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Australian Standard®

Liquefied natural gas—Storage and handling

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The following interests are represented on Committee ME/70:

The Australian Gas Association

Australian Institute of Petroleum

Confederation of Australian Industry

Department of Mines, W.A.

Department of Primary Industries and Energy (Commonwealth)

Work Health Authority, N.T.

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Liquefied natural gas—Storage and handling

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PREFACE

This Standard was prepared by the Standards Australia Committee on Liquefied Natural Gas—Storage and Handling in response to requests from authorities, industries and utilities associated with the subject.

A first draft had been prepared by the Work Health Authority of the Northern Territory, and was derived from the Canadian Standard Z276M—1981, *Liquefied natural gas (LNG)—Production, storage and handling,* with a small number of requirements taken from NFPA 59A, 1985, *Production, storage and handling of liquefied natural gas (LNG)*. Other changes had included references to Australian Standards where appropriate.

That draft, reflecting its origins, was oriented towards large-tonnage atmospheric tank installations, so it was necessary to add further requirements to treat the smaller but more numerous pressure tanks. For this AS 1596, *SAA LP Gas Code* was used as a model because of obvious similarities, but considerable adjustment was necessary to cater for the many differences between LPG and LNG. AS 1940, *SAA Flammable and Combustible Liquids Code* was also a useful source, because atmospheric LNG storage has something in common with flammable liquids storage, and the experience of the established cryogenics industry was also valuable.

While these analogies with LPG, petrol and cryogenics were helpful in the general drafting process, LNG has a number of particular properties that require measures that are specific to it. The Standard is therefore an amalgamation of requirements having origins in a variety of sources, but tailored to suit the particular needs of LNG, and arranged to cater for the essential distinctions between the two basic types of storage and handling systems, i.e. pressure tanks and road or rail tankers on the one hand, or atmospheric tanks for marine or pipeline transport systems on the other.

Currently a new British Standard in four parts to replace BS 4741 and BS 5387 is being circulated for public comment, see BSI drafts DC 90/73016, 90/73024, 90/73029 and 90/73037. It is intended to reference this Standard, when published, as the preferred Standard for the design and construction of atmospheric tank storages.

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FOREWORD

FIRE SAFETY

GENERAL CONSIDERATIONS

Fire safety is a critical aspect of any Standard that deals with the safe handling of flammable materials, and such a Standard usually incorporates a comprehensive section that requires the traditional fire-fighting implements, i.e. hoses, hydrants, extinguishers, and the like. Habit and instinct tend to lead the thinking towards the provision of the same equipment for LNG, on the grounds that if a fire is possible, one must provide means for fighting it, and this is the way it is done.

However, the fire characteristics of gases, particularly LNG, differ radically from solids and liquids, so that conventional fire-fighting methods and equipment are not often useful and can in some situations be counter-productive. The provision of inappropriate equipment not only represents a misdirection of effort, but more seriously a false sense of security can be generated, leading personnel to place themselves in danger.

Essential to a consideration of safety in gaseous fire is that uncontrolled drifting vapour is very mobile; unlike liquids or solids it may travel to an ignition source. Thus once gas is free, dissipation before reaching an ignition source is the only hope of safety. Separation distances, and the control and elimination of possible ignition sources, are aimed at this aspect.

If a gas escape ignites, there are two problems. Water streams will not readily extinguish such a fire, and in any case to extinguish the flame while leaving the escape flowing sets up a very considerable risk of potential re-ignition.

The only satisfactory means of stopping a gaseous fire is to shut off the fuel supply, so the design must incorporate sufficient isolating facilities to cope with any predictable event. However such facilities merely represent a cure after the event, and the principal objective must be prevention, i.e. the intent should be that escapes never happen and the escape-control measures never have to be used.

Thus the engineering of the whole installation becomes the critical fire safety provision. The first precautionary element in the design is the engineering of all the components to minimize the possibility that any failure may lead to an escape. The next element is a system of valves which controls all outflow of LNG whether liquid or vapour; these valves should be capable of shutting off flow, preferably automatically, should an incident occur.

