

LESSONS LEARNT FROM DECOMMISSIONING A TOP TIER COMAH SITE

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Ciba completed the decommissioning of the Clayton site in 2007. The site has been in use for over one hundred and thirty years producing dyestuffs and intermediates mainly for the textile and allied industries and was a 'Top Tier' COMAH site.

Site staff were committed to maintaining high EHS standards until the decommissioning was completed and the site handed over to its new owners. A project of this size and scale had never been completed within Ciba before. Careful planning was required to manage the work. New risk analysis systems, safe systems of work and working procedures had to be developed. New relationships had to be developed with decommissioning and demolition contractors and the number of Ciba staff was reduced progressively during the project.

The paper shares Ciba's learning experiences, highlighting key project issues, the systems which were developed for managing each issue and some of the unexpected things that occurred during the project. Lessons learnt from the project are also highlighted.

KEYWORDS: COMAH, Decommissioning.

INTRODUCTION

THE CLAYTON ANILINE COMPANY

The Clayton Aniline Company (CAC) was set up over 130 years ago in 1876 as one of the first manufacturing sites for aniline textile dyes. Benzol was sourced from the coal gas industry and used as a raw material for producing nitrobenzol and then aniline. The alkalis and inorganic acids required for textile dye manufacture were sourced from the local chemical industry. At the height of its success, the company operated a site covering over 57 acres, one of the largest single factory sites in the Manchester area. 2,000 people worked at the site. Figure 1 shows an aerial view of the site from 1974.

Companies which would later become Ciba (part of the The Basel Community of Interests) acquired a financial interest in CAC in 1918. A major rebuilding program was completed in the 1960's. Most of these buildings and plants then served the site until its final closure in 2007. Ciba obtained a majority shareholding in CAC in 1971 (Abrahart, 1976).

THE CIBA CLAYTON SITE

The site lies in an industrial area to the east of Manchester, abutting the Manchester, Stockport and Ashton canal (see Figure 2). About 200 staff worked at the site in the years

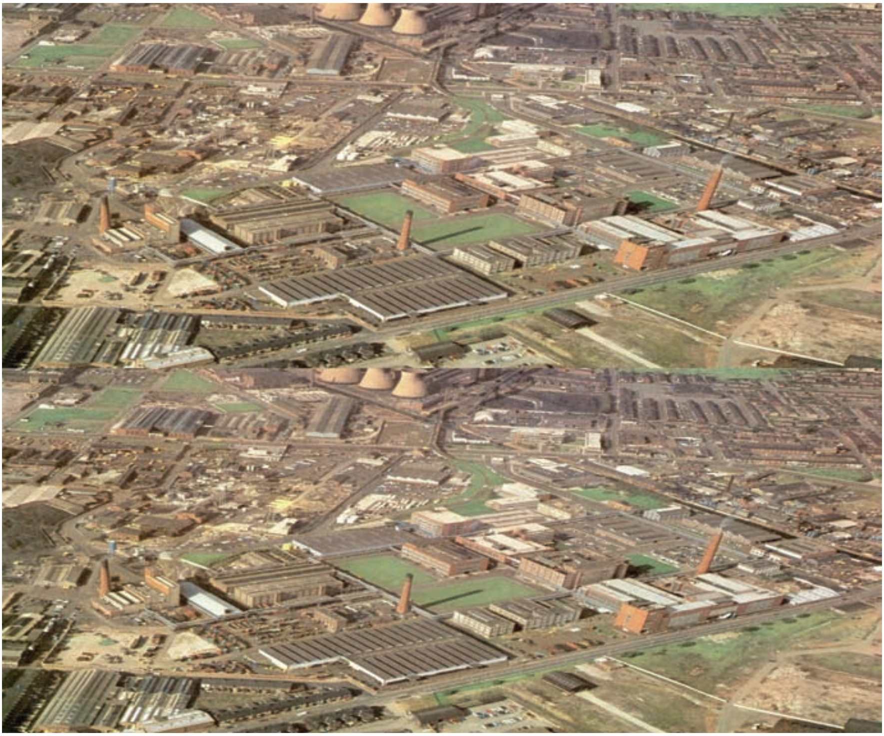

Figure 1. Aerial view of Ciba Clayton site (1974)

leading to its closure. The site included process plant, tank farms, warehousing, a power station and effluent treatment units. There were two main types of production line:

1. Older plant fed from roof tanks using flexible hoses. This plant included about 130 vessels. The main process safety concern related to potential unknown build up of diazo compounds, which decompose violently when dried (Dixon-Jackson et al, 2002).
2. More modern plant, fed from outdoor tank farms using fixed hard piped transfer lines. This plant included 12 reactors and 20 receivers. The main process safety concerns were the potential to cause toluene or oleum leaks. Toluene is a flammable solvent and oleum is a corrosive liquid which liberates a toxic gas (SO_3) on contact with air.

