

## Mode Based Alarm Solutions at Syncrude Canada

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**Abstract:** Syncrude is one of the largest operators in Canada's growing oil sands industry, with a 50-year history of innovation. Based in Fort McMurray, Alberta, and with a large research and facility in Edmonton, Syncrude is known for pioneering many of the technologies used today in the industry, including an expanding suite of techniques to improve environmental and economic performance. Syncrude uses Honeywell DCS infrastructure for Process Control.

Mode Based Alarm (also called a State-Based Alarm) Solution is an application that enables the Panel Operator to change the configuration (Alarm trip point, priority or suppression status) of a set of alarms to a predetermined configuration. This configuration would be appropriate for the current mode of operation of equipment or process unit / sub-units, at the click of a button. The ultimate objective of these solutions is to keep the unnecessary alarms out of the Alarm summary, when the plant is under normal operation. This paper discusses how Mode Based Alarm Solutions (may be referred to with the acronym MBS henceforth in this paper) are deployed in Syncrude for effective alarm management.

**Keywords:** alarm management, mode based, contact cutout, Alarm Configuration Manager (ACM), standing alarms.

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### 1. INTRODUCTION

The assignment of Alarm trip points and Alarm priorities constitute basic Alarm Documentation & Rationalization (D&R). Each individual Alarm is designed to provide a warning when that process indication deviates from normal. It is important to note that these features are static which would suffice for the majority of the alarms in a plant. Still, for a large number of alarms this static configuration of alarms will not provide the appropriate warnings, and will in fact, present warnings that are not appropriate for the current operation. Such alarms ultimately result either as "standing" or "defeated" alarms on an operator panel. For these alarms, configuration should not be static, but should change depending on the process operating mode. These modes can be simple, such as "Running" and "Standby" for equipment like a pump or compressor, or they can be complex such as different feed types, different feed rates, or different configurations that an equipment can assume ("Balanced", "Natural" or "Forced" draft for a furnace). These modes define the groups of alarms that need to be changed when the process operations enter that particular operating mode. Identifying such alarms as candidates for Mode Based Alarming is a logical extension of basic Alarm D&R.

As a guiding principle, each Alarm should always have an associated operator action. Mode Based Alarm solutions provide for the consistent application of this principle on all alarms for all operating scenarios. As an illustration, a low flow Alarm on a pump discharge will have an Operator action (e.g., 'check pump for cavitation' or 'swing-over to standby pump') when the pump is running; but when the

pump is not running (STANDBY mode), there is no Operator action associated with this Alarm. During STANDBY mode, this Alarm not only becomes 'irrelevant' but is also 'inconsistent' with the definition of Alarm. Mode-specific configuration of this Alarm— Alarm only in RUNNING mode and not in STANDBY mode – will provide the appropriate resolution to this problem.

Operating states of such equipment can be determined by any of the following:

- a. operator selection,
- b. equipment status indication,
- c. defined process variable that reaches a specific limit,
- d. logic that looks at many variables and indicators.

For implementation at Syncrude site, operator selection determines the operating states, however, wherever practical, automatic detection of the mode is considered for solutions as a safeguarding functionality. If the Operator misses changing the Alarm mode to Normal Mode matching with operating condition, this functionality will re-enable the alarming function automatically. Automatic detection of the current mode is based on a few predefined process conditions.

### 2. COMMONLY USED SOLUTION METHODS

In Syncrude, the Honeywell DCS infrastructure is used for Process Control. Given this, two broad categories of solution methods are summarized below.

## 2.1 Contact Cutout (CC):

This is a configurable DCS parameter of an alarmable point. By applying contact cutout the alarms of this data point prevent this data point's alarms from being reported to the operator.

ON – Alarms are “*cut-out*”; OFF – alarms are not “*cut-out*”.

