

NON-EVASIVE MAINTENANCE

The end-user's drive towards operational excellence is at the core to be competitive in a market place for the long term. It's no secret that the paradigm shift is towards improvement in maintenance practice as one of the major initiatives since a substantial savings and productivity gain can be possible with a better maintenance practice than the one prevailing today. The focus shift is to enable proactive and predictive maintenance practice.

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The maintenance practice at OMG Kokkola Chemicals can be broadly classified into two categories, preventive and corrective. Preventive maintenance is used for scheduled checks. These were planned at regular intervals during which overhaul of the equipment was performed, often whether it is really required or not. It is the most common maintenance for field instruments, motors, valves, pumps etc. This was done as an insurance against breakdown during operation, which would prove costly and may cause a total plant shutdown. The prevailing reason for this inefficient maintenance is the lack of factual data that quantifies the actual need for repair or maintenance of plant machinery, equipment and systems. Maintenance scheduling has been, and in many instances, is predicted based on earlier experience or some time on the actual failure of plant equipment. The most disturbing fact with this type of maintenance is although the maintenance was carried out at regular intervals this does not guarantee that the equipment will not break down in between the two maintenance intervals.

ASSET MONITORING FOR IMCS MAINTENANCE

The asset monitoring technology was deployed at OMG for Low Voltage IMCS to explore the maintenance effectiveness possibility in this area. The reason being is the low voltage constant speed motors form the bulk of the area for maintenance. Traditionally, the role of these motors concern the higher availability of plant was not considered significant; however most of the plant shutdowns can be attributed to them. A trip on any such motor or a fault in the operating motor starter in MCC was good enough to stop a part or full process.

An Asset Monitor is a software component that can gather data from various sources, bring it into the context of the asset and evaluate the information from the perspective of the asset. By evaluating the gathered data, conditions can be evaluated, possible degradation detected and remedies proposed. A fault report can be prepared and delivered to personnel equipped to act upon this information. The asset monitors runs directly on the DCS (Distributed Control System) platform supplied by the same supplier. The information collection

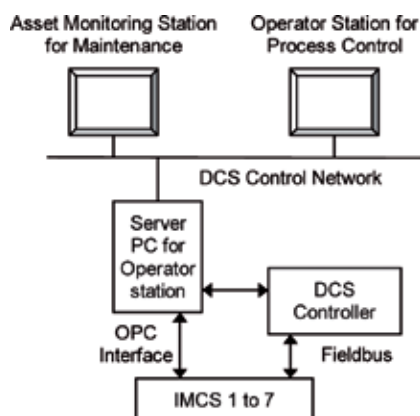


Figure 1

and presentation was performed as depicted in Figure 1.

The IMCS provided fieldbus interface for process oriented data exchange and control to the DCS Controller. However, all other electrical and maintenance specific information was directly routed via OPC server (OLE for Process Control where OLE stands for Object Linking and Embedded) installed directly on the DCS Operator Station PC Server. The Asset Monitoring Workstation provided exclusive workplace for maintenance purpose. The maintenance personnel can log on based on their specific roles for example Maintenance manager or engineer or technician. The screens and information provided could therefore change to user specific roles.

Inside the workplace there are four different structures provided for navigation purpose. The basic navigation is through Control Structure. All other structures are for help and their usage depends upon the operator needs.

Control Structure: All the IMCS are shown and navigated based on the communication structure.

Location Structure: This depicts the locations of the IMCS in the plant.

Asset Structure: Here the IMCS structure is divided into IMCS name followed by the grouping of motor starters based on the control schematics, for example: DOL, RDOL etc.

Documentation Structure: All the relevant IMCS documentation can be navigated through this structure.

Within these different navigation structures, there are several maintenance oriented faceplates and display structures for all IMCS motor starters. These displays are accessible from all four navigation structures.

These features and their purpose are as described below.

Event- and Alarm List: Displays chronological list of all alarms and events for operator attention.

Trend Display for Operation: Shows logging of all three phase currents, voltages and contact temperatures in all out going contracts in trend form.

Trend Display for Diagnostic: Captures trip currents, thermal image tracking, 'time to trip' in case of motor running under overload condition and calculation of 'time to reset'. This is the cool down time motors need, in case of motor thermal overload trip.

History Logs: All logged values storage data. This can be retrieved for data analysis at a later date.

