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Joint Industry Programme on carbon monoxide issues

A review of carbon monoxide incident information for 1996/7 produced from the full investigation of incidents which had resulted from the use of piped natural gas and LPG within Great Britain

Prepared by
Advantica Technologies Limited
(*formerly* BG Technology)
for the Health and Safety Executive

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A review of carbon monoxide incident information for 1996/7 produced from the full investigation of incidents which had resulted from the use of piped natural gas and LPG within Great Britain

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This report has been written by BG Technology as part of the Joint Industry Programme (JIP) Addressing Carbon Monoxide (CO) Issues, within the Incident Data project area. The aim of this project is to identify common causes of CO incidents related to appliance and system design, installation and maintenance. This information can then be used to further improve customer safety, to target expenditure on CO incident prevention and to identify further research work.

As part of this project a national data collection scheme for piped natural gas and L.P.G. CO incidents, which occur within Great Britain, has been established by Advantica. This has been with the support of the HSE and the gas industry. Information for incidents since 1996/97, which was prior to the setting up of the JIP, has been obtained from industry reports.

This is the first report of a series that are to be published. It covers the financial reporting period 1996/97. The incidents are only described by postcode to ensure anonymity. During this period, the majority of the incidents reported were domestic incidents. There were three non-domestic incidents reported and no LPG incidents.

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SUMMARY

This report has been prepared as part of the Joint Industry Programme (JIP) Addressing Carbon Monoxide (CO) Issues and within the Incident Data project area. The aim of this project is to identify common causes of CO incidents related to appliance and system design, installation and maintenance. This information can be used to improve customer safety, target expenditure on CO incident prevention and further research work. As part of this project a national data collection scheme for piped natural gas and LPG CO incidents, which occur within Great Britain, has been established. This has been with the support of the HSE and the gas industry. This information has been collected together by BG Technology for analysis. Information for incidents since 1996/97, which was prior to the setting up of the JIP, has been obtained from industry reports and is to be reported as part of the JIP. This is the first report of a series which are to be issued and covers the period 1996/97. Historical data has also been used within the report from previously unpublished internal company reports. This information has been used to show incident trends. The results of this report are summarised below: -

The number of domestic related CO poisoning deaths reported, at 25 during 1996/97, was in line with previous trends.

The total FPPY figure of 0.54×10^{-6} is within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However, societal concerns over gas safety override averaged numerical considerations.

The appliance types that were above the HSE's criteria for the tolerability of risk are single-point water heaters (3.81×10^{-6}) and wall mounted combi's (1.1×10^{-6}).

The majority of all CO poisoning deaths involved domestic open flued appliances.

Flueing and ventilation faults were common in many domestic incidents.

Domestic wet central heating system boilers were responsible for the majority of casualties.

There was an above average risk of a CO incident in domestic properties built before 1945 and also in tenanted accommodation that was privately owned.

The bedroom is a part of the house where many casualties are located.

Whilst it has often been suggested that annual appliance servicing could help prevent the majority of domestic incidents it has not possible to support or refute that conclusion from the data presented in this report.

There were no LPG incidents reported during 1996/97.

Reports on three non-domestic incidents were submitted and analysed during 1996/97.

1 INTRODUCTION

This report on accidental CO incidents resulting from the use of piped natural gas gives details of CO poisoning incidents for the period April 1st 1996 to March 31st 1997. The data for all sources of incidents comes from BG Technology's own incident recording system up to 1995. From 1996 the information is obtained from incident reports and investigation forms completed on behalf of gas suppliers.

The body of the main report deals solely with domestic incidents. Business incidents and LPG incidents are to be found in Appendix C and D. When it was indicated on the DIDR form that it was or was a strongly suspected intentional incident then the form was not included in the analysis.

This report gives tables and plots of actual fatalities and incidents reportable via the Downstream Incident Data Report (DIDR) - Form 551/7. It also gives plots relating to the risk associated when using gas appliances expressed in terms of fatalities per person per year (FPPY), as incidents per person per year (IPPY) and as casualties per person per year (CPPY). The definitions and use of IPPY and CPPY values are described in Appendix A. Fatality, casualty and incident trend data are presented for incidents which occurred between 1989/90 and 1996/7.

Note: Some inconsistencies may appear in some parts of the report because all the required information may not have been completed on the DIDR forms e.g. in Table 7 the numbers of casualties, as represented by their location, differs from the total number reported in Table 1. Some information was completed as "unknown" or "other" and in some instances the tick box was not completed (field empty).

Appendix B gives details of each of the CO poisoning incidents for 1996/7.

The order used in this report follows the layout used in the DIDR - Form 551/7.

2 ANALYSIS OF REPORTED DATA

2.1 TOTAL INCIDENT DETAILS - ANALYSIS OF SECTION 1 OF DIDR

BG Transco issued 94 Incident Notification Forms during the reporting period. These gave details of CO Poisoning Reports under the companies internal reporting procedures.

During the year there were 67 domestic reports which met the requirements for reporting on the DIDR form. The majority of these had been notified directly to Transco, via the operation of the gas emergency service, and reported by Transco's internal reporting procedures. In addition there were some incidents reported directly to gas suppliers by, for example, coroners or the police which do not get entered onto Transco's reporting system. These 67 forms were fully analysed for this report. Each form is treated as a separate DIDR incident and will be referred to as an "incident" throughout the rest of this report. The incident risk data and trend data has been combined with the casualty details described in section 2.2.

The date of occurrence of each domestic incident has been plotted by month in Figure 1, for the 12 month period April 1996 to March 1997.

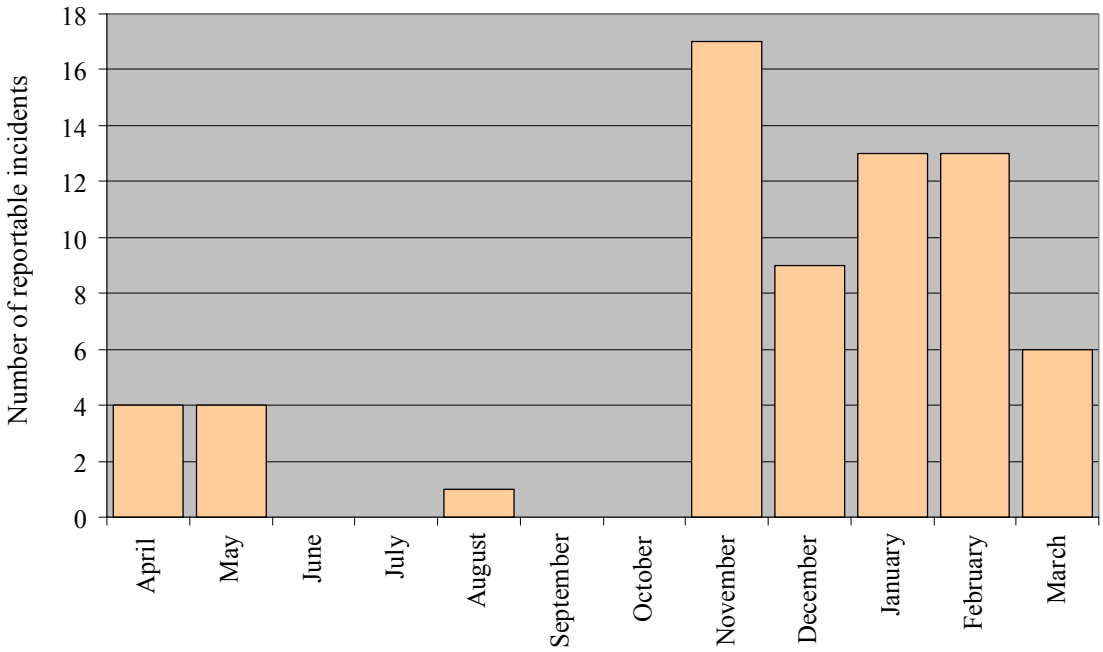

Figure 1 - Profile of incident occurrences over the year

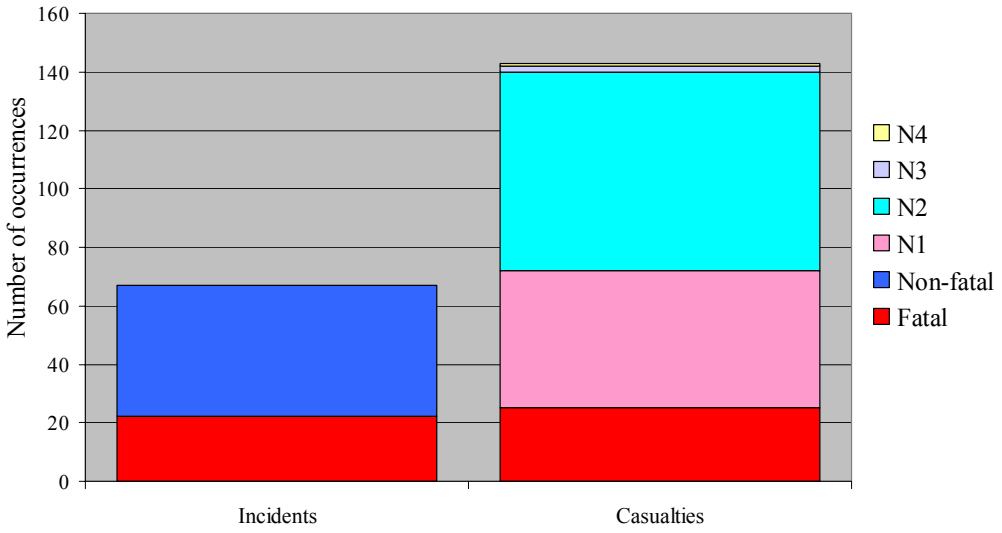

Figure 2 - Incident analysis

Figure 2 gives the number of reported domestic occurrences of CO incidents and CO casualties that took place during the year 1996/97. Further information on casualty groups are given in section 2.2 of this report.

Details of LPG incidents are given in Appendix C.

Note: There were no LPG incidents reported during this reporting period.

Details of business incidents are to be found in Appendix D.

2.2 TOTAL CASUALTY DETAILS - ANALYSIS OF SECTION 2 OF DIDR

The total number of people, reported by the DIDR form, to have been injured by piped natural gas for the period 1996/97, by CO poisoning, is presented below in Table 1.

Table 1 - Classification of non-fatal casualties

Classification	N1	N2	N3	N4	Total
Number of casualties	47	68	2	1	121

Table 1 indicates the breakdown of the non-fatal casualties by casualty classification N1 to N4 used on the DIDR form. The four classifications are:-

N1 - requiring immediate hospitalisation for more than 24 hours
N2 - requiring immediate hospitalisation for less than 24 hours
N3 - requiring other medical treatment
N4 - receiving no medical treatment

Note: There were 3 non-fatal casualties that were unclassified.

Figure 2, in section 2.1, gives the number of occurrences of incidents and casualties that took place during the year.

Using this data a corresponding risk data analysis has been carried out. The results from this are given in Table 2. The table also includes details of the number of fatalities and the number of incidents reported on the DIDR form.

Table 2 - The number of CO incidents and casualties, used for the risk analysis, with the corresponding risk values

Total number of incidents	Total number of fatal casualties	Total number of nonfatal casualties	Over-all IPPY ($x10^{-6}$)	Over-all FPPY ($x10^{-6}$)	Over-all CPPY ($x10^{-6}$)
67	25	121	1.46	0.54	2.63

In the calculation of FPPY, CPPY and IPPY the following statistics were used for this report.

a) The number of domestic customers i.e. the number of households using piped natural gas for 1996/97 - 18.93 million - see report section 7, reference 7.1.3.

b) The average number of people per household in Great Britain for 1996/97 = 2.43 - see report section 7, reference 7.1.4 .

Note: In the calculation of FPPY, CPPY and IPPY [a x b] replaces [Number of people at risk x Appliance Population]. Definitions are given in Appendix A.

Overall trends are given in Table 3 and plotted in Figures 3 and 4.

Table 3 - Trend data

Year	89/90	90/91	91/92	92/93
"A"	33	28	29	38
"B"	0.8	0.67	0.68	0.9
"C"	150	124	139	174
"D"	3.6	3	3.3	4.1
"E"	64	75	77	87
"F"	1.6	1.8	1.8	2

Year	93/94	94/95	95/96	96/97
"A"	29	31	-	25
"B"	0.65	0.69	-	0.54
"C"	167	189	-	121
"D"	4.4	4.2	-	2.63
"E"	86	102	-	67
"F"	1.9	2.3	-	1.46

Notes to Table 3:
A = Total number of deaths due to CO poisoning in each financial year
B = FPPY (Average fatalities per person per year are $x10^{-6}$). The FPPY was calculated by the same method as that used for Table 2.
C = Total number of non-fatal casualties due to CO poisoning in each financial year.
D = CPPY (Average non-fatal casualties per person per year are $x10^{-6}$). The CPPY was calculated by the same method as that used for Table 2.
E = Total number of incidents due to CO poisoning in each financial year.
F = IPPY (Average incidents per person per year are $x10^{-6}$). The IPPY was calculated by the same method as that used for Table 2.
Following the restructuring of British Gas insufficient information was collected to enable the statistics for 1995/96 to be calculated.

