LNG2026 Qatar قطر 2-5 FEBRUARY

PRESENTED BY IGU INTERNATIONAL GAS UNION UNION INTERNATIONALE DU GAZ GTI ENERGY IIF IIR INSTITUT INTERNATIONAL DU FROID INTERNATIONAL INSTITUTE OF REFRIGERATION

HOSTED BY قطر للطاقة QatarEnergy

Realiability Improvement for a LNG Safety Instrumented Loop with the Introduction of a Fault Detection Tool

Lead author: Abdeldjalil Chabbi, Sr. Instrument and Control systems Engineer, QatarEnergy LNG

Safety integrity level verification is a critical step in the life cycle of safety instrumented systems, it define the relationship between the criticality of the safety function of the loop and its reliability. For the chemical process industry, Safety integrity level verification often means calculation of average probability of failure on demand PFDavrg.

Due to the criticality of the safety systems the introduction of an online fault detection system is important to improve its reliability, Markov analysis show great flexibility for systems modeling and calculation of the probability of failure on demand, in this paper and by using of Markov molding a calculation of the probability of failure on demand for a simple case study of a pressure loop 1oo1 system, with and without the online fault detection is performed, the result prove the improvement of the system reliability with the introduction of the Fault Tolerant Control system.

This paper has given a thorough discussion of a number of important modeling issues related to quantification of SIS reliability performance, both for 1oo1 SIS system with and without including a fault detection system (FTC system). Issues like demand duration and verification of functionality by functional testing, successful response to demands and spurious activation are taken in consideration in our model.

A Markov model for a SIS element without FTC and including the demand rate is developed. The model can be used to calculate the probability of failure on demand, the calculation of the PFDavrg for the 1oo1 pressure loop show that the sensor meet only the SIL1 requirement which is not the required SIL for the said loop.

A Markov model for a SIS element with FTC and including the demand rate is developed. Calculation of the PFDavrg for the 1oo1 pressure loop show that the sensor meet requirement of the SIL3 which is the desired safety integrity level.

The classic solution to meet with the SIL requirement for a SIS loop is either to use more complicated architecture (Hardware redundancy) or to use more reliable instruments or to reduce the proof test frequency and all those solution will cost too much money and will be stopped by the operation constraint.

The proposed solution proven in this paper by the introduction of an FTC system shows that the SIL problem is solved without adding any hardware and also without reducing the proof test period, only programming the fault detection algorithm on the SIS PLC is required.