Annual Report on Liquefied Petroleum Gas (LPG) Related Accidents

(2016 version)

The High Pressure Gas Safety Institute of Japan (KHK)

1. Introduction

This Annual Report describes accidents that occurred in 2016 related to facilities for supplies and consumptions of Liquified 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 2016 by comparing with the past.

2. Definitions

2.1 Definition of accidents

(1) LPG accidents

[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)

[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.

[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.

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

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3. LPG accidents

3.1 Occurrences of accidents in the past

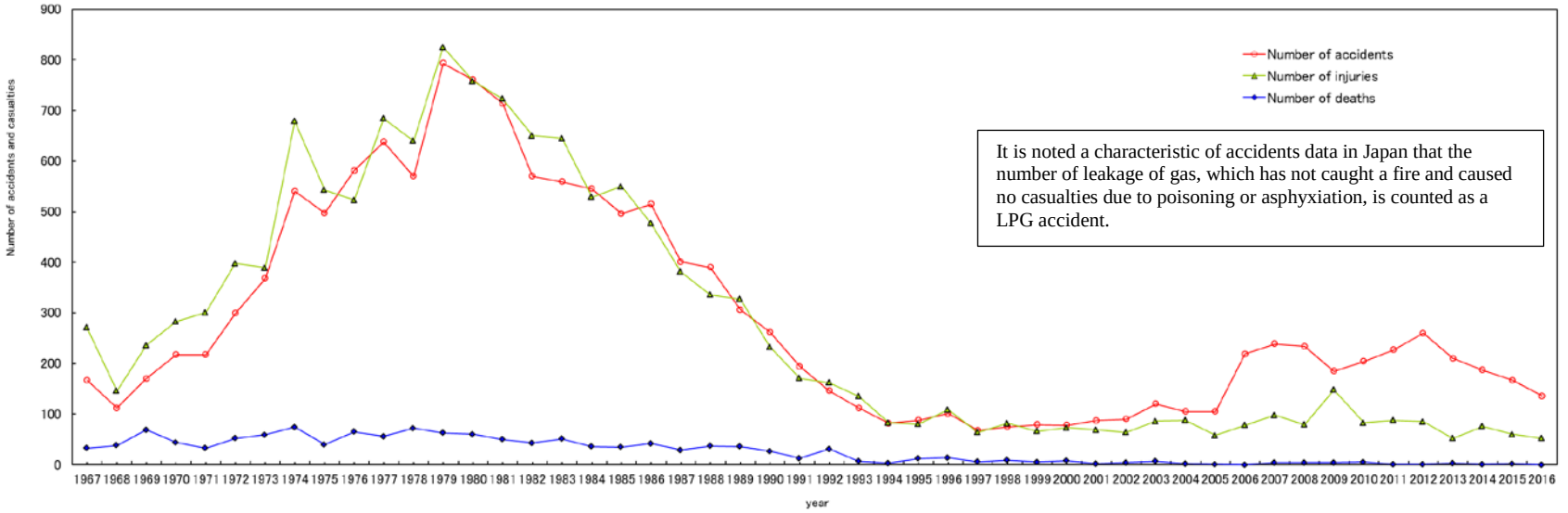

Figure 1: Accident occurrences and casualties by year

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

Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Number of accidents	167	112	170	217	217	299	368	540	497	581	638	570	793	761	714	570	559	545	496	515	401	390	306	262	194
Rate to the previous year	34	▲33	52	28	0	38	23	47	▲8	17	10	▲11	28	▲4	▲6	▲20	▲2	▲3	▲9	4	▲22	▲3	▲22	▲14	▲26
Number of deaths	33	38	69	44	33	52	59	74	40	65	56	72	63	60	50	43	51	36	35	42	29	37	36	27	13
Number of injuries	271	146	236	283	301	398	389	679	543	523	684	640	825	758	723	650	645	529	550	477	381	336	327	233	171

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of accidents	146	112	82	88	101	68	75	79	78	87	90	120	105	105	219	239	234	185	204	227	260	210	187	178	136
Rate to the previous year	▲25	▲23	▲27	7	15	▲33	10	5	▲2	12	3	33	▲13	0	109	9	▲2	▲21	10	11	15	▲19	▲11	▲9	▲42
Number of deaths	31	7	3	12	14	6	9	5	8	2	4	7	2	1	0	4	4	4	5	1	1	3	1	2	0
Number of injuries	162	135	83	80	109	64	82	66	73	69	64	86	88	58	78	98	79	148	83	88	85	52	76	60	52

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Figure 1 shows the number of accidents that occurred between 1967 and 2016 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 2006 and 2016. Looking at that of 2016, 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 decreased by 17, leakage and explosion (fire) accidents decresed by 15.

