The Importance of Management of Change in New Plant Construction

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Introduction

This paper will consider the importance of the Management of Change process in the design and construction of new plants, drawing on the positive and negative learnings from EPC Groupe's new Bulk Emulsion Plant in the UK.

To emphasise this link, it is important to first understand what the key elements of a good Management Of Change (MOC) process are, and the place of MOC in the Process Safety Lifecycle. The paper will also provide an overview of design elements, including relevant standards of compliance, and some of the complications that can arise throughout the construction process. Essentially, any major project of this nature is subject to both enforced and desired change, and the challenge for a high hazard industry like explosives manufacture lies in the management of these changes. Of course, we cannot forget that all businesses face other influences that can affect these decisions, primarily budget and timescale. The emphasis of this paper is that regardless of the reasons for change and the pressures involved, a rigorous MOC process correctly applied will maintain the integrity of the design and construction resulting in a safer plant.

Management Of Change (MOC) Process

Process and plant modifications are an inevitable part of the lifecycle of any installation and therefore it is vital that high hazard organisations have a robust process in place.

The Chemical Industries Association Safety Advisory Group advises that all plant modifications *"…should be subject to formal management procedures"* (http://www.hse.gov.uk/comah/sragtech/techmeasplantmod.htm; HSE website; UK).

A typical process may look something like this:

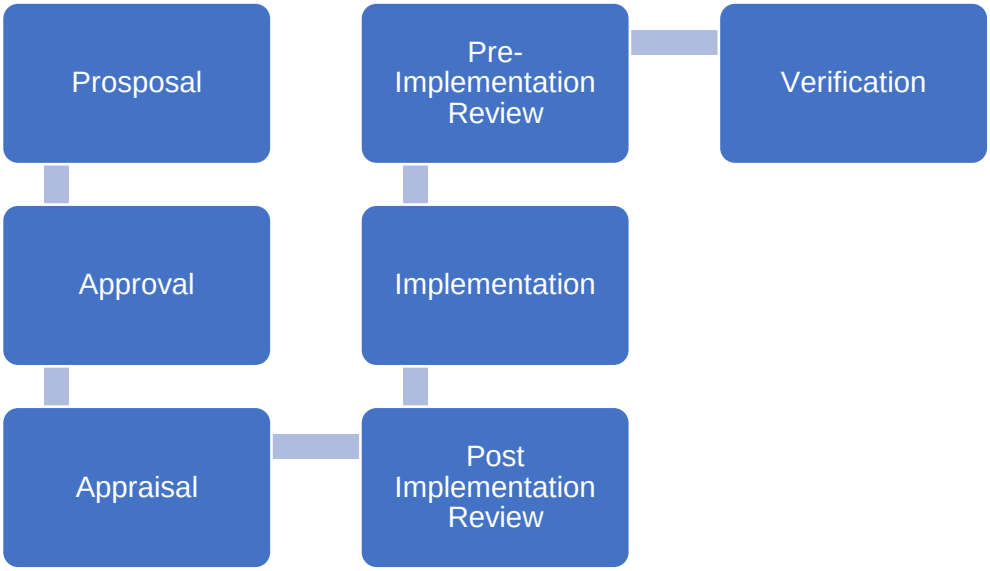

Figure 1 – Basic MOC Process

Leadership is essential and the procedure requires ownership from an appropriate level within the organisation. The person should have the relevant level of knowledge to understand the change and the authority to make decisions and ensure it is implemented fully. In addition, they must ensure that the change is subject to sufficiently detailed scrutiny by an expert team of contributors. In the case of plant construction this may be a combination of Engineering, Technical, Safety, Environmental and Operator reviews to give a comprehensive appraisal of all relevant aspects.
From these appraisals the actions required to implement the change can be clearly defined, resourced and implemented. Pre and post implementation safety reviews should be completed to control deviations, and the verification/closure of the change process should be completed once the change can be considered successful and part of normal operations.

Process Safety Lifecycle
In Europe the Seveso Directive has resulted in a significant focus on Process Safety and the avoidance of major accidents. In the UK, the Health & Safety Executive (HSE) have considered the root causes of major accidents which can be seen in the model below:

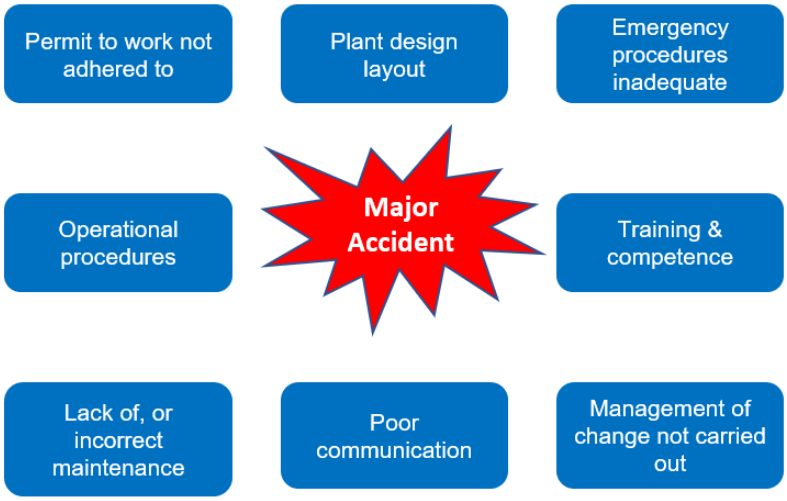

Figure 2 – Root Causes of Major Accidents

It should not be surprising that MOC features prominently here and I am confident that almost every organisation could provide their own examples of poorly managed changes. Within these failures there could be a variety of factors ranging from lack of expert technical consideration to lack of resource. What is clear though is that a well-managed process enables organisations to overcome the barriers to progress without compromising the integrity of design and construction.

