Writing Test Procedures for Safety Instrument Systems  
(from Cause & Effect Diagrams)

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This paper is based on recent experience on a multi-platform/FPSO project where extensive use was made of cause & effect diagrams for documenting the operations of the safety instrumented systems (SIS). This paper discusses the process of developing a Factory Acceptance Test (FAT) document for testing the SIS.

The SIS was separated into two distinct systems, one for process shutdown and one for fire & gas shutdowns. The Process Shutdown System (PSD) consisted of a variety of process analog and digital inputs with digital outputs shutting down valves, pumps, breakers, as well as 3rd party systems. The Emergency Shutdown System (ESD) consisted primarily of Gas Detectors that in addition to shutting down processes also took actions to sound fire & gas alarms and horns. The ESD contained a relatively large number of I/O but the logic was essentially simple to understand and program. On the other hand the PSD involved relatively more complex logic.

The Safety Instrumented System was a dual-PLC architecture connected to the Process Control system (PCS) via a communication link. An important aspect of conducting the Factory Acceptance Test was developing a robust testing procedure to test the operation of the SIS shutdowns and alarms, including testing of the PCS graphics.

The format of the SIS cause & effect drawings was a large all inclusive table using an excel file that eventually grew to structures as large as 200 inputs by 200 outputs. These drawings were plotted rather than printed and required “D” size paper, approximately 34 inches by 34 inches. The Automation Team determined that testing by ‘yellowing’ out the cause & effect table would suffice for the ESD System, but would be too cumbersome and inefficient a process for the PSD System. The team elected to write a test procedure that would test all features of the PSD cause & effect drawings but in a structure that could be contained in a more manageable form, which would also allow for future use of the test procedure and documents.

The resulting test procedure allowed for an efficient and robust testing of the SIS PSD programming and interface to the Process Control System.

This paper will review how the test procedure was developed based on the PSD project cause & effect diagrams and will illustrate how the process provided for a streamlined and efficient use of the test resources and personnel in conducting the overall SIS testing.