FEBRUARY 2018 ISSUE 920

The Chemical Engineer

NEWS AND VIEWS FROM THE PROCESS INDUSTRIES, BROUGHT TO YOU BY THE INSTITUTION OF CHEMICAL ENGINEERS

BREAKING IT DOWN

Top tips on avoiding demolition dangers

WATER

A COUNTRY IN CRISIS
Drought-stricken South Africa needs our help

PAGE 32

INDUSTRY

THE X-FACTOR
The next stage of industrial revolution

PAGE 36

TECHNOLOG

HU
Dis

HOW TO

HOW TO
Reduce the risk of a dust explosion

PAGE 50

This article first appeared in *The Chemical Engineer*, which is published monthly by the Institution of Chemical Engineers
Editorial: aduckett@icheme.org. **Subscriptions:** hrourke@icheme.org
Advertising: lucy.filamba@redactive.co.uk
www.thechemicalengineer.com

Demolition Man

Expert observations of demolition dangers and how to avoid them

STEVE ANDREW
DEMOLITION AND REMEDIATION MANAGER, ABB

THE current economic climate and the uncertainty around a soft/hard Brexit have widely affected industry confidence across almost all business sectors with quite devastating results for some. The current UK cost base puts added pressure on industry with many choosing to either relocate outside of the UK, mothball to later restart (which very seldom happens) or full closure. Organisations are very proficient at managing and maintaining their assets and producing 'product', but now they find themselves going into the world of decommissioning and potentially demolition.

Demolition by name is a destructive process with many outside of the industry viewing most demolition contractors as low skilled. Headlines similar to those shown in Figure 1 are a far too common sight.

However, demolition is a highly specialist area of engineering requiring unique skills built up over many years. Most clients only ever do this type of project once in their career – or twice if they are really unlucky.

FIGURE 1: NEWS STORIES SIMILAR TO THOSE SHOWN HERE ARE A FAR TOO COMMON SIGHT

DEMOLITION IS JUST CONSTRUCTION IN REVERSE?

This is one of the biggest misconceptions, and in reality nothing could be further from the truth.

In construction

- Typically new plant and equipment is used.
- There is confidence in construction; with today's quality and supervision there should be no surprises in the future.
- Laydown area - most pieces of the 'jigsaw puzzle' will be in a laydown area ready for assembly.
- Status of isolation - equipment has never been energised, therefore there should be no stored energy.
- Insulation - asbestos has been banned in the UK since 1999. There are other insulation materials but specific types and location should be well documented.

In demolition

- Residue on the product - I have *never* dismantled or demolished a 'clean' plant in over 35 years.
- Condition of plant and equipment is unknown.
- Others' bad practice, with examples ranging from a 2,400 t steel works building, where the roof trusses were not bolted to the main building support columns, to a process column that when it was installed did not function as planned. The column was then turned 180° and the drawings were never updated to show the new arrangement.
- Vessel weights and lifting equipment – these cannot be trusted due to a number of reasons and can be used as a guide.
- Restricted access and space - most operating plants develop around the older assets which in turn will normally be the first to be removed.
- Insulation - there are over 3,000 recognised uses for asbestos-containing materials (ACMs); past methods of removal aren't to today's high standards and it is recognised as the "hidden killer". There are also risks associated with HCFC/CFC blown foam backed sheeting, and refractory/cristobalite, to mention a few.

- Isolations of plant and equipment, stored energy, unpicking a plant's history from original design to modifications – both legal and illegal – is always underestimated.

In construction you have lots of knowns. When it comes to decommissioning/demolition there are potentially lots of unknowns. The objective during the planning process is to go from this potential unknown state to a known state.

RELEVANT LEGISLATION

The demolition and dismantling sector is one of the most heavily regulated industries. One of the most significant regulations is the Construction (Design Management) Regulations 2015. By law, all projects of this type must be carried out in accordance with Construction Design Management (CDM) regulations. The regulations have been in place since 1994, with the latest revision issued in 2015.