Motor Starter Asset Monitor: The asset monitors are the most important functionality aspect of Asset Monitoring. The Asset Monitor evaluates all events, alarms and trips for specific maintenance and essential working issues.

Motor Starter Maintenance Faceplate: This is a single line representation of motor starter in graphic form. This provides a dynamic view of any fault within the motor starter. This faceplate is quite suited for electricians.

Asset Viewer: This view provides a one glance overview of all motor starters' status in a tree form. *Continued on page 60* ▶

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IMCS MOTOR STARTER ASSET MONITOR

The Motor Starter Asset Monitor (here onwards referred as Asset Monitor) gathers on one hand usage data on motors, contactors and motor starter contacts for condition base monitoring for predicting the maintenance based on the actual usage. The Asset Monitors distinguishes equipment under continuous operation without switching, seldom operation or not used in specified time, under capacity or over capacity for pertinent maintenance.

On the other hand, it continuously evaluates all events, alarms and trips for specific maintenance and essential working issues. The Asset Monitor groups these conditions in electrical, mechanical, operating and process related conditions. This segregation is mainly to identify and direct the information to the respective maintenance operator who can act upon this information suitably. These conditions are further detailed as sub conditions with severity levels showing the degradation of asset performance for quick identification and operator action.

ASSET MONITORING BASE MAINTENANCE

The IMCS provides high amount of information and maintenance data. This data is put into the context for maintenance operator's utilisation by the above described Asset Monitoring software functionality and features. For example The IMCS is based on withdrawable motor starter technology where the number of insertion cycles of motor starters does matter. When the number of insertions on a particular module reach a certain level of cycles, specific maintenance on the electrical contacts is required. This is to ensure an optimum electrical contact connection and contact pressure for healthiness of the motor starter during the life cycle time. The similar condition base monitoring is performed by measuring the contact temperature continuously for quality deterioration of cable connection. The asset monitor also performs operation supervision and identifies motors or equipment in continuous operation without stoppage or seldom operated to raise the specific maintenance issues. It also checks that the motor starters are placed in a designated compartment after the maintenance. It also provides continuous checks on all internal components, their consumption and life time calculation and informs about their healthiness, maintenance or replacement planning. All such conditions are constantly monitored and evaluated by Asset Monitors. The maintenance issues are categorised for electrical, mechanical and process or operation related. The appropriate maintenance issues are then directed to the respective maintenance team.

On the other hand, operators are pre-warned on the developing conditions prompting for proactive action so that the condition can be adequately taken care of before it becomes critical. The pre-warning limits, time delay before the trip happens and the trip level, all these conditions are configurable on every individual fault, safety or motor protection functions. Most importantly, the thermal capacity is continuously tracked for all motors. In case a motor is running in overload conditions for any reasons then a precise time at which the motor may trip is calculated dynamically for operator monitoring and initiation of a needed corrective action. When the trip is imminent then all measuring values including the trip current are logged for post analysis and a detailed problem diagnosis report is issued for fault finding. These online working or maintenance issues are calculated based on current, voltage and temperature measurement by IMCS.

Additionally it also provides General Conditions that can be defined by the user for specific requirements, for example: monitoring of external conditions related to motors or a process interlocks etc. the condition details, cause, severity level and suggested actions can be defined by the user.

END USER EXPECTATIONS

Asset Monitoring was seen as an opportunity to improve the prevailing maintenance situation at OMG. The major points of evaluations considered from OMG perspective, at the time of decision making,

and their assessment after the experience, were as discussed below.

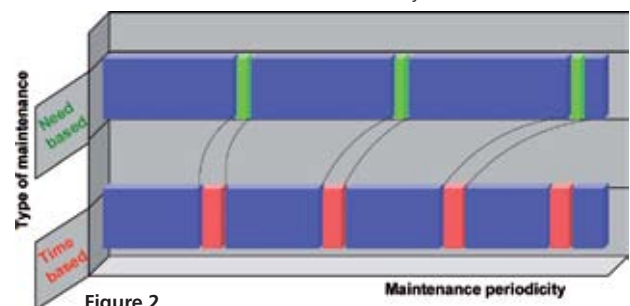
i *Plant-wide maintenance workplace*: The expectation was that all maintenance activities for connected switchgear should be possible from the same platform and no switching of applications should be required. It should also be possible to extend the same platform as a unified platform for plant wide maintenance at a later date. This requirement was however only partly fulfilled. The prerequisite was all other plant equipment and process instruments shall be from the same supplier since specific Asset Monitors are available by the same supplier. Although, it does offer generic Asset Monitors for third party equipment but they needed to be configured by OMG site personnel.

