# Managing the Risk of MOC

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## Abstract

During the execution of a change using Management of Change (MOC), the risk to the facility is increased because things are in flux until the change is completed and documented and personnel trained. During this time P&IDs, SOPs, and other procedures are being developed or changed. Construction or tie-ins in preparation, or as part of the change, are going on. Thus, during the change until it is complete, the potential for error, and therefore the risk, is increased. This potential for error emanates from the use of not-yet implemented P&IDs (which already have red marks), use of unapproved procedures (or use of old procedures after the change), and unintended connections and flows from or to piping which contains hazardous materials. Additional risk results from an incorrect workflow where the appropriate individuals were not included in the review of the technical basis and the safety aspects of the change, or the necessary approvals, are bypassed. Another, less common but possible risk, is unknowingly impacting an existing safeguard by changing related equipment. This is typically due to the inability to conduct a good search of the PHA or the MOC system itself.

Thus, the MOC process needs to be carefully managed, not only for an individual MOC but the aggregate of all the MOCs that are being worked on at the same time. The MOC system needs to provide easy simultaneous access to all personnel and be fully searchable. This enables seeing at any point in time what equipment is undergoing changes, or that has recently changed and is being started up. The longer it takes to complete a change the higher the risk and the MOC system needs to be monitored for late and/or undocumented MOCs. Metrics (preferable with graphs) that show the open and past due MOCs in any period of time, as well as the level of activity of opening and closing MOCs should be part of the system. To ensure proper review and approval there should be pre-configured workflows for the different kinds of changes. Approvals should be independent of reviews. The workflows should be easily configurable and editable as needed. It is important to have a system that is easy to use as this removes a barrier to doing good MOC as complexity leads to error and even avoidance or bypass of the MOC system. Names, responsibilities and dates of all actions, including approvals, should be

automatically captured, addition of information files or links to them should be a feature, as well as the creation of emails that automatically include the required action. Such a system will be illustrated.

## INTRODUCTION

Management of Change continues to be challenging part of PSM as it is still one of the identified direct causes of incidents in ~10% of major incidents (Han Siong 2017) and could be an indirect cause to others. For example, using an old procedure that has been changed may be attributed to a miss in the Conduct of Operations, and a failure of a piece of equipment may be attributed to a lacking Mechanical Integrity program rather than to the failure of MOC when changing the metallurgy of the equipment.

In order to minimize risk with its potential for incidents, a robust MOC program needs to be developed. The program has to address the basics: recognizing change, analyzing the change for safety, executing the change and confirming its proper execution. Beyond the basics, the process for carrying out an MOC is challenging (Kelly 2013) and because of the complexities of many changes and their impacts, not functioning at its best in most companies.

It has long been advocated that even in the simplest of changes, the key factors in an MOC are the safety analysis (the main reason for doing MOC), the description of the change (since the safety analysis will be based on it), and the Pre-Startup Safety Review (PSSR) which verifies that the desired change was properly implemented and people were trained (communicated) on the change (Chosnek 2010). Those are key, but it is not all. There are other factors that impact safety while executing the MOC as other areas of PSM in the plant are affected (Tew et al. 2012). In addition, it seems that one of the preoccupations of many companies is following the MOC procedure without modification rather than other quality aspects. This can be gleaned from a survey of most used metrics by companies (Kenan 2014) and suggests basic problems in the performance of MOC. The risks brought on by these factors need to be managed and minimized.

## RISKS DURING MOC

During the execution of a change using MOC, the risk to the facility is increased because things are in flux until the change is completed, documented, and personnel trained. During this time P&IDs, SOPs, and other procedures are being developed or changed. Construction or tie-ins in preparation of, or as part of the change, are going on. Thus, during the change until it is complete, the potential for error, and therefore the risk, is increased. The production pressures for completing the work in time for a startup may add to mistakes being made, sometimes resulting in significant consequences (Vanden Heuvel et al. 2017).

### The MOC Safety Analysis

An additional risk is added from an incomplete or incorrect safety analysis. Typically, MOC safety analyses will focus on the safety of the change, that is, the risk of changing from status ‘A’ to a final status ‘B’ and rarely to the risk during the change from ‘A’ to ‘B’. It often occurs

that during the change there will be a need to bypass some layers of protection while the work is being performed. The longer it takes to make a change, the greater the risk while the layer or protection is bypassed. One of the most egregious is a recent railroad incident (Houston Chronicle 2018) in which safety systems were bypassed in order to install a better safety system. A passenger train collided with a parked freight train resulting in two fatalities and about 100 injuries. Another is the one mentioned above (Vanden Heuvel et al. 2017) in which alarms were bypassed while installing a new DCS system. The alarms were never switched back on for the hurried startup resulting in the destruction of a fired heater.