The regulations require a number of duty holders to be appointed by the client, for example principal designer, designers, and principal contractor.

IN CONSTRUCTION YOU HAVE LOTS OF KNOWNS. WHEN IT COMES TO DECOMMISSIONING/DEMOLITION THERE ARE POTENTIALLY LOTS OF UNKNOWNS

The duties in the regulations have changed significantly over the years and now place many more duties on the client, for example the 1994 edition allowed for the client to appoint a "client's agent" to undertake the client's role on their behalf. It's widely recognised that the client has the greatest influence on a project and they should determine the potential success of the project.

The main duties of the client are as follows.

- Make suitable arrangements for managing a project, including making sure:
  - other duty holders are appointed as appropriate; and
  - sufficient time and resources are allocated.
- Make sure:
  - relevant information is prepared and provided to other duty holders;
  - the principal designer and principal contractor carry out their duties; and
  - welfare facilities are provided for all workers.

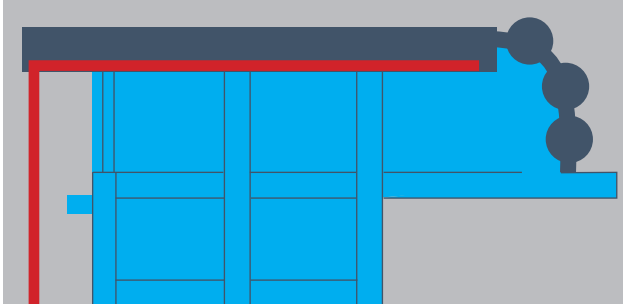
The word "competence" has been removed from the regulations and replaced with the words "skills", "knowledge" and "experience". In the event something goes wrong, this is the benchmark that clients under the regulations will be measured against when appointing duty holders.

One of the main requirements of the regulations is to remove

FIGURE 2: A SCHEMATIC OF A TYPICAL SITE THAT HAD REDUNDANT PLANT AND EQUIPMENT INTERWOVEN WITH LIVE PLANT AND EQUIPMENT

– CONTAINS LIVE PLANT AND EQUIPMENT
– CONTAINS REDUNDANT PLANT AND EQUIPMENT
– STRUCTURES UP TO 30 M HIGH
– POOR CONDITION
– ASBESTOS
– UNKNOWN LEVELS OF CONTAMINATION

FIGURE 3: LIVE PLANT AND EQUIPMENT HAS BEEN REMOVED FROM THE VICINITY OF THE REDUNDANT EQUIPMENT



– CONTAINS LIVE PLANT AND EQUIPMENT
– CONTAINS REDUNDANT PLANT AND EQUIPMENT
– STRUCTURES UP TO 30 M HIGH
– POOR CONDITION
– ASBESTOS
– UNKNOWN LEVELS OF CONTAMINATION
– CONTAINS REDUNDANT PLANT AND EQUIPMENT

foreseeable risk, on a construction project that can be easily achieved through design. For example, substituting solvent-based paints for water-based paints. However, on a demolition project this is much more difficult due to the hazards already existing and the objective of the project maybe to remove those hazards, eg asbestos-containing materials.

The location and type of isolations, and the standard of decommissioning can greatly influence the demolition methodology, from explosives/machine-intensive "remote" demolition carried out by operatives working in protective

cages, to hands-on dismantling with all the risks associated with working at height, exposure to vibration, noise and hazardous materials.

This could class the client as designers under the regulations with a duty to prove they have removed foreseeable risk. A great example is shown in Figures 2 and 3. Figure 2 shows a schematic of a typical site that had redundant plant and equipment interwoven with live plant and equipment.

The risks involved include significant exposure to working at height, dismantling in and around live plant and equipment, potential business interruption, resulting in an extended programme and cost increase.

In Figure 3 the live plant and equipment has been removed from the vicinity of the redundant equipment resulting in the methodology being able to become more remote due to the use of machines. An added benefit at the end of the project is that a much more suitable structure remains, further reducing ongoing maintenance costs.

