Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities

API PUBLICATION 2510A
SECOND EDITION, DECEMBER 1996

REAFFIRMED, DECEMBER 2015

AMERICAN PETROLEUM INSTITUTE

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Downstream Segment

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FOREWORD

This publication covers aspects of the design, operation, and maintenance of liquefied petroleum gas (LPG) storage facilities from the standpoints of prevention and control of releases, fire-protection design, and fire-control measures. The storage facilities covered are LPG installations (storage vessels and associated loading/unloading/transfer systems) at marine and pipeline terminals, natural gas processing plants, refineries, petrochemical plants, and tank farms. This publication provides background, philosophy, methods, and alternatives to achieve good fire protection.

Information on the production or use of liquefied petroleum gas is not included.

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SECTION 1—GENERAL

1.1 Scope

1.1.1 This publication addresses the design, operation, and maintenance of LPG storage facilities from the standpoints of prevention and control of releases, fire protection design, and fire-control measures. The history of LPG storage facility failure, facility design philosophy, operating and maintenance procedures, and various fire protection and firefighting approaches are presented. This publication, since it supplements API Standard 2510 and provides the basis for many of the requirements stated in that standard, must be used in conjunction with API Standard 2510. In case of conflict, API Standard 2510 shall prevail. Alternate designs are acceptable provided equal safety can be demonstrated.

1.1.2 The storage facilities covered by this publication are LPG installations (storage vessels and associated loading/unloading/transfer systems) at marine and pipeline terminals, natural gas processing plants, refineries, petrochemical plants, and tank farms. The following types of LPG installations are not addressed:

a. Underground storage, such as buried tanks, storage caverns, salt domes, or wells.
b. Mounded storage tanks.
c. Refrigerated storage at pressures below 15 pounds per square inch gauge.
d. Installations covered by API Standard 2508.
e. Installations covered by NFPA Standards 58 or 59.
f. Department of Transportation (DOT) containers.
g. Those portions of LPG systems covered by NFPA 54 (ASME Z223.1).
h. Small installations with a single LPG tank of less than 2000-gallon capacity.
i. Process equipment for LPG manufacture or treatment preceding LPG storage.

1.2 Retroactions

The provisions of this publication pertain to new installations, but may also be used to review and evaluate existing storage facilities. The applicability of some or all of these provisions to facilities and equipment already in place or in the process of construction or installation before the date of this publication will have to be considered on a case-by-case basis.

1.3 Introduction

1.3.1 In developing fire-protection guidelines for an LPG storage facility, the greatest concern is the massive failure of a vessel with a full inventory of LPG. The probability of this type of failure can be made virtually negligible with properly engineered and operated facilities. The fire-protection principles of this publication are intended to prevent fire-induced vessel failure.

1.3.2 Most LPG fires originate as small fires that have the potential to become larger and more hazardous. It is important to note that LPG fires usually occur, not as a result of tank failure, but because of pump seal leaks, piping leaks, or failure to follow safe work procedures. Human failure such as overfills and piping leaks from poor drawoff (water and sample) procedures can lead to LPG release and consequent fire. This publication treats the prevention and control of such incidents and provides various fire extinguishment and containment methods.

1.4 Failure History

1.4.1 The most serious LPG release is a massive failure of a storage vessel. Such failures are rare and seldom occur without exacerbating circumstances such as exposure to fire or external explosion.

1.4.2 To project LPG storage vessel failure frequency, fire-protection professionals have reviewed applicable U.S., British, and German failure statistics for pressure vessels.[1] These statistics reveal that the failure rate for pressure vessels from causes other than pre-existing fires or explosions, has been about 1 failure per 100,000 vessel years. To assume this failure rate for hydrocarbon storage vessels is conservative, since most of the data in these studies are for steam boilers and drums operating under more adverse conditions.

1.4.3 A more likely LPG incident, and in the context of this publication a more relevant one, is leakage from piping or other components attached to or near the vessel followed by ignition, a flash fire or vapor cloud explosion, and a continuing pool fire and pressure (torch) fire. The possibility of a pool fire is greater with lower-vapor-pressure LPG or in cold climates. Should flames impinge on a nearby LPG vessel, a boiling liquid-expanding vapor explosion (BLEVE) involving one or more storage vessels may ensue. Injury to facility or neighboring personnel and damage losses of several million dollars can be incurred in these types of LPG incidents.

[1] Spencer H. Bush, "Pressure Vessel Reliability," *Transactions of the ASME: Journal of Vessel Technology,* February 1975.