

DRILLING RIG CONTROL SYSTEM SAFETY

OUTLINE FOR AN IADC GUIDELINE FOR DRILLING RIG CONTROL SYSTEMS MINIMUM SAFETY FEATURES

The Upstream Oil and Gas sector has a long history of drilling equipment related collisions and human induced machine damage events which have led to the development of the IADC Guideline for Drilling Rig Control Systems Minimum Safety Features.

This guideline makes recommendations on safety features that should be employed in a drilling control system to enhance safe operation of a rig.

Safety is a responsibility of everyone involved in a certain operation, task, or area. Safety is not only understanding how to respond to unsafe events but also providing all the necessary steps to prevent them. It is of high importance that drilling contractors understand the design, operation, and safety features of both the control system and machinery involved and how these machines interact with each other and managed by the control system for specific sequences. Typically driller's and crew members have a good understanding of the various well construction processes but it's also important for them to understand how to safely deviate, if necessary, from these processes. This includes understanding the rig's control system safety features that are in place to prevent unsafe events and how to safely deviate from a sequence.

When a machine is integrated into the control system, a minimal set of safety features should be employed to ensure safe functionality of the machine and its interaction with other machines. This includes emergency stops (primary, secondary, hardwired, wireless, etc.), internal interlocks, and operational interlocks.

As machines interact with each other during drilling sequences, a matrix outlining interlocks for every machine should be created. This matrix should include internal interlocks (internal to the machine) and general interlocks applicable to the process.

The status of all interlocks and operational states should be presented to the user through the human machine interface (HMI) or supervisory system. These interlocks or safety features should not hinder the process but rather enable a smooth and fluent collaboration amongst all machines integrated on a drill floor for various operations.

A good safety philosophy along with operating practices should guarantee that all system interlocks are working and enabled and the relationship between machines is safe for operations.

In order to have a good visualization of interlocks and the operation of an anti-collision system among machines, a starting point would identify the interlocks of single machines, machines by operation group and by process.

Control systems and machine safety is a crucial topic, not only for drilling operations that are of high risk, or the cost of the assets, but also for human interaction.

Proposed Outline of the Guideline for Minimum Drilling Rig Control Systems Safety Features:

- Title
- Table of Content
- Definitions
- Introduction
- Emergency Stops
- Internal Machine Interlocks
- Process Interlocks
- Collision Avoidance
- Recommended Safety Practice for Bypassing & Lock-out / Tag-out
- Human machine interaction
- Conclusion
- Appendix (Example of each)

Example:

Function Command	Function Status																										
	1	0	Compensator Active	Compensator Lower	IBOP Open	IBOP Close	Pipehandler CW Rotation	Pipehandler CCW Rotation	Pipehandler Auto Positioning	Link Tilt Drilling / Pickup	Link Tilt Stop Mode	Elevator Open	Airflex Brake On	Torque Wrench Clamp On	Torque Wrench Make Up	Torque Wrench Break Out	Torque Wrench Auto Make Up	Torque Wrench Auto Break Out	Main Shaft Rotate CW	Main Shaft Rotate CCW	Main Shaft Spin In / Out	Main Shaft Toolface Mode	Link Tilt parked	Main Shaft Rotation > 3rpm	Speed Setpoint Out Of Zero	Shaft Drive Motor Enable	Slips Closed Status
Compensator Active		1																									
Compensator Lower	R																										
IBOP Open																											
IBOP Close				R																							
Pipehandler CW Rotation							R	R						1		1	1										
Pipehandler CCW Rotation							R	R						1		1	1										
Pipehandler Auto Positioning							1	1	R	1	1			1		1	1							1			
Link Tilt Drilling / Pickup										1																	
Link Tilt Stop Mode									1																		
Dolly Extend / Retract														1		1	1						1		1		
Elevator Open																											0
Airflex Brake On / Off														1		1	1		0	0			1		1	1	
Torque Wrench Clamp On							1	1	1				1						1	1			1		1	1	
Torque Wrench Make Up							1	1	1						R				1	1			1		1	1	
Torque Wrench Break Out							1	1	1							R			1	1			1		1	1	
Torque Wrench Auto Make Up							1	1	1					1			R	R		1	1			1		1	1
Torque Wrench Auto Break Out							1	1	1					1			R	R		1	1			1		1	1
Main Shaft Rotate CW / Spin In														1		1	1			1			1		1	1	0
Main Shaft Rotate CCW / Spin Out														1		1	1			1			1		1	1	0
Main Shaft Rotate Free																			0	0							
Main Shaft Toolface Mode													1	1		1	1					1		1		0	

	Interlocks generates Operator message		Interlocks without Operator message		Possible to override from DV
	Airflex Off interlock when Equipment Stop				

SmartZone related interlocks to be defined and described in SmartZone functional description