This approach not only significantly reduces SHE and operational risks but there have been a number of examples where it proved to be cost neutral.

DECOMMISSIONING MINDSET

As mentioned earlier, clients are very good at preserving, maintaining and operating their assets. However, when an asset is no longer required, the biggest mistake made is they decommission and isolate, still protecting the asset value, using existing procedures, in most cases resulting in putting people at unnecessary risk.

Figure 4 shows an example where the original methodology was to insert decommissioning operatives into the vessel to dig out the residual material, wearing breathing apparatus through a confined-space entry. However, an alternative method was employed by removing the top section of the vessel above the residual product, which allowed the product to be removed using machine methods, greatly reducing the risk to the operatives and reducing cost.

Also, capturing essential knowledge before it is lost, and to plan the appropriate level of equipment decontamination can lead to significant efficiencies in final decommissioning and removal. Avoiding the added pressure to save a little time and cost by not planning the decommissioning early enough will not be easy, but it is a challenge worth overcoming.

HEALTH & SAFETY RISK COMMERCIAL REDUCTION

The term "risk management" is used regularly in business, but what is risk and what is the real risk from this type of project? A definition of risk is threat of damage, probability, liability, injury, reputation or any negative occurrence that will affect a business. There is a real danger that all of the above could result from a badly-planned and executed project of this type.

FIGURE 4: CONTAMINATED VESSEL WITH RESIDUAL MATERIAL

De-risking a project can result in significant saving to a client. In one project that ABB was involved with, the client had already tendered the project, and due to a number of different issues, then appointed ABB to re-scope the project and re-tender. After a review of the information provided to the prospective contractors, it became apparent that all the risks on the project had been passed on to the contractor and there were a number of gaps. Further studies where carried out and the project re-tendered. After a bid review and clarifications, the money paid back to the client (credits) increased by over 1,000%.

AVOIDING THE ADDED PRESSURE TO SAVE A LITTLE TIME AND COST BY NOT PLANNING THE DECOMMISSIONING EARLY ENOUGH WILL NOT BE EASY, BUT IT IS A CHALLENGE WORTH OVERCOMING

Sometimes the risks are unknown, but having a good process and contingency in place can help ensure the client only pays what they need to. For example if there is a potential issue with ground contamination, the risk can be estimated and the money ringfenced as contingency.

In the event there is no contamination, the money is not spent, but if the risk turns out to be real then the client only pays what they would have paid in the first place. In the above example, if the risk had been passed onto the contractor and no contamination was found, this would result in needless spend.

There is a specific requirement under the CDM Regulations to remove "foreseeable" risk to help ensure the health and safety of anyone who could be affected by a project.

The following outlines some examples of the unique risks associated with projects of this type.

INSULATION MATERIALS

There is a significant cost associated with identifying and safely removing ACMs (for simplicity we are only discussing ACMs, but there are other insulating materials which can have a similar impact).

The Controls of Asbestos Regulations 2012 require that people with responsibility know where their ACMs are and they are safely maintained.

HSE HSG 264: Asbestos – The survey guide (2012) provides guidance on how to identify the location of ACM. There are two main types of surveys.

- **Management survey** - a management survey is the most common survey that clients have. Its purpose is to locate the presence and extent of any suspect ACMs which could be damaged or disturbed during normal operation. The survey is mainly non-intrusive but may be supplemented with some intrusive sampling. This type of survey is not suitable for demolition work.
- **Refurbishment and demolition surveys** – this type of survey is needed before any refurbishment or demolition work is carried out. This type of survey is used to locate and describe all ACM in the area where the work is planned to take place. The survey will be fully intrusive and involve destructive inspection, eg breaking holes into walls, inspecting ceiling or roof voids as necessary, to gain access to all areas.

