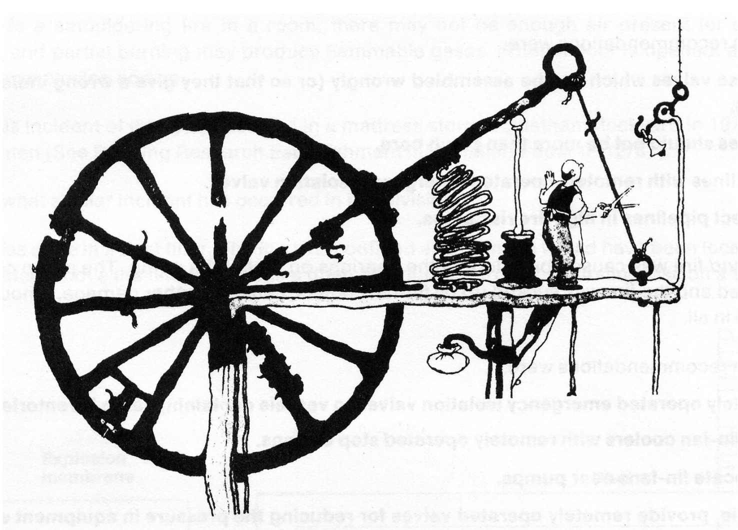
SAFETY NEWSLETTER

No. 154
OLD PLANTS AND MODERN STANDARDS



Best wishes to all our readers for Christmas and the New Year.

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

154/1 HOW FAR SHOULD WE GO IN BRINGING OLD PLANTS UP TO MODERN STANDARDS?

One of the major oil companies had a number of serious fires in early 1981. The recommendations made following the fires are familiar ones, but nevertheless worth repeating.

The *first* fire occurred because a 2 inch plug valve, used for draining water from a liquid butane vessel, was assembled incorrectly. An operator thought it was shut when it was open and fully opened a second valve in series. The escaping butane caught fire and several other lines, including the flare header, failed, adding fuel to the fire. Over 40 tonnes of hydrocarbon burned, causing nearly £1m damage.

The main recommendations were:

Do not use valves which can be assembled wrongly (or so that they give a wrong indication of position).

Drain lines should not be more than ¾ inch bore.

Fit drain lines with remotely operated emergency isolation valves.

Fire protect pipelines in high fire risk areas.

The *second* fire was caused by failure of the bearings on a naphtha pump. The pump could not be isolated and the fire was sucked up by fin-fan coolers, causing further damage, amounting to £500 000 in all.

The main recommendations were:

Fit remotely operated emergency isolation valves to vessels containing large inventories.

Provide fin-fan coolers with remotely operated stop buttons.

Do not locate fin-fans near pumps.

If possible, provide remotely operated valves for reducing the pressure in equipment exposed to fire.

The *third* fire was caused by failure of the seal on a propane pump. This pump was fitted with remotely operated emergency valves but they were not operated. Why? Because before they could be operated, the fire damaged the instrument cables and the valve position indicator in the control room showed closed. Each operator thought someone else had closed the valves. Again the fire was sucked up by fin-fan coolers.

The recommendations repeated those on fin-fan coolers and on fire-protection of flare headers made after the earlier fires. In addition, we would recommend that **emergency isolation valves installed close to a pump or other source of leak should be protected against fire.**

Most of these recommendations are included in the Engineering Practice of the Company concerned and would be incorporated in new plants. However existing plants had not been modified. We cannot bring all our old plants up to modern standards in every respect. It is difficult to improve the layout, though the propane pumps involved in the second fire are being moved. We can, however, easily and at moderate cost fit old plants with:

Emergency isolation valves

Remote stop buttons for fin-fan coolers

Small bore drain lines

Extra fire-protection

See my paper, “Old Plants and Modern Standards”, Loss Prevention, Vol 14, 1981, p 165 and Health and Safety at Work, Feb 1981, p56.

Thought for the month:

Wise men learn by others’ experience; fools by their own.