The site handled a range of bulk hazardous chemicals and came within the scope of the COMAH Regulations (COMAH, 1999).

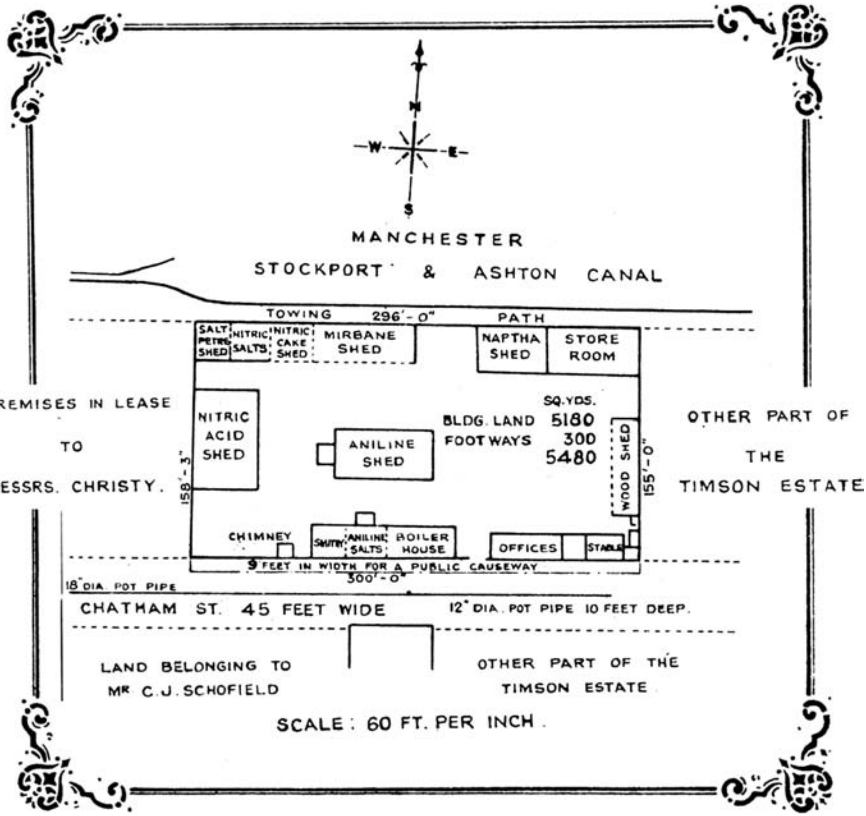

Figure 2. Site layout (extract from 1877 lease)

SITE CLOSURE

During the 1990's and the early part of the twenty first century, an acceleration occurred in the movement of the textile manufacturing industry from Europe to low cost countries, such as China, in Asia. The industry was subject to savage cost pressure as textile sales prices reduced. This price pressure was passed up the supply chain until it was uneconomic to produce textile dyes and intermediates in the UK. Over its 130 years, the Clayton site had specialised in products for the textile industry. There had been little diversification into other industry segments. The plant was old and the average age of the workforce was over 50. In 2003, it was therefore announced that the site would close. Detailed project planning then started, leading to final site closure in 2007. It is to the workforce's credit that the site was decommissioned with no serious safety incidents.

LEGAL REQUIREMENTS

The decommissioning project took place within the framework of four key pieces of EHS legislation:

1. The Health and Safety at Work Act (HASAWA, 1974), in particular covering the responsibilities of individuals for their own and other people's safety. Critical issues for the success of the project included the need for people to follow agreed written procedures, to challenge decisions and working procedures if people were unhappy with them and to comply with risk assessments and Permits-To-Work.
2. The Construction, Design and Management Regulations (CDM, 2007), in particular covering the role of the planning supervisor (a specialist contractor), the principal contractor (a specialist demolition contractor) and the client (Ciba) and the management of the interfaces between the three organisations.
3. The COMAH Regulations (COMAH, 1999), as the site was a 'Top Tier' COMAH site. In general, hazardous chemicals were removed from the site before decommissioning started, mainly by processing them into products, but also by removing them as waste. The project team was, however, aware that any unidentified residual quantities of hazardous chemicals could have led to chemical release, fire or explosion.
4. Pollution Prevention and Control (PPC, 1999), relating to releases of prescribed substances to air and water courses and the management of waste from the site.

