IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No.88

CONTENTS

88/1 A STEELWORKS EXPLOSION WAS DUE TO A FAILURE TO FORESEE THE RESULTS OF TECHNICAL CHANGE

Eleven men were killed in an explosion at Appleby-Frodingham steelworks, Scunthorpe, only a few miles from Flixborough, on 4 November 1975. The official report (published by Her Majesty's Stationery Office, price £4) shows that the explosion occurred because the results of technical change were not foreseen.

Molten iron at 1500°C was being allowed to run out of a blast furnace into a closed ladle or torpedo, a long, thin vessel, able to carry 175 tons of iron and mounted on a railway truck. The molten iron enters the torpedo through a hole in the top, two feet across. About 2 - 3 tons of water from a leak also entered the torpedo and rested on top of the molten iron, separated from it by a crust of iron and slag. When the torpedo was moved, the water came into close contact with the molten iron and vaporised with explosive violence. Ninety tons of molten iron were blown out and the pouring spout, weighing over a ton, was blown onto the roof of the building.

A flow of water onto the top of molten iron in an old fashioned open ladle did not matter as, when it turned to steam, there was plenty of room for the steam to escape. No-one realised that, when the design of the ladle was changed, entry of water became very dangerous.

The report describes the cause of the water leak in detail — for twenty years plugs had been made of steel, which corroded, instead of brass — but this was irrelevant. If anyone had realised that water was dangerous attempts could have been made to dam or divert it.

Though the report describes the events in great detail, it ignores the fundamental question: What can we do to help us foresee the effects of technical change? Would an operability study have helped?

The explosion was very similar to the slop-overs that have occurred in ICI and in other companies when water has been mixed with hot oil above 100°C. (See Newsletters 3/10, 9/8, 12/4d, 42/8 and 47/8 and Safety Note 73/4).

Official reports by Government inspectors have been published for many years on mining accidents (see Newsletter 70/4), steam boiler explosions (see Newsletter 13/4) and railway accidents (see Newsletter 85/5). This is the first official report on an accident in industry generally. There may be more to come.

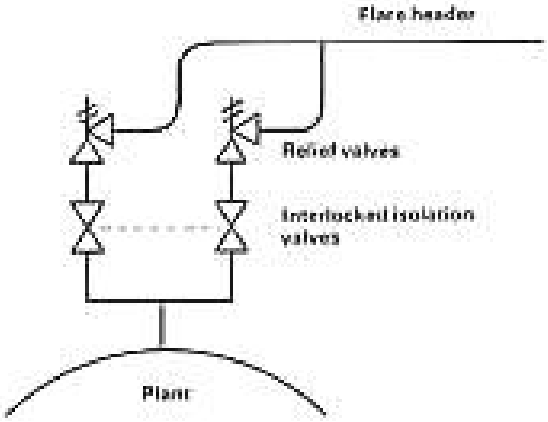
For other examples of failures to foresee the results of technical change see Newsletter 83, especially item E of Part 1. (Gas at -100°C and steam were mixed and no-one foresaw that the steam would condense and freeze).

88/2 A LIQUID RELEASE WHILE A RELIEF VALVE WAS BEING CHANGED

Sometimes a relief valve has to be changed with a plant on line. An interlocked spare is provided so that this can be done.

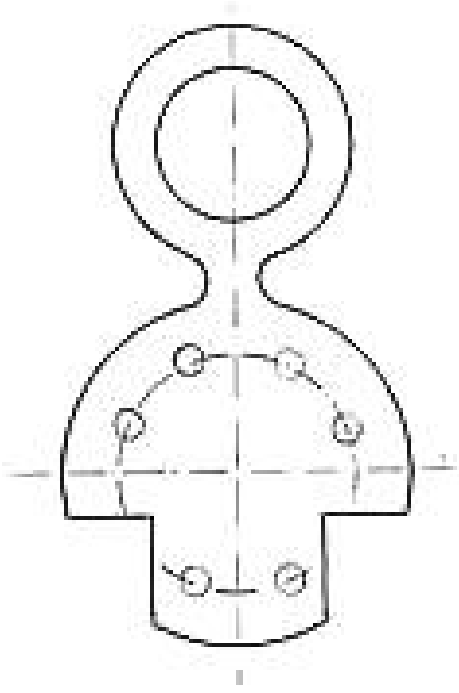
The relief valve is removed and a blank quickly placed over the end of the flare header — before enough air is sucked in to cause an explosion. Later the blank is removed and the relief valve replaced. (Some years ago, on a different Works, an explosion occurred because someone removed a relief valve, and then went for his lunch before fitting the blank).