154/2 FIRES FOLLOWED BY EXPLOSIONS

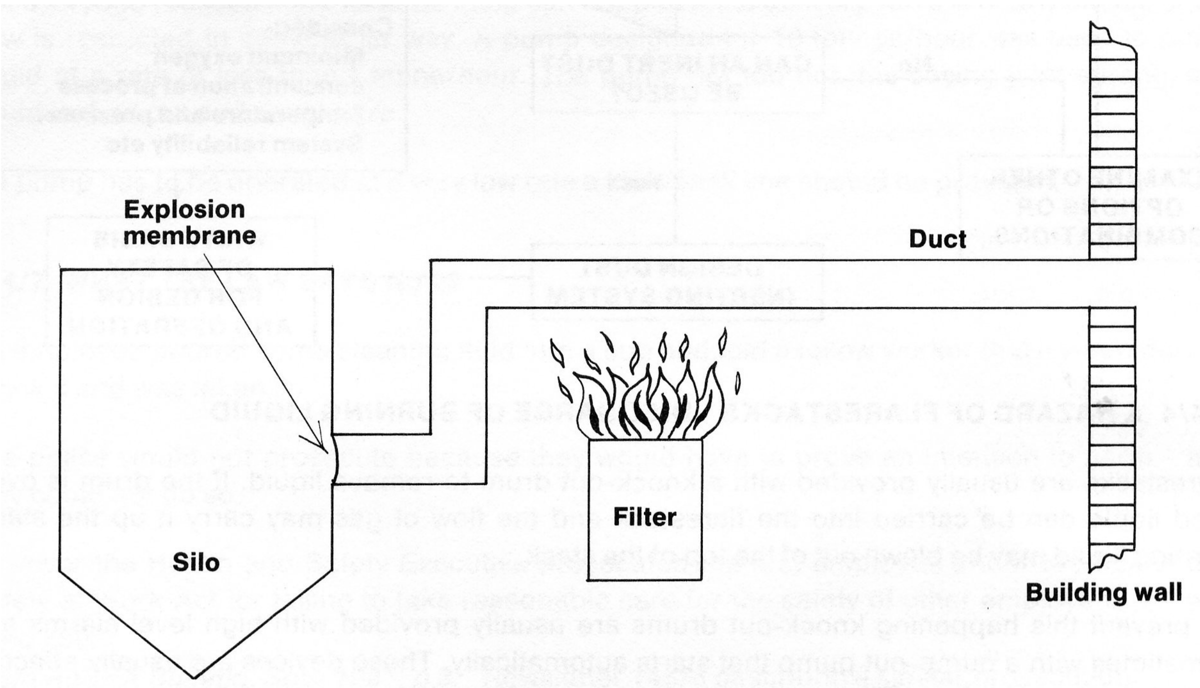
Explosions of gases or vapours are usually followed by fires. It is not always realised that fires can be followed by explosions.

If there is a smouldering fire in a room, there may not be enough air present for complete burning and partial burning may produce flammable gases. When a door is opened, air rushes in and an explosion occurs.

A famous incident of this type occurred in a mattress store at Chatham dockyard in 1975, killing two firemen (See Building Research Establishment Information Paper IP 12/81).

A somewhat similar incident has occurred in the Division.

There was a fire in a dust filter. The fire was confined and damage would have been localised but immediately above the filter there was a duct. The duct led from the bursting disc on a silo to the open air.



The fire heated the duct. There was a deposit of powder in the duct. The powder decomposed and the products of decomposition exploded. The explosion could not fully relieve itself through the open end. It travelled back into the silo, which ended up with curved sides instead of flat ones, and the duct was shattered.