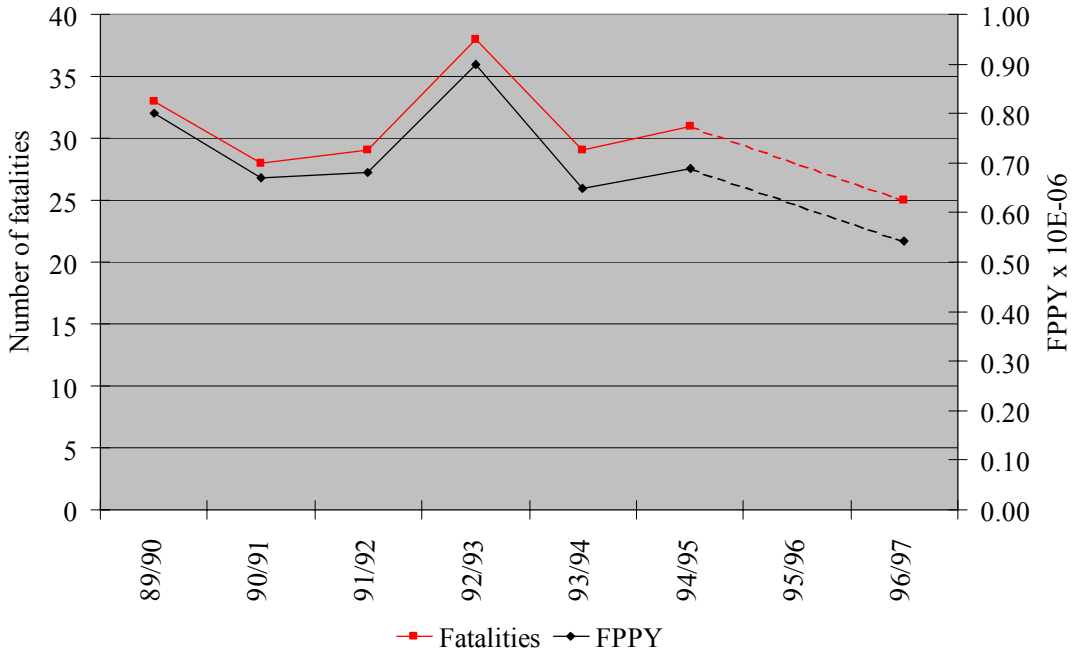

Figure 3 - Graph of fatality trends

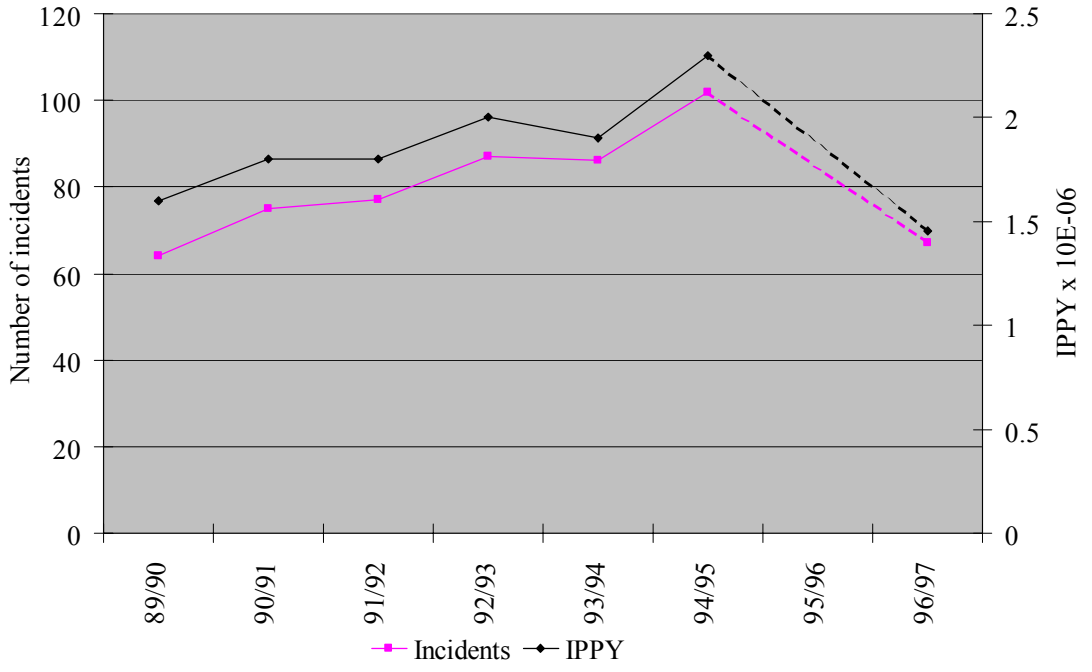

Figure 4 - Graph of incident trends

The age and numbers of the combined totals of the fatal and all non-fatal casualties are given in Figure 5.

Note: this was for all incidents where the casualty age details had been completed.

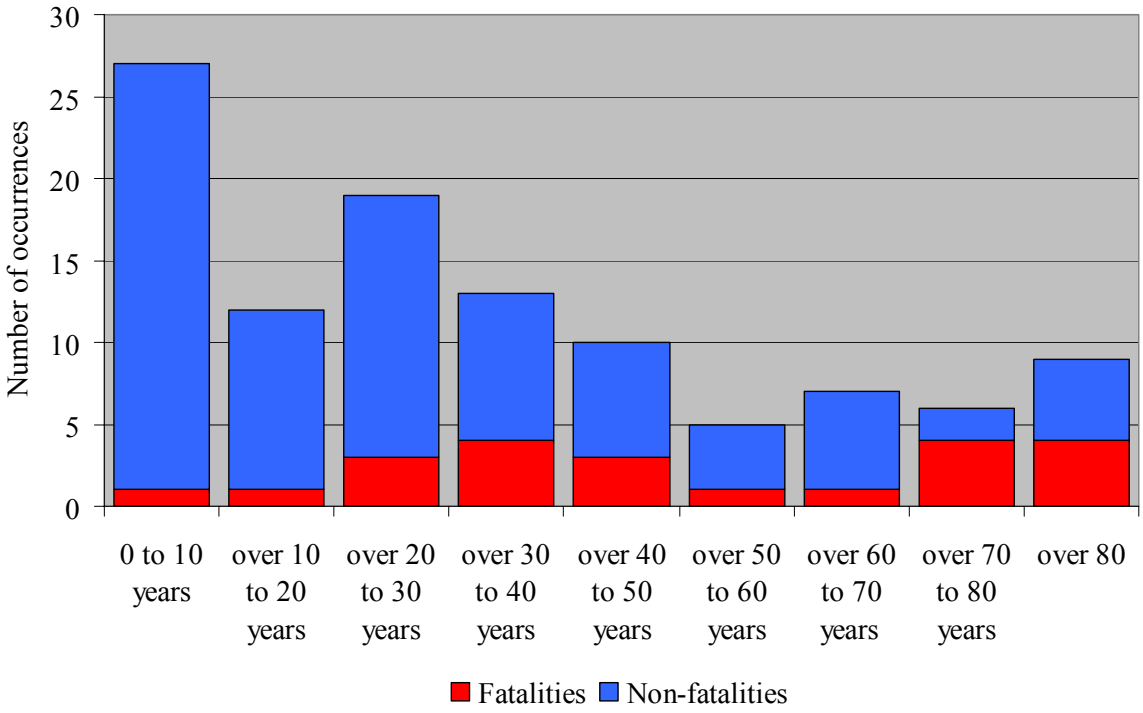

Figure 5 - Casualty age profile

2.3 PROPERTY DETAILS - ANALYSIS OF SECTION 3 OF DIDR

Figure 6 indicates the proportion of houses (64%) that featured in incidents, compared to other property types. The second largest group was flats at 24%.

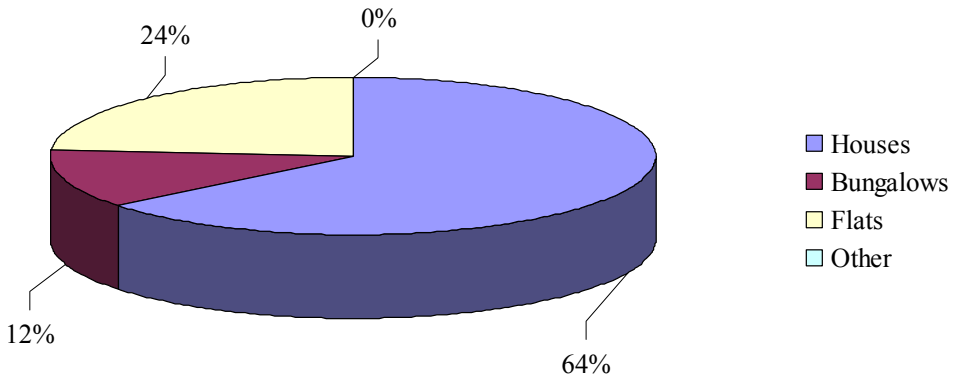

Figure 6 - Property types

Table 4 shows the number of and percentage of each style of property, within each property type, in which incidents took place during the year. There are no incident properties categorised as "other".

Table 4 - Breakdown of incident sites by property style

Bungalow	Nos	Flat	Nos (%)	House	Nos (%)
Detached	6 (9)	Bed sit	0 (0)	Detached	7 (11)
Semi-detached	2 (3)	Conversion	4 (6)	Semi-detached	17 (25)
Terraced	0 (0)	Maisonette	1 (2)	Terraced	19 (28)
		PBB (4 storeys or less)	11 (16)	Townhouse	0
		PBB (5 storeys or more)	0 (0)		

The Living in Britain 1995 General Household Survey from the ONS gives a breakdown of types of accommodation in Britain. The analysis is given below where it is compared to the incident statistics.

Table 5 - Comparison of DIDR incident stats with accommodation stats

Property style	Accommodation Stats for GB (%)	Incident Stats (%)
Detached house/bungalow	22	20
Semi-det house/bungalow	31	28
Terraced house	28	28
Purpose built flat/maisonette	15	18
Converted flat/maisonette/rooms	4	6

The age bands of the properties in which incidents took place are shown on Figure 7.

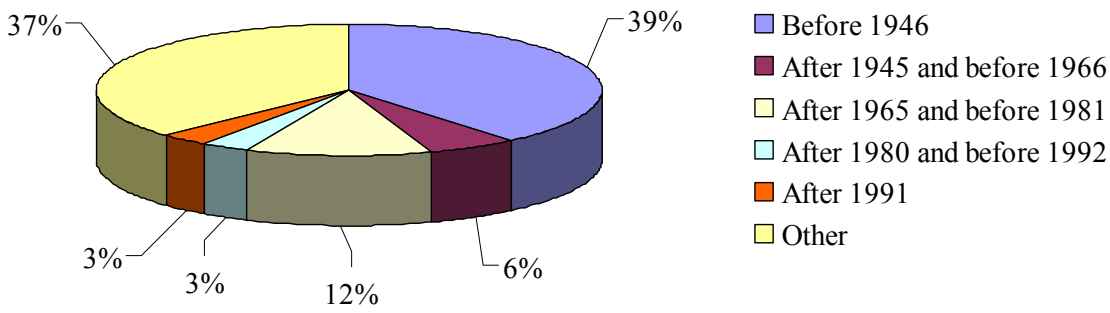

Figure 7 - Property construction period

The two largest sectors are properties built pre 1945 at 39% and unclassified at 37%. Where the age was specified (42 properties) the pre 1945 group is the majority at 62%. The next largest group was 19% for those built between 1966 and 1980. The Social Trends 27 publication, 1997 edition, from the Office for National Statistics (ONS) states that for Britain (for 1995/96) 41% of all dwellings were built before 1945, 23% were built in the period 1945 to 1964 and 35% were built during or after 1965.

Figure 8 gives the occupancy types of the properties shown on the DIDR forms. The percentage owner occupied was 67% and 27% were tenanted. Empty fields or unrecognised values made up the remainder. Of the tenanted properties all 27% were single occupancy, with no multiple occupancy. The percentage of the tenanted sector that were council owned is 9%, privately owned was 15% and 1.5% were owned by a housing association, the remainder were classified as other.

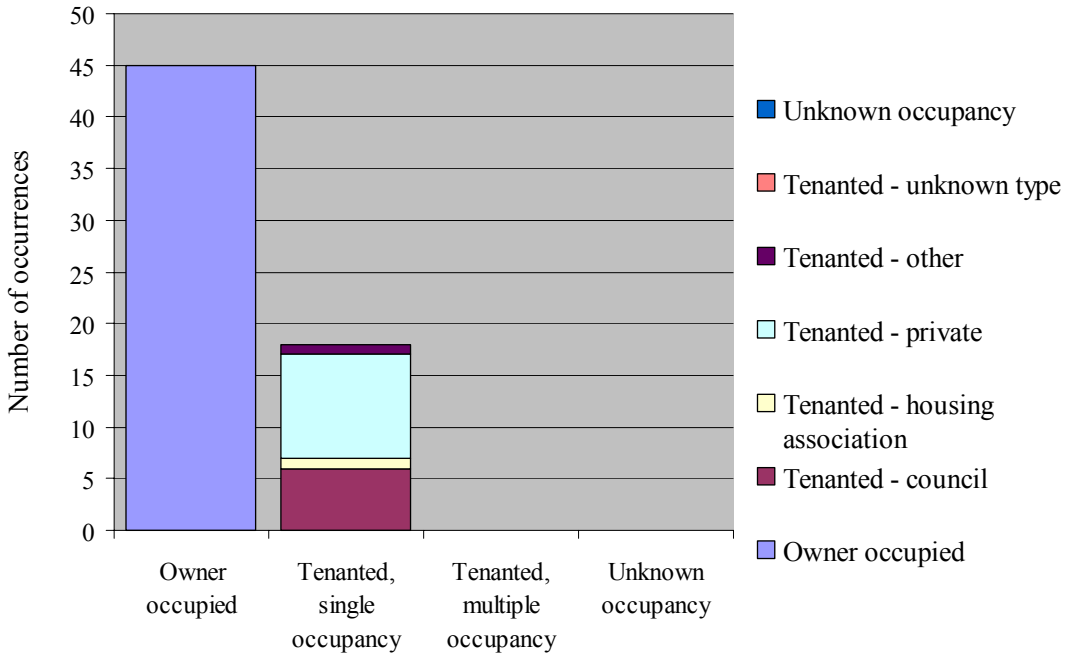

Figure 8 - Occupancy type

The Living in Britain 1995 General Household Survey from the ONS gives the owner occupied tenure group as 67% and the tenanted sector as 33%. This covers renting from the local authority at 18%, privately at 8% and from a housing association at 4%.

Table 6 shows the analysis of the glazing and ground floor details for the incident sites. These are also described graphically in figures 9 and 10.