There are examples in the industry of taking the view to treat all insulation on a project as ACM but this will result in potentially paying more for the removal than is required. Not only will this drive up costs but also potentially put people at risk from wearing a higher level of respiratory protection than may be required, adding to the risk of fatigue, reduced vision etc.

ACM removal is an expensive process and costs can significantly run out of control if proper identification is not carried out.

THERE ARE A NUMBER OF FACTORS THAT AFFECT THE COST OF DEMOLITION THAT CARRY RISKS, BUT THROUGH GOOD PLANNING, THEY CAN BE REMOVED AND ARE MORE LIKELY TO HELP ACHIEVE A SUCCESSFUL PROJECT PLUS REDUCE THE COST OF NOT ONLY THE PROJECT BUT ALSO ONGOING RUNNING COSTS

When and by whom the removal is carried out can also impact the cost. For example, removal by an in-house insulation term contractor has its advantages, as they will have a better understanding of where known ACM is and understand the site rules etc. However, the removal may be much more complex due to working around redundant plant equipment.

Removal by the decommissioning contractor however, will allow for the removal of non-ACM contaminated material, reducing the potential overall programme and cost for example.

Another potential risk is if the removal is carried out prior to demolition and ACM is found during the demolition process. This could result in loss of containment and expensive standing time payable to the demolition contractor due to having to arrange for the ACM to be removed. Most demolition contractors are multi-skilled and, if the removal scope is within their contract, in the event unidentified ACM is found they will be readily equipped to safely manage the removal process.

TYPES OF CONTRACT

The type of contract employed on a demolition project can have a significant impact on the potential successful outcome. There are several different types of contracts, mainly:

- **Reimbursable** – time and materials, typically with a mark-up, useful if the scope is not well defined or there is potential for hold ups.
- **Target cost/gain share** – can help to share the risk on large projects with a significant amount of recoverable scrap metal.
- **Fixed/all-in** – cost certainty against a set scope of work. On projects of this type the revenue gained from recycling scrap metal can greatly cover the cost of the demolition or in some cases pay a credit back to the client.

On a major project that runs for a number of years, if we use the fixed price/all-in contract model we are asking the contractor to price work that they will not get the revenue back on for a considerable period of time. Looking at Figure 5, it can be seen the payment for recoverable material will be 50% of what it

FIGURE 5: PRICE INDEX FOR IRON – RELATIONSHIP BETWEEN SCRAP RECOVERY AND PAYMENT TO THE CONTRACTOR

Source: Tradingeconomics.com

was when the contractor priced it at point A compared to when they get paid at point B.

The contractor needs to build this risk into quotes – this is one of their major risks and the client pays for this risk. A better way, maybe, is to benchmark the credit of the recoverable material against one of the metal indices and have a gain share that is fair to both parties.

There are a number of factors that affect the cost of demolition that carry risks, but through good planning, they can be removed and are more likely to help achieve a successful project, plus reduce the cost of not only the project but also ongoing running costs.

TEN THINGS I WISH I'D KNOWN

What are the ten things I wish I had known when I started in the demolition industry over 35 years ago?

1. It is not construction in reverse, there are lots of unknowns that need to be managed.
2. Projects of this type always take longer than expected, don't underestimate the effort.
3. Things *do* go wrong, don't believe people who tell you they won't. There are loads of examples even on YouTube; challenge anything you are not sure about.
4. There are experts out there, who have experience of supporting clients on projects of this type. As with appointing all suppliers, look past the flashy website and check project history and chase up references.
5. Resale of plant and equipment can create revenue, but start the process early and make sure you understand what is included in any quotes.
6. Identify key people early and get them tied into the project – their corporate knowledge will be critical.
7. Consider carefully the type of contract and its potential implications.
8. Control and keep information, it will be critical when handing over to a contractor, and very expensive to replace.
9. Consider the effects on the demolition process when decommissioning and designing isolations, how will it affect the demolition methodology?
10. Start demolition as close to closure as possible; demolition is safer when the plant is still intact and there is still access to people with historical knowledge. ■