

Annual Report on Liquefied Petroleum Gas (LPG) Related Accidents

(2017 version)

The High Pressure Gas Safety Institute of Japan (KHK)

1. Introduction

This Annual Report describes accidents that occurred in 2017 related to facilities for supplies and consumptions of Liquefied Petroleum Gas (hereinafter, “LPG”) at home or on business, which are regulated by the Act on the Securing of Safety and the Optimization of Transaction of Liquefied Petroleum Gas (hereinafter, the “LPG Act”). This report also describes analyses of the data of the accidents in 2017 by comparing with the past.

2. Definitions

2.1 Definition of accidents

(1) LPG accidents

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|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1] Leakage | A case in which LPG leaked, but it did not catch fire and cause human damages of poisoning and asphyxiation. However, leakage of a very little amount of LPG from joints as little as soap bubbles formed when those of threaded parts or rubber tubes are soaked by soap water is excluded. |
| [2] Leakage and explosion | Cases in which LPG leaked, and it resulted in an explosion or a fire caused by the explosion, as follows.
A. Leakage and explosion, when the explosion resulted from leaked gas only.
B. Leakage, explosion and fire, when a fire broke out following explosion caused by leaked gas. |
| [3] Leakage and fire | A case in which a fire resulted from leakage of LPG excluding those covered by [2] above. This is not limited to that recognized as a fire by the fire department. Here, a fire without leakage, which is caused by the overheating or the failure of LPG appliances including their accessories or by spreading of flames from a cooking oven, grill, etc., is not classified as a LPG accident. |
| [4] Poisoning and asphyxiation | A case in which human damages of CO poisoning and asphyxiation are caused due to incomplete combustion, leakage of LPG, or leakage of exhaust gas from exhaust pipes, etc., at LPG consumption facilities. |

(2) Other accidents (not classified as LPG accidents)

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|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| [1] Accidents caused by suicide, damage by intention, mischief, theft, or other similar causes | |
| [2] Accidents resulting from a natural disaster | |
| Example) | Accidents caused by facilities' damages resulting from collapse of houses due to earthquake |
| Example) | Accidents caused by facilities' damages resulting from flood and landslide |

Even if accidents are resulted from natural disasters, however, those caused by defects in toppling prevention measures, fallen snow prevention measures (snow shelters, protective boards), or other insufficiencies in safety measures, are classified as LPG accidents.

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| [3] Accidents involving portable cooking stoves and gas cartridges | |
| [4] Other accidents not categorized in the LPG accidents of (1) above | |

2.2 Classification of human damages

Classified as follows according to the level of damage.

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|--------------------|--------------------------------------------------------------------------------------------------------|
| Death: | When a person was confirmed to have died within five days from the time of accident |
| Seriously injured: | When a person suffered an injury at the time of accident that took 30 days or more for full recovery |
| Slightly injured: | When a person suffered an injury at the time of accident that took less than 30 days for full recovery |