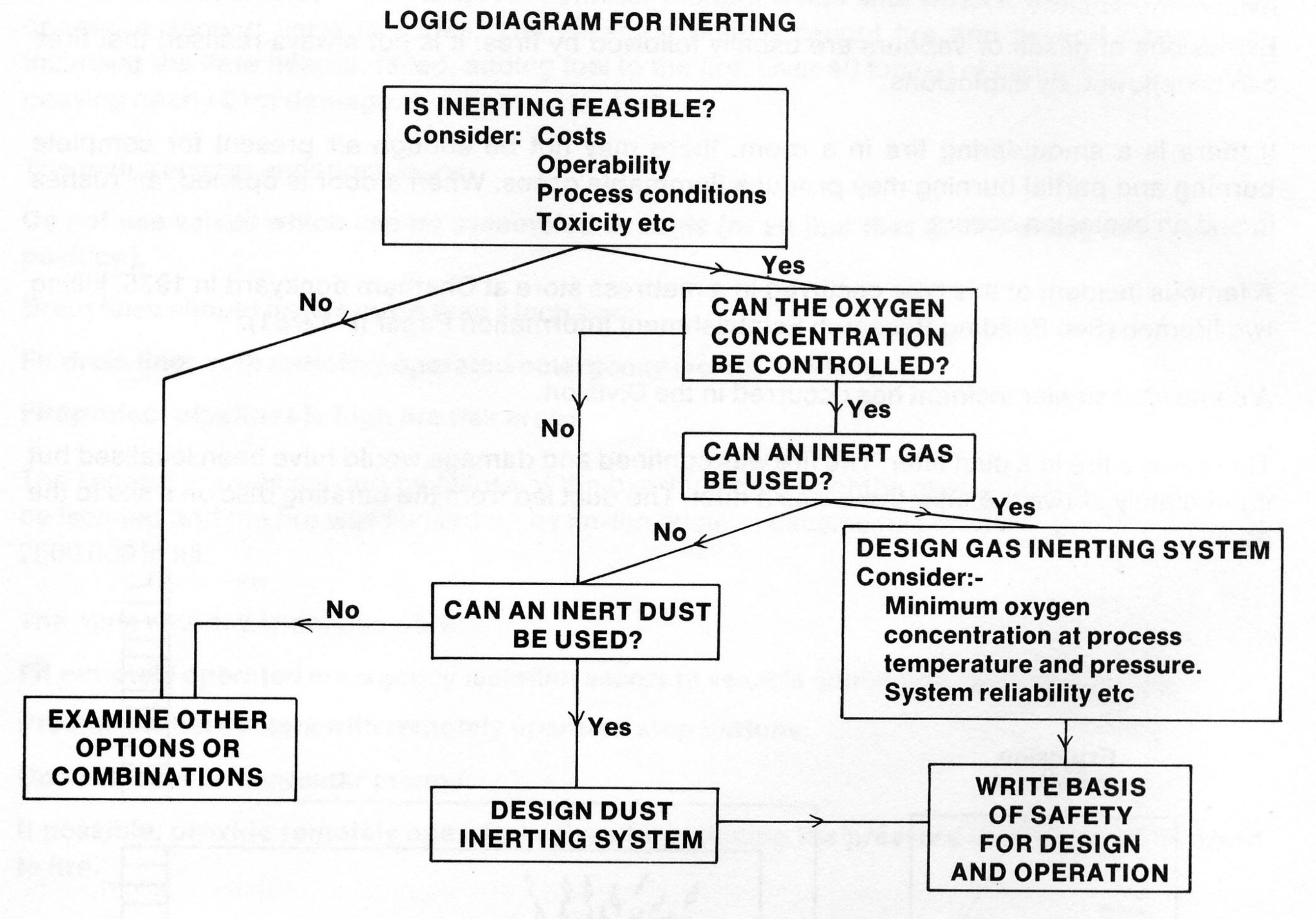
How did the dust get into the duct? It got in through the explosion membrane which was broken. Analysis of the dust showed that the membrane had been broken for some time.

The explosion membrane was fragile and easily broken so should have been inspected regularly. This was difficult. **All safety equipment needs regular inspection.**

Ducts through which explosions are relieved should be straight. Explosions do not like going round bends. Instead they go straight on, through the walls.

154/3 DUST EXPLOSIONS

Process Safety Guide No 7 (Report No HO/SD/70010/7, available from Division Reports Centres) gives advice on the design of systems in which dust explosions could occur. A feature of the report is a series of logic diagrams; an example is shown below. Other diagrams cover containment, venting, exclusion of ignition sources and suppression.



154/4 A HAZARD OF FLARESTACKS - DISCHARGE OF BURNING LIQUID

Flarestacks are usually provided with a knock-out drum to remove liquid. If the drum is over-filled liquid can be carried into the flarestack and the flow of gas may carry it up the stack; burning liquid may be blown out of the top of the stack.

To prevent this happening knock-out drums are usually provided with high level alarms and sometimes with a pump-out pump that starts automatically. These devices are usually effective and it is very unusual for burning liquid to be blown out of a stack.

However an incident occurred recently in the Division. It was then found that the high level alarm on the knock-out drum was reading 50% low and did not sound until “fireballs” were coming out of the stack.

Perhaps you should check the settings on your knock-out pot level alarms and see if any extra protective equipment is needed.

In the recent incident a vessel was vented to the flare system as the pressure in it was high. Unfortunately the vessel was full of liquid and so liquid flowed down the vent line and filled the knock-out pot in half-an-hour.

How long will it take to fill your knock-out pot if there is a flow of liquid into it?

154/5 ANOTHER CHANGE THAT WAS NOT SEEN TO BE A CHANGE

Earlier Newsletters have emphasised the importance of controlling plant modifications — and modifications to the process as well. One of the difficulties is recognising when a modification occurs.