Catchments are provided for certain types of tank to hold any possible spillage of liquid. Any substantial spill of liquid will form a pool, but the liquid has a fairly high evaporation rate, so that it is desirable to keep the surface area of the pool as small as possible to minimize the rate of vapour generation.

It is traditional to spread foam on petrol spillages to blanket the surface and inhibit evaporation, thus reducing the vapour cloud and reducing the possibility of ignition. Foam is not as effective on LNG, because of the interface between the warm foam and the cryogenic LNG, which increases evaporation breaking through the foam. Thus a further reason for keeping the surface areas of spillage catchments as small as possible is to optimize the thickness of the foam blanket, so that the barrier to heat radiated into the pool, and the general insulating effect on the pool, is as effective as possible.

Should a compound catch fire, then little can be done to fight it. Foam is ineffective and water streams will increase the problem by increasing the evaporation rate. All that can be done is protect nearby installations and property from the high level of radiated heat.

Nearby fires that radiate heat are not an important consideration for LNG tanks. The separation requirements ensure that the radiation levels at the outer tank surface are reasonable, and the insulation of the tank will be adequate protection for anything but the most intense fire, active for a prolonged period. Accidental on-site fires can be dealt with in the main by conventional fire-fighting methods, and are not likely to last long enough to present any threat to a tank. Only tank support structures have any degree of vulnerability to weakening by heat. Therefore, this Standard makes little provision for protection from accidental heat from incidental nearby fires.

ENGINEERING FOR FIRE SAFETY

While the general principles of containment of contents apply equally to both pressure and atmospheric tanks, there are differences in detail which require different approaches. Pressure tanks are of small volume, but can have quite high pressures. Atmospheric tanks have very large volumes at lower pressures.

Pressure tanks Pressure tanks are not treated as being a major potential for liquid loss, because of the relative thickness of the shell, and are considered more likely to suffer an outflow of liquid due to the downstream failure of some component, possibly due to accident. The engineering of the containment provisions has as its objective the elimination of any such downstream escape by the application of the following principles:

(a) An escape of liquid is more serious than an escape of vapour.

(b) Openings into a tank should not be more numerous, nor larger, than they need to be.

(c) Every opening above a stated minimum size should have double protection, the inboard member being at least a manual shut-off valve, with either an excess flow valve or a non-return valve mounted outboard of that.

(d) Non-return valves are used preferentially wherever they can be used and are mandatory in every one-way liquid filling entry. The reason for this preference is that a non-return valve will shut in any condition of backflow, whereas an excess flow valve will shut only in specific outflow conditions.

(e) Where a non-return valve is used, the manual valve inboard of it is considered to be adequate back-up.

(f) Where an excess flow valve is unavoidable, the inboard manual valve is not alone adequate, and must be supported by an emergency shut-down system, or for smaller tanks at least a remote operating control of some sort.

(g) Careful thought must be given in the design stage to ensure that any filling or withdrawal connection, shear point, screwed or flanged connection, or other feature to which flame could flash in the event of a fire, is located and directed to avoid flame impingement. Pipework should be designed to minimize the number of flanges and joints.

(h) Water sprays and sprinkler systems have little place and cannot be substituted for protective valving.

(i) Site management has a continuing responsibility to ensure that training, operating, and maintenance procedures are set up in the first place, are implemented, and are not subsequently allowed to lapse or become outdated.

(j) A certain basic level of fire-fighting equipment is required for all but the most minor installations, to cope with the unpredictable.

Atmospheric tanks Atmospheric tanks are considered to have a higher need for protection from possible spills, partly because of field construction uncertainties, and thinner shells, and partly because the very high volume stored warrants more caution. The main principles are as follows:

(a) No openings are permitted through the shell below the maximum liquid level in the tank. Liquid is pumped over the top.

(b) Excess flow valves and check valves have little place in such arrangements, and any downstream escape is terminated by an emergency shut-down system that controls the pumps. Some provision is necessary to prevent siphoning after a pump shuts off.

(c) Separations are chosen on the basis of a design liquid spill of 10 min duration.

(d) The compound around the tank is designed to minimize the possible surface area of any spill, so that compounds for LNG tanks tend to be narrow and deep, and commonly consist of only an outer shell.