PROJECT OBJECTIVES

Decommissioning the Clayton site represented the largest ever whole site demolition project in Ciba's history. As such, the project team had to adapt existing corporate standards and procedures and develop new procedures where none were present. Before developing detailed plans and procedures, the team set the following project objectives:

1. ***No accidents or incidents*** during the decommissioning project.
2. ***Equipment to be clean*** as far as practicable before decommissioning work was started.
3. ***Residual contamination*** to be identified and quantified prior to decommissioning.
4. Work to be completed using ***demonstrably safe systems***.
5. Plant to be handed over to demolition contractors safely, clearly ***identifying physical disconnections*** within a building and between buildings and low points where trapped chemicals could have accumulated.
6. ***Records to be provided***, proving how the decommissioning project was managed.
7. Project completion ***on time***.

DECOMMISSIONING STRATEGY

Considerable uncertainties exist when carrying out a decommissioning project on a site which was built in the nineteenth and twentieth centuries. Work which was completed many years ago may not have been documented or the documents could have been lost. Drawings may be inaccurate or may not exist. People will not remember all of the activities which have occurred on the site. This is especially true as the project progresses and site manning levels drop almost on a daily basis. Many of the people working at the site will be contractors and will be unaware of site operations and systems.

It was rapidly identified that robust systems would have to be used to manage the decommissioning project. Due to the large variety of plant and infrastructure which had to be decommissioned, it was decided that safe systems would have to be built around:

- Risk assessments.
- Permit-To-Work systems.
- Engineering method statements and risk assessments.
- Detailed step-by-step operating instructions.

This provided a framework to:

- Identify hazards, assess risks and identify appropriate risk controls.
- Control work in compliance with the requirements of each risk assessment.
- Ensure that everybody understood the detailed work requirements, working safely in line with agreed standard operating procedures.

This was considered to be the best way to minimise risk, accepting that some residual risks would always be present in a project of this complexity and novelty.

Many existing corporate and site standards and procedures fitted in well with the requirements of the decommissioning project. These included risk analysis methodologies, permit-to-work systems, confined space working, plant isolation and plant maintenance procedures. Indeed, safety management systems have to be suitable for decommissioning activities, as small scale decommissioning takes place regularly on most sites.

Three major gaps were, however, identified. Firstly, the corporate Ciba risk analysis methodology was too focused on chemical processes and did not have the required detailed guidewords which are suitable for decommissioning work. A special decommissioning risk analysis therefore had to be developed. Secondly, it was felt that workers and contractors required additional training about the decommissioning procedures for the site, supported by additional safety checks, which became known as 'transfer safety stops'. Thirdly, it was recognized that the demolition contractor needed to have assurance that plant was safe to decommission on handover. This was achieved by using a system of certificates to formally hand areas of plant over to the contractor.

PLANNING

Three main types of plant had to be decommissioned:

- Textile effects manufacturing plant, with feed tanks on the roof, linked to process vessels by flexible hoses. Battery limits for each part of the decommissioning work were easy to specify as the vessel.

Table 1. Typical activities covered by a work instruction

Decontamination	Decommissioning
• Receive washes. • Transfer out washes. • Cleaning of nozzles. • Cleaning of routes not normally cleaned. • Cleaning of reflux routes. • Cleaning of receiver inlets and outlets. • Prevention of recontamination.	• Drain oil. • Open valves. Drain all pipes. • Electrical disconnection. • Air isolation. • Control isolation. • Pumps.

- Printing chemicals (carbonless copying paper dyes) manufacturing plant, linked via pipes to tank farms. Battery limits for each part of the decommissioning work had to be defined on the P&ID documents.
- Site infrastructure.

The site was therefore split into sections and battery limits were defined for each section, supported by drawings. Drawings were not necessarily accurate due to the age of the plant, uncertainty about whether all modifications had been recorded correctly, difficulties in accessing all relevant drawings and because some plant and infrastructure (such as control systems, utilities and power supplies) may already have been removed or disconnected. It was therefore essential to walk the plant and adjust drawings to reflect actual plant conditions.

