

**PIPELINES SAFETY MANAGEMENT: RISK ASSESSMENT AND FUNCTIONAL SAFETY
APPLIED AFTER A REAL SEVERE ACCIDENT**

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ABSTRACT

Pipelines integrity is a fundamental issue. Several accidents showed that incidents associated with pipeline failures could result in severe events for both safety and environment. In certain cases also security and business continuity are a major concern.

Activities described in this paper move from a real accident that involved in 2016 a crude oil pipeline located in Liguria (Italy), owned by IPLM S.p.A. This case study concerns rupture and spill occurred in the oil pipeline running from Porto Petroli in Multedo to IPLM S.p.A. refinery located in Busalla, near Genoa; it was built in the early 60s, becoming operational in 1963. Total length of the buried oil pipeline is 24.5 km, of which 19.8 km with the outer diameter equals to 16", and the other part has an outer diameter equals to 12". Following this accident a number of assessment activities have been put in place by the company to increase safety level of all the managed pipelines.

These assessments have been submitted by the Authorities Having Jurisdiction and, in particular, to National Fire Brigade that is responsible of the "Fire certificate" of oil and gas pipelines according to a specific national regulation (D.P.R. 151/2011) that requires for a formal authorization to operate of the pipeline with a periodic assessment of the safety conditions to maintain the license.

Given the occurred accident the RCA as well as the risk assessment identified a number of new requirements to be applied to increase the safety level of several different pipelines in the framework of an updated pipeline management system. Requirements have been identified in several areas of concern: asset physical integrity, quantitative risk assessment, human factor.

Each aspect has been investigated with updated tools and methodologies. Part of the work is connected with the installation of safety critical systems composed by so-called Safety Instrumented Functions (SIFs) having a selected Safety Integrity Level (SIL). Proposed work aims to explore the fundamentals of the functional safety norms that, more and more often, constitute an important reference for the definition of the safety requirements of critical instrument systems for safety, from the definition, to the design, to the realization and to the maintenance over time.



Faced with a classification of the reference standards (first of all the IEC 61511 standard) and of close relations with the regulatory body on the protection of safety and prevention of major accidents (which are subject to numerous process chemical companies in which the automatic security locking systems have played a major role) as well as European directives such as PED, ATEX, MACHINES, etc. it will proceed to highlight the specific novelties of the second version of the recently issued regulations in light of several years of application of the previous edition.

Work will highlight the importance of two key elements of the functional safety management process and in particular the first coinciding with the risk analysis and the last coinciding with the maintenance of functional safety requirements over time through an appropriate management system and via the Safety Requirement Specification (SRS) discussing the specific requirements. Hinting then the part of implementation connected with the design, development and installation of a safety instrumented system it will be underlined as on one hand the risk analysis lays the inalienable foundations for the identification of the correct level of safety to be achieved by a certain reduction in the risk also made by the safety system and, on the other hand, an incorrect management of safety critical systems over time leads to a significant weakening of the availability of these fundamental protection barriers.

The functional safety approach, together with the resulting SRS, will be shown together with the presentation of the main requirements that will be applied also to the pipelines not affected by the accidents. In this sense, the IEC 61511 CEI standards, traditionally applied to the process industry assets with particular reference in our country to companies subject to the Seveso III Directive (Legislative Decree 105/2015), NOT APPLICABLE TO THE PIPELINES MANAGEMENT, turn out to be a good technical and organizational-procedural response for the management of the risk associated with the transfer of liquid hydrocarbons by means of pipelines characterized by tens of kilometers of development according to specific altimetries that determine specific problems in the event of spill as a result of loss of containment. In compliance with the incident prevention requirements (DPR 151/2011) functional safety management also comes to constitute an element of novelty and significant importance of a "pipeline safety management system" according to API RP 1173.

Discussed case study shows the improvements identified and verified with the functional safety methods for existing pipelines, from quantitative risk assessment to the verification of the increased degree of safety associated to the improvements, also showing the benefits coming from the periodic auditing of safety instrumented systems through formal safety assessments. In particular analogy with other safety management systems will be shown as well as the advantages coming for all the involved stakeholders (owner, AHJ, public).