Table 6 - Construction details of the incident property

Glazing details	%	Ground floor details	%
Single	10	Solid	5
Double	27	Suspended	1
Partial double	5	Partial solid	0
Undefined	58	Undefined	94

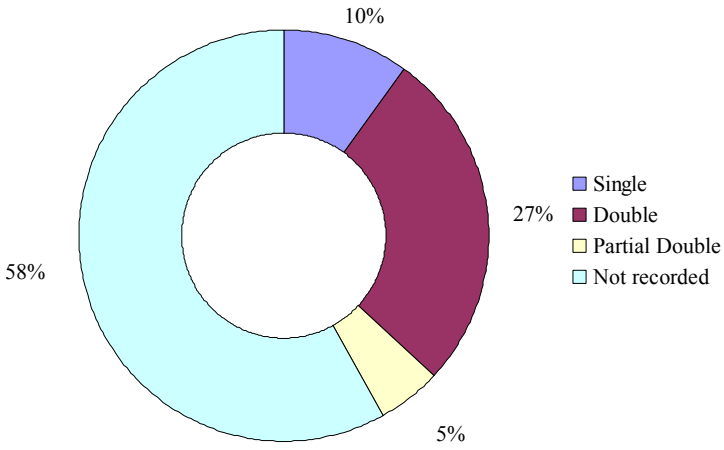

Figure 9 - Glazing details

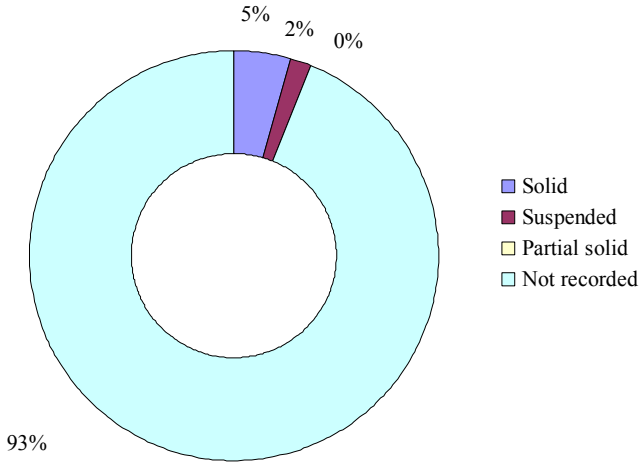

Figure 10 - Ground floor construction

2.4 CASUALTY & APPLIANCE LOCATION - ANALYSIS OF SECTION 4 OF DIDR

The location of the incident appliance and the casualties are given below in Table 7.

Table 7 - Appliance and casualty locations

Location	Number of appliances at each location	Number of casualties at each location	Number of casualties reported in the same room as the appliance
Attic	0	0	0
Bathroom	1	3	2
Bedroom	1	47	1
Bedsit	1	2	1
Cellar	1	0	0
Dining Room	2	3	2
Utility	3	0	0
Garage	0	0	0
Hall	7	3	1
Kitchen	38	15	13
Landing	1	2	0
Living room	10	25	9
Shower-room	0	0	0
Other	2	0	0
Empty Field	0	10	0

Of the 67 incident sites the majority of incident appliances were located in rooms (79%). The remaining 21% were described as being located in compartments. This is shown on Figure 11.

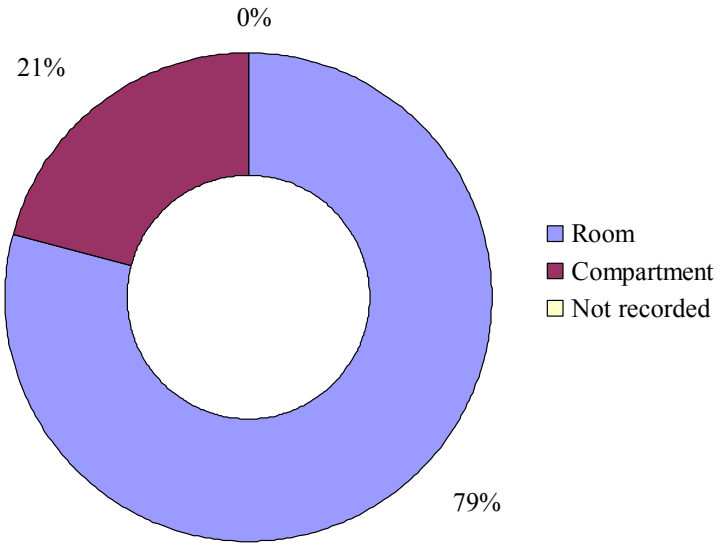

Figure 11 - Appliance location

There was only 1 appliance located in a room below ground level. The majority of casualties were located in the same property as the incident appliance. This is shown on Figure 12. But in 1 instance the appliance was in an adjacent property, and in another incident the appliance was classified as “elsewhere”.

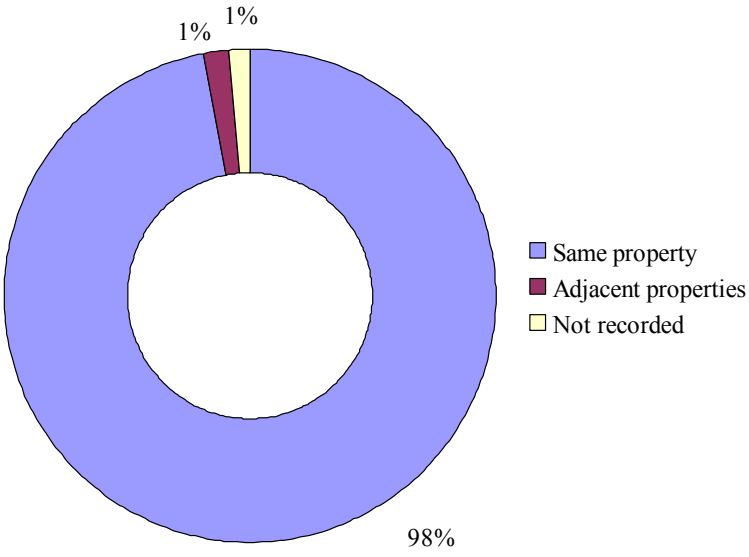

Figure 12 - Casualty/Appliance location

2.5 INCIDENT APPLIANCES - ANALYSIS OF SECTION 5 OF DIDR

2.5.1 Incidents during 1996/97

Details of the CO poisoning incidents for 1996/97, by appliance type, are given in Table 8 and in Figure 13.

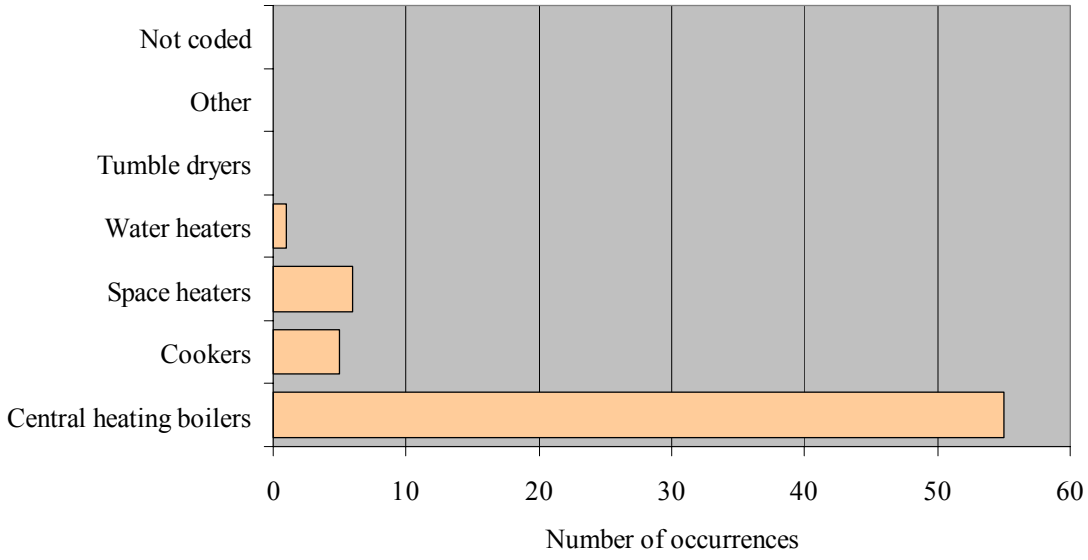

Figure 13 - Incidents by appliance type

TABLE 8 - Incidents by appliance types

Appliance	Incidents (All) - Total	Incidents - Fatal	Casualties (All) - Total	Casualties - Fatal
Central Heating Boilers				
Back unit	7	2	10	3
Floor standing	13	2	34	2
Floor standing combi	0	0	0	0
Thermal storage unit	0	0	0	0
Wall mounted	19	5	39	5
Wall mounted combi	14	2	44	3
Warm air unit	1	1	1	1
Cookers				
Free standing	5	4	8	5
Built-in oven	0	0	0	0
Built-in hob	0	0	0	0
Space Heaters				
Balanced flue g .f.	0	0	0	0
Cabinet heater	0	0	0	0
Decorative g .f.	1	0	1	0
Flueless heater	0	0	0	0
Inset live fuel effect g	0	0	0	0
Rad. & rad. con. g .f.	4	3	6	3
Wall heater	0	0	0	0
Dryers				
Tumble Dryers	0	0	0	0
Water Heaters				
Bulk storage	0	0	0	0
Circulator	0	0	0	0
Multi-point	0	0	0	0
Single-point	1	1	1	1
OTHER	**2**	**2**	**2**	**2**
TOTAL	**67**	**22**	**146**	**25**

Notes: Appendix B gives details, by appliance type, for each incident. ***In the above table and following tables g .f. has been used as an abbreviation for gas fire***

There were no reports of any condensing appliances having been involved in any incidents during this reporting period.

The breakdown of the types of central heating units involved in incidents is given in Figure 14.

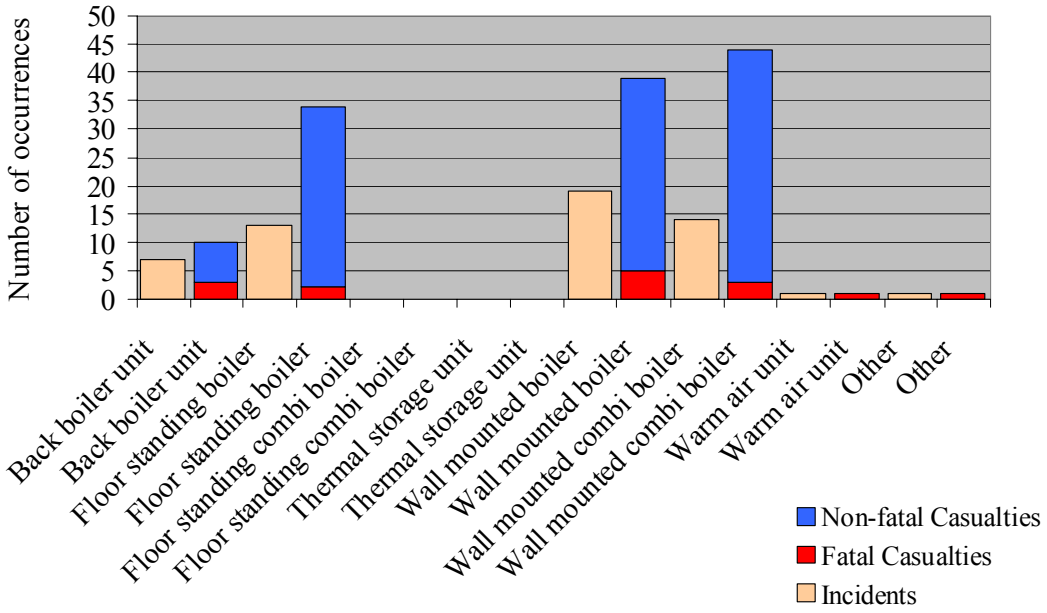

Figure 14 - Central heating boilers

Figure 15 shows the fatality trends associated with appliance type since 1989/90. It should be noted that it is likely that there have been changes to the profile of gas appliances in use within Britain between 1989/90 and 1996/97. The FPPY risk values shown in Table 12 take account of the changes.

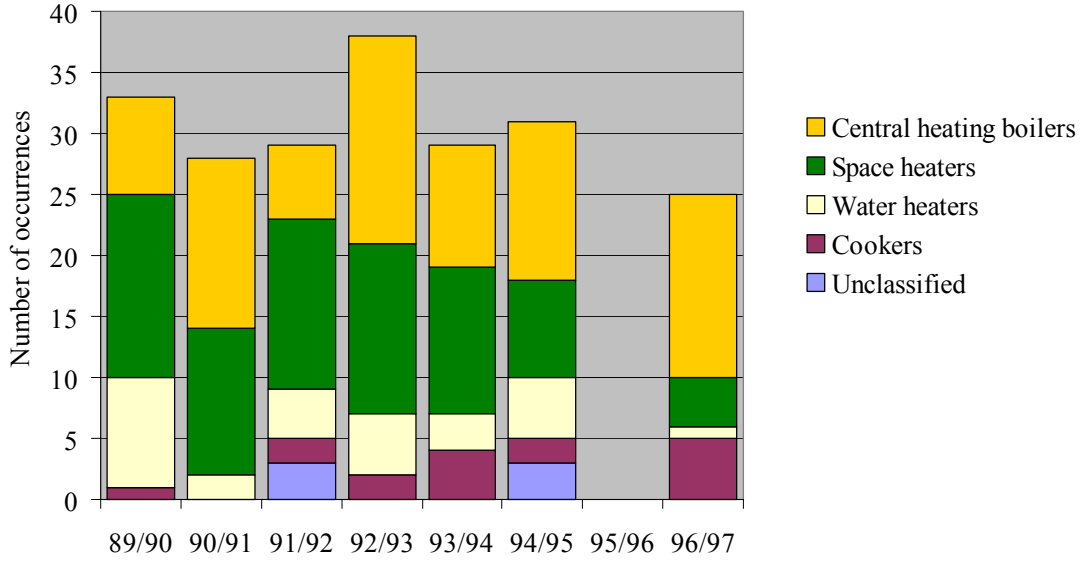

Figure 15 - Fatalities by appliance type

The age of the appliances involved in incidents during the reporting period has been given under the main appliance groups in Table 9. It is also described in Figure 16.