3. LPG accidents
 3.1 Occurrences of accidents in the past

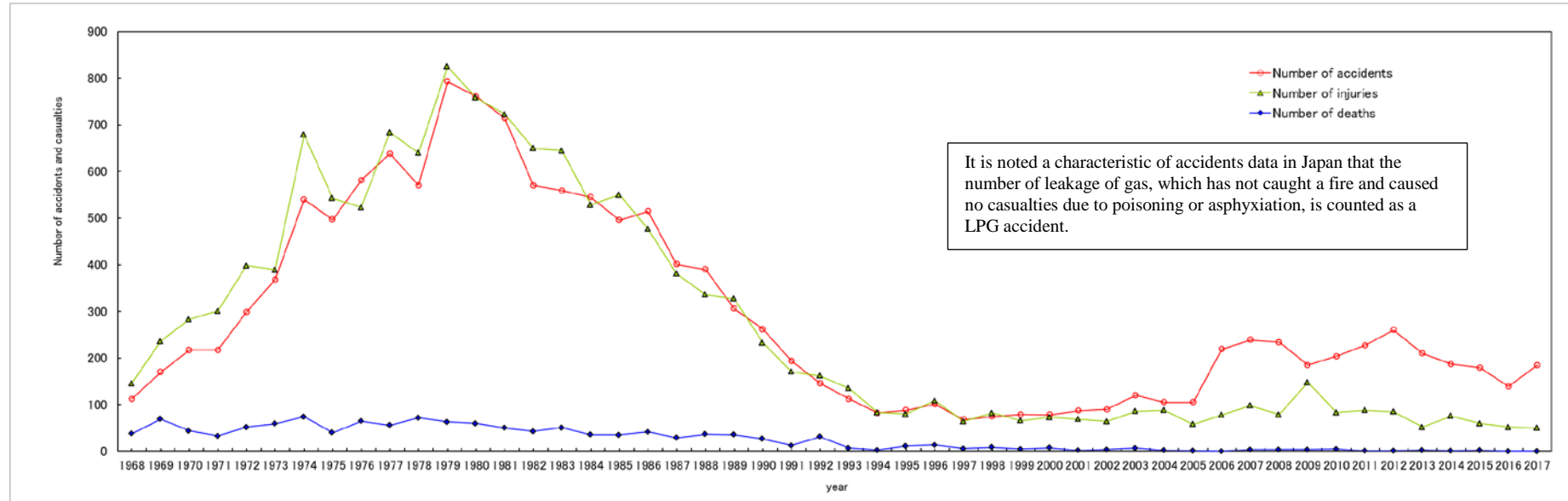


Figure 1: Accident occurrences and casualties by year

Table 1: Change in the number of accidents and casualties by year

Year	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Number of accidents	112	170	217	217	299	368	540	497	581	638	570	793	761	714	570	559	545	496	515	401	390	306	262	194	146
Rate to the previous year	▲33	52	28	0	38	23	47	▲8	17	10	▲11	28	▲4	▲6	▲20	▲2	▲3	▲9	4	▲22	▲3	▲22	▲14	▲26	▲25
Number of deaths	38	69	44	33	52	59	74	40	65	56	72	63	60	50	43	51	36	35	42	29	37	36	27	13	31
Number of injuries	146	236	283	301	398	389	679	543	523	684	640	825	758	723	650	645	529	550	477	381	336	327	233	171	162

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of accidents	112	82	88	101	68	75	79	78	87	90	120	105	105	219	239	234	185	204	227	260	210	187	179	139	185
Rate to the previous year	▲23	▲27	7	15	▲33	10	5	▲1	12	3	33	▲13	0	109	9	▲2	▲21	10	11	15	▲19	▲11	▲4	▲22	33
Number of deaths	7	3	12	14	6	9	5	8	2	4	7	2	1	0	4	4	4	5	1	1	3	1	2	0	0
Number of injuries	135	83	80	109	64	82	66	73	69	64	86	88	58	78	98	79	148	83	88	85	52	76	60	52	50

Figure 1 shows the number of accidents that occurred between 1968 and 2017 and the resulting casualties. Looking at the data, the number of accidents increased gradually during the 1960s and the 1970s along with the number of households using LPG and reached a peak in 1979 with 793 accidents, causing 63 casualties. This was the year that marked the highest number of accidents and casualties. In July 1978, a part of the LPG Act was revised : measures such as dealer's obligation to general consumers, the establishment of a certified research institution system, etc. were implemented.

In August 1980, a large-scale city gas explosion took place that resulted in enormous human damages marked by 15 deaths and 222 seriously and slightly injured persons. In February 1981, Ministerial Ordinance Reform was carried out : safety standards of the basement were established, installation of gas leak alarm equipment for LP gas for the basement and business facilities was obliged, and odor of LP gas concentration strengthened.

Thereafter, the number of accidents continued declining linearly from the late 1980s, falling below 100 in 1994, to 82. Meanwhile, amendments to Act and Ministerial Ordinances were implemented several times. For example, in July 1985, the Ministerial Ordinance Amendment was implemented to strengthen the installation of end gas faucets (fuse gas stoppers) with excess overflow safety mechanisms and the connection method of rubber tubes for eating house.

After that, initiatives for eradicating accidents, such as promoting the deployment of safety devices in conjunction with the public and private sectors, have been promoted.

3.2 Accident situations by phenomenon

Table 2 shows the number of accidents by phenomenon that occurred between 2007 and 2017. Looking at that of 2017, the number of leakage-only accidents that did not start fire or explosion was more than half of total accidents. Compared to the previous year, the number of leakage-only accidents increased by 22, leakage and explosion (fire) accidents increased by 14.

Table 2. Number of accidents by phenomenon

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Leakage	113	115	84	76	116	160	113	98	99	84	106
Leakage and explosion(Fire)	64	53	45	60	55	48	48	59	43	27	41
Leakage and fire (Excluding explosion)	51	60	42	60	45	44	43	27	31	19	35
CO poisoning and asphyxiation	11	6	14	8	11	8	6	3	6	9	3
Total	239	234	185	204	227	260	210	187	179	139	185

4. Analysis of accident situations

The following kinds of LPG accidents that have occurred frequently were analyzed.

