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Why Sometimes May be Neglected Management of Change?

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Management of Change is a process for evaluating and controlling modifications to facility design, operation, organization, or activities – prior to implementation – to be sure no new hazards are introduced. This article does not examine all the issues related to MOC during the life cycle of a plant, but considers only a particular type of changes; therefore we will not discuss how to manage the replacement in kind (RIK), but only those which according to their specific attributes are difficult to manage. There are two very difficult kinds of change to be identified or managed one falls under the category of Reactive Changes and the other is the Emergency Change. This document contains some considerations on the basis of personal experiences, about the possible reasons why the MOC often may fail or can not be handled as for the procedures or theory, taking into account all its characteristics and activities in a systematic way. The article will discuss, starting from the beginning of the life cycle phase of a project about the various issues to face to manage or try to do it with this particular type of changes.

1. Introduction

A lots of incident investigation reports indicate ineffective MOC as one of the major contributing factors in many catastrophic incidents in the process industry (i.e. CSB reports 2005, 2008). A study determined that 80% of all large scale incidents are traced back to failure in MOC. Another study shows that for every 1,000 work orders, there would be about 50-100 changes that require the employees to follow the MOC procedure. Of these 50-100 changes, about 5-10 of them would be considered potentially high risk changes.

Every organization, whatever the model is inspired, is a system of organic relations between structure, people and processes that contribute to achieving objectives. Any change in one of the three components of the organization is reflected automatically on the others. Any suggestions for change should include the impact of change on all three components and hence the control actions necessary to govern the inevitable disruption that the same change are derived.

The Process Safety Management Systems (i.e. OSHA) include rules about the Management of Change (MOC), usually they require employer to establish and implement written procedures to manage changes both permanent and temporary (except for RIK) to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process. In all cases, the developments of an organization involves a specific change strategy that takes into account the starting point and clearly define the end point, based on a realistic assessment (quantifiable) of the strengths and weaknesses of organization itself, the objectives to be achieved, the resources available and how you intend to take. In other word the MOC should be manage as project itself; next paragraphs will examine the MOC issues in the different lifecycle phases of a project. Changes, including temporary, caused a number of trouble and accidents over the years.

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2. Design Phases

Change management during the design phase is hard and very difficult, in fact the first problem is defining what is a change during this phase of the lifecycle of a project, the second one is that most of these changes may be classified as reactive change (a reactive change is occurs spontaneously, rarely planned and can lead to positive, negative or even unintended results) and the source is usually a human factor. At these phases of a project the target should be the qualification of its technical issues like capital and operating expenditure, plant flexibility and capability, equipments efficiency, reliability, availability, maintainability to determine its effectiveness, design can be thought of as a sequence of specifications of increasing detail which finally result in a detailed design solution to the technical requirements specification, which can then be implemented. With the progress of the project activities the technical information is available at different times, in this iterative cycle the coordination of the different information allow to all specialist involved in the project to verify and examine the possible effects of the choices on their area. As design proceeds there is potential for errors to be made, particularly if the design becomes complicated. Lack of information, wrong or misinterpretations, time and budget constrains, are the possible sources for a lot of variations in the project and, they can be minimized adopting formal procedures for reviewing or verifying the compliance of the design at standards and contractual requirements at appropriate stages. Such verification exercises are the main method to prevent errors within the design phase but, are themselves sources of changes and not always are handled properly and critically by the project teams. Reading in the HSE Plan the chapter on MOC is easy to find things like:" All aspects of change have the potential to impact HSE. This can occur due to design development during the engineering phase, changes during construction, operational activities and equipment or organizational modifications. The HSE system will capture changes and formally review them to evaluate the impact, if any, on the plant and incorporate into the change, modifications necessary to assure HSE criteria have been fully addressed and standards have not been compromised". The only problem is we do not know how the HSE management system will identify the changes even if we can imagine how they can review and assess their impact. In many companies the formal use of the engineering change process starts when a design project has reached its first baseline (e.g. "System Design Review", "HAZOP"), after which all project documentation will be submitted for approval and locked for further work. To assess whether the change is a simple adjustment or a change engineers may use a general rule where anything that is likely to result in a change in operating procedure or system protection, or have an impact on safety, should qualify. Most organizations will also have a monetary threshold. Different rules and procedures may be applied in the case of changes to programmable control and monitoring systems. Changing hardware components (e.g., hardware sensors) might require changes in software components [e.g., caused by changed value ranges, data types (e.g., analogue / digital sensor), or number of connection points].
The reason for making changes can originate from different causes like for examples:

- Changes in the legislation, international standard or project specifications.
- Changes in the equipment depending on altered function or production requirements.
- Faults in the interpretation of customer demands into technical requirements.
- Introduction, revision, withdrawal of components in the equipment.
- Correction of errors on a document bringing an old document up-to-date
- Difficulties in construction or assembly.

All the above changes may be reactive change and classified as overt (that is known about, and whose consequences can be mitigated before the commissioning of the plant) or covert (not known about before it "announces" itself). The formal process starts when after a document has been released, which means that the document has been distributed from the issuing department to other departments within the Project Team. On the basis of the experience changes in the document are often discovered from other departments since many different departments may be affected when document are to be changed. In order to perform the change in the best way possible and fulfill the wishes of all parties, the MOC process should be performed in a cross-functional environment. This has often proven to be difficult, since functions typically have different goals. For example the goal of engineering is to perform a certain function in the best way possible, whereas the goal for construction is to assemble it in a short time and for purchasing cutting material and so on. The MOC process is often associated with long lead times, which is caused by a number of factors. First, the process requires meetings with all affected specialists of different departments, where alternative solutions should be evaluated to satisfy everyone. Secondly, the process requires extensive document management. Old and new documents should be checked out; new documents are created to evaluate changes and sent for their approval. This is time consuming, obviously a function of the change (large or small). Sometimes the complexity of MOC procedure or understanding often leads to frustration and employees tend to be unwilling to use it. Instead, some changes are avoided

or performed without using the formal process. This can lead to an incorrect or incomplete documentation and problems in the latter stages of the project development. The nature of the MOC is also a source of irritation. When starting a MOC process, it means that designers have to redesign something they have already done before. The designer might feel accused of having done something wrong or that he/she must do the work again because some other designer has made a design error on a connecting part.
The reviews activities themselves sometimes can not be taken as the right time to freeze the design choices since project management or contract requirements anticipate the activities to achieve a contractual milestone or issue of material orders therefore this practice may increase the risk of reactive changes. The reviews activities are of primary importance in the design phases and should be carried out not only at disciplinary level but also at multidisciplinary; to help engineers to manage the changes is a common practice to built registers (HSE Action Tracking Register, HSE Decision Dossier, etc.). However despite all the efforts spent in review activities, sometimes they are sacrificed as considered a waste of time at the design phase even if the experience shows that the correction of a change or an error identified during the construction is much more expensive due the internal and external constraints that do not allow the designer to choice the best solution as in the early stages of the project. Thus, key questions in context of change management are (a) how changes can be handled more efficient and (b) how relevant change requests can be passed to involved engineers. Keep in mind that a modest MOC system that is regularly used and works is much better than an elaborate, sophisticated system with an impeccable paper trail that is occasionally winked at, bypassed, or sometimes totally ignored. Developing an effective MOC system therefore requires evolution in a company's culture; it demands significant commitment from line management, departmental support organizations, and by its own employees. Strong management commitment should include allocation of adequate resources for managing change and the willingness to modify existing management systems when necessary to accommodate MOC requirements. Only when management commitment is visibly demonstrated is it possible to obtain the widespread involvement and support essential to implementing an MOC system. In addition, to obtain the employee commitment necessary to make widespread employee involvement effective, management should provide effective orientation and training for all personnel (including contract personnel) involved in activities that can result from or be affected by changes.

3. Operations

Starting a new plant the RIK should only made, therefore in this life phase the MOC should become simpler and clearer, plant was built, structure and equipment specified, tested and validated. Unfortunately, realty is more complex and cannot be dealt only in these terms. Reading an old book, Trevor Kletz , (Kletz, 1998) identified different kinds of change:

- Start up
- Minor
- Modifications made during maintenance
- Temporary modifications
- Sanctioned Modifications
- Process Modifications
- New Tools (introduction of)
- Organizational Changes
- Gradual Changes
- Modification chains
- Modifications made to improve the environment.