Table 9 - Age of incident appliances

Appliance Type	Age (years)					
	0 –5	6 - 10	11 - 15	16 - 20	Over 20	Unknown
Central heating boilers	9	5	6	4	3	28
Cookers	0	0	0	0	2	3
Space heaters	0	1	2	0	0	3
Dryers	0	0	0	0	0	0
Water heaters	0	0	0	0	0	1
TOTAL	9	6	8	4	5	35

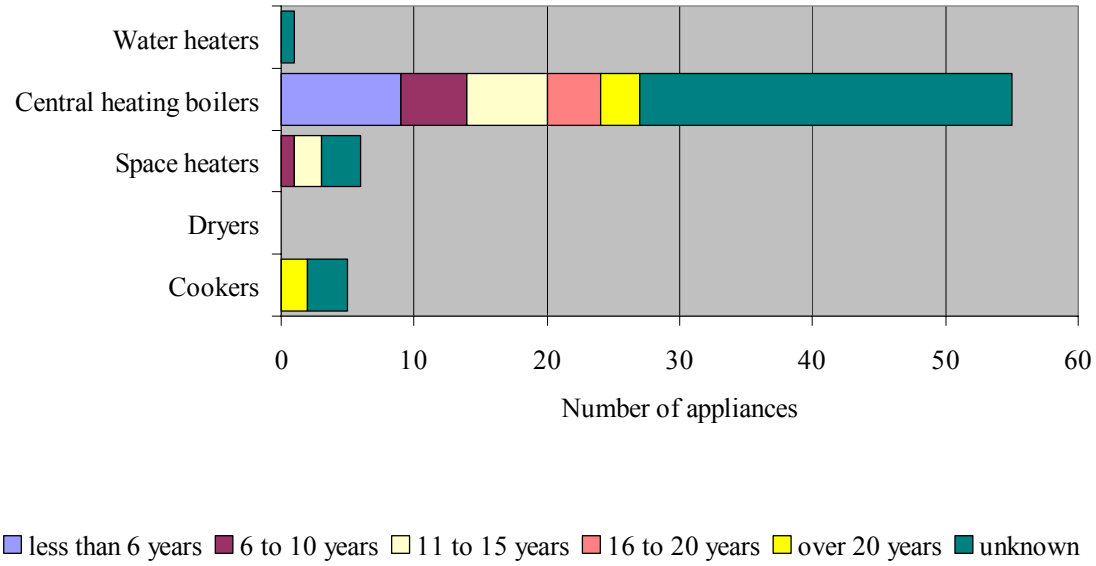

Figure 16 - Appliance age distribution

2.5.2 Notes relating to individual appliance types and models

The following information is extracted from the incident details given in Table 8 and Appendix B:

2.5.2.1 Central Heating Boilers

Overall the number of incidents resulting from all types of central heating appliances was 55. This was 82% of all incidents reported and also accounted for 59% of all the fatalities recorded. There were no incidents where the model of the boiler was not given.

Back boiler units

There were 7 incidents involving back boilers, 2 of these incidents were responsible for 3 fatalities. Non-fatal casualties totalled 7.

In 3 cases the flue was blocked, and 3 incident properties were found to have flue installation defects. One appliance was installed with ventilation which met the current standards and 5 appliances were found to have a heat exchanger blocked with soot. Three back boiler units had a defective flame picture, with linting of the burner also detected on 3 occasions.

Note: For one of these incidents, involving a Myson Housewarmer S back boiler unit / radiant convector fire, the fire was also on and also producing CO, thus contributing to the incident.

Floor standing boilers

All 13 incidents involved open flued models (all open, individual, natural draught flues). There were 2 fatalities and 32 non-fatal casualties.

From the models identified 5 were manufactured by Potterton (3 were Potterton Kingfisher's), accounting for 38.5% of the total incidents. Another 4 (30.8%) were made by Glow Worm.

Note: Some appliance models may appear under several different manufacturer's names within Appendix B. For example Apollo boilers have been entered under Thorn, Myson and Potterton Myson.

In 7 (53.8%) of the incidents the flue installed was to current standards and in 6 (46.2%) cases the ventilation was to current standards. Blockage of the heat exchanger featured in several of the incidents. There were 4 incidents with shale blockage and 5 due to soot. Test results showed that in 7 (53.8%) incidents a high CO/CO_2 ratio was reported during on-site investigations, whilst in 8 (61.5%) incidents the incident appliance failed a spillage test. Weather was thought to be contributory factor in 10 instances (76.9%).

Floor standing combi boilers

There were no incidents involving floor standing combi boilers.

Thermal storage units

There were no recorded incidents involving these appliances.

Wall mounted boilers

There were 19 incidents involving wall mounted open flued boilers, with 5 fatalities and 34 non-fatal casualties.

Note: There were 20% of all fatalities recorded from this appliance type.

The manufacturers were Glow Worm (6 incidents), Potterton (5), Thorn (2) and Ideal (2) boilers featured, along with Baxi, Vokera and Radiation boilers (all of whom featured in 1 incident). All 6 Glow Worm appliances were Fuelsaver models accounting for 31.6% of the total appliances listed. Three of the Potterton models (15.8%) were Netaheat's, the other Potterton's being an Apollo and a Flamingo.

In 2 incidents (10.5%) the ventilation was to current standards and in 6 incidents (31.6%) the flue was to current standards. Weather was thought to be a contributory factor in 10 incidents (52.6%).

In 9 incidents the appliance burner was linted and in 9 incidents the heat exchanger was blocked with soot. Bad siting of the terminal was believed to be a contributory factor in 8 incidents, while down draughts were identified on 6 site investigations.

There were 3 incidents involving wall mounted, room sealed, fan flued boilers (the rest were open individual natural draught flued) and these all involved Potterton Netaheat models. These accounted for 2 fatalities and 1 non-fatal casualty. In each incident, a fault on the casing seal led to the injuries.

There were no recorded incidents involving wall mounted room sealed natural draught boilers.

Wall mounted combi boilers

There were 14 incidents, including 3 fatalities (and 41 non-fatal casualties), involving wall mounted combi boilers. Models involved were 7 Vaillant boilers (6 VCW models), 4 Ferroli boilers, 2 Vokera boilers, and 1 Guival boiler.

In the majority of the incidents ventilation and flueing was not to current standards or to standards current at the time of installation. There were 8 badly sited terminals identified.

Weather was reported as having been thought to be a contributory factor in 10 incidents (71.4%).

Warm air units

There was 1 incident involving a warm air unit, the model responsible being a McClary 5025/30. There was 1 fatality as a result of the incident and in this incident both flueing and ventilation was reported to be sub-standard. This appliance was in a generally poor condition with a defective flame picture. There was, however, a second appliance identified as contributing to this incident, this was a Chaffoteaux Convec Celt Instantaneous sink water heater.

2.5.2.2 Cookers

From the 5 incidents reported from free standing cookers there were 5 fatalities and 3 casualties. Grill burners were responsible in each incident.

Note: There were 20% of all fatalities reported from this appliance type. In one fatal incident it is suspected that the grill may have been being used at the time of the incident for space heating purposes.

2.5.2.3 Space Heaters

Space heaters were involved in 6 incidents, with 4 fatalities and 4 non-fatal casualties.

The space heating incidents all involved open individual natural draught flued fires. Flue and burner faults were a significant cause of incidents. In 60% of incidents the appliances were 10 or more years old and for the remaining 40% of incidents the appliance age was unknown.

There were 4 incidents involving radiant and radiant convector gas fires and one incident involved a decorative gas fire. In the latter case, the incident appliance was actually in the property adjacent to the casualties location, with fumes from the appliance leaking into the bedroom of the house next door. This resulted in 1 non-fatal casualty. In 4 instances the appliance was fitted in the living room and in the other case the space heater was fitted in the main dining room.

Note: In one incident two appliances were producing CO, a Myson Housewarmer S radiant convector fire was in operation as well as the Housewarmer's back boiler unit.

2.5.2.4 Dryers

There were no tumble dryer appliances reported during the year in association with CO incidents.

2.5.2.5 Water Heaters

There was 1 incident involving a water heater which led to 1 fatality. This incident involved a flueless, single-point water heater installed in a bedsit. Linting led to flame impingement and soot production which then blocked the heat exchanger on this appliance.

A second water heater also featured during the reporting period, however this was one of two appliances (the other being a McClary 5025/30 warm air unit) simultaneously producing CO.

2.5.3 Appliance risk values

Details relating to the risk values by appliance type are shown below in Table 10. In terms of the risk of a fatal incident (FPPY) the appliances in descending order of risk are as follows: Single-point water heaters (3.81 x 10^{-6}); wall mounted combi's (1.1 x 10^{-6}); then below a risk value of one are warm air central heating units, back boilers, wall mounted boilers, free standing cookers, floor standing boilers and radiant / radiant convector gas fires.

Table 10 - Risk values by appliance type

Appliance	Population ($x10^6$)	FPPY ($x10^{-6}$)	CPPY ($x10^{-6}$)	IPPY ($x10^{-6}$)
Central Heating Boilers				
Back unit	3.188	0.39	0.9	0.9
Floor standing	3.532	0.23	3.73	1.51
Floor standing combi	-	-	-	-
Thermal storage unit	-	-	-	-
Wall mounted	7.63	0.27	1.83	1.02
Wall mounted combi	1.118	1.1	15.09	5.15
Warm air unit	0.541	0.76	-	0.76
Cookers				
Free standing	8.731	0.24	0.14	0.24
Built-in oven	-	-	-	-
Built-in hob	-	-	-	-
Space Heaters				
Balanced flue g .f.	-	-	-	-
Cabinet heater	-	-	-	-
Decorative g .f.	1.804	-	0.23	0.23
Flueless heater	-	-	-	-
Inset live fuel effect g .f.	-	-	-	-
Rad. & rad. con. g .f.	7.832	0.16	0.16	0.21
Wall heater	-	-	-	-
Dryers				
Tumble dryers	-	-	-	-
Water Heaters				
Bulk storage	-	-	-	-
Circulator	-	-	-	-
Multi-point	-	-	-	-
Single-point	0.108	3.81	-	3.81

Note: Population figures provided by GfK Marketing Services Ltd. (Reference 7.1.1).

2.5.4 Trends (1989/90 -1996/97)

Trends regarding CO Poisoning incident fatalities by appliance type are given below in Table11 and are also shown in Figure 15 which is in section 2.5.1 of the report. This table has been completed as fully as possible using information that was available from the 96/97 DIDR forms and from historical records held by BG Technology (Reference 7.1.2). As future years are added to the table then the level of detail shown will improve.

Table 11 - Trend data of the number of fatalities due to CO incidents, by appliance type

Appliance	Year							
	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97
C/H Boilers -Total	**9**	**14**	**6**	**17**	**10**	**13**	**-**	**15**
Back unit	-	-	-	-	-	1	-	3
Floor standing	-	-	-	-	-	6	-	2
Floor standing combi	-	-	-	-	-	0	-	0
Thermal storage unit	-	-	-	-	-	0	-	0
Wall mounted	3	2	0	0	2	1	-	5
Wall mounted combi	1	1	2	4	2	2	-	3
Warm air unit	1	0	0	1	1	2	-	1
Cookers -Total	**1**	**0**	**2**	**2**	**4**	**2**	**-**	**5**
Free standing	-	-	-	-	-	-	-	5
Built-in oven	-	-	-	-	-	-	-	0
Built-in hob	-	-	-	-	-	-	-	0
Space Heaters -Total	**15**	**12**	**14**	**14**	**12**	**8**	**-**	**4**
Balanced flue g .f.	-	-	-	-	-	-	-	0
Cabinet heater	-	-	-	-	-	-	-	0
Decorative g .f.	-	-	-	-	-	-	-	0
Flueless heater	-	-	-	-	-	-	-	0
Inset live fuel effect g .f.	-	-	-	-	-	-	-	0
Rad. & rad. con. g .f.	-	-	-	-	-	-	-	3
Wall heater	-	-	-	-	-	-	-	0
Dryers	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
Water Heaters -Total	**8**	**2**	**4**	**5**	**3**	**5**	**-**	**1**
Bulk storage	-	-	-	-	-	-	-	0
Circulator	-	-	-	-	-	-	-	0
Multi-point	-	-	-	-	-	-	-	0
Single-point	-	-	-	-	-	-	-	1
Other	**0**	**0**	**3**	**0**	**0**	**3**	**-**	**0**
TOTAL -All Appliances	**33**	**28**	**29**	**38**	**29**	**31**	**-**	**25**

Trends in terms of the risk of a fatality by appliance type, expressed as FPPY values are shown below in Table 12. This table has also been completed as fully as possible using information that was available from the 96/97 DIDR forms and from historical records held by BG Technology. As future years are added to the table then the level of detail shown will also improve.

Table 12 - Trend data of fatalities per person per year (FPPY)

Appliance	Year							
	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97
C/H Boilers -Total	**0.22**	**0.47**	**0.14**	**0.38**	**0.17**	**0.27**	-	-
Back unit	-	-	-	-	-	-	-	0.39
Floor standing	-	-	-	-	-	-	-	0.23
Floor standing combi	-	-	-	-	-	-	-	-
Thermal storage unit	-	-	-	-	-	-	-	-
Wall mounted	7.1	41.1	0	18.3	37.5	0.65	-	0.27
Wall mounted combi	0.58	0.35	0.64	1.1	0.54	0.54	-	1.1
Warm air unit	0.46	0	0	0.67	0.7	1.38	-	0.76
Cookers -Total	**0.03**	**0**	**0.1**	**0.06**	**0.01**	**0.07**	-	-
Free standing	-	-	-	-	-	-	-	0.24
Built-in oven	-	-	-	-	-	-	-	-
Built-in hob	-	-	-	-	-	-	-	-
Space Heaters -Total	**0.38**	**0.4**	**0.43**	**0.42**	**0.36**	**0.24**	-	-
Balanced flue g .f.	-	-	-	-	-	-	-	-
Cabinet heater	-	-	-	-	-	-	-	-
Decorative g .f.	-	-	-	-	-	-	-	-
Flueless heater	-	-	-	-	-	-	-	-
Inset live fuel effect g .f.	-	-	-	-	-	-	-	-
Rad. & rad. con. g .f.	-	-	-	-	-	-	-	0.16
Wall heater	-	-	-	-	-	-	-	-
Dryers	-	-	-	-	-	-	-	-
Water Heaters -Total	**1.59**	**0.33**	**0.5**	**1.3**	**0.9**	**1.47**	-	-
Bulk storage	-	-	-	-	-	-	-	-
Circulator	-	-	-	-	-	-	-	-
Multi-point	-	-	-	-	-	-	-	-
Single-point	-	-	-	-	-	-	-	3.81
Other	-	-	-	-	-	-	-	-
TOTAL -All Appliances	**0.33**	**0.28**	**0.29**	**0.34**	**0.28**	**0.29**	-	-

Note: In Table 12 all the FPPY values are $x10^{-6}$

2.6 SAFETY DEVICES - ANALYSIS OF SECTION 6 OF DIDR

Chemical spot detectors were present at 2 incident sites during 1996/97.

