

Title	FABIG Technical Note 8: Protection of Piping Systems subject to Fires and Explosions
Publisher/Author	The Steel Construction Institute
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Scope	<p>Executive Summary</p> <p>The principles of structural design to resist fire and explosions on offshore installations have been extensively described in the Interim Guidance Notes and subsequent FABIG Technical Notes. Much of this guidance is also applicable to land-based petrochemical installations.</p> <p>Techniques for the design of offshore piping to resist explosions have been described in OTO 1999-046 Explosion Loading on Topsides Equipment, Part 1 Treatment of explosion Loads, Response Analysis and Design. FABIG Technical Note 8 seeks to combine this guidance with the design for fire and to extend the techniques to cover onshore plant design. Guidance on minimising hazard, assessing hazard, on pipe support and pipe rack design is also given. The work follows a review of current industry practice in this area.</p> <p>It is neither practical nor necessary to design all pipes to withstand explosion and/or fire effects and a two-level criticality rating system is advocated for those pipes that do require treatment.</p> <p>Three design and analysis methods for explosions are described. The basic Category 1 analysis is a simple static load and code check approach to ASME B31.3. Category 2 is an enhancement of the method, with SDOF analysis to determine and incorporate suitable Dynamic Load Factors. Category 3 is a full MDOF – NLFEA approach for more complex situations. Categories 1 and 2 are illustrated by worked examples.</p> <p>Industry experience has shown that there are practical limits to the general level of explosion resistance that can be achieved with process piping. It is consequently necessary to take measures in the overall plant design and local layout to reduce probable explosion pressures. An extensive part of the guide is devoted to this aspect, the objective being to reduce hazard and consequence by implementation of the principles of inherently safe design. For onshore plants a major goal is to prevent the spread of explosion effects from one plot/unit to adjacent plot/units and to people beyond the plant boundary (Landuse planning aspects).</p> <p>An important feature that distinguishes design of piping systems from design of structures is that structures respond principally to the overpressure effects of explosions whereas pipe systems respond mostly to drag (explosion wind). Guidance is therefore given on how to relate drag loads to design overpressure loads, especially where the latter are produced probabilistically. Inevitably, some reliance on CFD modelling is required and guidance on this area is also included.</p> <p>The ability of pressure-relieving and depressurisation systems to safeguard pressurised systems is critically dependent upon the assumptions made about the type and size of the threatening fire and the consequential levels of heat flux that each process segment is likely to be subject to. The onshore and offshore industry has traditionally used the American Petroleum Institute’s Recommended Practices (API RP 520 and 521) when designing pressure relief systems to enable pressure vessels and associated pipework to withstand the effects of fire. The recommendations in API RP 521 are typical for conditions of low heat flux fires in refinery or chemical plant. However, it is now widely recognised that, should process plant fitted with protected systems designed to API RP 521 or a similar standard be exposed to severe fires, such systems may be insufficient to prevent</p>

	<p>failure of the pressure system before the inventory has been safely removed. The next revision of API RP 521 will incorporate restrictions as to its applicability to low heat flux and non-impinging / non-engulfing fires.</p> <p>The main principles of design of pressure systems to resist fires have been relatively recently described in the UK Institute of Petroleum Guidelines for Design and Protection of Pressure Systems to Withstand Severe Fires and in similar guidance by Statoil / Norsk Hydro / Scandpower in Norway. This subject was also addressed in the UK HSE Offshore Technology Report OTO 2000 051.</p> <p>The above UK and Norwegian guidelines address the limitations of API RP 521 and provide an up-to-date guidance for the design of pressure systems to withstand severe fires.</p> <p>The objective of this Technical Note is to provide a methodology on the design and the protection piping systems and piping supports on both offshore installations and onshore plants for fires and explosions. The guidance covers the methods used to carry out both simplified design checks and advanced non-linear analysis.</p> <p>The original research, on which this document is based, was sponsored by the Health and Safety Executive and was carried out by The Steel Construction Institute. FABIG sponsored the production of the Technical Note.</p>																																																																		
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