Another company had a runaway reaction in a batch reactor. Addition of a trace of iron would explain the runaway, but how did the iron get into the reactor?

The batch that ran away was the first one after a 4 weeks holiday break and this gave the local Sherlock Holmes a clue.

One of the constituents of the batch is oleum. It is kept in a stainless steel tank but even so during the 4 weeks the oleum dissolved enough iron to catalyse a runaway reaction.

Another modification that was not recognised until too late was described in Newsletter 149/8.

154/6 A LOOK BACK AT NEWSLETTER 54 (July 1973)

Everyone knows that if a pump is allowed to run against a closed delivery valve it may get too hot.

Not everyone realises that the same thing can happen if the delivery valve is nearly closed or the flow is restricted in some other way. A pump designed for 10 tonnes/hour was used to pump liquid at a rate of less than ¼ tonne/hour. The pump got too hot, the casing joint sprang, and liquid leaked out and caught fire.

If a pump has to be operated at a very low rate a kick-back line should be provided.

154/7 WHAT THE LAW SAYS No 23

An employee poured some cleaning fluid into a cup and told a fellow worker that it was cider. He drank it and was taken ill.

The police would not prosecute because they would have to prove an intention to harm — and they could not do so.

However the Health and Safety Executive prosecuted the first employee under the Health and Safety at Work Act for failing to take reasonable care for the safety of other employees. He was fined £50.

From RoSPA Bulletin, Sept 1981, p 3. Newsletter 143/6 described a similar prosecution.

154/8 THE LADY AND THE TIGER — A new version of an old fairy tale.

A king offered a challenge to three young men. Each young man would be put in a room with two doors.

The young man could open either door he pleased. If he opened the one, there came out of it a hungry tiger, the fiercest and most cruel that could be procured, which would immediately tear him to pieces. But if he opened the other door, there came forth from it a lady; the most suitable to his years and station that His Majesty could select among his fair subjects. So I leave it to you, which door to open?

The first man refused to take the chance. He lived safe and died chaste.

The second man hired risk assessment consultants. He collected all the available data on lady and tiger populations. He brought in sophisticated technology to listen for growling and detect the faintest whiff of perfume. He completed checklists. He developed a utility function and assessed his risk averseness. Finally, sensing that in a few more years he would be in no condition to enjoy the lady anyway, he opened the optimal door. And was eaten by a low probability tiger.

The third man took a course in tiger taming.

From WC Clark, in "Societal Risk Assessment", edited by R C Schwing and W A Albers, Plenum Press, London & New York, 1980, p 302.

The moral of the story (for those who like to have parables explained).

The young men represent us all.

The tiger represents fire or explosion or a release of toxic gas. The lady represents our products and the benefit they bring to mankind.

Like the first young man, society can leave the game. We can do without chemical plants and their products, the benefits they bring and the risks they carry.

Like the second young man we can (and do) try to work out the risks and open the safest doors —but we can never be completely safe.

When possible, we should try, like the third young man, to change the work situation, to choose designs or methods of working which eliminate or reduce the hazard.

154/9 UNUSUAL INCIDENTS No 113

During a night when summer time ended, an operator reset the clock on a computer controlled plant.

The computer had not been programmed to deal with reverse flow of time, only forward flow. It did not know what to do, so it sounded a few alarms and shut the plant down.

Perhaps operability studies should consider reverse flow of time as well as reverse flow in pipelines.

For more information on any item in this newsletter please 'phone P.2845 or write to us at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask us to add your name to the circulation list.

December 1981

An Engineers Casebook No 54
STEAM ENGINE CONTROL

It may surprise many readers of these notes to learn that there are steam engines operating in the Division which are nearing fifty years service, and it might be thought that after all these years, and the generations of engineers who have devoted themselves to improving their reliability and efficiency, there would be little left in the way of opportunities for improvement.

However, a recent proposal illustrates that it is never too late to look again to see if even the oldest and well-proven workhorses cannot benefit from some new approach.

In 1934 Bellis and Morcom two-cylinder compound double acting vertical steam engines, rated at 650 brake horsepower at 214 rpm with 245 psig 250°C inlet and 17 psig exhaust steam conditions, were installed, driving high pressure circulators on the "Petrol from Coal" process and they are driving the same circulators on a similar duty today.

The engines are run at a constant speed, controlled by a centrifugal governor which operates the HP cylinder steam inlet valve cut-off and the steam supply throttle valve.