2.7 FLUE DETAILS - ANALYSIS OF SECTION 7 OF DIDR

Of the total of 67 incidents (fatal and non-fatal), 57 (85%) involved individual open flued, natural draught appliances (52 boilers and 5 fires), with 6 (9%) involving flueless appliances (5 cookers, 1 water heater). Flueing details are given in Figure 17. Another 3 (4.5%) incidents involved individual room sealed, fan powered, central heating boilers. The flue type of the one remaining incident was unknown.

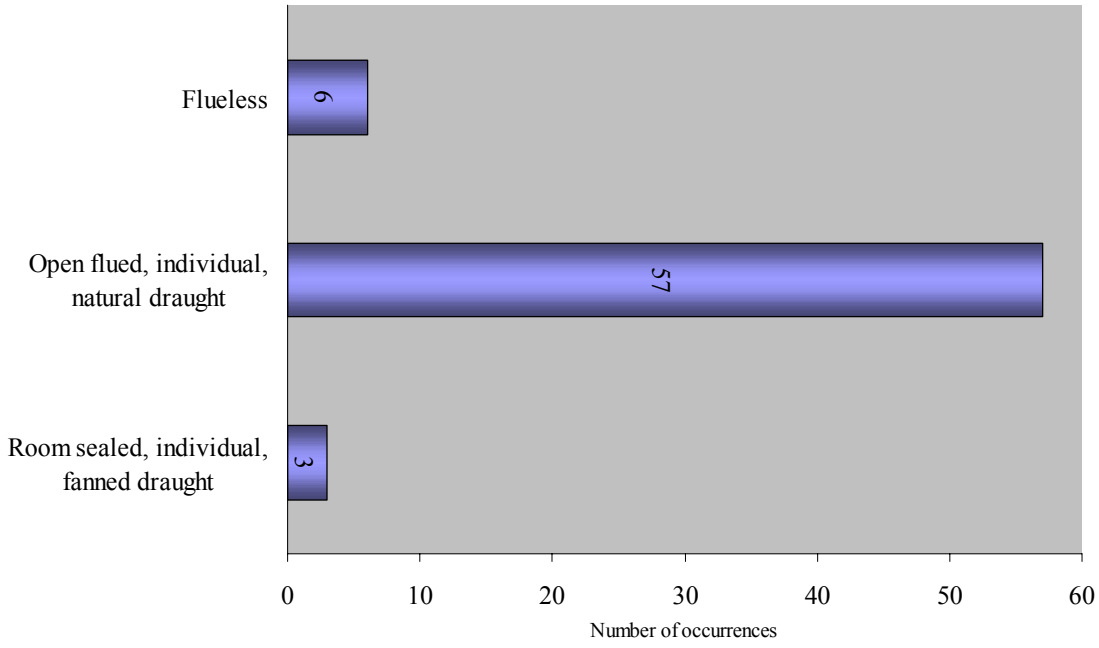

Figure 17 - Incidents by flue type

The analysis of flues to standard is given in Figure 18. There were 33 (49%) flues on incident appliances deemed to be not to required standards and 25 (37%) which were to current standards or the standard current when the appliance was installed. The remaining incidents were listed as unsure/don't know.

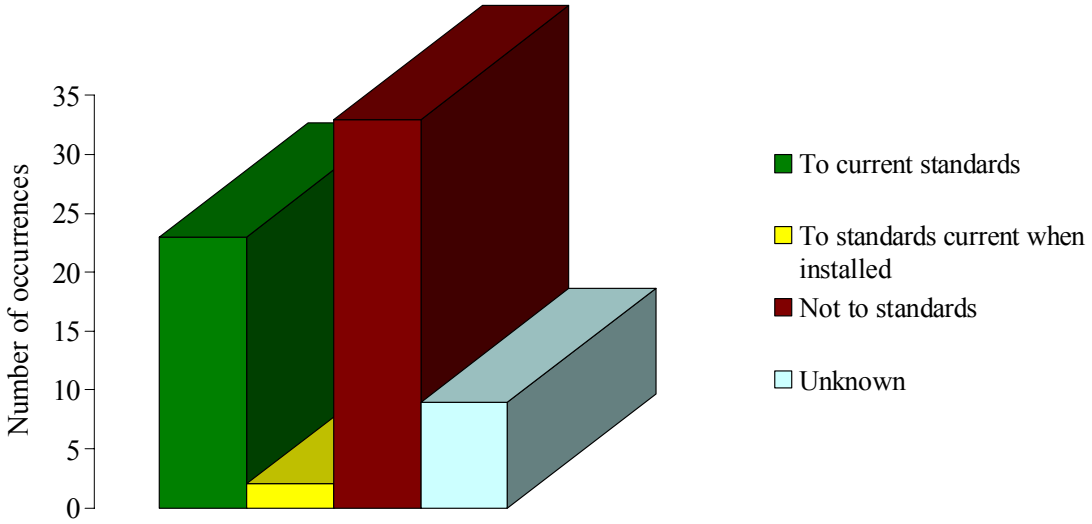

Figure 18 - Flues to standard

The number of flueing faults found are given in Table 13 (report section 2.9). A breakdown of the flueing faults, by appliance type, is given in Appendix B. Details of the flue compliance to standards, for each incident appliance, is also given in Appendix B.

A chimney flue liner was fitted at 6 incidents. In each case in was unknown whether or not the liner was fitted at the same time as the appliance.

2.8 PERMANENT VENTILATION - ANALYSIS OF SECTION 8 OF DIDR

Permanent ventilation was required in 52 (83%) of the incidents. Within this group it had been provided in 71% of the total. Where provided the air vent/vents were to current standards in 13 (36%) instances and not to current standards in 23 (64%) incidents.

Where air vents were fitted they were still effective in 23 (68%) incidents and partially effective in 7 (21%) of the incidents. In 4 incidents the ventilation was totally ineffective. Of those with totally or partially ineffective ventilation, 5 were blocked intentionally and 5 unintentionally.

Where the appliance was fitted in what was reported as a compartment / cupboard it was to standards applicable at the time of installation in 7 (54%) instances. It was not to standards in 6 (46%) instances.

Extract fans, recirculating fans and cooker hoods were reported to have been in use during one incident.

The number of overall ventilation faults found are given in Table 13 (report section 2.9). A breakdown of the ventilation faults, by appliance type, is given in Appendix B.

2.9 ON-SITE CHECKS - ANALYSIS OF SECTION 9 OF DIDR

The following details in Table 13 are for all incident appliances. They give the total numbers of faults found upon incident appliances. In Appendix B a breakdown of the information from the DIDR is given by appliance type. The number of faults, by the main fault groups listed below, are given in Figure 19 and in Figure 20 each individual fault is shown, for comparison purposes.

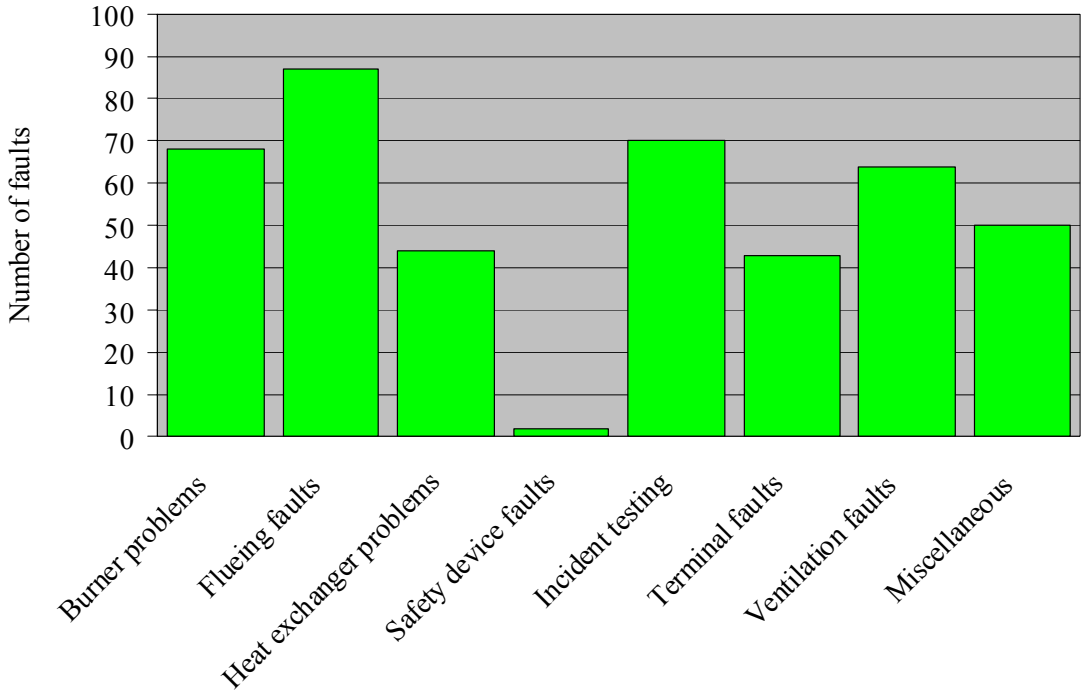

Figure 19 - Main fault groups

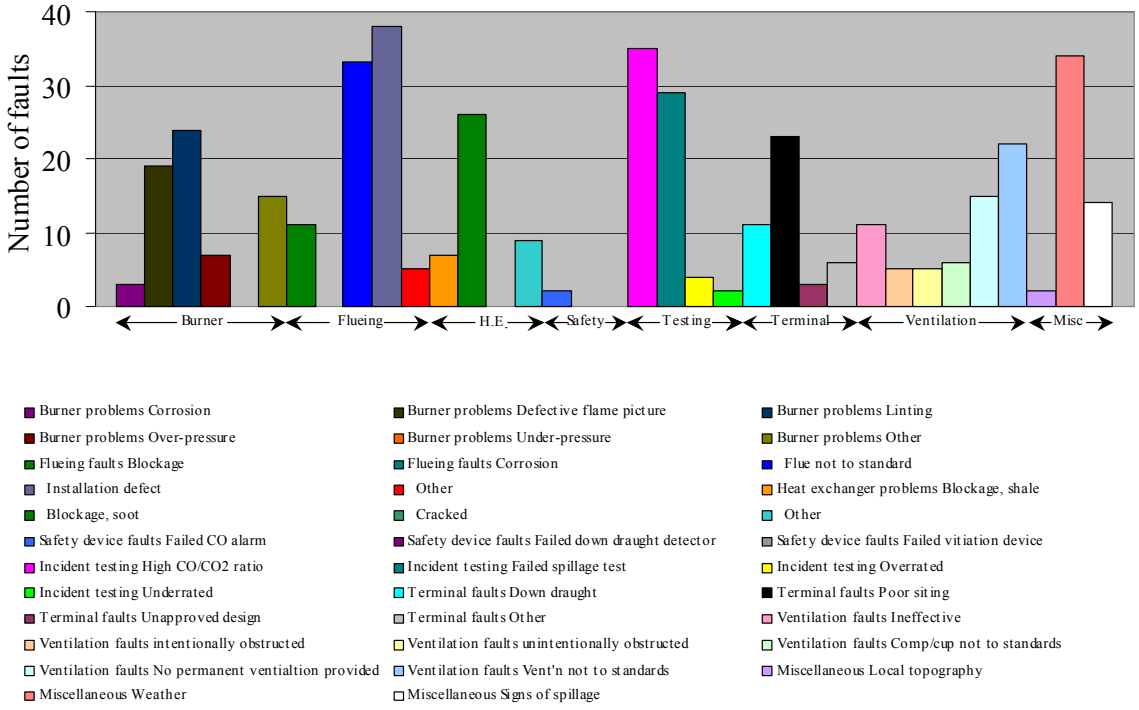

Figure 20 - Individual faults

Table 13 - Incident appliance faults

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	3	High CO/CO2 ratio	35
Defective flame picture	19	Failed spillage test	29
Linting	24	Overrated	4
Over-pressure	7	Underrated	2
Under-pressure	0	**Terminal**	
Other	15	Down draught	11
Flue		Bad siting	23
Blockage	11	Unapproved design	3
Corrosion	0	Other	6
Flue not to any standard	33	**Ventilation**	
Installation defect	38	Air vent/vents ineffective	11
Other	5	Air vents obstructed - intentionally	5
Heat exchanger		Air vents obstructed - unintentionally	5
Blockage - shale	7	Compartment/cupboard not to any standards	6
Blockage - soot	26	No permanent ventilation provided	15
Cracked	0	Ventilation provided was not to any standard	23
Other	9	**Miscellaneous**	
Safety device		Local topography	2
Failed CO alarm	2	Weather	34
Failed down draught detector	0	Signs of spillage	14
Failed vitiation device	0		

Note: In Table 13 the numbers quoted are the number of appliances found with the fault listed.

In the majority of cases CO was proven to be able to enter the incident property when tested in the as-found condition and to be the likely cause of the incident. It was not proven/unknown in 16 of the 67 incidents.

In the majority of cases a sufficient concentration of CO was produced by the incident appliance which would have resulted in the level of COHb found in the victims. It was not proven/unknown in 5 of the 67 incidents.

In the majority of cases it was indicated that the concentration of CO could be achieved in the available time. It was not proven/unknown in 1 of the 67 incidents.

A safety warning notice had been attached to the incident appliance or at the gas meter prior to the incident on one occasion.

2.10 INSTALLATION DETAILS - ANALYSIS OF SECTION 10 OF DIDR

Incident appliances were installed new at 22 sites (33%). They were second hand at 2 sites (3%) of sites and it was unknown if the appliance was fitted as new or second hand for the remaining 43 (64%) incident locations. The time period when the incident appliance was fitted, before the incident, is given in Table 14 along with the number of appliances in each age group.