Besides considering the bypass of safeguards during execution of the MOC, the bypass or elimination of protection layers can also happen because other MOCs or previous PHAs were not carefully examined. This can easily happen if the change doesn't directly involve those layers of protection but are affected by it. It can also happen when PHA recommendations were resolved in a different manner than the one dictated in the PHA. The connection between cause and effect is lost if the new resolution doesn't explicitly have a description. This may result in the wrong initiating event being considered in the safety analysis. Evolution of the safety information during the change may be another influence on the quality of the safety analysis (Hoff 2014).

### Necessary Time for the Change

One of the requirements of OSHA's Process Safety Standard is the consideration of the "necessary time period for the change" (OSHA 1992). We tend to interpret this to apply only to temporary changes, but any change should carefully consider the time element in implementing it. In view of what is discussed above, we can see that the more time that passes the greater the risk. Changes may also not be independent of each other and the implementation of a change may depend on the completion of another change. Sometimes changes can be implemented out of sequence and it may be (incorrectly) assumed during a safety analysis that a necessary precursor has been completed, if there is no way to continuously monitor the changes. This author witnessed such a case in the upgrade of a metering station for the plant. The upgrade required new instrumentation by a contractor and piping changes by a different contractor. Two independent MOCs were created giving the instrumentation project time to be completed well before the piping project. It happened that the piping project was completed while the instrumentation one was delayed due to materiel logistics, but it "looked" complete on paper. The metering station was switched on and it promptly caused a total plant shutdown.

## MANAGING THE RISK OF MOC

### Considerations

We can see that in order to minimize the risk of conducting an MOC we need the following:

- Conduct a good safety analysis of the change and of the execution of the change. For this we need to consider:

    - Preparing a very detailed description of the change with its necessary documentation.
    - Review previous changes that could be related (search of the MOC system).
    - Review PHA recommendations that could be relevant (search of the PHA).
    - Examination of the plant's Hazards Register or similar documentation that details resolutions emanating from PHAs and other safety studies.
    - Analyze potential bypass, degradation or elimination of existing safeguards resulting from the change.
    - Analyze potential bypass or degradation of existing safeguards during the change
- Carefully consider the time necessary for any change, not only temporary changes:
    - Assess the availability of necessary resources that could impact your timing. This includes approvals and hazards review. It's better to delay the start of the change rather than start and have to wait with half-finished equipment and documentation. The latter leads to higher risks.
    - Evaluate the need of having the changed equipment ready for other planned events – including having completed the PSSR.
    - Include completion of the documentation in your time line – use of process safety information that hasn't been updated is another frequent cause of incidents.
- Have a clear and simple procedure for performing MOCs. The more detailed the procedure, the harder to easily follow, the more the potential deviation from it, and the more the frustration created. Since all changes are not equal, allow for flexibility and different workflows.
- Have an easy way of monitoring the status of your changes and obtain statistics on the progress of all MOCs as even independent changes can conflict with each other. Promptly address any snags in the process.

**An MOC Management Tool**

With the accumulated experience over the years, a computer application that meets all of the above requirements was developed (Knowledge*One* 2004-2018). In order not to create a complex procedure that would have to be checked for every MOC, the procedure is built in based on the needs of the facility. Since all the changes may not require the same review and the same number of approvals, the program allows for pre-building the checklist and allowing for ad-hoc addition (or removal) of requirements. If there are types of changes that occur regularly, workflows can be pre-built and selected from a drop-down list. For example, a P&ID revision may not require the involvement of as many disciplines as changes to the facility. The latter may involve disciplines that normally are not involved such as structural engineering and civil engineering. Equally, reviews by various people or departments may be solely for input to the approver(s). If they don't have to commit resources or participate in the change, their approval may not be necessary. Thus, the number of reviewers may be different than the number of approvers, and the MOC provides for this arrangement. All this can be easily set up or changed in minutes. The workflow, though, should be well thought out but it can be easily changed as needs evolve. The program checks that each step of the procedure is complete before allowing

the next step. For example, the MOC cannot be approved if the requirements in the checklist have not been marked as complete; the PSSR cannot be started until somebody certifies mechanical completion, and so on. Most importantly, the MOC is not considered closed until the coordinator certifies that all the documentation has been updated. See Figure 1 for a typical MOC.