Recently, while an 8 inch relief valve was being replaced, the on-line relief valve lifted and a considerable quantity of warm petrol came out of the open end. Fortunately, it did not ignite and all the men on the job were able to scramble to safety.



The plant instructions state that before a relief valve is removed or replaced on a plant which is on-line, the people concerned must make sure that the plant is steady and that a relief valve is unlikely to lift. Unfortunately, with the passage of time, this procedure had lapsed. Changing relief valves had become a routine job and more attention was given to the danger of air getting in than to the danger of petrol getting out; previous incidents, such as the one described, were remembered. There were also several other jobs in progress and they demanded attention from the operating team.

The best way to change a relief valve with a plant on-line is to use the special sealing plate shown below (and originally described in Newsletter 1 0/7).



All but two of the bolts joining the relief valve to the flare header are removed; the sealing plate is then inserted and secured by special bolts with small heads that pass through the bolt holes in the relief valve flange, but not through the holes in the sealing plate. The last two bolts can then be removed and the relief valve removed. To replace the relief valve, the procedure is reversed. For details see Engineering Standard TDB 2411.

This system is recommended when changing relief valves on lines greater than four inches bore. On some plants, flanges are provided in the flare lines so that ordinary slip-plates can be inserted. **This system is not recommended as the slip-plates may be left in by mistake. The sealing plate cannot be left in by mistake.**

88/3 TRIPS SHOULD STAY IN WHEN THE BUTTON IS PRESSED

When the incident described in 88/2 occurred, someone tried to trip out a neighbouring furnace by pressing the trip button, but nothing happened. Afterwards it was found that the button had to be held down for 14 seconds — a long time in an emergency.

All trip buttons should be of the fleeting contact type, that is, once the button is pressed, the trip should operate.

Similar incidents have happened before; see Accidents Illustrated No. 6.

How long do you have to hold in the trip buttons on your plant?

Reminder: Trips should not reset themselves when the trip condition is removed. See Newsletter 52/3.

88/4 TEN YEARS AGO —A FATAL ACCIDENT INSIDE A VESSEL

A number of incidents that have occurred during entry to vessels and other confined spaces were summarised in Newsletter 77/1.

Here is another incident which occurred on the Wilton Site ten years ago. For a fuller account see Report No. D.70434/B.

Instrument personnel were working inside a series of new tanks, installing and adjusting the instruments. About eight weeks earlier a nitrogen manifold to the tanks had been installed and pressure tested; the pressure was then blown-off and the nitrogen isolated by a valve at the plant boundary.

The day before the accident the nitrogen line was put back up to pressure as the nitrogen was required on some of the other tanks.

On the day of the accident an instrument artificer entered a 2 m^3 tank to adjust the instruments. There was no written entry permit as the people concerned believed, mistakenly, that they were not required on new plant until water or process fluids had been in them. Although the tank was only six feet tall and had an open man-hole at the top, the instrument man collapsed. An engineer arrived at the vessel about five minutes later to see how the job was getting on. He saw the first man lying on the bottom, climbed in to rescue him and was overcome as soon as he bent down.

Another engineer arrived after another five or ten minutes. He fetched the process supervisor and then entered the vessel. He also collapsed. The supervisor called the Works Fire Service. Before they arrived the third man recovered sufficiently to be able to climb out of the vessel. The second man was rescued and recovered, but the first man died.

It is believed that an hour or two before the incident somebody opened the nitrogen valve leading to the vessel and then closed it.

What can we learn from this incident?

1 If someone is overcome inside a vessel or pit we should never attempt to rescue him without breathing apparatus. We must curb our natural human tendency to rush to his aid or there will be two people to rescue instead of one. See also Newsletter 59/4.

2 Once a vessel has been connected up to any process or service line, the full permit-to-work and entry procedures must be followed. In the present case, this should have started eight weeks before the incident and the nitrogen line should have been disconnected or slip-plated where it entered the vessel.

There should be a formal hand-over from Construction so that everyone is aware when it has taken place. The final connection to process or service lines is best made by plant fitters rather than Construction people. On each Works the procedure for hand-over should be described in a Works instruction. Is there one on your Works?

Newsletter 56/4 described an explosion and a fire which occurred because Construction people connected up pipelines without authority.