Table 14 - Installation period for incident appliances

Appliance type	Age (years)						Total
	0 - 5	6 - 10	11 - 15	16 - 20	Over 20	Unknown	
New	9	4	4	2	3	0	**22**
Second-hand	1	1	0	0	0	0	**2**
Unknown	0	1	3	1	0	38	**43**
Total	**10**	**6**	**7**	**3**	**3**	**38**	**67**

The incident appliance was known to have been installed by a CORGI registered fitter (or equivalent) in 3 instances (4.5%), in 1 instance by non-CORGI registered fitter (1.5%) and by DIY persons in 2 incidents (3%). Unknown persons fitted the remainder (91%).

In the majority of incidents (52) the appliance was fitted to standards (78%). The appliance was not installed correctly and to the standards applicable at the time of installation in 9 of the 67 incidents recorded (13%). It was unknown in a further 6 incidents (9%).

2.11 INCIDENT APPLIANCE HISTORY - ANALYSIS OF SECTION 11 OF DIDR

2.11.1 Servicing information

The DIDR returns show that there were 17 incident appliances covered by a regular service contract at the time of the incident. In 16 cases there was no regular service contract and for the remaining incidents the situation was unknown.

2.11.2 Last working visit information

Analysis of the number of tick boxes completed for the "last working visit" is given in Table 15.

Table 15 - Details of the last working visit

Last working visit by:	Number of tick-boxes completed
CORGI fitter	18 (27%)
Non-CORGI fitter	1 (1%)
Other	4 (6%)
Unknown	44 (66%)

2.11.3 Reason for the visit

Analysis of the number of tick boxes completed for the "reason for the visit" are given in Table 16.

Table 16 - Reason for the last working visit

Reason for visit:	Number of tick-boxes completed
Breakdown	1 (1%)
Report of fumes	1 (1%)
Safety check/inspection	3 (4%)
Service	19 (28%)
To install the incident appliance	1 (1%)
Other	1 (1%)
Unknown	41 (61%)

2.11.4 Time period from the last working visit

Analysis of the number of tick boxes completed for the time period involved between the last working visit and the incident are given in Table 17.

Table 17 - Interval between the last working visit and the incident

Time between the last working visit and the incident	Number of tick-boxes completed
Less than 6 months	12 (18%)
6 months to 1 year	6 (9%)
1 year to 2 years	4 (6%)
More than 2 years	5 (7%)
Unknown	40 (60%)
Not applicable	0 (0%)

2.11.5 Fumes history

Prior to the incident, the incident "appliance" had been inspected following reports of fume spillage in 5 incidents and the "installation" in 5 incidents. The occupants reported previously experiencing symptoms typically associated with CO poisoning at 6 incident sites.

3 GENERAL DISCUSSION

The final CO analysis report compiled within British Gas, before its reorganisation, was for the year 1994/95. This is the first of a new analysis of CO incident information brought about by the introduction of the DIDR form for a trial period in June 1998. Where possible information was collected on DIDR forms from CO incident investigations which had been carried out before the introduction of DIDR form. The period 1996/97 is the first full year where comprehensive reporting had been carried out and which therefore enabled DIDR forms to be completed and an annual report to be produced. The year 1995/96 has provided minimal information. This has therefore left a gap in the historical data which is indicated as a zero return during the historical trend analysis.

With the new incident reporting form and associated classifications there is no "history", which would allow comparison with historical data, for many of the items recorded on the DIDR form. For such items they will be reported for the first time within this report for 1996/7.

Central heating appliances were involved in the majority of incidents and fatalities. However this was generally due to installation problems rather than appliance faults. Flueing and the provision of ventilation, for all appliances, was found to be a particular problem.

It has been observed on the DIDR forms that 11 of the 67 incidents (16%) have taken place in extensions to existing properties. The flue terminal position above the extension has often been found to have been not to current standards and to be badly sited. It may therefore be necessary to modify the DIDR form to allow extensions to be noted as a separate item.

In addition to the domestic incidents there were a further 3 business incidents reported in Appendix D. One incident site may have suffered from deliberate vandalism. A lack of servicing was noted at the remaining sites, one of which had been previously inspected following a report of fumes and still had a Transco safety label attached to it.

3.1 TOTAL INCIDENT DETAILS

The number of domestic CO incidents fully investigated, reported and analysed for use in this report was 67. In the last 1994/95 annual report there were 102 CO incidents that were analysed, but in previous years it varied between 64 and 87. Changes within the organisation of the gas industry and the introduction of new reporting procedures have led to new structures and systems. With these now in place it appears that the annual number of CO incidents being reported and investigated has not changed significantly. The use of the DIDR forms has led to more comprehensive information becoming available. This has been of benefit for not only this report, but for future statistical reports using the same common format.

As in previous years the majority of the incidents took place during the heating season. In particular a cold spell featuring a strong Easterly wind in November1996 led to an increase in the number of incidents.

The incident locations were analysed by postcodes. Although the number of incidents is small, compared to the number of homes in Great Britain, the three postcode areas which featured most were NW10 (twice), SN2 (twice) and SW16 (twice).

The NW10 area is in West London and is described as the Willesden area. This area is mainly in the SE half of the Borough of Brent. It also takes in small parts of the Northern areas of Ealing, Kensington & Chelsea and Hammersmith & Fulham. The SW16 area is in South London and is described as Streatham. This area mainly covers the South of the Borough of Lambeth. It also takes in the SE part of Wandsworth, the NE part of Merton and the NW part of Croydon. The SN2 area is the Hawksworth and Blunsdon areas of North Swindon.

3.2 TOTAL CASUALTY DETAILS

The total number of fatalities and non-fatal casualties recorded were lower than in previous years. Possible reasons for this have been given in section 3.1. It would be expected though that with changes in legislation relating to landlord responsibilities and the enhanced training and registration of gas installers that safety would be improved and that casualty levels will reduce.

The total FPPY figure of 0.54×10^{-6} is within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However, societal concerns over gas safety override averaged numerical considerations.

3.3 PROPERTY DETAILS

Although incidents took place more often in terraced and semi detached properties it can be seen from the results that incidents took place across all property styles in close agreement to the proportions of each type of property within Britain.

Where the age was specified it was older properties (pre 1945) which are seen to feature more often in incidents. Using the information from the ONS on age profiles it is confirmed that the greatest risk of an incident is in such properties.

From the figures on occupancy quoted in section 2.3 it can be seen that there were more incidents within owner occupied properties than in tenanted properties. But when a relative risk analysis is carried out it indicates that tenanted/privately owned accommodation is the area of greatest relative risk and that tenanted/housing association and tenanted/council properties show the lowest relative risk.

Comparison of the relative risk factors (based on a division of the percentage split of DIDR reported incidents for that group by the national percentage of occurrences of that group - 100 being the overall average factor, and using the figures quoted in section 2.3) shows that the tenanted/housing association group has the safest relative risk factor of 37. This was calculated as follows ((1.5/4) x 100) = 37. Tenanted/council owned properties have a relative risk factor of 50, owner occupied have a relative risk factor of 100 and tenanted/privately owned accommodation is the area of greatest relative risk with a factor of 187. This is over three times the relative risk factor of the other types of rented accommodation.

3.4 CASUALTY & APPLIANCE LOCATION

The majority of appliances which led to incidents were located in the kitchen of the incident sites. The next most common area was in the living room. These are as expected for the typical majority of domestic gas appliances.

The casualty locations were found to have a different emphasis. The most common location being the bedroom, then the living room and kitchen.

Examination of casualties located in the same room as the incident appliance indicates that the kitchen and living room are the two main locations.

It would appear that casualties located in the kitchen resulted from the use of kitchen appliances whereas bedroom casualties resulted from appliances fitted in other parts of the property. Over half the living room casualties were as a result of appliances installed in other parts of the property.

As would be expected the great majority of incidents took place with the casualties and incident appliance in the same property.

3.5 INCIDENT APPLIANCES

The total number of incidents was made up of 55 incidents involving central heating boilers (one was listed as "Other"), 6 incidents involving space heaters (one was listed as "Other"), 5 involving cookers and 1 involving a water heater. Central heating boilers therefore account for the majority of CO incidents and casualties. However, the cause of the incident is normally related to the installation rather than the appliance itself.

Note: In a very few incidents 2 appliances were identified as producing CO which may have caused the incident. Only the most likely appliance to have caused the incident has been entered onto the database.

The fatality trend tables indicate that central heating appliances are responsible for a broadly similar number of fatalities over the eight year period. Space heaters have been responsible for less fatalities in more recent years.

The majority of fatal and non-fatal incidents involved central heating boilers. The risk of a fatality, related to a CO incident, though appears to be far greater with single-point water heaters and wall mounted combi boilers. These appliances have risk values above what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk (1×10^{-6}). These two appliance types were also noted as being high risk in previous BG Technology reports for 1993/4 and 1994/5.

Historically water heaters were a major problem and this led to changes in safety requirements and major initiatives to replace potentially unsafe appliances. Problems were particularly due to their unflued use, their use in bathrooms and from a lack of servicing. Although the numbers of these appliances in use has decreased in recent years and the number of people at risk will also have fallen the FPPY was expected to remain high. The incident reported this year involved a flueless appliance which was fitted in a bedsit and was also in need of servicing.

The open flued combi boilers this year featured incorrect ventilation, poor flueing and a lack of servicing. This appliance group have high gas ratings in comparison to other domestic appliances. Thus when problems do occur vitiation is likely to take place sooner, leading to CO being produced faster and in larger quantities.

The number of non-fatal casualties associated with all central heating appliances is eight times the number of fatalities. This is typical of results shown in BG historical data for 1993/4 and 1994/5. But for cookers, space heaters and water heaters, a ratio of three to one or less is typical. A different Accident Ratio Triangle therefore appears to exist for these appliances.

The age of incident appliance has proven difficult to find out and more ages were unknown than known. Where known the age of central heating appliances featuring in CO incidents was spread across all age groups and appears not to be age related. Further information on other appliances can not be reported due to the low number of appliances that featured in incidents, as shown in Table 9.

The information given on the boilers types shows that flueing and ventilation faults were common and that flue and heat exchanger blockage was also a cause of incidents.

The grills on cookers were the cause of incidents related to the use of cookers.

Space heater incidents took place on old, open flue fires which generally had flue and burner faults.

3.6 SAFETY DEVICES

These devices have only been fitted by manufacturers, as part of the appliance, for a limited period. There were no reported incidents where any of these devices had been fitted to the incident appliance during the recording period.

The use of powered CO detectors within domestic properties is now becoming common. There were no reported incidents where any of these devices had been fitted at the incident site during the recording period. However two chemical spot detectors had been found in use at two fatal incident sites. One of these was date expired.

3.7 FLUE DETAILS

As in previous years the most significant point to be noted is that the majority of incidents involved open flue appliances (85%). There were found to be 49% of the flues that were not installed to appropriate standards and 57% which had an installation defect. Flue blockage had also taken place in 11 (16%) incidents.

The second most common flue type involved with CO incidents were room sealed, individual fanned draught flues. There were 3 incidents involving this type of configuration with 2 fatalities and 1 "N2" casualty. These were all Potterton Netaheat boilers. Further details are given in Appendix B under "Wall mounted boilers". Each appliance was operating with a positive pressure casing which upon failure of the casing/seal led to CO products within the property. It is understood that design improvements have since been made to this appliance type to address any risk that may have been present.

3.8 PERMANENT VENTILATION

During the period there were incidents where the permanent ventilation required had not been provided or if provided had not been to current standards or had become restricted. Such factors can affect flue performance and in combination with other faults are generally acknowledged to contribute towards the causes of CO incidents.

As a common fault at incident sites this is an item which can be improved by continued customer awareness campaigns and during routine servicing.

3.9 ON-SITE CHECKS

When investigated it was found that often there were similar faults on the appliance ie. the appliance was spilling products and had a high CO/CO2 ratio, the heat exchanger was partially or fully blocked, there was a defective flame picture and linting had also taken place, were the most common. To a lesser extent almost all of the faults listed on the DIDR form have taken place somewhere and have been discovered during an investigation.

3.10 INSTALLATION DETAILS

There were only a few appliances which had not been installed correctly and to the relevant standards. Only a very few incident appliances had been installed second-hand. But in the majority of incidents information was not forthcoming on where the appliance was bought and who fitted the appliance.

3.11 INCIDENT APPLIANCE HISTORY

Where information was given it appears that about a quarter of the incident appliances had been regularly serviced by CORGI registered fitters, a quarter had not been regularly serviced and it was unknown for the remainder. A combination of factors was present at most incident sites with several separate occurrences probably leading to the production of CO. In 5 incidents the appliance had been inspected following reports of fumes and also in 5 installations.

4 SUMMARY

4.1 The number of domestic related CO poisoning deaths reported, at 25 during 1996/97, was in line with previous trends.

4.2 The total FPPY figure of 0.54×10^{-6} is within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However, societal concerns over gas safety override averaged numerical considerations.

4.3 The appliance types that were above the HSE's criteria for the tolerability of risk are single-point water heaters (3.81×10^{-6}) and wall mounted combi's (1.1×10^{-6}).

4.4 The majority of all CO poisoning deaths involved domestic open flued appliances.

4.5 Flueing and ventilation faults were common in many domestic incidents.

4.6 Domestic wet central heating system boilers were responsible for the majority of casualties.

4.7 There was an above average risk of a CO incident in domestic properties built before 1945 and also in tenanted accommodation that was privately owned.

4.8 The bedroom is a part of the house where many casualties are located.

4.9 Whilst it has often been suggested that annual appliance servicing could help prevent the majority of domestic incidents it has not possible to support or refute that conclusion from the data presented in this report.

4.10 There were no LPG incidents reported during 1996/97.

4.11 Reports on three non-domestic incidents were submitted and analysed during 1996/97.

5 CONCLUSIONS

Analysis of the CO incident statistics, collected from the Downstream Incident Data Report form, have produced results in line with previous years results. The analysis identifies the most common faults found at incidents. This information can be used to improve customer safety, target expenditure on CO incident prevention and further research work.

6 RECOMMENDATIONS

6.1 The continuing importance of collecting and analysing incident statistics needs to be stressed. Without this data the risks associated with appliances, installations etc, cannot be accurately assessed and acted upon.

6.2 The data should be made available to all interested parties, ie, those concerned with the safety, transportation and supply of gas and also those involved in the installation and maintenance of gas appliances.