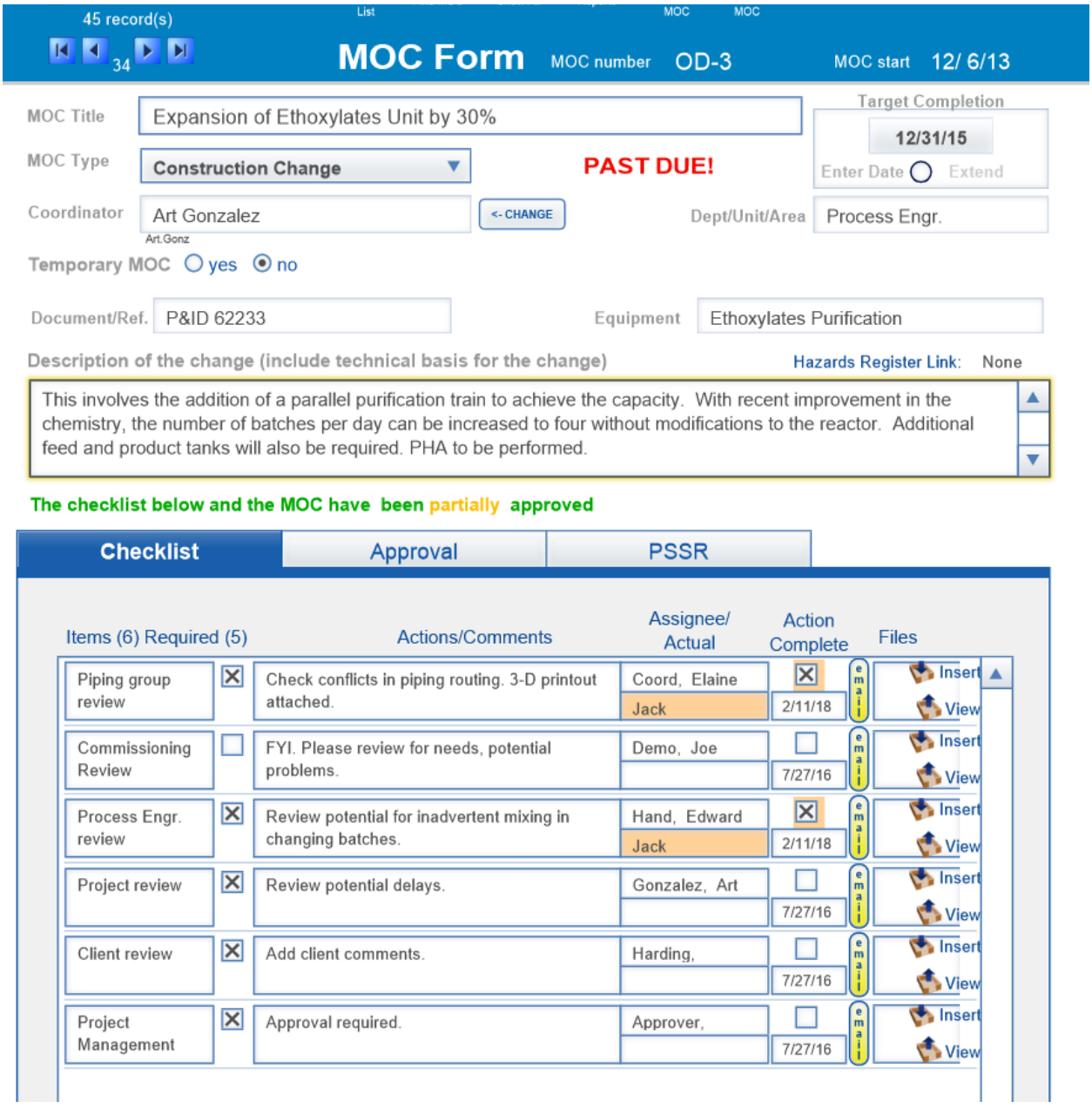
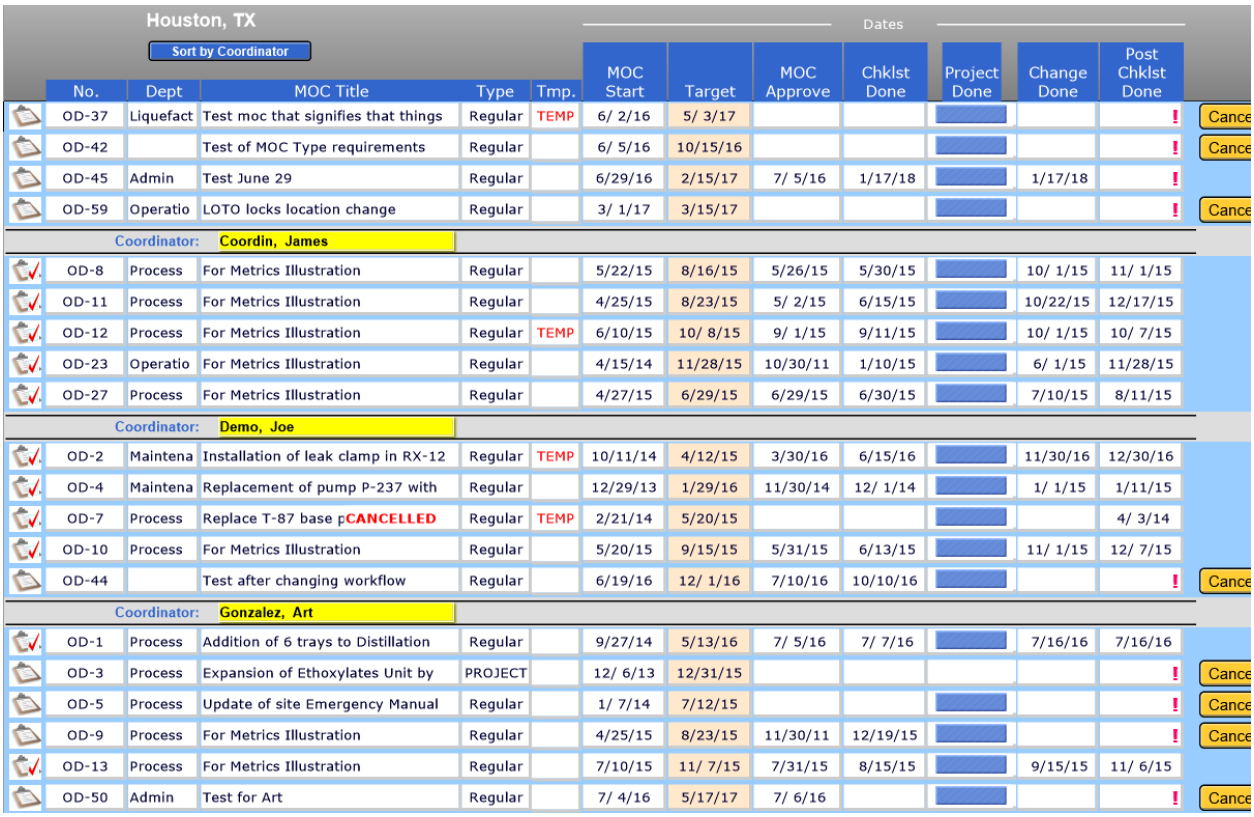