The Process Safety Lifecycle (see Figure 3 below) perfectly illustrates the life of a plant:

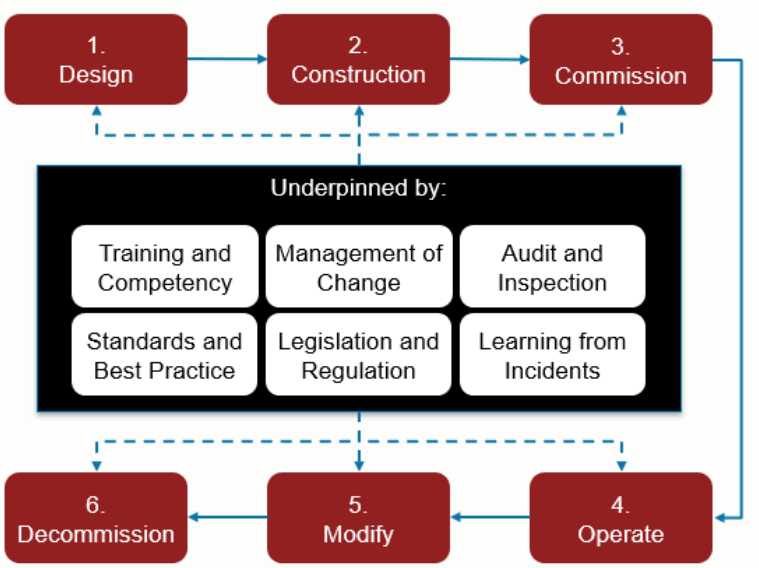

Figure 3 – Process Safety Lifecycle

Management of Change is a key element which underpins all stages, but it is arguably most important during the critical design and construction stages. Explosive manufacturing plants simply cannot afford to make fundamental errors since ultimately these can cost lives and jeopardise the very future of the organisation.

Plant Design & Construction

For many, the opportunity to be involved in the design and construction of a new plant is a once in a lifetime event. Having been fortunate enough to have experience of what's involved, I can attest that it is a unique environment and a true test of an organisation's teamwork. It takes tremendous focus to ensure that the inevitable changes that occur during a project are rigorously managed.

Design

Modern plant design is increasingly subject to compliance with functional safety standards, and in the case of EPC-UK's Bulk Emulsion Plant in the UK the benchmark was BS EN 61511 (*Functional safety – Safety instrumented systems for the process industry sector). This standard sets out a defined approach through a process of risk assessment, specification, design, installation, testing and commissioning. This can be an incredibly long and detailed process and can actually enforce change at different stages.*

Plant design should be subject to a rigorous Hazop (Hazard Operability Study), this detailed analysis of all potential deviations, can highlight design deficiencies, which in turn result in significant changes. In extreme cases it may necessitate a complete plant re-design, and a new Hazop, whatever the outcome all changes should be captured within the Hazop process.
EPC-UK completed a Hazop for the design of their new Bulk Emulsion Plant (BEP) in 2016, but a change of contractor prompted a full review and resulted in a re-design late in 2017. It would have been easy to assume that the fundamental aspects remained the same, but the decision was taken to complete a second Hazop.
In hindsight, not doing so could have resulted in numerous changes during the construction that would have been far more difficult to control, and arguably they would not have been given the correct level of scrutiny amidst the busy schedule of such a large project. Another major positive from conducting a robust second Hazop was that the Project Team could be assured that any further changes were unforeseen and had to be managed through the MOC process.

Construction, Installation, Testing & Commissioning
Depending on the nature of the project, it is always possible that the theory of the design does not translate correctly through to the construction and installation. This can be as a result of a variety of factors, but at this point in a project any change is likely to cause delay. The natural instinct is to find a workaround and resolve the problem quickly to maintain the schedule, however, this is probably the most crucial time to step back and assess the potential for change thoroughly.
Additionally, the testing and commissioning carried out to validate the design and construction will often present change requirements. At this point the changes required may seem obvious, and the solution is dangerously simple to implement. However, it is important to remember that a good MOC process will challenge this assumption and ensure that all possibilities are identified, documented and managed.

MOC in Design & Construction
A good MOC procedure should have clear criteria with which to assess a change and consider if it needs to be managed formally.