(1) CO poisoning accidents (excluding asphyxiation)

As shown Figure 2, three CO poisoning accidents occurred in 2017, showing an decreased by six from the previous year. Among three, two accidents happened in the industrial facility where industrial ventilation alarming and CO alarming were not installed.

[1] Incomplete combustion of a dishwasher. (one case)

[2] Supply and exhaust failure without the operation of Ventilation fan in using rice cooker. (one case)

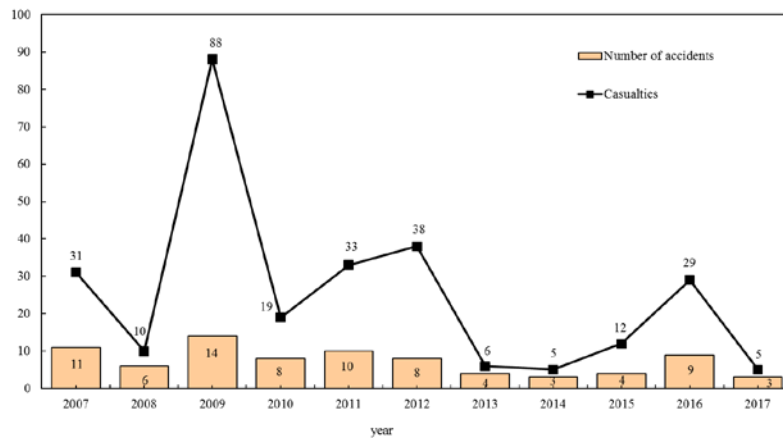


Figure 2: Number of CO poisoning accidents by year and casualties

(2) Buried pipes accidents

The pipes that are installed between LPG cylinders and a gas meter are called supply pipes, and are installed between a gas meter and consumption devices like heaters are called distribution pipes in Japan. Pipes are installed on the ground or underground. The number of supply pipe accidents is greater than distribution pipe accidents.

Figure 3 shows that 41 accidents involving buried pipes took place in 2017, a increase of eight from the previous year.

Causes of accidents include damages in 29 accidents (supply pipes in 23 accidents and distribution pipes in six accidents) and deterioration due to corrosion in 12 accidents (supply pipes in four accidents and distribution pipes in eight accidents). In many cases, damage is caused by a construction company erroneously cutting or breaking in a construction unrelated to gas facilities, causing gas leakage. In such a case, since people are involved directly and treatment such as gas stoppage is taken relatively quickly, most of them have not reached a large-scale accident.

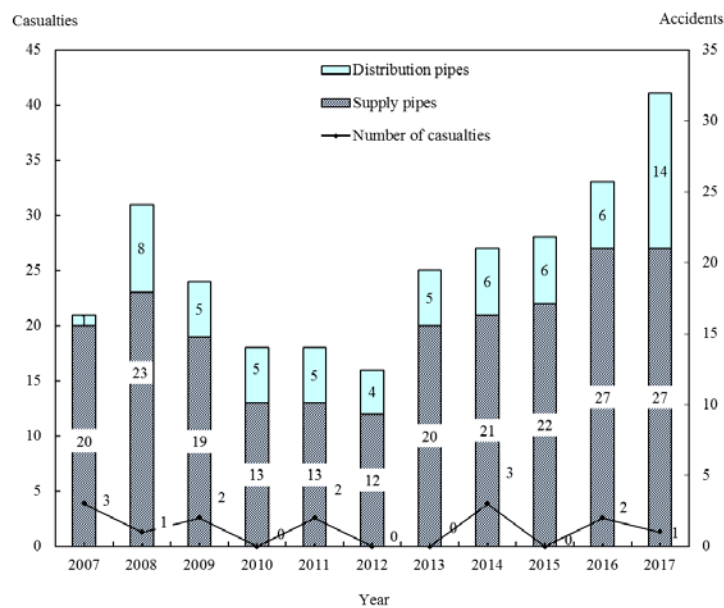


Figure 3. Number of buried pipes accidents by year and casualties

(3) Bulk supply accidents

In 2017, two accidents involving bulk supply (supply facilities only) occurred, showing a decrease of three from the previous year. The breakdown of these accidents is shown below.