Table 2. Number of accidents by phenomenon

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Leakage	137	113	115	84	76	116	160	113	98	98	81
Leakage and explosion(Fire)	70	64	53	45	60	55	48	48	59	43	28
Leakage and fire (Excluding explosion)	6	51	60	42	60	45	44	43	27	31	18
CO poisoning and asphyxiation	6	11	6	14	8	11	8	6	3	6	9
Total	219	239	234	185	204	227	260	210	187	178	136

4. Analysis of accident situations

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

(1) CO poisoning accidents

As shown Figure 2, nine CO poisoning accidents occurred in 2016, showing an increased by five from the previous year. The breakdown of these accidents is shown below.

[1] Poor air supply and exhaust because the windows were closed while using boiler, fryers or ovens. (three cases)

[2] Poor air supply and exhaust because the ventilation fan was not operating while using the casting stove or the oven. (two cases)

[3] Mishandling of combustion equipment. (two cases)

[4] Typhoon wind and rain blown into the exhaust duct, and air supply and exhaust fault occurred due to closing doors and windows. (one case)

[5] Blockage of supply and exhaust port of RF(Roof top Flue) type water heater by insulation material. (one case)

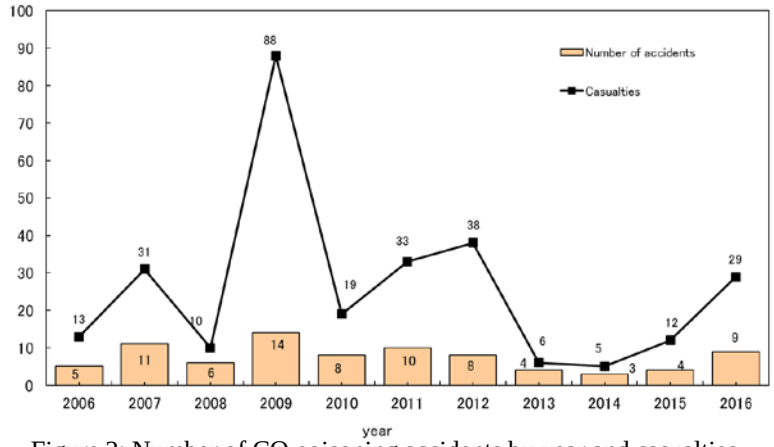

Figure 2: Number of CO poisoning accidents by year and casualties

(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 33 accidents involving buried pipes took place in 2016, a increase of five 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 four accidents (supply pipes in four accidents and distribution pipes in zero 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.

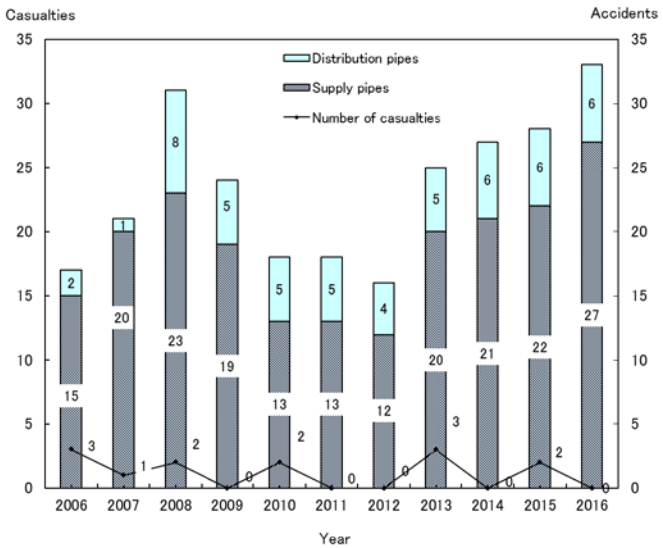

Figure 3. Number of buried pipes accidents by year and casualties

(3) Bulk supply accidents

In 2016, five accidents involving bulk supply (supply facilities only) occurred, showing a increase of one 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] Work mistake at replacement of safety valve. (one case)
[2] Clogging failure of gas extraction valve. (one case)
[3] Safety valve release pipe deterioration. (one case)
[4] Production defective of liquid extraction valve neck part. (one case)
[5] Aged deterioration of pressure gauge packing. (one case)