## 2.2 Alarm Configuration Manager (ACM):

This is a Honeywell product that houses the master alarm database (MAD) for the DCS. As well as maintaining the master alarm database, ACM performs consistency checks on the alarms on the specific console to ensure alarms are appropriately configured. This is referred to as “*enforcing*” the MAD alarm settings to the DCS. When enforcement occurs, discrepancies between the DCS alarm settings and the master database values are noted and can automatically change the alarm setting on the DCS to be consistent with the MAD.

Tags in the MAD can have more than one set of alarm settings – one for each mode. Thus ACM can also be used for mode based alarming.

## 3. COMPARISON OF THE TWO METHODS

### 3.1 Mode Change Response Time

The Contact Cutout (CC) solutions execute the mode changes faster than the ACM solution as there is no dependence on servers external to the DCS.

### 3.2 Interference with console alarm enforcements

ACM has the ability to provide a method to improve change control to the configured DCS alarm setting. This is done by setting regular “*console-wide alarm enforcement*” of the MAD with the DCS to assess any unauthorized changed to the DCS configured alarms.

The ACM solutions use the same enforcer server that is used for “*console-wide alarm enforcements*” so can interfere with this regularly scheduled ACM enforcement.

CC solutions are implemented at the DCS level so there is no interference with ACM alarm enforcements.

### 3.3 Reliability of the solutions

The ACM solutions rely on servers external to the DCS and are thus less robust than the Contact Cutout solutions that are entirely within the DCS.

### 3.4 Flexibility to select alarm parameters to suppress

The Contact Cutout solutions are far less versatile in selectively suppressing alarm parameters for a unique point while the ACM solution can suppress any or all alarm parameters for a unique point.

### 3.5 Versatility to change different alarm settings

The ACM solutions allow changing the alarm trigger points (e.g., PVLOTP etc.) or alarm priorities (HIGH, LOW etc.); whereas the Contact Cutout solutions do not.

## 3.6 Interface with the Console Operators

User Interfaces (console schematics) can be designed for each solution type so that operators see no difference in interfacing with either solution.

## 4. DESIGN BASIS FOR MBS

### 4.1 Intent of Mode Based Alarm solutions

The intent of MBS is to address the standing or defeated alarms arising out of:

Equipment or sections of a plant that are taken out of service on a routine and regular basis;

Known changes to operating conditions – like Furnace draft modes (Balanced, Natural or Forced draft); different feed types or feed rates.

Mode Based Solutions should not to be used to address standing or defeated alarms arising from:

Broken equipment;

Equipment or sections of a plant that are abandoned but not yet “mothballed”.

In other words, MBS is not a trash can to bypass root cause resolution.

### 4.2 Changing Modes

Manual operator action is the preferred trigger mechanism to suppress alarms as automatic mode change might result in undesired loss of alarms due to malfunction of some instruments on which mode detection is based.

The operator changes the mode using MBS schematics.

### 4.3 Wrong Mode Detection

Although the operator is able to manually set the MBS mode to the “*Normal mode*” (ie un-suppress alarms), if the operator fails to switch the mode there is a risk of running without alarms when they are required.

To mitigate such a risk, a safeguarding functionality to detect wrong mode selection and to change it back to ‘normal’ (when wrong mode is detected) is provided for almost all solutions.

This functionality is given a generic name AMIR (Automated Mode Identification & Reversion).

AMIR is one (or more if there are too many solutions) custom program written for all the solutions on a console. For identifying the current mode of the equipment or plant-section, it relies on logic or condition(s) unique to each MBS based on process indications.

## 5. OPERATOR INTERFACE (SCHEMATICS)

Custom Operator displays (schematics) are built for the panel operators for operating the MBS.

There is a main MBS Display showing all mode based alarm solutions on a console.

Wherever needed and practical to build, MBS Details Displays are built for each solution to display the details of solution (ie. tags that are part of the solution; alarm settings for each of these tags in each mode and the current alarm settings for each tag).

Related process displays are also updated to show the current state of the MBS and to allow changing the mode, if requested by Operations.