3 When the plant is still in the hands of Construction the normal permit-to-work procedure is not necessary but an entry permit system should be in force. Before anyone enters a vessel, it should be inspected by a competent and experienced person who will certify that it is isolated and free from danger. When a tank is being built, at a certain height of walls (say, equal to the diameter) it should be deemed to be a confined space and the entry procedure should apply.

4 All managers and supervisors must be aware of the procedure for hand-over and entry to vessels.

88/5 SOME RECENT INCIDENTS

(a) Re-starting a stirrer causes a violent reaction

On one of the plants in the Division an acid effluent is neutralised with a chalk slurry in a tank. The operator noticed that the effluent going to drain was too acidic. On looking round, he found that the stirrer in the tank had stopped. He switched it on again. The sudden violent reaction blew off the manhole cover and lifted the bolted lid of the tank. No-one was injured.

A similar incident took place in 1972. A standing instruction was then issued detailing the action to be taken when a stirrer stops. This instruction was not followed by the operator when the recent incident occurred. He was not aware of its existence. No copy of it could be found on the plant, though there was one in the supervisor's office.

Are your plant instructions readily available — and known?

(b) Another slip-plate lug breaks

Newsletter 62/6b described how a large slip-plate, weighing half a ton, fell while being lifted; afterwards it was discovered that the lifting lug had been welded on without any particular care being taken. The precautions to be taken are described in *Engineering News* for December 1973 (Report No. Al 28,120/73/12) and ICI Standards 04/2400 to 2406.

Now another incident has occurred. While a storeman was trying to remove a 20 inch diameter slip-plate, 1½ inches thick, the lug came off in his hand. The lug was a non-standard one and consisted of a length of 15 mm diameter bar bent into a "U" and lightly welded to the plate.

Before lifting slip-plates have a look at the lugs. When ordering new slip-plates make sure the orders refer to the Company specification.

(c) Electric cables touch a hot pipe

A cable moved off a cable tray and came in contact with a hot pipe. The heat melted the plastic insulation and caused a short circuit.

Look out for similar cables on your plant.

(d) **An attempt to isolate a pipe-line by freezing is unsuccessful**

Newsletters 62/10c and 65/11a described how pipelines can be isolated by freezing the contents.

An attempt was made to freeze Marlotherm heat transfer medium with a mixture of Drikold (solid carbon dioxide) and acetone. The temperature reached was well below the freezing point stated by the manufacturer, but when the pipe-line was broken the Marlotherm flowed out.

It is believed that products of degradation lowered the melting point. Before freezing any pipe-line containing a heat transfer medium or any other liquid of uncertain composition, measure the freezing point on the actual material in the system.

Materials such as Marlotherm that are mixtures of several compounds often do not have a definite freezing point but get thicker and thicker as they get colder.

Manufacturers often quote a “pour point”. This means that the mixture will not flow out of a horizontal jar in 5 seconds. It may still flow when there is pressure behind it. Great care is therefore needed before a pipe is isolated by freezing a mixture.

88/6 SOME QUESTIONS I AM OFTEN ASKED -

22—HOW CAN I FIND OUT QUICKLY AND EASILY WHAT HAS BEEN WRITTEN AND RECOMMENDED ABOUT SUBJECTS I AM INTERESTED IN AT THE MOMENT?

For example, if somebody becomes interested in bellows, floating roof tanks, screwed plugs or anything else, he often wants to know what accidents have occurred in the past involving this type of equipment and what recommendations have been made. We have therefore prepared a detailed index to Newsletters 1-6 and 39-82. It has been prepared by writing an abstract of each Newsletter item and then feeding them into a computer which indexes every word except those words that it is told not to index. The following is a sample of the index.

PASSENGER

LESSONS FROM RAILWAYS

SAFETY NEWSLETTER 80/6

PAY

FREE OFFER TO ALL READERS OF THIS NEWSLETTER — £100,000 OF INFORMATION.

SAFETYNEWSLETTERS48/9 and 16/10

PENTANE

A TANK WAS OVERFILLED BECAUSE LIQUID OF LOWER SPECIFIC GRAVITY WAS PUT INTO IT.

SAFETY NEWSLETTER 65/6

PERFORMANCE

THREE MONTHS IN THE LIFE OF AN OIL COMPANY

SAFETY NEWSLETTER 42/7

PERMIT TO WORK

OIL WILL SPREAD A LONG WAY ON TOP OF WATER.

SAFETY NEWSLETTERS 62/4 and 11/10

SAFETY POSTERS.