**Figure 1.** MOC Form shown in the Checklist tab (PSSR and completion will appear in the PSSR tab).

The entire MOC management system is, of course, electronic. There is no paper shuffling – reviews and approvals are all done securely in the computer. Login to the program is done through the regular company login and privileges for coordinating an MOC, approving or managing the system are automatically recognized by the program. The name and date of a review or approval are automatically captured. Additional documents can be stored in the program for each MOC (e.g. marked-up P&IDs) – either the document itself or a link to the document's location in the company's document management system.

One of the greatest features of the program is its search capabilities. Searches can be done in every layout (screen) of the program. This allows to conduct very detailed searches of all the MOCs in order to find where similar instrumentation or equipment was involved and examine if that could affect the current change. (PHA software ought to have the same capabilities).

In order to manage a process, you have to be able to gauge its performance. The program shows the stage at which every MOC is (Figure 2). There are pre-configured reports for open and past-due MOCs but any report can easily be created by using the search features. Searches can be saved so frequently used reports can be reproduced. Besides that, metrics are automatically generated showing the number of MOCs that have been open and/or past due over any period of time (Figure 3). This allows for having metrics of the MOC system without having to commit resources to get them. The effort involved in getting metrics for a process sometimes drives a company to abandon the collection of the data (Kenan 2014).