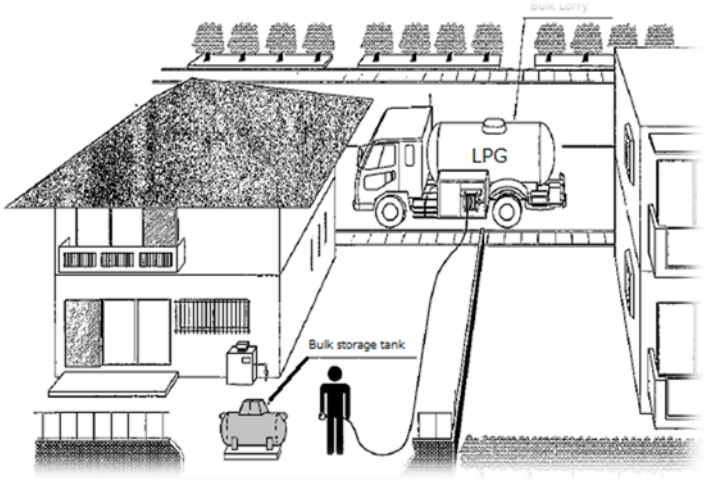

Figure 4. Bulk supply system

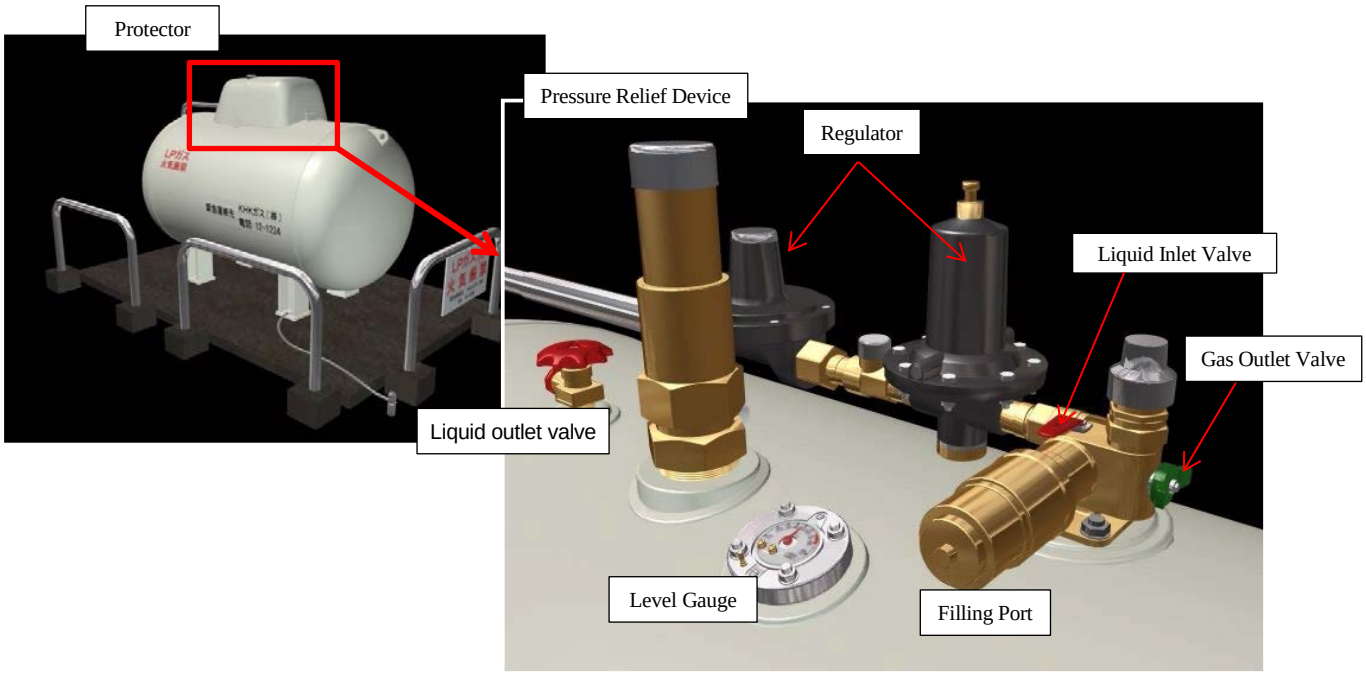

Figure 5: Bulk Storage Tank

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 deth ore injured by phernomenon.

