Failure modes, effects, and diagnostic analysis (FMEDA) of ESD Valves in oil and gas industry

Omar Bensmaine, Rachid Naït-Saïd and Fatiha Zidani
Laboratory of Research in Industrial Prevention
Institute of Health & Safety
University of Chahid Mostepha Ben Boulaid Batna 2
Batna, Algeria
o.bensmaine@univ-batna2.dz, r.naitsaid@univ-batna2.dz, f.zidani@univ-batna2.dz

Abstract

The Safety Instrumented System (SIS) is an automated system used to implement one or more safety instrumented functions. A SIS, like the Emergency Shutdown (ESD) system, consists of any combination of sensor(s), safety PLC(s) and final element(s) (e.g. ESD valves). ESD valves are the last line of defense against risks, although the ESD valve has high performance, the data (based on expert judgment and OREDA database) indicates that ESD valves failures are the most critical in the ESD systems.

In order to improve the reliability and safety of these valves, we applied the FMEDA diagnostic technique. We started with a decomposition of the ESD valve to the subsystems and we identified their functions. Then we described the failure modes, their mechanisms, their sites and their effects. Then we identified the impact of each failure mode according to the criticality classes and identified the failure rates and their class according to the criticality and the detectability by automatic diagnosis of each mode and from the failure rates we calculated the Safe Failure Fraction (SFF) and Safety Integrity Level (SIL) required and we concluded that the actuator subsystem is the most critical system. Finally, we proposed preventive and protective measures to eliminate or reduce the risk of failure.

Keywords
ESD system, ESD valve, Diagnostic and FMEDA.

Biographies

Mr. Omar Bensmaine, PhD Student in Control of Industrial Risks, Institute of Health & Safety, University of Batna 2. he holds a MSc in Control of Industrial Risks, Institute of Health & Safety, University of Batna 2. His main Research topics are risk Prevention, reliability and safety of industrial systems.

Pr. Rachid Naït-Saïd, is a Full time Professor at the Institute of Health & Safety, University of Batna 2. He received the B.Sc., M.Sc., Ph.D. degrees in health and safety engineering from the University of Batna. He is with the Laboratory of Research in Industrial Prevention of the University of Batna 2. His current research interests include the application of fuzzy logic to risk assessment and diagnosis.

Pr. Fatiha Zidani, is a Full time Professor at the Electrical Engineering Department, University of Batna 2. She received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from the University of Batna. She is with the Laboratory of Propulsion and Induction Electromagnetic Systems. of the University of Batna 2. Her current area of research includes advanced control techniques and diagnosis of electric machines and drives.