Houston, TX

Sort by Coordinator

| | No. | Dept | MOC Title | Type | Tmp. | Dates: MOC Start | Target | MOC Approve | Chklst Done | Project Done | Change Done | Post Chklst Done | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD-37 | Liquefact | Test moc that signifies that things | Regular | TEMP | 6/ 2/16 | 5/ 3/17 | | | | | ! | Cance |
| | OD-42 | | Test of MOC Type requirements | Regular | | 6/ 5/16 | 10/15/16 | | | | | ! | Cance |
| | OD-45 | Admin | Test June 29 | Regular | | 6/29/16 | 2/15/17 | 7/ 5/16 | 1/17/18 | | 1/17/18 | ! | |
| | OD-59 | Operatio | LOTO locks location change | Regular | | 3/ 1/17 | 3/15/17 | | | | | ! | Cance |
| | Coordinator: | Coordin, James | | | | | | | | | | | |
| | OD-8 | Process | For Metrics Illustration | Regular | | 5/22/15 | 8/16/15 | 5/26/15 | 5/30/15 | | 10/ 1/15 | 11/ 1/15 | |
| | OD-11 | Process | For Metrics Illustration | Regular | | 4/25/15 | 8/23/15 | 5/ 2/15 | 6/15/15 | | 10/22/15 | 12/17/15 | |
| | OD-12 | Process | For Metrics Illustration | Regular | TEMP | 6/10/15 | 10/ 8/15 | 9/ 1/15 | 9/11/15 | | 10/ 1/15 | 10/ 7/15 | |
| | OD-23 | Operatio | For Metrics Illustration | Regular | | 4/15/14 | 11/28/15 | 10/30/11 | 1/10/15 | | 6/ 1/15 | 11/28/15 | |
| | OD-27 | Process | For Metrics Illustration | Regular | | 4/27/15 | 6/29/15 | 6/29/15 | 6/30/15 | | 7/10/15 | 8/11/15 | |
| | Coordinator: | Demo, Joe | | | | | | | | | | | |
| | OD-2 | Maintena | Installation of leak clamp in RX-12 | Regular | TEMP | 10/11/14 | 4/12/15 | 3/30/16 | 6/15/16 | | 11/30/16 | 12/30/16 | |
| | OD-4 | Maintena | Replacement of pump P-237 with | Regular | | 12/29/13 | 1/29/16 | 11/30/14 | 12/ 1/14 | | 1/ 1/15 | 1/11/15 | |
| | OD-7 | Process | Replace T-87 base pCANCELLED | Regular | TEMP | 2/21/14 | 5/20/15 | | | | | 4/ 3/14 | |
| | OD-10 | Process | For Metrics Illustration | Regular | | 5/20/15 | 9/15/15 | 5/31/15 | 6/13/15 | | 11/ 1/15 | 12/ 7/15 | |
| | OD-44 | | Test after changing workflow | Regular | | 6/19/16 | 12/ 1/16 | 7/10/16 | 10/10/16 | | | ! | Cance |
| | Coordinator: | Gonzalez, Art | | | | | | | | | | | |
| | OD-1 | Process | Addition of 6 trays to Distillation | Regular | | 9/27/14 | 5/13/16 | 7/ 5/16 | 7/ 7/16 | | 7/16/16 | 7/16/16 | |
| | OD-3 | Process | Expansion of Ethoxylates Unit by | PROJECT | | 12/ 6/13 | 12/31/15 | | | | | ! | Cance |
| | OD-5 | Process | Update of site Emergency Manual | Regular | | 1/ 7/14 | 7/12/15 | | | | | ! | Cance |
| | OD-9 | Process | For Metrics Illustration | Regular | | 4/25/15 | 8/23/15 | 11/30/11 | 12/19/15 | | | ! | Cance |
| | OD-13 | Process | For Metrics Illustration | Regular | | 7/10/15 | 11/ 7/15 | 7/31/15 | 8/15/15 | | 9/15/15 | 11/ 6/15 | |
| | OD-50 | Admin | Test for Art | Regular | | 7/ 4/16 | 5/17/17 | 7/ 6/16 | | | | ! | Cance |

**Figure 2.** List of MOCs (sorted by MOC Coordinator) showing stage of progress for the MOCs. Clicking on the left side icon takes you to the individual MOC.