(e) The entire design of the installation, its control systems, valves, emergency shut-down provisions, sensing and monitoring devices, is considered to be an individual engineering exercise for that particular plant, carried out in conjunction with a risk assessment. It is for this reason that the Standard says little about the detail of such installations.

TREATMENT OF EMERGENCIES

The requirements of this Standard have been devised on the basis of a definite concept as to the handling of a fire emergency involving LNG storages, the elements of which are as follows:

(a) Rapid evaluation of the nature of the fire is imperative.

(b) If the fire is in adjacent buildings or materials, and is of normal intensity and duration, then it can be taken that the tank will be unaffected and attention can be concentrated on fighting that fire.

(c) If LNG or gas is escaping, the priority task is to prevent escalation, then to stabilize, then to terminate. The major objective is to shut off the flow of the escaping LNG.

(d) If a gas fire is burning but the situation is stable, there is nothing wrong with letting the gas burn if it can do no harm, even to the extent of burning off all the stored gas if this is the safest thing to do.

(e) If the situation is obviously escalating, and the fuel flow to the fire cannot be stopped, then the emergency teams must be evacuated.

STANDARDS AUSTRALIA

Australian Standard
Liquefied natural gas—Storage and handling

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies requirements for the design, construction and operation of installations for the storage and handling of liquefied natural gas (LNG). It does not apply to or deal with—

(a) the functional design of liquefaction equipment;

(b) frozen-ground storage techniques;

(c) aspects of natural gas distribution and use that are covered by other Standards and publications such as pipeline and reticulation codes, appliance and vehicle installation codes, and the like;

(d) any transport operations that are covered by the Australian Dangerous Goods Code; or

(e) the transport of LNG by ship.

1.2 NEW DESIGNS, INNOVATIONS Alternative materials, designs, methods of assembly, procedures, etc., which do not comply with the specific requirements of the Standard, or are not mentioned in it, but which give equivalent results to those specified, are not necessarily prohibited. The Standards Australia Committee ME/70, Liquefied Natural Gas—Storage and Handling, can act in an advisory capacity concerning equivalent suitability, but specific approval remains the prerogative of the Authority.

1.3 INTERPRETATIONS Questions concerning the clarity, meaning, application or effect of any part of the Standard may be referred to Committee ME/70 for explanation. The authority of the committee is limited to matters of interpretation, and it will not adjudicate in disputes.

1.4 REFERENCED DOCUMENTS A list of the documents referred to in this Standard is given in Appendix A.

1.5 DEFINITIONS For the purpose of this Standard, the definitions below apply.

1.5.1 Automotive refuelling station—a location at which vehicle fuel tanks are filled from dispensers while on the vehicle.

1.5.2 Approved, approval—approved by, or approval of, the Authority.

1.5.3 Authority—the Authority having legal control of the subject installation.

1.5.4 Atmospheric tank—a tank that operates at a nominal vapour pressure that does not exceed 100 kPa.

1.5.5 Boundary—the boundary of the whole of the site under the same occupancy as that on which the installation is included.

1.5.6 Bund—an embankment of earth, or a wall of brick, stone, concrete, or other approved material which may form part or all of the perimeter of a compound.

1.5.7 Capacity (of a tank)—the total volume of the space enclosed within the tank for a pressure tank, or the total volume of the space up to the maximum permitted filling level for an atmospheric tank.

1.5.8 Combustible liquid—a Class C1 liquid or a Class C2 liquid as defined in AS 1940.

1.5.9 Compound—an area bounded by natural ground contours or by a bund, and intended to limit the spread of any potential spillage or leakage.

1.5.10 Emergency shut-down system—a system of controls and components that complies with specific requirements of this Standard, the purpose of which is to facilitate safe shut-down in an emergency.

1.5.11 Excess-flow valve—a normally open valve which closes automatically when a predetermined flow rate in a particular direction has been exceeded.

1.5.12 Fire-resistance level—the fire-resistance level of a structure as defined and determined by AS 1530.4.

1.5.13 Fire wall—a wall or other barrier constructed and placed with the object of preventing the spread of fire or the radiation of heat from any place to some other place.

1.5.14 Flammable liquid—a flammable liquid as defined in AS 1940, or in AS 1216.1, or in the ADG Code.

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