*Bulk supply refers to supply of liquefied petroleum gas into bulk storage tanks from portable LPG generators (bulk tank trucks). See Figure 4.

[1] Deterioration of a sealing property of a resin plug. (one case)

[2] A minute gap of a flange joint. (one case)

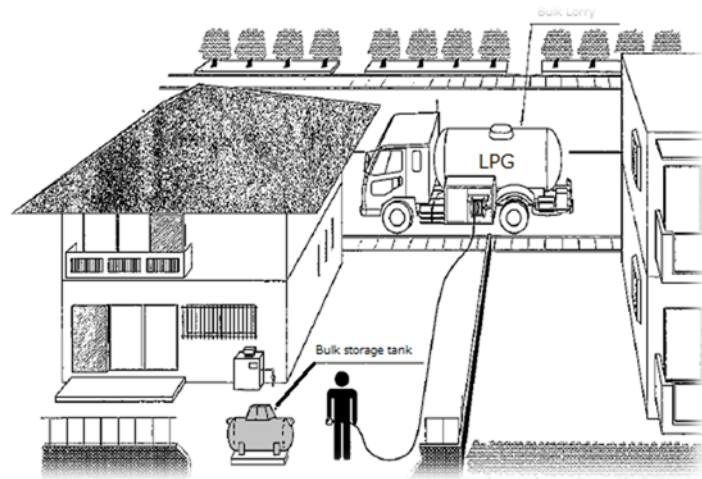


Figure 4. Bulk supply system

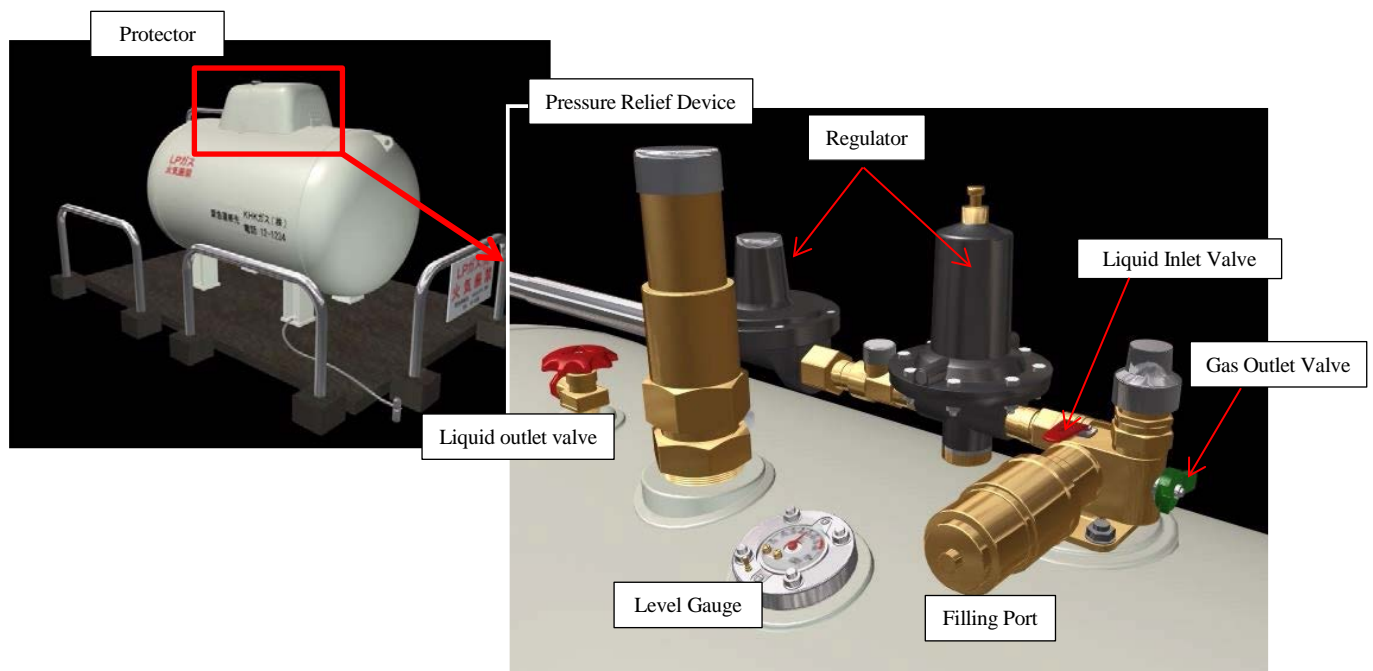


Figure 5: Bulk Storage Tank

5. Number of accidents that resulted in death or injured

Number of the accident that described so far contains non death and non injured cases. Of course, most of the leakage only accident didn't result in death or injured. Table 3 and Figure 6 show the number of accidents that resulted in death or injured by phenomenon.