7 DATA USED AND REFERENCES

7.1 DATA USED

7.1.1 Appliance Population Statistics - Statistics for Great Britain provided by GfK Marketing Services Ltd., Sheer House, Station Approach, West Byfleet, Surrey, KT14 6NL.

7.1.2 Historical Incident Data - BG Technology database.

7.1.3 Number of Natural Gas Customers - Best estimates, for Great Britain, obtained from BG Group plc company records.

7.1.4 Population & Housing Statistics for Great Britain - The size of the average household has been calculated from figures produced by the Office for National Statistics and published in the Annual Abstract of Statistics.

7.2 REFERENCES

7.2.1 Definitions of FPPY, CPPY and IPPY - BG Technology Reports.

APPENDIX A DEFINITIONS AND THE USE OF FPPY, IPPY AND CPPY VALUES

a) Fatalities Per Person Per Year (FPPY)

FPPY is a measure of the risk of death from owning a specific appliance type.

FPPY is defined as:-

$$FPPY = \frac{\text{Number of Fatalities}}{\text{Number of people at risk x Appliance Population}}$$

Notes:

1) In the report the number of people at risk is taken as the average number of people per household (2.43 in 1996/7). - provided from Government Statistics - see report section 7.

2) The "Overall FPPY" is calculated, as above, except that "Appliance Population" is replaced by the number of customers - see report section 7.

3) The appliance population figures used have been taken from information provided by GfK Marketing Services- see report section 7.

b) Incidents Per Person Per Year (IPPY)

IPPY is a measure of the risk of having an accident with a specific appliance type.

IPPY is defined as:-

$$IPPY = \frac{\text{Number of Incidents}}{\text{Number of people at risk x Appliance Population}}$$

c) Casualties Per Person Per Year (CPPY)

CPPY is a measure of the risk of being injured by owning a specific appliance type.

CPPY is defined as:-

$$CPPY = \frac{\text{Number of Casualties}}{\text{Number of people at risk x Appliance Population}}$$

APPENDIX B TABLES, BY APPLIANCE TYPE, SHOWING THE NUMBER OF FAULTS AND INDIVIDUAL INCIDENT DETAILS

Table B1 shows the tables included in this appendix. They have been completed for the appliance groups only where there were relevant incident appliances to describe.

The nomenclature adopted allows data to be presented for any of the appliance groups. This has the advantage that tables with the same code may be readily identified, which can aid the comparison on a year-by-year basis. However, groups may not have been implicated in incidents in any particular year, so they are indicated in this appendix as "no reported incident".

The appliance groups have been ordered in the same way as section 2.5.2 of the report.

Table B1 – Summary of incident fault analysis and summary tables presented

Appliance group	Appliance sub-group	Code	Incidents	Appendix Tables
Central Heating Boilers	Back unit	1.1	7	B.1.1a & b
	Floor standing	1.2	13	B.1.2a & b
	Floor standing combi	1.3	0	*No reported incident*
	Thermal storage unit	1.4	0	*No reported incident*
	Wall mounted	1.5	19	B.1.5a & bi & bii
	Wall mounted combi	1.6	14	B.1.6a & b
	Warm air unit	1.7	1	B.1.7a & b
Cookers	Free standing	2.1	5	B.2.1a & b
	Built-in oven	2.2	0	*No reported incident*
	Built-in hob	2.3	0	*No reported incident*
Space Heaters	Balanced flue g .f.	3.1	0	*No reported incident*
	Cabinet heater	3.2	0	*No reported incident*
	Decorative g .f.	3.3	1	B.3.3a & b
	Flueless heater	3.4	0	*No reported incident*
	Inset live fuel effect g .f.	3.5	0	*No reported incident*
	Rad. & rad. con. g .f.	3.6	4	B.3.6a & b
	Wall heater	3.7	0	*No reported incident*
Dryers	Tumble Dryers	4.1	0	*No reported incident*
Water Heaters	Bulk storage	5.1	0	*No reported incident*
	Circulator	5.2	0	*No reported incident*
	Multi-point	5.3	0	*No reported incident*
	Single-point	5.4	1	B.5.4a & b

B.1 CENTRAL HEATING BOILERS

B.1.1 BACK BOILER UNIT

Table B.1.1a - Central heating boilers : back boiler unit : Summary fault analysis

number of incidents=7

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	3
Defective flame picture	3	Failed spillage test	4
Linting	3	Overrated	1
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	1	Down draught	1
Flue		Bad siting	1
Blockage	3	Unapproved design	0
Corrosion	0	Other	1
Flue not to any standard	1	**Ventilation**	
Installation defect	3	Air vent/vents ineffective	1
Other	0	Air vents obstructed - intentionally	1
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	5	No permanent ventilation provided	1
Cracked	0	Ventilation provided was not to any standard	3
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	3
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Table B.1.1b - Central heating boilers : back boiler unit : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
HX2	2 (0)	Glow Worm Majorca 2	Unknown	Current		Severe weather conditions at time of incident - snow blockage of terminal possible. C/H boiler provided source of CO due to flame elongation and impingement. No permanent combustion ventilation available, which may have contributed to incident. During tests no CO detected in room atmosphere which would lead to COHb levels of the victims.
CV1	0 (1)	Baxi Bermuda	Unknown	Current		The heat exchanger was blocked with soot, leading to spillage. Route of spillage unclear as appliance assembly had been altered. Likely that spillage passed into the bedroom due to seal between appliance catchment space, flue liner and false chimney breast being incomplete - allowed fumes to pass into bedroom when appliance was spilling. Also ventilation was sub-standard and appliance needed servicing.
B76	0 (1)	Eastham Maxal 10		Current		Most likely to be poor servicing of backboiler which left in an "immediately dangerous" condition. Could not be 100% sure that it was back boiler that caused the CO - but very likely. Soot and debris around back boiler was likely cause of CO and formation of soot on outer case supports this conclusion.
L77	0 (1)	Glow Worm Galaxie			Current	Partial blockage of flue leading to spillage. Made worse by poor condition of the flue system. Due to collector it was found that appliance operation in flat 46 adversely affected flue operation in 44.
SK5	0 (1)	Myson Housewarmers model 1n	Unknown	Current		Boiler restricted by soot due to linting of burners injectors. This combined with spillage from flue hood led to CO entering the room. Cause of flue causing spillage not investigated.
S73	0 (2)	Glow Worm Metro fire/chb	Unknown	Current		CO was produced by BBU due to lack of servicing under severe weather conditions (as at time of incident) may get down draught. Poor flue pull due to poor terminal position and adverse airflow into builders opening.
NE4	0 (2)	Fireside	Unknown	Current		As a result of a blocked flue liner at bottom of brick chimney and subsequent blockage of the heat exchanger with soot - the products of combustion from the boiler entered the property from base of the combustion chamber. Flue liner blocked with debris.

B.1.2 FLOOR STANDING BOILER

Table B.1.2a - Central heating boilers : floor standing boiler : Summary fault analysis

number of incidents=13

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	2	High CO/CO_2 ratio	7
Defective flame picture	3	Failed spillage test	8
Linting	4	Overrated	2
Over-pressure	4	Underrated	0
Under-pressure	0	**Terminal**	
Other	4	Down draught	3
Flue		Bad siting	6
Blockage	2	Unapproved design	1
Corrosion	0	Other	1
Flue not to any standard	6	**Ventilation**	
Installation defect	8	Air vent/vents ineffective	4
Other	1	Air vents obstructed - intentionally	1
Heat exchanger		Air vents obstructed - unintentionally	3
Blockage - shale	4	Compartment/cupboard not to any standards	2
Blockage - soot	5	No permanent ventilation provided	2
Cracked	0	Ventilation provided was not to any standard	5
Other	0	**Miscellaneous**	
Safety device		Local topography	1
Failed CO alarm	0	Weather	10
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Table B.1.2b - Central heating boilers : floor standing boiler : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
HX3	0 (2)	Glow worm Cf 67/75	Unknown		Current	Boiler in need of servicing, produced CO. Spillage detected on cold start up with cold appliance and flue. Configuaration and termination of flue not to current specifications. Although no CO detected in rooms it is probable that when switched on appliance from cold, the flue failed to operate effectively.
ST13	1 (1)	Potterton Kingfisher Cf55 mk1	Unknown	Current	Current	Heavy snow on day of the incident. Low temps. (approx. 0.5 deg C), and strong easterly wind (approx 25 knots) - atmosphere neutral with no upward convection taking place. Air brick covered by piece of card - may have adversely affected flue performance. Boiler produced CO>2000ppm and on day of incident flue may have been seriously affected by weather causing blockage or reversal.
KY12	1 (2)	Glow worm Hideaway	Unknown	Current		Flue terminal position unsatisfactory and in certain weather and atmosphere conditions flue would be subject to downdraught, leading to flue reversal and spillage. Appliance was capable of producing dangerous concentrations of CO. Performance improved after servicing and setting burner operating pressure to correct level. Compartment ventilation unsatisfactory and not to standard. Misuse of compartment as a store had further impaired the ventilation.
B74	0 (2)	Glow worm 40	Unknown	Current		Flue products escaping from a flue which had become separated within compartment in flat 7 (top floor), by builders work on the roof.
DN34	0 (4)	Glow worm 45-60 cf	Unknown			C/h boiler produced a significant amount of CO so it is likely that due to lack of permanent ventilation and not ideal flue termination point, that a change of external conditions led to a downdraught. No visible signs of spillage so downdraught thought to be intermittent.
DY8	0 (1)	Thorn M42	Unknown	Current		CO produced due to poor servicing, but usually cleared by flue. Although flue worked, on day of incident as cold and windy, possible that lack of flue pull resulted in spillage - chimney was external. Lack of combustion ventilation may have affected flue pull.
LN3	0 (4)	Ideal mexico Slimline Cf55	Unknown		Current	Material from flue wall fell to bottom of flue and obstructed it (within the chimney). Boiler produced CO due to partial flue blockage. Blockage due to debris from glazed lining and soot/cement deposits with partial flue blockage; terminal restriction and the less than 90 deg. Bend at bottom of flue created a situation where flue failed to operate. Strong winds may have caused fall of debris down flue.
GU2	0 (5)	Potterton Kingfisher Cf55	Unknown			Boiler - incorrect sited flue system. Inadequate ventilation. Lack of servicing contributed to levels of CO being produced. Weather would be expected to adversely affect the flue.
AB10	0 (2)	Baxi801	Unknown	Current	Current	Boiler susceptible to flue reversal in cold weather. Work carried out by builder may have made it worse.
MA9	0 (2)	Ideal eType 50n cf	Unknown			Sub-standard flue configuration combined with lack of servicing and purpose provided ventilation.
SK8	0 (2)	Potterton Diplomat 41/48	Unknown	Current	Current	Down draught diverter had corroded and had collapsed directly onto the boiler blocking the flue.
KT6	0 (4)	Potterton Kingfisher Cf50	Unknown		Current	Boiler not correctly installed or maintained which resulted in high levels of CO being discharged into property when flue failed to operate satisfactorily.
AB15	0 (1)	PottertonC95/28	Unknown	Current		Boiler was producing high levels of CO which could not be reduced by servicing. Likely that due to weather at time of incident flue did not clear products of combustion and they passed into the property.

B.1.3 FLOOR STANDING COMBI – NO REPORTED INCIDENT

B.1.4 THERMAL STORAGE UNITS – NO REPORTED INCIDENT

B.1.5 WALL MOUNTED BOILER

Table B.1.5a - Central heating boilers : wall mounted boiler : Summary fault analysis

number of incidents=19

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	1	High CO/CO_2 ratio	11
Defective flame picture	6	Failed spillage test	6
Linting	9	Overrated	1
Over-pressure	0	Underrated	1
Under-pressure	0	**Terminal**	
Other	5	Down draught	6
Flue		Bad siting	8
Blockage	1	Unapproved design	1
Corrosion	0	Other	0
Flue not to any standard	12	**Ventilation**	
Installation defect	11	Air vent/vents ineffective	5
Other	2	Air vents obstructed - intentionally	2
Heat exchanger		Air vents obstructed - unintentionally	2
Blockage - shale	2	Compartment/cupboard not to any standards	2
Blockage - soot	9	No permanent ventilation provided	7
Cracked	0	Ventilation provided was not to any standard	7
Other	5	**Miscellaneous**	
Safety device		Local topography	1
Failed CO alarm	1	Weather	10
Failed down draught detector	0	Signs of spillage	5
Failed vitiation device	0		

Table B.1.5bi - Central heating boilers : wall mounted boiler : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
DY3	0 (2)	Glow Worm Fuelsaver Mk2	Unknown	Current	-	As no evidence of spillage into property is not clear-cut. It is felt that with severe weather conditions as occurred on day of incident CO may have entered property due to intermittent downdraught from c/h boiler.
ST4	1 (4)	Glow Worm Fuelsaver 50r Mk2	Non CORGI	Current	-	The boiler was producing CO at levels >1400ppm, under normal conditions the flue cleared the products of combustion, but with conditions on day of incident it is likely that flue did not clear the products - flue reversal. A lack of purpose provided combustion air supply could have reduced boiler flue performance.
L49	0 (1)	Potterton Flamingo Cf50	Unknown	-	-	Weather bad - heavy snow and strong winds. Temp. of 2 deg. C. Boiler needed servicing and was spilling. Boiler produced high levels of CO. Excessive external route of flue and substandard termination. Lack of ventilation may have contributed.
ST5	0 (3)	Glow Worm Fuelsaver 50r Mk2	Unknown	-	-	Boiler was producing CO>300ppm. Flue when tested cleared products safely, but under severe weather conditions flue may have different result. It was on east side of property. No permanent ventilation supplied, would have reduced room ventilation rate and adversely affected flue performance.
B17	0 (2)	Thorn Apollo 15/30c	Unknown	-	-	Flue design incorrect, appliance in need of service - thought likely to spill under certain conditions as flue pull probably weak. High levels of CO being produced so when flue fails to clear products they entered property and particularly bedroom above the appliance. Lack of servicing led to severe linting and thence high levels of CO when heat exchanger blocked by soot.
SE5	0 (2)	Thorn Apollo 15/30c	Unknown	-	-	Incorrectly sited flue system. No combustion ventilation provided. Lack of servicing. Weather conditions would be expected to adversely affect operation of the flue.
KT20	1 (0)	Glow Worm Fuelsaver Mk2 Cf40	Unknown	-	Current	Appliance fitted to a poorly designed flue system. Combustion vent had been completely sealed off. Lack of servicing contributed to high levels of CO being produced. Adverse weather conditions would be expected to affect a barely working flue system.
DN32	0 (2)	Vokera 21/84mcf	CORGI	-	Current	Spillage from c/h boiler.