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

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Leakage	Number of accidents	3	5	0	1	0	1	0	1	1	1
	Number of deaths	0	0	0	0	0	0	0	0	0	0
	Number of injuries	3	7	0	1	0	2	0	1	1	1
Leakage and explosion (Fire)	Number of accidents	44	36	25	38	32	27	24	38	22	16
	Nnumber of deaths	1	1	1	1	0	0	0	0	1	0
	Number of injuries	54	45	39	49	39	33	30	50	37	21
Leakage and fire (Excluding Explosion)	Number of accidents	12	15	17	17	11	10	15	9	8	1
	Number of deaths	1	1	0	1	0	0	0	0	0	0
	Number of injuries	12	20	24	17	15	13	17	21	8	1
CO poisoning and asphyxiation	Number of accidents	11	6	14	8	11	8	6	3	6	9
	Number of deaths	2	2	3	3	1	1	3	1	1	0
	Number of injuries	29	8	85	16	34	37	5	4	14	29
Total	**Number of accidents**	**70**	**62**	**56**	**64**	**54**	**46**	**45**	**51**	**37**	**27**
	Number of deaths	**4**	**4**	**4**	**5**	**1**	**1**	**3**	**1**	**2**	**0**
	Number of injuries	**98**	**80**	**148**	**83**	**88**	**85**	**52**	**76**	**60**	**52**

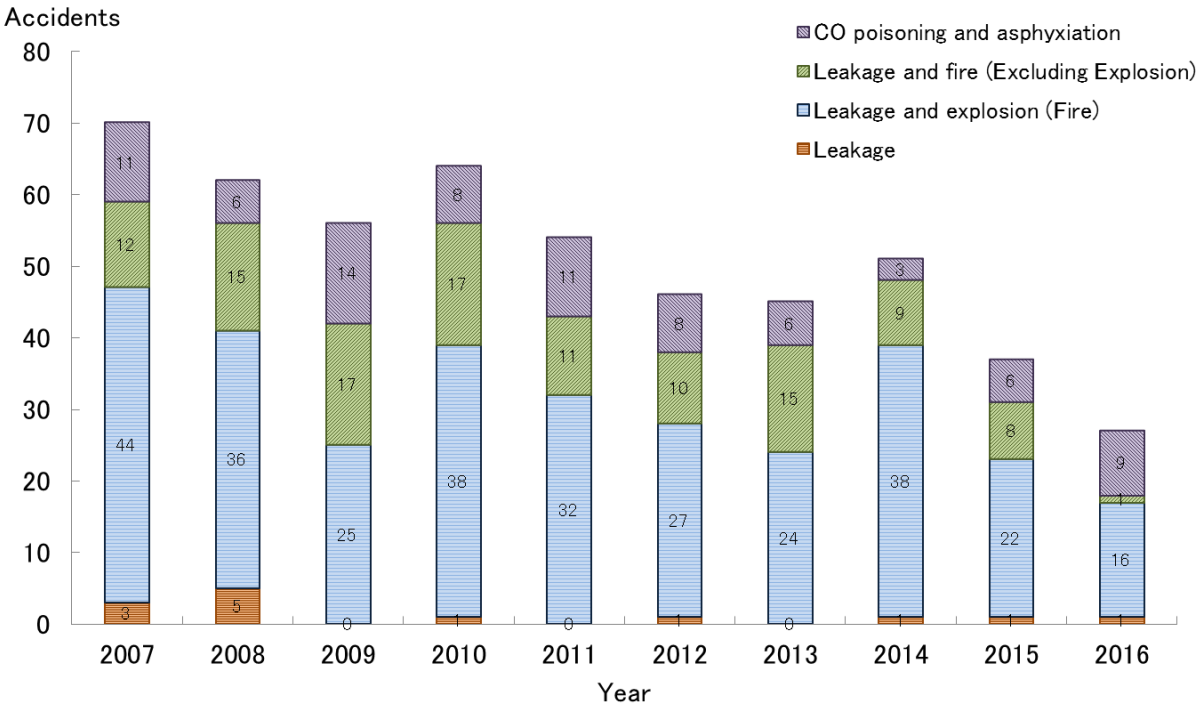

Figure 6: Number of accidents by phenomenon that resulted in death or injured

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