An example of an overview schematic for all MBS on a single console is shown in Fig 1 and an example of a detail schematic for an individual MBS from the overview is shown in Fig 2.

Fig 1: Example of console's MBS schematic overview



## 6. CONTACT CUTOFF SOLUTION – 3 TYPES

### 6.1 Type 1: Using CL Program

A generic CL program is used to change the CONTCUT parameter of the constituent tags of a MBS.

This solution type is used when either:

- all the constituent tags are NOT HPM tags (i.e., some are AM/CLM type)
- constituent tags of an MBS are on different nodes (or different UCNs).

Type 1 design permits a maximum of 5 modes and 80 constituent tags per solution.

Fig 2: Example of detail schematic for MBS



### 6.2 Type 2: Using Logic Block

Logic block(s) is (are) used to change the CONTCUT parameter of the constituent tags of a MBS.

This solution type is used when all the constituent tags of a mode based solution are HPM tags on the same UCN.

Although solution type 1 is adequate for these types of solutions, type 2 is faster and a more reliable than type 1.

Type 2 design permits a maximum of 3 modes. There is no limit on the number of constituent tags but more logic blocks are required.

### 6.3 Type 3: Special solution for status tags of equipment (pumps/ fin-fans etc.)

This solution type is used when it is required to suppress alarms on a status tag (for equipment such as pumps, fin-fans etc.) based on the state of the tag itself.

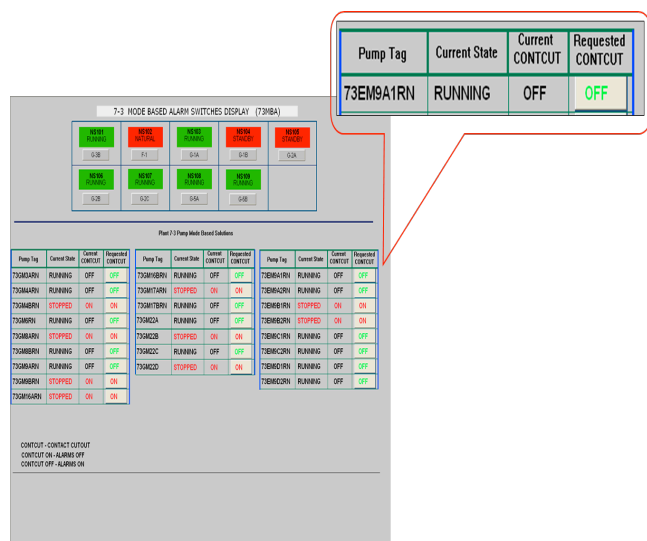
Although solution type 1 or 2 could also be applied for this requirement, this solution is especially designed for efficient use of the system resources (fewer tags required).

This method also changes the Contact Cutoff parameter of the status tag using AM CL program.

One solution tag (Custom AM tag) can accommodate 40 status tags of digital type (DIGIN, DEVCTL, DIGCOMP); 40 tags of SWITCHAM type; and 20 tags of HPM Flag type.

This requires a special sub-picture for the mode change. A different operator schematic is used for this type of solution. An example of the schematic is shown in Fig 3.

Fig 3: Example of MBS schematic for Status Tags



In-house spreadsheet based MBS stewardships are also developed to assess the service factor and the working of the MBS for every console. It can be run for any period of time duration, however, we typically steward on a monthly period. It gives the equipment description, the downtime for this equipment, the service factor of MBS in that downtime period and also reports if there was an error in automatic re-activation of alarm (AMIR) when the equipment came back. An example of the MBS stewardship can be seen in Fig 4.