The MOC system outlined below applies throughout EPC-UK (Procedure :EPC SAF 028) and consists of the following three change areas:

- *Technical*

Technical changes apply to:

- *plant, equipment, materials and include changes to electrical systems;*
- *operational processes (physical change to existing plant, operational process, or deviation from documented design limits or requirements in a critical document);*
- *changes to safety instrumented systems (SIS);*
- *changes to the shutdown of any plant or process that may introduce safety, environmental, security or quality issues;*
- *raw materials and factored goods;*
- *changes to vehicles where the change could have legal, safety or operational implications.*

- *Administrative*

Administrative changes apply to:

- *Safety Critical policies, procedures and processes (changes to, or deviations from, requirements in a controlled document e.g. work instruction).*

- *Organisational*

Organisational change applies to:

- *People (permanent changes in the organisational structure, business acquisitions or mergers, changes to safety critical roles or a change in personnel with specific knowledge or experience.*

If there are changes to any of the above, then the use of the MOC process will be required.
Once the need to follow the MOC process has been identified, the onus then falls to the relevant experts to provide valued feedback on the potential impacts. As I mentioned previously, in the pressurised environment of a major project this input is vital and there may be no quick and easy answer. Aspects to consider may include (but not be limited to):

- *Upstream & downstream impacts, Operator inputs, Basic Process Control System settings/parameters, additional equipment (process, safety or ancillary), maintenance requirements, Functional Safety (for*

Safety Instrumented Systems), changes to procedures/work instructions, manufacturer guidelines, legislation, future requirements, environmental impact, cost.

The considerations should be specific to the change, and some will inevitably be more complicated than others. Changes to Safety Instrumented Systems (SIS) for example are among the most complex and would also need to be managed through the Functional Safety Lifecycle. It is of course an organisational decision as to what level of assessment & detail is required, which in turn will depend on the nature and complexity of the change.
When the actions required to implement the change are identified it is equally important to ensure that they are carried out as intended. A good pre and post implementation safety check should maintain integrity and follow through with an appropriate level of detail.
During EPC-UK's project there were three specific changes identified and managed under MOC, one of which provides an ideal example. During testing it was realised that a shared pipeline would not give suitable accuracy for the specification of a production phase and as a result a proposal was made to install a separate pipeline. As a minimum, this fell into the criteria of "Changes to process plant and equipment" therefore there could be no question that this required formal management.
Although it sounded a relatively simple change requiring a new pipeline, additional pump and 2-way valves into the process tanks, the assessment identified several important considerations including the following:

- *Materials of construction*
- *BPCS software changes*
- *Impact on Safety Instrumented Systems*
- *Pump specification*
- *Valve specification*
- *Contractor control*
- *Operation & Maintenance of new equipment*
- *Pipework specification*
- *Installation standards*
- *Testing & commissioning*
- *Updating documentation (P&ID, electrical drawings, operational & maintenance procedures)*

- *Timescale*
- *Cost*
- *Internal/External resource*

The Senior Management Team were provided with a detailed appraisal which might be considered a simplified cost benefit analysis, and approval was given to proceed. The change was implemented quickly, safely and successfully. Most importantly though, the MOC team were not pressurised and were able to focus on the details of the change without distraction. The post implementation check was carried out as part of the comprehensive audit of the entire plant with full involvement from the Senior Management and Safety personnel. To summarise, it was an extremely positive experience that benefitted from previous learnings on the implementation of MOC in the organisation, and having been fully documented in the Quality Management System it also serves as a historical reference point.

Organisational Change

While this paper has focussed on plant related change it is essential to remember that the MOC process should incorporate other business changes, perhaps none more so than significant organisational change. The movement of key people in or out of an organisation during a project can play a major role in the successful management of changes.

For EPC-UK this was certainly the case during a project whose lifecycle spanned from 2015 to 2019. Some challenges have included:

January 2018 – New Operations Manager
April 2018 – New Maintenance Technician
August 2018 – New Project Manager
April 2019 – New Safety Advisor
June 2019 – Departure of Maintenance Technician

In such a major project it is vital to retain the knowledge and experience and understanding of the project history, although new knowledge and experience can prove highly beneficial.

Conclusion

While the principles of Management of Change should be consistent, the application of the process to a particular change can often vary. The importance of establishing the right team of skilled individuals, to provide the required level of detail to identify necessary changes, and subsequently implement the changes safely, cannot be overstated.

The level of detail required to manage such a construction project is huge, and as such we often underestimate the impact that a minor change can have. The focus of many people tends to be on the big picture, and there are often added pressures within an organisation such as cost and timescale that can influence decisions. A change may be seen by some as an unnecessary project delay or an increase in costs and these factors can cause people to underestimate the control required. This is where managerial discipline to the MOC process is paramount.

Arguably, it is most important to rigorously manage change during the design and construction phases, particularly in high hazard environments as underestimating the requirements can potentially allow major accident risks to be incorporated into the new plant.

It is vital to have a clear and concise process to adequately evaluate change, coupled with the discipline within an organisation to follow through with the changes. The opportunity to design and build new plants does not occur every day, therefore it is imperative that the inevitable changes in these projects remain well managed.