ii *Additions/modifications and usage*: This was the main consideration that while establishing the Asset Monitoring program there should not be any alterations needed to be performed to the existing DCS structure nor should it intrude in the process control task. There should not be any additional programming required in the DCS Controller and the process control operation should not be disturbed. At the same time the usage of the system should not ask for other additions in order to utilise the system. The package should be easy to acquire, put in to operation and possible to use from day one. This, however, was fairly complied. The information gathering was performed in real time and it is routed to the operator's directly without passing through the DCS process controller.

iii *Workplace for technician*: Maintenance information provided should be clear and technician friendly. There should not be a need of any specific expertise required from user qualification perspective to operate or work with the system. The experience showed that it took some time for maintenance team to adapt and exercise. Training was necessary to familiarise with the system.

iv *Maintenance practice improvement*: This was the most important expectation and objective that the Asset Monitoring shall substantially reduce the maintenance requirement and improve the IMCS performance. However the whole maintenance improvement possibility was not very clear how this would really be addressed. The assessment based on the experience is as summarised.

The Asset Monitoring can not be interpreted as a substitute for the traditional preventive or reactive maintenance management methods. It is, however, can be a valuable addition to a comprehensive, total plant maintenance program. The Fig. 2 below depicts on how the Asset Monitoring can help to complement the traditional maintenance but cannot eliminate it entirely.



Preventive maintenance is time based and are performed on regular intervals. Whereas predictive maintenance also need to be performed regularly but the intervals are need based. Therefore the intervals can be shorter or longer. The difference however is in the duration of maintenance time; in a preventive maintenance this duration can be comparatively longer as maintenance is performed on all equipment and in predictive only on the equipment as needed. Most importantly, preventive maintenance precautionary measures are performed regularly but at times still cannot avoid the catastrophic shutdown when maintenance is required between two maintenance time intervals. This is precisely where the online condition monitoring in Asset Monitoring helps since the visualisation of key plant

information and asset performance are continuously under the radar of maintenance personnel.

MANUFACTURER'S PERSPECTIVE


From the manufacturer's perspective, the premise of the Asset Monitoring technology is that continuous monitoring of the actual condition of an asset will ensure the right prediction of maintenance interval, reducing the probability of asset failure in between the maintenance intervals, improve the availability and healthiness of the asset and in turn increase the overall availability of operating plants while reducing the maintenance cost involved.

In reality, it would enable a condition-driven preventive maintenance program. Additionally, it would help to reduce spare parts inventory, as there would be sufficient lead time to order repair or replacement of parts as needed. Prevention of the unplanned failures and early detection of incipient asset problems would surely increase the useful operating life of the plant equipment. As the consumption of asset can be monitored, it would also help to decide if the replacement of the asset is more viable than the repair cost itself.

CONCLUSIONS

On a positive note, the Asset Monitoring technology can be a possibility for a continuous online maintenance based on real time information. The Asset Monitoring Maintenance Workplace organises and arranges asset information for maintenance personnel in a way that is needed for efficient daily activities. Additional filters further refine this information for specific maintenance roles, such as the maintenance technician, maintenance engineer, and maintenance manager. The Asset Monitor does enable meaningful fault analysis with root cause and suggested actions. It is possible to transmit information to those able to act. Most importantly, the data collection is performed in a non intrusive way. This means although it is presented on a DCS operator platform, it is not routed through the DCS process controller. The DCS controllers are provided only with process related data for process control and interlocking. This makes the process control communication fast and pertinent. The controller on the other hand could utilise this for more effective and critical execution of process control loops.

At the operator level, however, the different operator can access the information of interest and act on them directly. This also reduces the latent time between process operator and maintenance operator. Implementing an Asset Monitoring program will require an investment in both capital equipment and manpower. If it has to be effectively utilised and accomplish the intended goals, management must be willing to commit the necessary resources. Education of the personnel is an important factor otherwise it would not result in the desired success of the program.

A well implemented and exercised Condition Monitoring maintenance practice should enable reduction in unnecessary maintenance and downtime, and higher performance while lowering maintenance cost. And most importantly, optimise all aspect of asset operational performance. 



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