Why do we test?
The BOP is a stack of valves which include annular valves, pipe rams, blind rams and shear rams. The main purpose of a BOP is to control the downhole pressure which may reach the surface and cause a blowout. Failures in the BOP control system may lead to problems that make it necessary to abort drilling operations and possibly pull the BOP, which in turn leads to unproductive periods. In the worst-case scenario, failures in the BOP control system may fail to prevent a blowout, which in turn could injure personnel and damage equipment or the environment.

The scope of BOP HIL testing is to verify correct functionality according to rules and regulations, functional descriptions and user manuals, and to detect hidden software errors, erroneous configuration parameters and design flaws in the BOP control system software before commencement of operations on the rig.
How do we test?
The BOP control system may either be tested in a test set-up at a vendor location or in a virtual test bed in an HIL test lab. A BOP HIL simulator will include a project-specific BOP stack with different types of valves, accumulators, diverter systems, choke and kill systems, etc. The test set-up will also include several control panels, such as the driller control panel, toolpusher control panel and diverter control panel. The test set-up for a deep-water BOP may, in addition to a BOP HIL simulator, also include a signal failure simulator connected between the topside control system and subsea control systems.

Our BOP HIL simulator responds to the commands from the BOP control system in a realistic manner, and feedback from sensors and actuators to the control system is simulated according to the project-specific BOP. The control system responds as it would with the BOP in real operation. Functionality, failure handling capability and safety-critical software barriers can then be tested systematically in a controlled environment.

Troubleshooting may be used within the lab set-up to identify the cause of BOP software problems on the vessel or rig.

Test scope and simulation scenario
Functional testing covers verification of control system functions and modes, such as:
- Command, sensor and feedback monitoring, including conflicting commands
- Alarm and messaging functionality
- Hot swap/redundancy of PLC
- Multiplex electronic control
- Diverter control and interlock sequence
- BOP emergency disconnect system
- Communication network failure/overload
- Compliance with documentation
- Compliance with applicable rules and regulation

Failure testing covers testing of control system robustness, including failure detection and handling. Failure testing includes single and multiple errors, such as loss of power, signal freeze, wild points, out-of-range signals, loss of signal, signal noise and random drift, in addition to simulating stuck valves, valves closing without command and network failure and overload.

Life-cycle services
The lab set-up established in the project may be used to provide life-cycle services for the BOP control system:

Software update may be thoroughly tested in a controlled environment before they are installed on a vessel or rig in operation, verifying that the update is according to specification and does not introduce unexpected behaviour.

HIL TEST LAB PARAMETERS
The HIL test lab from DNV GL is equipped with all the necessary hardware – including a control station PLC and sensors, which is connected and commissioned in the exact same way as on the rig. This ensures reliable results during real-life scenarios.

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