Systems begin to change when they become operational with the progress of the aging process (gradual changes). Equipment require change from the beginning of its operating life for a lot of reasons like incorrect dimensions, faulty material, fabrication or welding defects not identified in manufacturing test or with the non destructive test (NDT), effects of loads and environments not foreseen during the engineering phase. Equipment is exposed to conditions of stress and aggressive environment that will degrade the material. Ageing is not about how old your equipment is; it's about what you know about its condition, and how that's changing over time (RR509 HSEUK). Erosion, corrosion and fatigue are typical reactive changes. A research showed that 50% of European major hazard 'loss of containment' events arising from technical plant failures were primarily due to ageing plant mechanisms such as erosion, corrosion and fatigue (RR823 HSE UK) and, between 1980 and 2006, there have been 96 major accident potential loss of containment incidents reported in the EU Major Accident Database (MARS) which are estimated to be primarily caused due to ageing plant mechanisms. This represents 30% of all reported 'major accident'

loss of containment events in the MARS database, and 50% of the technical integrity and control and instrumentation related events. These 'ageing' events equate to an overall loss of 11 lives, 183 injuries and over 170Million € of economic loss. All this despite in the complex systems there are policies and structural plans to monitor any assets through inspection and maintenance to ensure their integrity in compliance not only with the project specifications but to meet requirements of laws and company. The difficulties to manage reactive changes in a plant are therefore easily understood since due to the heaviness to localize and diagnose them properly. Besides this the covert changes may occur in process units but may arise in the utility systems or external sources (ship tanker, etc.). The normal practice is to enforce the laws but, all equipment that contains a hazardous fluid or pressure needs to be appropriately maintained and inspected according to the potential hazard. Another type of dangerous change may occur in the early stages of commissioning and operation life phase are the temporary changes. Temporary changes have caused a number of catastrophes over the years, and Companies need to establish ways to detect temporary changes as well as those that are permanent. It is important that a time limit for temporary changes be established and monitored since, without control, these changes may tend to become permanent. Temporary changes are subject to the management of change provisions. In addition, the management of change procedures should be used to insure that the equipment and procedures are returned to their original or designed conditions at the end of the temporary change. Proper documentation and review of these changes is invaluable in assuring that the safety and health considerations are being incorporated into the operating procedures and process.

The first difficulty is to understand that continuing with certain procedures or interventions is changing the step up or structure of the system, which is coming out of the limits or boundary set by designers. Understand that what you are doing is a change and not a permitted practice, is the step to mange successfully a change. This step is the most delicate because you have to explain the reasoning and thought behind the need for change. Identify possible changes to make easier a task or improve the control of the process normally sees the contribution, participation and support from the staff. Difficulties arise when they are asked to critically examine the single contributions during the implementation of the change, to review not only the technical aspects but also the economical or the safety features, in other words to manage the risk assessment of the change. All these difficulties are reflected in the failure to comply with procedures or deficiencies in the hazards identification and as consequence in the risks assessment. Indeed, all systems, without exception, are reluctant to accept comments and much less critical to their work. How to change knowledge is a point usually overlooked as it may seem strange in a world prides on being in constant transformation and change quickly. The knowledge of the change can be achieved through the normal methods of training and education. Other methods of knowledge transfer, such as coaching, forums and mentoring, are also helpful, so do not limit this training process. Two kinds of knowledge need to be addressed: knowledge of how to change (what to do during the transition) and the knowledge of what to execute once the change has been implemented. When the theory knowledge on how to change is fine we need the practice too, and the staff performances need to be supported. This requires time and can be achieved through testing, coaching and feedback, skills and behaviors. Despite all the above efforts, to ensure individuals do not revert to old ways can be achieved through positive feedback, rewards, recognition, measuring performance and taking corrective actions. Organization need a MOC procedure, even simple but adopted and applied and where staff are able to measure its performances, to ensure proper performance of MOC procedures, periodic audits should be carried out.