Fig 4: Example of excel based MBS stewardship

8-1 MBS							
© 2014 Syncrude Canada Ltd.							
Monitoring Time Span (yyyy/mm/dd hh-mm)							
Start:	2016/04/01 00:00	Start The					
End:		Get The Detail					
Interval:	30 minute						
Statistics	8-1 PV-540 MBS						
Console	Switch Name	Switch Description	Process/Equipment Downtime (%)	MBS Usage Time (%)	Process/Equipment Uptime (%)	AMIR Error (%)	
81NS101	B-1 DESALTER MBS		24.0%	97.5%	75.0%	0.0%	
81NS102	B-1 V4-43 MBS		54.0%	0.0%	46.0%	0.0%	
81NS103	B-1 PV-510 MBS		100.0%	100.0%	0.0%	0.0%	
81NS104	B-1 V4-540 MBS		11.4%	100.0%	88.6%	0.0%	
81NS105	B-1 PV-7 MBS		51.7%	48.6%	48.3%	0.0%	
81NS106	B-1 V4-77 MBS		1.7%	0.0%	98.3%	0.0%	
81NS107	B-1 C-20 MBS		11.0%	97.3%	86.3%	0.0%	
81NS112	B-1 F3A MBS		88.9%	100.0%	11.1%	0.0%	
81NS113	B-1 E2B MBS		55.4%	100.0%	44.6%	0.0%	
81NS114	B-1 F3B MBS		88.9%	100.0%	11.1%	0.0%	
81NS115	B-1 E4B MBS		11.6%	93.5%	88.4%	0.0%	
81NS116	B-1 A1 X PV-10N MBS		100.0%	100.0%	0.0%	0.0%	
81NS118	B-1 SCTL MBS		54.7%	88.7%	45.3%	0.0%	
81NS123	B-1 PV-534 MBS		83.4%	0.0%	16.6%	0.0%	
81NS127	B1 PV-5044 MBS		100.0%	100.0%	0.0%	0.0%	
160NS123	B1 PV-5044 MBS		0.0%	100.0%	100.0%	0.0%	
PDS			Average	78.4%	Average	69.0%	
			Total Averages	78.4%	Total Averages	69.0%	

## 7. ACM SOLUTION

This solution type is used when the requirements of a MBS cannot be met using Contact Cutout solution. For example:

- Selective suppression of only a few alarm parameters in different modes
- Change of alarm trigger points.

As mentioned previously, console-wide alarm enforcements might interfere with mode change requests, if the same enforcement server is used.

ACM R320 prioritizes mode change enforcements but only if the request is coming from the same console that is doing the console-wide enforcement.

Current design of the solution at Syncrude limits the maximum number of modes to 5 (due to limitations on the SWITCHAM tag used for changing modes). However, there is no limit on number of constituent tags.

## 8. MBS PERFORMANCE MONITORING AND STEWARDSHIP

It is important to assess whether an implemented MBS is providing the desired value to operations. To do this alarm Key Performance Indicators (KPIs) are measured. These include standing counts and defeated counts. Standard Alarm reports are available for each console to monitor alarm KPIs. These reports are monitored to see if there is a measurable improvement after implementing MBS. Two reasons why the results may not be apparent are:

- the MBS are not being used (toggling the MBS switches corresponding to modes)
- inappropriate candidates for MBS were identified.

## 9. CONCLUSIONS

Mode Based Solutions are very useful in effective alarm management. They enable the panel operator to change the configuration of a set of alarms (trip point, priority or suppression status) to the predetermined configuration appropriate for the current mode of operation of equipment or process unit/sub-units. They keep the unnecessary alarms out of the alarm summary as the plant operation is adjusted to alternative modes of operation. They reduce standing alarms, and defeated alarms.

At Syncrude, MBS is widely deployed using two broad methods based on available Honeywell DCS functionalities or tools: Contact Cutout and ACM. Both methods have advantages and disadvantages. A particular type of solution is adopted depending on the situational requirements.

While suppression of alarms when equipment goes offline is always manual (operator selected), the un-suppression of alarms when equipment comes back online has an automatic backup to the manual selection (AMIR). This is adopted as a safe practice in Syncrude.

The operator interface for using a MBS is developed through custom schematics.

Ultimately, for any tool to be successful, monitoring and stewardship is required. Thus, a stewardship is developed at Syncrude for the MBS for each console on which they are deployed.