Recommended Practice for the Design of Offshore Facilities Against Fire and Blast Loading

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FOREWORD

This recommended practice is under jurisdiction of the API Subcommittee on Offshore Structures. This Recommended Practice for the Design of Offshore Structures against Fire and Blast Loading is based on sound engineering principles and many years of experience gained by the owners, operators, designers, fabricators, suppliers, and classification/certification agencies of offshore facilities. In no case is any specific recommendation included that could not be accomplished by presently available techniques and equipment. Consideration is given in all cases to the safety of personnel, compliance with existing regulations, and prevention of pollution.

This recommended practice has been developed with the help and extensive contributions from industry experts of different areas of expertise. This recommended practice covers both fixed and floating structures that are in use by the industry as offshore oil and gas production systems. These include systems supported by column-stabilized units (semi-submersible vessels), ship-shaped vessels, Tension Leg Platforms (TLP), deep draft caisson vessels (also known as SPARs), and other hull shapes.

This recommended practice provides an assessment process for the consideration of fire and blast in the design of offshore structures and includes guidance and examples for setting performance criteria. This document complements the contents of the Section 18 of API RP 2A, 21st Edition with more comprehensive guidance in design of both fixed and floating offshore structures against fire and blast loading. Guidance on the implementation of safety and environmental management practices and hazard identification, event definition and risk assessment can be found in API RP 75 [51] and the API RP 14 series [52, 53]. The interface with these documents is identified and emphasized throughout, as structural engineers need to work closely with facilities engineers experienced in performing hazard analysis as described in API RP 14J [52], and with the operator's safety management system as described in API RP 75 [51].

This recommended practice provides general guidelines for incorporating hazard analysis output into the structural response assessment in determining whether the structure or its components meet the specified performance criteria.

This recommended practice includes code provisions and associated commentary. The commentary provides design guidelines for the evaluation of structural response to fire and blast loads. Nominal blast load cases are provided for certain classes of facilities. Guidance is also provided for the calculation of fire loads. Discussion of alternative methods for the calculation of blast loads, in lieu of applicable nominal load cases, is included with reference to sources of detailed guidance. The commentary also includes examples of good practice for fire and blast design including guidelines for facilities layout and structural connection detailing.

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Suggested revisions are invited and should be submitted to the Standards and Publications Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

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Recommended Practice for the Design of Offshore Facilities Against Fire and Blast Loading

0 Definitions

- **Blast Relief Panel:** Parts of a module wall, ceiling or roof, which are designed to increase the area of venting in an explosion by being opened or removed by the force of the explosion.
- **Blast Wall:** A structural barrier, which is designed expressly for the purpose of resisting blast loads.
- **Blow-down:** The rapid controlled or accidental depressurization of a vessel or piping network.
- **Cellulosic Fire:** A fire with a fuel source predominantly of cellulose (e.g. timber, paper, cotton). A fire involving these materials is relatively slow growing, although its intensity may ultimately reach or exceed that of a hydrocarbon fire.
- **Conduction:** The mode of heat transfer associated with solids. Each solid has a temperature dependent factor, which is a measure of the rate of conduction.
- **Convection:** Heat transfer associated with fluid movement around a heated body; warmer, less dense fluid rises and is replaced by cooler, denser fluid.
- **Ductility Ratio:** The ratio of the total deflection to the deflection at elastic limit. The deflection at elastic limit is the deflection at which strength behavior can be assumed to change from elastic to plastic.
- **Emergency Shutdown System:** A safety shutdown system comprising detection, signaling and logical control, valves and actuators, which can, in tandem with alarm and direct control mechanisms, enable the safe and effective shutdown of plant and machinery in a controlled manner.
- **Emmissivity:** A constant used to quantify the radiation emission characteristics of a flame. Emmissivity of a perfect black body is 1.
- **Fixed Platform:** A platform extending above and supported by the sea bed by means of piling, spread footings or other means with the intended purpose of remaining stationary over an extended period.
- **Heat Flux (heat density):** The rate of heat transfer per unit area normal to the direction of heat flow. A convenient unit is kW m^{-2} (1 kW m^{-2} = 317 Btu ft^{-2} h^{-1}). It is a total of heat transmitted by radiation, conduction and convection.
- **Hydrocarbon Fire:** A fire fuelled by hydrocarbon compounds, having a high flame temperature achieved almost instantaneously after ignition. A hydrocarbon fire will spread rapidly, burn fiercely and produce a high heat flux.
- **Mass Burning Rate:** The mass-burning rate of a pool fire is the mass of fuel supplied to the flame per unit time, per unit area of the pool. Units are typically kg/m^2/sec.
- **Mitigation:** Mitigation actions are defined as modifications or operational procedures that reduce loads, increase capacities, or reduce exposure.
- **Nominal Value:** The value assigned to a basic variable determined on a non-statistical basis, typically from acquired experience or physical conditions [ISO 32].
- **Operator:** The person, firm, corporation or other organization employed by the owners to conduct operations.
- **PFP:** Passive Fire Protection
- **Prevention:** The action that is taken to reduce the probability of an event in order to reduce the overall risk that the event poses to the platform.