

Safety

NEWSLETTER

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Dealing with Failure: Up-Dating Repair Techniques

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The Obsolescent Becomes Obsolete

In an earlier Safety Newsletter (158/3) I wrote about problems caused by Intermittent or campaign operation of manufacturing plants. Regrettably, the time may come when the demand for a product is so low or the plant or process have been superseded that it is time for the plant to be shut down permanently.

168/2

Dudgeons Wharf, Isle of Dogs

This is not a story of a pirates' den, but of a redundant tank farm on the northern bank of the River Thames.

Is the plant then to be left standing? It cannot be left for ever. Is any part still useful? Can it be left or modified for a different purpose? Can it be cannibalised and some of the items of equipment be used in similar surviving plants? Should the whole plant be demolished and the site cleared?

Whatever you decide to do, there will be problems. This edition illustrates some of those problems and suggests ways of overcoming them. As usual, there is lots of further useful reading you could do and some suggestions for that are included.

A wide variety of oils had, from time to time, been stored in the tank farm – including fuel oil, lubricating oil, seed oil, fish oil, linseed oil and various types of turpentine. Tank 97 had contained Myrcene, a hydrocarbon oil similar to turpentine but having a higher flash point. Over a period of time it is liable to produce gummy deposits on the inside of the tank in which it is stored. These deposits can be readily ignited and when heated give off a flammable vapour which, if mixed with air, become potentially explosive. Unlike many deposits found in storage tanks this gummy deposit is not amenable to removal by steam.

In 1969 it was decided to demolish the tank farm and clear the site. That the site was in a mess and that there were hazards was plain. A large quantity of flammable and other rubbish had accumulated. Pools of oil were lying about. Furthermore, some of the tanks and supply pipes contained the remnants of their former contents.

Cutting was begun using oxy-propane equipment and, not surprisingly, there were several fires. Some recommendations were made for precautions to be taken and the work continued. On 17 July, two men used oxy-propane cutting equipment on the roof of Tank 97. Only a short cut had been made when flames emerged, first of all through the cut and then through the open manhole in the roof. The flames appeared to die down quickly but water was sprayed over the cut and subsequently into the tank through the open manhole.

It was difficult to see exactly the condition of the tank interior. Since it was stated that the tank had previously

been purged with steam and had just had water poured into it, people thought there was no further risk of fire or explosion. It was decided to remove the cover of the manhole near the bottom of the side. Because some of the securing nuts and bolts were seized it was decided to cut or 'blow' off the nuts. An oxy-propane cutter was applied.

Almost instantaneously the roof of the tank was blown off and six men were killed.

At the official enquiry the recommended precautions were said to be unclear.

Did "purge with steam for 24 hours" mean for 24 hours continuously or would overnight interruptions be acceptable? Did "all solid residues left in tanks should be removed prior to the steam purging" apply to deposits on the sides or roofs or only to sludge on the floors? More fundamentally, it was questioned whether, even if the advice had been followed as intended, an accident could have been avoided. No one sufficiently understood the nature of the materials with which they were dealing and the appropriate methods to use.

The official report does not say in detail what was done to demolish the rest of the tanks safely. Every case is different so the details might not be relevant to any job you have in mind. However the principles are the same. Find out what you are dealing with. Prepare a proper plan of action, taking appropriate advice. See that those concerned understand the plan and how it is to be carried out. See that they have the resources to carry out the work. Monitor progress carefully. If unexpected snags nevertheless occur, STOP and have another think.

(Report of the Public Inquiry into a Fire at Dudgeons Wharf on 17 July 1969. Published by Her Majesty's Stationery Office. Probably now out of print but copies in most good libraries.

168/3

Assumptions

Shortly after I transferred from research to process development in a Works I was asked to prepare a proposal for capital expenditure to improve a plant. I wrote a document

In those days, Assistant Works Managers were powerful, lucid and direct! That one was not afraid to take decisions. He was simply saying it was foolish to take decisions without considering facts which are known or can be readily ascertained in the time available before the decision needs to be made.

In planning demolition, in contrast to emergency repair work, there is usually time to get some hard facts about the problems likely to be met. In the case of Dudgeons Wharf it would have been prudent to have obtained more

and in good research style I stated all the assumptions underlying the case. The document was passed up the ladder of the hierarchy as far as the Assistant Works Manager and then returned, as if down a snake, straight to my desk. Across the top was written "Why assume anything?"

168/4 Dead or Alive

Sometimes, even though careful plans have been or are being made, people rush ahead with good intent but make mistakes.

168/5 Clean or Dirty

information. Here is a simpler example.

Some men were examining a piece of plant equipment when they noticed that a lagger nearby was removing insulation from a pipeline. Some dust was blowing about and they became concerned that it might be asbestos. A line diagram was consulted and it showed that the line should have been insulated with different material. However there was still some anxiety and uncertainty and a sample of the lagging was sent to the laboratory. The material was in fact a type of white asbestos.

In old plants it is especially advisable to make a check on the spot before planning and starting a job. In the case of lagging, for example, it is possible that a short length has been patched and material has been used which is not the same as the original. There is less chance of that having happened on a newer plant because of increased awareness of problems caused by modifications and there is more control of them. But the effects of earlier changes on older plants do stay with us for a long time.

An electrician was asked to remove some equipment and the associated cables from a redundant unit. He was familiar with the plant and soon completed the task without difficulty. He knew that it was intended to remove similar equipment and cables on two adjacent operational units and he decided to start work on one of them.