Table 3. Number of accidents that resulted in death or injured by phenomenon

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Leakage	Number of accidents	5	0	1	0	1	0	1	1	1	1
	Number of deaths	0	0	0	0	0	0	0	0	0	0
	Number of injuries	7	0	1	0	2	0	1	1	1	1
Leakage and explosion (Fire)	Number of accidents	36	25	38	32	27	24	38	22	16	24
	Number of deaths	1	1	1	0	0	0	0	1	0	0
	Number of injuries	45	39	49	39	33	30	50	37	21	29
Leakage and fire (Excluding Explosion)	Number of accidents	15	17	17	11	10	15	9	8	1	12
	Number of deaths	1	0	1	0	0	0	0	0	0	0
	Number of injuries	20	24	17	15	13	17	21	8	1	15
CO poisoning and asphyxiation	Number of accidents	6	14	8	11	8	6	3	6	9	3
	Number of deaths	2	3	3	1	1	3	1	1	0	0
	Number of injuries	8	85	16	34	37	5	4	14	29	5
Total	Number of accidents	62	56	64	54	46	45	51	37	27	40
	Number of deaths	4	4	5	1	1	3	1	2	0	0
	Number of injuries	80	148	83	88	85	52	76	60	52	50

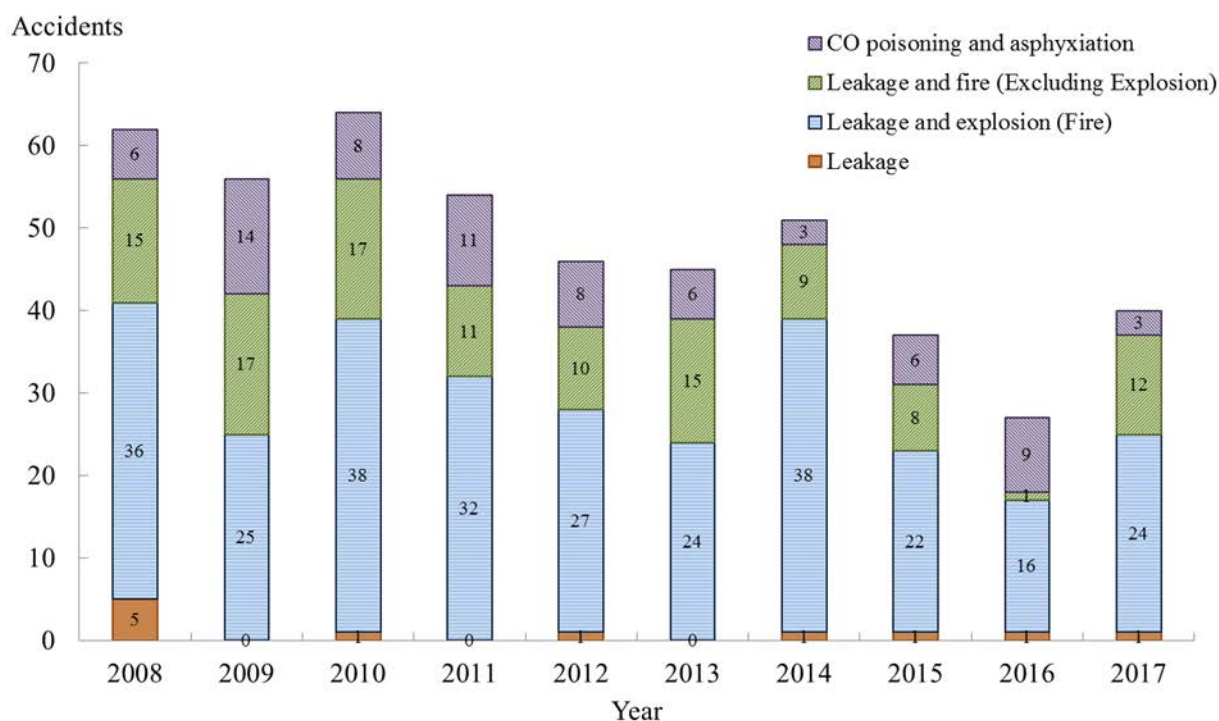


Figure 6: Number of accidents by phenomenon that resulted in death or injured

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