At high power outputs, the throttle valve is wide open and the governor controls the cut-off. On reduced power outputs the engine is controlled at minimum cut-off by governor operation of the throttle valve.

Text books of the 1930's explain the benefits of expansive working of steam at minimum cut-off, the taking and interpretation of indicator diagrams for setting valve timings and showing what is happening inside the cylinders, all of which is relevant today for the efficient operation of these engines.

As one might expect, the engines were oversized for the required circulator power and need to run at minimum cut-off with throttle control only.

The governor control is through levers to an oil operated servo unit from which further rods, levers, cranks and pins operate the cut-off and throttle valve.

Inevitably, there needed to be working clearances between pins, bushes, rods, levers and glands which increase with wear. Thus, although the governor should be controlling the steam supply pressure only, at minimum cut-off, this wear in the linkages results in engine operation at less than the optimum, at above minimum cut-off.

In addition, steam leaks from glands at the cut-off and throttle valve, and the surface areas for heat loss from these large valve castings, result overall in inefficient steam consumption.

A simple solution is to lock the cut-off valve in the minimum position, remove the rods, linkages and gland assembly, blank off and fully insulate the valve housing.

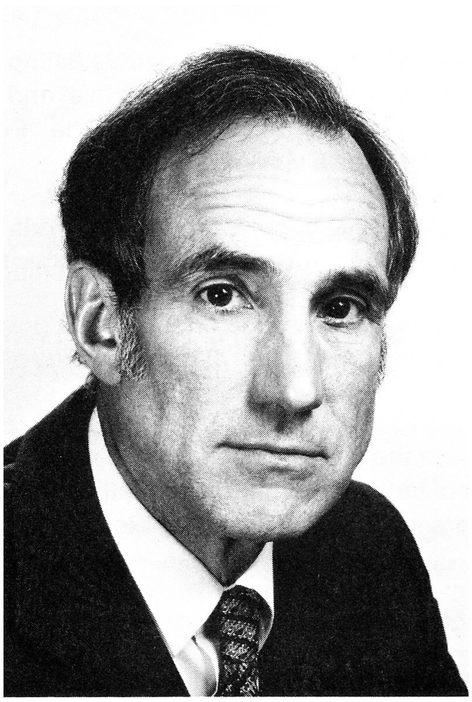
The large throttle valve with its attendant gland, linkages, pins and bushes, the servo mechanism and associated oil supply, and the centrifugal governor, can all be replaced by a pneumatically-operated steam valve, controlled from an electronic tachometer.

The mechanical overspeed trip mechanism to the existing steam supply trip valve can be retained as a proven reliable fail-safe system and it is not a contributor to heat loss or inefficiency.

The resultant improvement in engine steam consumption and reduction in maintenance costs more than justify the cost of new control valves, controllers and tachometers, particularly at today's energy costs.

T T Hay

WHO'S WHO IN SAFETY



No 36 R E JONES

Mike Diggle, Wilton Site Safety, Security and Fire Services Manager retires next March and will be succeeded by Richard Jones.

Richard was born and brought up in the London suburbs. He spent his national service in the Royal Navy where he gained some practical experience of fire fighting with the Fleet Air Arm. He was a member of the RNAS Arbroath team which won the Royal Naval Air Service fire fighting competition in 1948.

After demobilisation he worked for the Building and Civil Engineering Contractors, Richard Costain, and was involved in the building of the embankment along the South bank of the Thames to provide the site for the Festival of Britain and the Royal Festival Hall.

From Costains he went to London University to study Civil Engineering, but later transferred to Mechanical.

Richard joined ICI Dyestuffs Division in 1954 and served a graduate apprenticeship with Peter Brotherhood's at Peterborough. He completed his design and development training at Hexagon House in Manchester and moved to Nylon Works, Billingham, in 1957. He spent 10 happy years at Billingham as a plant engineer and later as Services Engineer.

In 1967 he crossed the river to Nylon Works, Wilton as Services and Workshops Engineer, and later became Section Engineer of the Adipic Acid Plants.

Having lived in Guisborough for 24 years Richard has 'gone native' and regards himself as a Clevelander. He is a widower with 3 children, and when he is not involved with housework he likes to be out of doors dabbling in pursuits such as walking, cross-country running, field sports and industrial archaeology.

He is looking forward to the new job where he will be responsible to Alan Rimmer, the Division Senior Safety Adviser, for Security and Fire Services and safety co-ordination on the Wilton Site.