As the second unit was still in use some cables were still live but others, associated with the item to be removed, had been cut at points about ten feet above it. Altogether there were about 20 cables in the bunch. The electrician decided to cut the redundant cables again, but much nearer to the equipment. Starting at one end of the original cuts he followed the line of the cable with his eye down to a point near the equipment and then cut it. Unfortunately he cut through a low voltage trip cable which was still in use and shut down the unit! Fortunately it was a low voltage and he was using cutters with insulated handles. There was no spark and no damage. No one was hurt.

If there is a plan, it is important to stick to it. The local management and supervision must be asked for their agreement and the work must be done under an appropriate "permit to work" system.

In order to make the answer to these questions crystal clear, one set of instructions for a laboratory experiment used to

How clean is clean, what is dirty?

start with the words “weigh a beaker, empty, clean and dry...”. There was to be no room for debate about whether a wet beaker was clean.

In dealing with plant due for demolition we cannot be so pedantic but we must be careful. Two recent incidents have involved redundant pipelines left for some time in an unclean state.

One plant was shut down several years ago and cleaned out as far as was practicable without dismantling it. Demolition of part of it was commenced. Instruction were given that ‘tagged’ service lines were to be removed. No stainless steel process lines were to be ‘burned out’ as they might contain product residues. The team had difficulty in dropping an apparently mild steel pipe which passed through a wall and a burner was asked to cut it. It was then discovered that the pipe was the jacket of an inner stainless steel process pipe. The burner then applied his oxy-acetylene torch to the inner pipe. Process residues in the pipe caught fire, flames shot out of the pipe and the man was severely burned.

In another case, a line containing spontaneously flammable material was left out of use for about three months. Eventually, material leaked out of a flanged joint and caught fire. Lines which are not required and contain such materials should be emptied and completely cleaned out. They can only get more difficult to deal with the longer they are left and there is always the risk of an accident in the meantime.

However, emptying and cleaning must be done carefully. On one plant which was to be mothballed, a man was asked to remove a bobbin piece to enable a check to be made that a line was empty. Wearing the proper clothing, he removed the bolts from the flanges. Some fuming was noticed at the flanged joints but the bobbin stuck in position. The man then stood on an autoclave and tried to lever the flanges apart using a scaffolding pole. Some more fuming occurred and as he jumped away the man injured his back!

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Severance of Connections

A plant which is to be demolished should first be disconnected from services and from other plants, supply lines etc.

A pair of storage tanks were used to supply material to several plants hundreds of yards apart in two different Works. The supply pumps fed into a complicated manifold of pipes. One plant was shut down and left prior to being demolished and valves were used at the supply manifold and at the plant to isolate the supply line.

When demolition began, the supply line was cut near the plant, thus creating an ‘open end’. It was assumed that the line was isolated by valve and slip-plate (blind) at the supply

This should be done when the plant is shut down. This applies even if the demolition itself is to be delayed.

**168/7
Postscript**

Clearly, demolition is a process fraught with a wide variety of problems.

**An Engineer's Casebook
No. 68
A F Hall
Dealing with
failure: Updating
repair techniques**

It is now about twenty-five years since we introduced new methods of repair for plant equipment using synthetic resins and rubbers in various forms. Initially, these methods were regarded as temporary expedients until permanent repairs by conventional means could be achieved or a replacement fitted at a time convenient to the operation of the plant.

manifold.

One dark night a man opened the wrong valve on the manifold and some LPG was pumped out through the open end into the demolition area. The isolation should have been made by removing a substantial piece of pipework and blanking-off the open ends.

Special cases will always need special arrangements but an excellent guide to the general principles is given in

BS6187: 1982
Code of Practice for Demolition
(It can be obtained from The British Standards Institution London W1A 2BS)

There is now plenty of evidence in case histories which demonstrate not only the reliability of the methods but also the versatility of the techniques. The many different applications fall into two main tasks:

- 1 Leak sealing
- 2 Building up worn or corroded metal parts

It is, of course, essential that the material used for the repair is compatible with the process conditions. The synthetic resins which are used in the majority of cases are suitable for use with a wide range of chemicals. Examples of products which can cause difficulty are phenol, amines, concentrated nitric acid and glacial acetic acid. Even these difficulties can be overcome.

The approach to leak sealing depends upon the type of equipment and the conditions. Some jobs are as simple as placing a fibreglass patch on a gas holder, wrapping a pipeline with glass-fibre and resin, or encapsulating a leaking valve in a block of resin. At the other end of the spectrum is the work done on a cross country pipeline which operates at a pressure of about 100 bar. Leaks on that line were sealed without shutting the line down and the work has been effective for about fifteen years. Tank bottoms have been repaired at a fraction of the cost of replacement.

There are many cases where the profile of metal parts have been restored using resins. Experience has shown that in many cases the repair has a better service life than the original material, especially when damage is due to erosion or cavitation. An example is the repair of cutwaters in pumps. All that may be necessary to repair a hole in a casting is to simply knife in a paste made of resin and filler.

In other cases simple moulds may be required. Machining to quite fine limits is also possible. Repairs of this type extend from the filling of small holes in castings to restoring labyrinth seals on shafts which operate at high speed. One of the more remarkable achievements has been the repair of damage in steel sealing rings and joint faces of the Bredtschneider joints in converters which are about 1,500 mm diameter and operate at 250 bar. Furthermore, the result was achieved in less than twenty four hours.

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