No activities were allowed to be completed without a risk assessment, which could be a permit-to-work or a specialised risk assessment. This team based activity identified the required controls involving the operators. The risk assessment was then incorporated into a detailed work instruction, known as a 'decontamination and decommissioning instruction'. Safe practices and required Personnel Protective Equipment (PPE) were identified in the detailed work instruction. Any permits were cross referenced to the relevant work instruction. Operators were briefed prior to starting each piece of work. The briefing included a walk of the job to confirm that the work was properly understood. The work instructions were signed off step by step to confirm that they had been completed correctly. Typical issues covered by a work instruction are illustrated in Table 1.

It was found that isometric drawings were particularly helpful for communicating the requirements within work instructions. A typical isometric is shown in Figure 3.

RISK ASSESSMENT

Ciba's normal risk analysis methodology is based around a checklist, using guidewords to identify possible process deviations. Each deviation is then assessed to estimate the frequency and severity of occurrence and to check that the required risk reduction measures are in place. The guidewords in the checklist are very effective for identifying process deviations

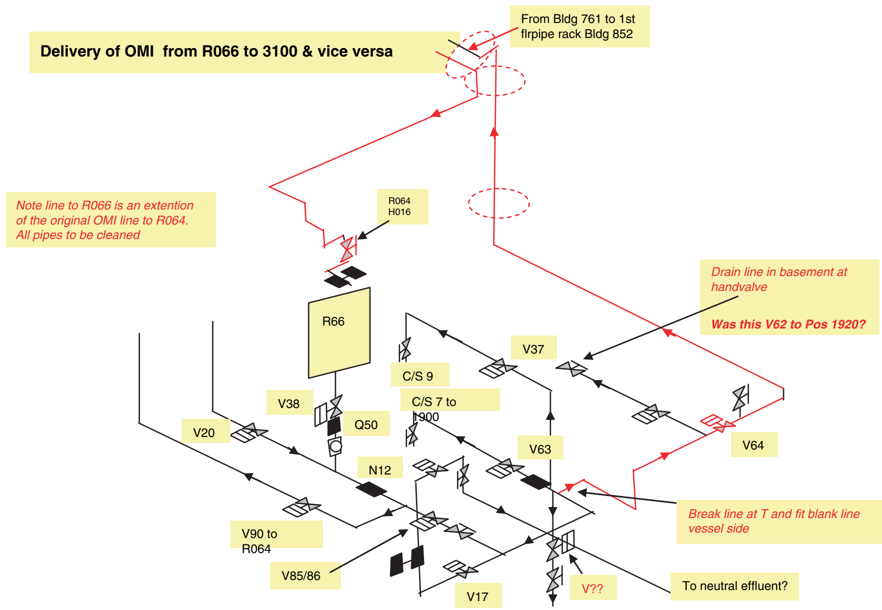

Figure 3. Typical isometric for supporting work instructions

from events such as power loss, overcharging, high temperature, loss of cooling etc but there are very few guidewords which specifically address decommissioning risks. The project team therefore produced a new set of guidewords, which were more relevant to decommissioning activities and incorporated them within the general framework of the existing Ciba risk analysis methodology. Table 2 summarises the general guidewords which were used for the decommissioning risk analysis. These guidewords were grouped by activity types for use in the risk analysis, based on the nature of each task being analysed.

PROJECT CONTROL

Risk assessment therefore lay at the heart of the decommissioning project as shown in Figure 4.

Risk assessment in itself will not guarantee that work is completed safely. It will provide a framework for safe operations. Safety at the plant level requires people to understand the risk assessments, communicate with colleagues and comply with the requirements of the risk assessments and the detailed work instructions which flow from them. For this reason, Ciba uses a system of 'safety stops' to confirm compliance before critical activities are started. Safety stops are really designed for controlling engineering building

Table 2. General decommissioning guidewords

Personnel Movements	Plant vehicle Movements	Paints lead/luminous	Connection lines/valves	Graviners/Hammers
Plant Activities	Burning	Draining	Steam	Cleaning agents
Confined spaces	Cutting	Access	Electricity	Blockages
Access equipment	Isolations	Work at Height	Computer	Lining of item
Manual Handling	Surround's	Recontamination	Waste gas	Fumes
Cleaning	Blowing	Lone working	Compressed air	Fume extraction
Lifting	Washing	Dust	Nitrogen	Biological
Removal of fittings	Jetting	Gases	Chemicals	Explosive
Welding	Breaking Flanges	Asbestos	Contamination	Radiation
Sharp Edges	Insulation/Lagging	Drains	Condensate	Mercury (thermos)
Adverse weather	Inspections	Water	Lubricating Oils	PCB
Supply of electricity	Heat/cool Media Stored Energy	Speed of agitation	Man-made Fibres	Mix-up chemicals
Check of equipment	Refrigerants	Sampling	Contaminated Water	Temperature
	Fumigation Agents	Open Manway	Hot Surfaces	Pressure pH Value
Charging/Dosing	Pathogens Treatments	Disposal		