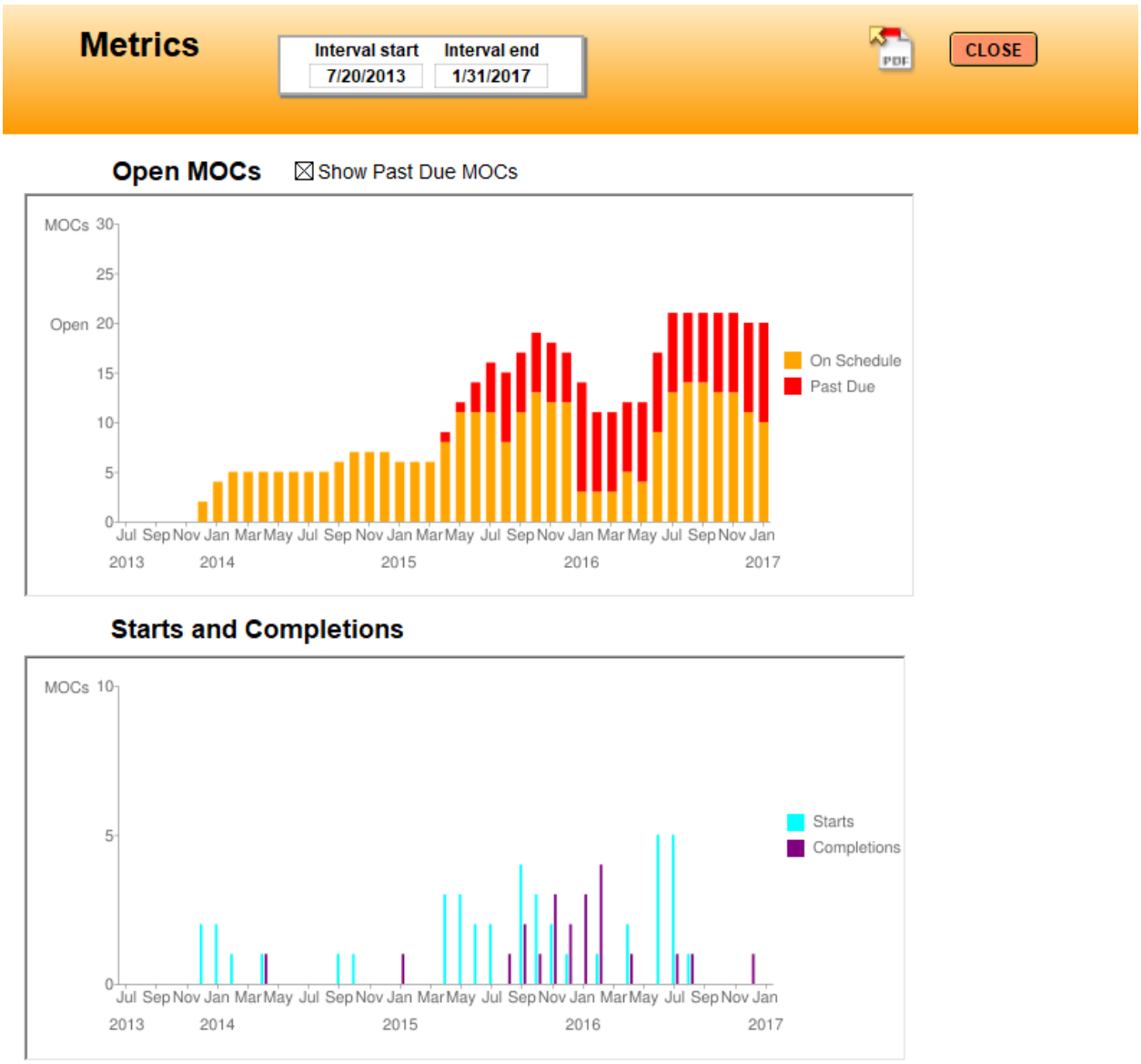



**Figure 3.** MOC Metrics showing Open and Past-Due MOCs, and MOC Starts and Completions for the period 7/20/2013 to 1/31/2017.

## CONCLUSIONS

There is added risk to the facility during the execution of an MOC. This is due to the state of flux of the documentation, lack of training or communication, and not well-thought-out bypass or degradation of safeguards. Examples of the latter that resulted in severe consequences were given.

The elements for minimizing the risk of a change were listed:

- Conducting a safety analysis that includes looking at previous MOCs and at recommendations or hazardous scenarios resulting from the process PHA and that may have an impact on the current MOC.
- Taking into consideration and controlling the time element for performing an MOC, whether temporary or permanent. The longer the duration of the MOC, the higher the probability of making hazardous mistakes and of creating conflicts with other plant activities.
- Having an MOC procedure that is easy to follow and hard to deviate from it.
- Having an easy-to-use monitoring system to gauge the effectiveness of the MOC program.

A user-friendly tool that provides an easy way for performing MOCs and incorporates all the risk-reducing elements was shown.

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