SAFETY NEWSLETTER 1/6

LEAKS OF CORROSIVE LIQUIDS.

SAFETY NEWSLETTER 3/5

TANK VENTS ARE CHOKED.

SAFETY NEWSLETTERS 5/2 and 6/10

The index takes up 400 pages so it has been copied onto two pieces of photographic film, each 6 inches by 4 inches, known as microfiches. To read them a microfiche reader giving 40 times magnification is needed. There is one in every Library, but as it is not very convenient to go down to

the Library to look up a reference, you can buy a small one for use in your office for £50, e.g. the Kodak “Ektalite” Model 140.

The microfiches cost 28p per pair. A paper index would cost several pounds per copy plus the cost of posting it to you if you are not at Wilton. If the index proves popular it will be extended to cover earlier Newsletters and other reports and will be updated regularly. The cost of your microfiche reader will therefore soon be recovered. In addition, it can be used to read the increasing number of other documents which are being prepared in this way.

If you would like a copy of the index it can be obtained from Mrs. E.T., extension P284 5.

Note added in 2007. A few years ago I asked a former colleague if this index was still available. He made inquiries and then told me that no one could find them and if they find them it was doubtful if they would be able to open them. Only 10% of ancient Greek literature and a third of ancient Latin literature have survived to the present day. I wonder what the figure is for ancient (that is, pre-1985) computer files? We learn more quickly and forget sooner than earlier generations.

88/7 UNUSUAL ACCIDENTS No.57

A radio-controlled overhead crane in a Wilton workshop suddenly started to move without any signal from the driver.

A transistor in the crane’s receiver had failed and as a result the receiver responded to the radiation from a high frequency argon arc welding unit.

According to the manufacturer of the radio control system, Telemotive UK, no similar failure has occurred before, although 2000 control systems have been in use for an average of 5 years. Nevertheless, they have designed and installed a duplicate circuit. Failure of both will be needed before a similar event can happen again.

A full report is available on request.

88/8 RECENT PUBLICATIONS

(a) Last year, in another Company, a tube burst in a distillation column reboiler furnace. The flow to the furnace was isolated, but liquid entered the furnace through the vapour line and the fire burned for two hours. Safety Note 76/8A reviews the provision made in Petrochemicals Division to prevent a similar incident occurring.

(b) An article by H G Lawley in *Hydrocarbon Processing*, April 1976, page 247, describes in detail the faults found when an operability study was carried out on the feed system to a batch reactor using ethylene oxide.

(c) The Institution of Chemical Engineers have published a “Users Guide for the Safe Operation of Centrifuges with particular reference to hazardous atmospheres.” (Price £2.15 from the IChemE, 165-171 Railway Terrace, Rugby, CV21 3HQ). All centrifuge users should read it.

For a copy of (a) or (b) or for more information on any item in this Newsletter please ‘phone 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 Turner to add your name to the circulation list.

June 1976

Who's Who in Safety?

No.5— D WATERS

Dennis Waters, usually called Denny or Danny, comes from Tow Law in County Durham. He started work at the local steelworks as a sand chemist in 1941, volunteered for the RAF in 1942 and trained as a pilot. On his first solo flight he made eight attempts to land a Tiger Moth — and became a wireless operator/air gunner instead.

After 24 missions in a Lancaster bomber, the plane caught fire and crash-landed in France — one day after the Germans had left the area. Denny spent three weeks in hospital with burns and believes this is the reason he joined the Fire Brigade on demobilisation.

He joined ICI after 3½ years with the North Riding Fire Brigade, and now, as the Senior Fire Officer at Wilton, his job covers all aspects of fire, including design, fire prevention, means of escape, rescue, breathing apparatus and operational fire-fighting. He says he has one of the most interesting jobs in ICI. He has been asked to carry out fire surveys of Works in other Divisions and subsidiary companies and has visited Holland, Germany and Algeria to discuss and advise on fire problems. He achieved fame by extinguishing a fire in a British Steel waterless gasholder in 1971 after the area had been evacuated.

Denny is a member of a committee of fire advisers from the petrochemicals industry and the Fire Research Station investigating the fire problems associated with firefighting in flammable liquid storage tanks.

Denny is married and has a married daughter who works for ICI Fibres. During his wartime service he played football for the RAF Bomber Command and later played as an amateur for two Football League professional clubs before joining Crook Town and later South Bank. His hobbies are walking, sunbathing, dancing, sport, gardening and "do-it-yourself".