For these reasons MOC procedure really should be composed of different steps like for example:

(1) Initiation – change identification and determination of whether the MOC procedure must be applied.
(2) Scoping – The change is scoped, which identifies, at a minimum:
    i) What tasks need to be done
    ii) Who reviews the MOC
    iii) Who approves the MOC
    iv) Who is notified
(3) Change design. Documents that describe the change are created or redlined
(4) Impact analysis (Review). The potential impacts of the change are analyzed and evaluated. These include:
    i) Health, Safety (Process and Personal), Environmental hazard and risk analysis
    ii) Financial impacts (i.e. capex/opex)
    iii) Product and quality impact
(5) Approval – previously identified reviewers and approvers accept, reject or cancel the proposed change. Rejection implies that further work is needed to detail the physical or financial aspects of the change proposal.

(6) Implementation / Installation – Execution of change proposal, including documentation, communication and training.
(7) Pre-Start up Safety Review (PSSR). In case of plant based MOC. The PSSR validates that the change has been made safely. Discrepancies are noted and resolved. PSSR ends with an authorization to start up.
(8) Closeout – Verification of satisfactory completion of implementation activities, the change is formally closed.

And a possible list of performance indicators to manage the MOC procedure may be like:

- Number of request of Changes raised
- Number of Changes made, classified by impact and priority, and filtered by period
- Number of Changes back out, with detailed explanations.
- Number of Changes that were successful at first attempt, second attempt, etc.
- Number of MOC reviews each month
- Number of MOC reviews in each facility/activity area each month/per year
- Number of incidents having MOC failure as a contributing factor or root cause
- Average amount of calendar time between MOC origination and authorization
- Average amount of calendar time between MOC authorization and closeout of all action items
- Average backlog of Changes / Active Changes
- Average number of man-hours expended per MOC from the time it is originated until it is approved for implementation.
- Average time taken for changes, as a function of impact and priority
- Percentage of requested Changes accepted and approved
- Percentage of Changes within the MOC system that were reviewed incorrectly
- Percentage of MOCs that were reviewed but were not properly documented
- Percentage of MOCs for which training of affected personnel was not conducted
- Percentage of work orders/requests that were misclassified as RIKs rather than as changes, or were not classified
- Percentage of recent changes involving alternate MOC reviewers
- Percentage of changes that were properly evaluated but did not have all of the required authorization signatures on the change control document
- Percentage of changes that were processed on an emergency basis
- Percentage of temporary changes for which the temporary conditions were not corrected/restored to their original state by the deadline
- Percentage of personnel involved in the MOC system who believe it is effective
- Ratio of identified undocumented Changes to the number of Changes processed through the MOC system
- Difference between the percentage of senior managers and the percentage of routine users who believe the MOC system is effective
- Post implementation evaluations

4. Conclusions

Systems are subject to external changes (laws, market, quality, etc.) or internal (errors, aging, adjustments, etc.), however, not all the changes that occurs can be easily identified or detected. An effective and systematic application of MOC process allows us to try to control and better understand them and thus preventing possible accidents. Not only reactive or gradual changes difficult by themselves to be identified, there are also the pitfalls at the human factor level to be taken into account. Experiences in the implementation and auditing of MOC process and systems let us to identify the following common pitfalls:

- Inadequate definition of change or underestimation of possible effects of no RIK change on the system.
- Management of temporary change (approach, extension and resolution).
- Management of organization changes (approach, design, test, corrective actions, etc.).
- Management of operative procedures changes (how to decide if a Pre-startup safety reviews is needed, hazard analysis validity, training, etc.)
- Communication of change (documentation maintenance, updating, training, etc.) and process safety information to close the MOC in time.

Evaluating the MOC process, for example through collecting data for performance parameters help to identify problems also in the process safety culture and management systems of the organization. The MOC process involves in fact all the organizational departments, from inspections to training. An inadequate MOC is a signal of inefficiency of our management system from the operational point of view with consequences on quality, safety, health and environmental due to the gradual deterioration of performances of the process under control which could rise dangerous or very hazardous situation.

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