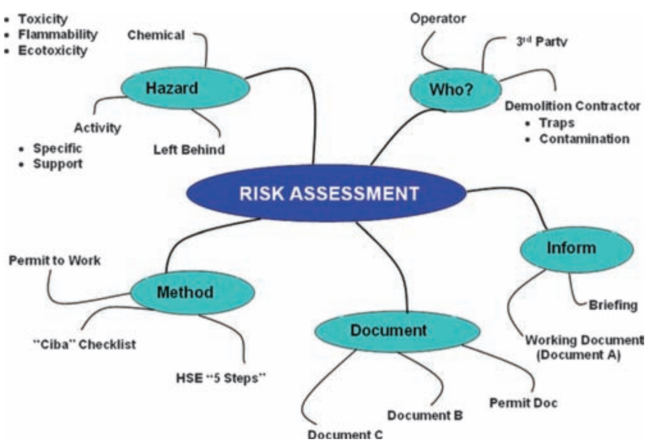

Figure 4. Role of risk assessment within overall project

projects and have limited use for controlling decommissioning work. It was therefore decided to evolve the existing safety stop system to cover decommissioning activities.

This led the project team to develop the 'transfer safety stop'. It is designed to ensure that risks are properly assessed before any material transfers are carried out. The transfer safety stop considers issues such as:

- Are the conditions (inerting, earthing etc) correct for the transfer?
- What is the consequence of any mixing which might take place?
- Is the resulting mixture safe (thermochemistry, flammability, combustability etc) and acceptable for disposal?
- Can effluent streams be safely sent to drain and will they be compliant with site discharge consents?
- What other transfers may be in progress at the same time?

This poses two practical problems:

1. Mixtures and residues inside vessels may have unknown safety properties. It is often necessary to consult experienced chemists and it will sometimes be necessary to conduct additional laboratory safety tests before an operation can proceed.
2. Sites often have extremely tight discharge consents for named chemicals. Normal operations are then managed using captive drainage systems. When the time comes to decommission plant, residual contamination cannot be released to the effluent system as this would cause a breach of the discharge consent. Careful thought and planning is therefore required and some wash streams will have to be sent for offsite disposal by road tanker. If this is the case, it is essential to miminise cross-contamination and cleaning liquid volumes, as this will massively increase waste disposal costs.

It was recognised at an early stage in the project that the project objective of no accidents or incidents could only be achieved if there was a strong link between Ciba and the demolition contractor. The selection of the demolition contractor was carefully considered and it was decided to use a contractor who had previous experience in the decommissioning of chemical sites. They had already worked at the Ciba Clayton site on other projects and their standards and performance had been audited.

Ciba staff then needed to have a system for formally handing over individual site areas to the contractor. This was achieved using a formal system of handover documents, which covered:

- Basic data about chemicals and equipment, supported by drawings and plans where they were available.
- A handover report for the building covering the chemical and engineering activities and hazards, bulk contaminations and photos, highlighting any disconnections. This report was typically about ten pages long.
- A walk round of the site area.
- Certificates for service electrical and control isolation, decontamination and decommissioning.

LEARNING EXPERIENCES

Ciba have gained a lot of valuable experience about decommissioning a large chemical manufacturing site. Six particularly important lessons have been learnt:

1. **The need for detailed risk assessment and systems to support the project.** The project was complex and involved people from different organisations. Detailed systems, procedures and paperwork were required to manage the project.
2. **Maintaining staff motivation as the site closes down.** The project can only succeed if the site staff are fully committed to the project. Effective consultation is required with all staff and key staff need to be retained until the project is finished. This can be difficult to manage as the project enters its final stages, with staff leaving the company on an almost daily basis. Detailed plant knowledge is essential for completing this type of project successfully.
3. **Ensuring site security prior to closure.** At the final stages of the project, the site will have a large perimeter and there will be few people present on the site. A lot of valuable scrap metal is often left at the site and is often cut and pre-loaded, ready for offsite disposal. The site was very vulnerable to theft and security breaches at this time.
4. **Additional safety testing is required before material can be removed for disposal.** Mixtures and unknown residues were found and collected during decommissioning. The hazardous properties (fire, explosion, thermal stability etc) of these materials were unknown. Material samples were taken and analysed in the Ciba Safety Testing Laboratory in Macclesfield before starting work.
5. **Chemicals must be used up before the production plants are shut down.** Commercial logic would suggest that valuable raw materials are converted into saleable finished products before the site is finally closed down. Inventory management plans must be in place well before closure operations start. Unforeseen problems can also occur with less valuable raw materials. In one case, an outline agreement was made with the supplier to buy back an inventory of chemical. Ciba planned on the basis of this agreement but last minute problems occurred when the liquid had to be removed. The supplier was not prepared to buy the material and as Ciba were not the producer of the raw material, it became classified as waste. This caused time delays whilst alternative disposal routes were found. Eventually, the liquid had to be sent offsite in road tankers for waste disposal, converting a small planned revenue into a large unplanned cost. Further practical problems occurred. Firstly, it was realised that the storage tank was designed for road tanker offloading into the tank and not for loading from the tank into a road tanker. Additional engineering work was required. Then, when this work had been completed and the transfer was behind schedule, it was discovered that the control system, instruments, power supplies, services and effluent connections had all been decommissioned. A job which appeared to be simple had become extremely complicated.
6. **Some operations will not go to plan for totally unforeseen reasons.** A storage tank of concentrated sulphuric acid had to be emptied and washed out. The tank was

constructed of mild steel. It was envisaged that the washing operation would be completed quickly. When the work was started, it was found that there was only one way to fill the tank with water because the control system was no longer operational. Unfortunately, this involved using a 2″ diameter water connection. It took a long time to fill the tank for washing and generated an unforeseen corrosion/reaction hazard as dilute sulphuric acid attacks mild steel, generating flammable hydrogen gas. The original procedure was safe but the practicalities of the operation changed the intent of the original procedure, generating a potential hazard.

CONCLUSIONS

The major decommissioning project was completed with no reportable accidents or incidents. This was achieved with a combination of the efforts and commitment of site and project team staff, the use of risk assessment and project control systems and careful briefing of plant staff before starting each item of work. Figure 5 summarises the links between the key planning and control elements which allowed the project to be completed successfully.

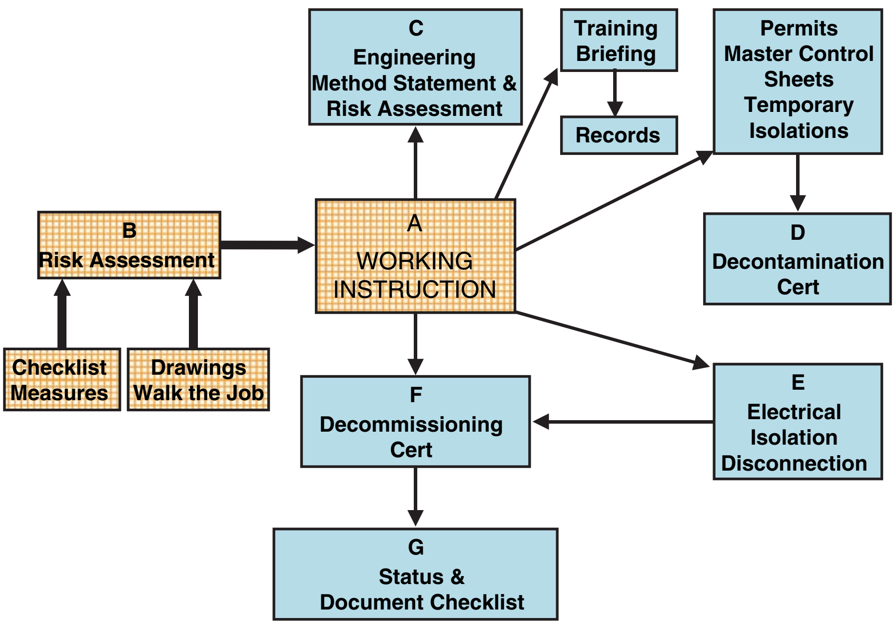

Figure 5. Overview of critical project planning and control elements

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