

Case Study of a Reliability Analysis of Subsea Pipeline Equipped with HIPPS

Luiz Fernando Seixas de Oliveira and Joaquim Domingues (DNV GL)

The application of HIPPS systems to subsea pipeline is gaining more importance among major international operators. Some projects in the North Sea have already been using it for some time and it starts to be introduced in other parts of the world, especially in the Gulf of Mexico after the publication of API Standard 170 in 2014. Most existing applications so far are for flowlines (from reservoir to platform) but there are also some for exporting pipelines. Among the main advantages of the application of HIPPS to subsea pipelines are: 1) reduced topside pressures, 2) reduced flowline and riser wall thickness, 3) potential to use existing, lower pressure flowlines and risers, 4) potential to use existing, lower pressure exporting pipelines. The first three apply to flowlines and the fourth applies to exporting pipelines.

The case study presented in this paper is for an exporting gas pipeline of a major international oil company and it was deployed to make it possible the connection of an existing 200 km gas pipeline to three platforms. The existing pipeline has lower MAWP than the compressors in each of the three platforms and the HIPPS was deployed to prevent the pipeline from bursting in case of downstream flow blockage. A single HIPPS was used although each platform had different configurations of additional safety systems that were used to complement the HIPPS as pressure protection systems.

Unique to this case when compared to other HIPPS applications is that the system was required to comply with SIL 2 only, while in most cases they are required to comply with SIL 3. This lower SIL requirement was established following the results of a comprehensive risk analysis which considered that the downrated pipeline was far away from the platforms and there was also a fortified zone near the coast. Therefore, the risk to people in case of a burst of the pipeline was evaluated to be very low. Since the fluid is natural gas, similarly the environmental risks were judged to be very low. Therefore, the main consequences of a burst of the pipeline are economic losses and by the company standard only SIL 2 is required in such cases. This conclusion was also reinforced by the fact that there were other safety systems in the platforms which could be used to complement the HIPPS.

The reliability analysis was performed with the utilization of event and fault trees which considered all safety features involved in the identified safety scenarios. Transient times were used as inputs to human reliability analyses which were conducted to take evaluate the probability of human errors by the platform operators in their response to the scenarios initiating events.

Several HIPPS testing policies have been analyzed. Results have shown that the compliance with SIL depends not only on the testing policy but also on the configuration of the platform safety systems. For some cases it is possible to reach SIL 2 compliance even for a testing period interval of one year which was also one of the objectives of the oil company.