Table B.1.5bii - Central heating : wall mounted boiler : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
SW15	0 (3)	Glow Worm fuelsaver mk2 cf30	Unknown	-	-	Not possible to investigate effectively as boiler serviced and part of flue removed before investigation carried out.
AB12	0 (3)	Potterton Myson apollo 80c	CORGI	-	-	On day of tests could not prove flue reversal and spillage. But there was evidence spillage had occurred in the past. There was substandard compartment ventilation and substandard terminal fitted and on incident day the prevailing weather conditions may have led to spillage.
M26	0 (1)	Ideal elan 2 cf40	Unknown	-	-	Boiler badly in need of servicing. It produced high levels of CO and was spilling. Contributory factors: excessive external route of flue; substandard flue design; lack of purpose ventilation; lack of maintenance.
SW16	0 (1)	Potterton netaheat 10-16 mk2	Unknown	Current	-	Appliance case assembly inadequately fitted, leading to escape of CO
B77	0 (2)	Thorn apollo 15/30c	Unknown	-	-	Lack of servicing resulted in partially blocked heat exchanger and subsequent poor combustion performance. Flue system faults made matters worse plus lack of ventilation.
CM14	1 (0)	Radiation fuelsaver 15	Unknown	-	-	Due to lack of service and inadequate ventilation the combustion was poor. As a result CO was produced. Due to poor flueing arrangements spillage occurred at dangerous levels.
S63	0 (3)	Baxi wm552	Unknown	-	-	Boiler burner almost completely blocked causing poor flames which impinged on heat exchanger creating soot which blocked the heat exchanger. Result was CO in property. Problem due to lack of servicing.
NW6	1 (0)	Potterton netaheat 6/10	Unknown	Current	-	Operation of boiler with top 2 screws removed and casing tilted forward at the top. In this state high levels of CO were generated and passed into the room. May have been a suicide?
DA5	1 (0)	Potterton netaheat 10-16 mk2	Unknown	Current	-	Delayed ignition within boiler - cause unknown. Led to casing becoming open and combustion products entering the property.
ST1	0 (4)	Glow Worm fuelsaver mk2 30r	Unknown	-	-	Boiler producing high levels of CO due to partially blocked heat exchanger. Due to inadequate ventilation and flue design spillage occurred
AB45	0 (1)	Ideal elan 2 cf260	Unknown	Current	-	Lack of servicing led to poor combustion and high levels of CO. Spillage caused by ineffectual flueing, combustion air vent position, deteriorating pathways in the heat exchanger and linted burner filter would, with time, lead to deterioration of utility room air oxygen available for combustion. Once oxygen level fell, would rapidly have led to CO in property

B.1.6 WALL MOUNTED COMBI BOILER

Table B.1.6a - Central heating boilers : wall mounted combi boiler : Summary fault analysis

number of incidents=14

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	8
Defective flame picture	2	Failed spillage test	7
Linting	4	Overrated	0
Over-pressure	1	Underrated	1
Under-pressure	0	**Terminal**	
Other	0	Down draught	1
Flue		Bad siting	8
Blockage	0	Unapproved design	1
Corrosion	0	Other	2
Flue not to any standard	10	**Ventilation**	
Installation defect	10	Air vent/vents ineffective	1
Other	1	Air vents obstructed - intentionally	1
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	2
Blockage - soot	6	No permanent ventilation provided	4
Cracked	0	Ventilation provided was not to any standard	7
Other	4	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	10
Failed down draught detector	0	Signs of spillage	4
Failed vitiation device	0		

Table B.1.6b - Central heating boilers : wall mounted combi boiler : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
UB1	2 (0)	Vaillant20/1t3 wh	Unknown			Boiler fitted to a poorly constructed and incorrectly sited flue system. Level of ventialtion inadequate. Boiler needed servicing and contributed to high levels of CO produced by the boiler.
SN2	0 (4)	Ferroli77cf	Unknown	Current		Probably lack of ventilation, but not proven. The house was quite tight. Appliance performance ok when tested, but flue had been extended and ventilation installed.
SW4	1 (0)	Vaillant Vcw 20/1 t3wh				Flue system poorly constructed and incorrectly sited. Ventilation to kitchen inadequate. A lack of servicing noted. Wind conditions would be expected to adversely affect the barely working flue system.
WR10	0 (3)	Vokera 18-72 dmcf	DIY	Current When Installed	Current	Flue only gave problems in extremely cold weather when probably failed to clear combustion products. Combustion poor due to restricted heat exchanger leading to increased level of CO in products.
G42	0 (4)	Ferroli 77cf	CORGI			A combination of installation defects, lack of ventilation to the boiler, deterioration of the flue system over time and effects of prevailing weather conditions on an externally run flue.
TR18	0 (1)	Vaillant Vcw 20/1	Unknown			Due to cold weather on external flue it is likely flue performance deteriorated and failed to function. CO then spilled into the kitchen.
SE19	0 (1)	Ferroli Scorpio 100cf	Unknown			Lack of ventilation provided to boiler was inadequate. Lack of servicing of boiler contributed to high levels of CO being produced. Weather conditions would be expected to adversely affect an already barely working flue system.
LN1	0 (4)	Vaillant Vcw 25/1 t3wh	Unknown			Flueing totally inadequate and not to standards. Appliance not working correctly - deemed "immediately dangerous". Ventilation inadequate. CO produced due to vitiation.
OL11	0 (1)	Vokera 18-72 dmcf	DIY			Lack of servicing since installed 2nd hand led to blockage of heat exchanger by combustion deposits. Boiler should not have been fitted in a bedroom.
SE4	0 (2)	Vaillant Vcw 20/1 t3	Unknown			Incorrectly designed flue system; no purpose provided ventilation; no servicing; weather conditions likely to adversely affect performance.
M43	0 (2)	Vaillant Vcw bgb 240h	Unknown			CO entered the property due to poor flue pull due to: strong gusting winds; permanent air vent undersized; flue termination too close to roof - only 650mm above roof tiles.
PO12	0 (3)	Vaillant Vcw 20/1	Unknown	Current When Installed	Current	Boiler suffered downdraught pushing combustion products into the property. The combustion products contained high levels of CO due to restriction on the plates.
SN2	0 (2)	Ferroli 77cf	Unknown	Current	Current	Weather at time may have caused flue to stall.
UB4	0 (5)	Guival Phoenix	Unknown			Lack of servicing contributed to high levels of CO. Flue system sub-standard. Ventilation undersized. Weather could affect the operation of the flue.

B.1.7 WARM AIR UNIT

Table B.1.7a - Central heating boilers : warm air unit : Summary fault analysis

number of incidents=1

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	1	Failed spillage test	0
Linting	0	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	1
Flue not to any standard	0	**Ventilation**	
Installation defect	1	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	1
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.1.7b - Central heating boilers : warm air unit : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
RM10	1 (0)	Mc Clary 5025/30	Unknown			CO poisoning - unable to prove which appliance caused death; could be one of 2 on site or missing cooker; no appliances found on after incident. Both sink heater and warm air heater in a poor service condition with no permanent ventilation.

B.2 COOKERS

B.2.1 FREE STANDING

Table B.2.1a - Cookers : free standing : Summary fault analysis

number of incidents=5

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	3	Failed spillage test	0
Linting	1	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	5	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.2.1b - Cookers : free standing : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
E16	2 (1)	Flavel Fiona +s	Unknown			Gas fired grill on cooker creating high levels of CO due to extremely poor service condition.
S56	1 (0)	Parkinson Cowan	Unknown			Combustion on grill of cooker poor due to combination of primary air being entrained into combustion process and a severely distorted burner. Led to high levels of CO being produced.
NW10	1 (0)	Cannon A133 sd/u	Unknown			Cooker grill produced high levels of CO due to inability to open it fully to correct operating position.
NE13	0 (2)	Cannon Cordon Bleu 4	Unknown			Cooker grill produced CO due to deterioration of burner.
BL3	1 (0)	Radiation S 1480	Unknown			Would need grill on for 3 hours to get 20% COHb found in fatality. This may have taken place but unclear. Grill faulty due to lack of maintenance and cleaning - dust and grease deposits found in burner - flames impinged onto frets.

B.2.2 BUILT-IN OVEN – NO REPORTED INCIDENT

B.2.3 BUILT-IN HOB – NO REPORTED INCIDENT

B.3 SPACE HEATERS

B.3.1 BALANCED FLUE GAS FIRE – NO REPORTED INCIDENT

B.3.2 CABINET HEATER – NO REPORTED INCIDENT

B.3.3 DECORATIVE GAS FIRE

Table B.3.3a - Space heaters : decorative gas fire : Summary fault analysis

number of incidents=1

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	0
Defective flame picture	0	Failed spillage test	0
Linting	0	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	0
Other	1	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.3.3b - Space heaters : decorative gas fire : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
WN3	0 (1)	Hi-Tech 16" Tappered Basket	Unknown	Current		Fumes in back bedroom of no.1 came from lounge in house next door (no.3). The flue in no.3 lounge is leaking allowing products to escape at 1st storey floorboard level.

B.3.4 FLUELESS HEATER – NO REPORTED INCIDENT

B.3.5 INSET LIVE FUEL EFFECT GAS FIRE – NO REPORTED INCIDENT

B.3.6 RADIANT AND RADIANT CONVECTOR GAS FIRE

Table B.3.6a - Space heaters : radiant and radiant convector gas fire : Summary fault analysis

number of incidents=4

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	2
Defective flame picture	1	Failed spillage test	3
Linting	2	Overrated	0
Over-pressure	1	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	3	Unapproved design	0
Corrosion	0	Other	1
Flue not to any standard	3	**Ventilation**	
Installation defect	4	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	1	Weather	1
Failed down draught detector	0	Signs of spillage	2
Failed vitiation device	0		

Table B.3.6b - Space heaters : radiant and radiant convector gas fire : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
CM12	1 (1)	Parkinson Cowan Prima	DIY			Dining room gas fire in poor condition and connected to a dangerous flue configuration. It was producing high levels of CO which was being discharged into the property.
TQ1	1 (0)	Berry Sunlord	Unknown	Current		Flue failed to clear products due to severe rewstriction and undersized flue. Closure plate was detatched. Fire was producing high level of CO due to lack of servicing.
HD7	1 (0)	Parkinson Cowan Fireflame	Unknown			Blockage of flue on gas fire. It was in need of servicing.
SW16	0 (2)	Baxi Bermuda401 bbu/c2 fire	Unknown		Current	Under certain wind conditions and with the effects due to hole into separate chimney from the builders opening the fire could spill flue products.

B.3.7 WALL HEATER – NO REPORTED INCIDENT

B.4 DRYERS

B.4.1 TUMBLE DRYERS – NO REPORTED INCIDENT

B.5 WATER HEATERS

B.5.1 BULK STORAGE – NO REPORTED INCIDENT

B.5.2 CIRCULATOR – NO REPORTED INCIDENT

B.5.3 MULTI-POINT – NO REPORTED INCIDENT

B.5.4 SINGLE-POINT

Table B.5.4a - Water heaters : single-point : Summary fault analysis

number of incidents=1

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	0	Failed spillage test	0
Linting	1	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	1	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Table B. 5.4b - Water heaters : single-point : incident summary

Post Code	Number of casualties - fatal & (non-fatal)	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
NW10	1 (0)	Vaillant MAG 125/7	Unknown			Poor maintenance of water heater. Linting led to flame impingement and soot production which blocked the heat exchanger.

APPENDIX C DETAILS OF LPG INCIDENTS THAT TOOK PLACE DURING 1996/97, AND AN ANALYSIS OF THE DATA

There were no incidents (domestic or business) reported using DIDR Form 551/7 that involved LPG gas during the 1996/97 year.

APPENDIX D DETAILS OF NON-DOMESTIC CO INCIDENTS THAT TOOK PLACE DURING 1996/97, AND AN ANALYSIS OF THE DATA

BUSINESS INCIDENTS: -

During the reporting year 1996/97 there were 3 CO incidents reported using the DIDR form that involved piped natural gas within business properties.

There was one in July 1996 and two during January 1997. Details of the three incidents and the casualties are given below in Table D1. Of the 3 businesses, 2 (incidents B and C) were classified as commercial units, the other was retail. The postcode references for these incidents are LS29, E12 and PA15. It is known that property B was constructed pre-1945 and that A was tenanted and of single occupancy.

Table D1 - The number of CO incidents and casualties

Incident	Appliance involved	Flue type	Number of incidents	Number of fatal casualties	Number of non-fatal casualties			
					N1	N2	N3	N4
A	Floor standing boiler	RS, I, ND	1	0	0	3	0	0
B	Wall mounted combi boiler	O, I, ND	1	0	2	0	0	0
C	Other: commercial range / grill	O, S, FD	1	0	0	1	0	0

Note: RS, I, ND = Room sealed, individual, natural draught (balanced) flue
O, I, ND = Open, individual, natural draught flue
O, S, FD = Open, shared, fanned draught flue

Incidents A and C appliances both had flues that were fitted to current standards. The appliance involved in incident B had an open, individual, natural draught flue which was not fitted to any appropriate standards. None had flue liners fitted.

All three incident appliances were fitted in rooms, none in compartments, although the appliance in incident A was actually located in the adjacent property to the 3 casualties. One of the appliances (involved in incident B) was located below ground level in the cellar, the casualties in this incident were also located in the cellar. Ventilation was not required for 2 appliances (A and C), for the incident where appliance ventilation was required (B), it had not been provided. A fan / cooker hood was in use during incident C. Casualty and appliance locations are given in Table D2.

Table D2: Appliance and casualty locations

Incident	Appliance location	Casualties & location
A	Other: "back of shop".	3 (unknown)
B	Cellar	2 (cellar)
C	Kitchen	1 (kitchen)

The following details in Table D3 are for all business incident appliances. They give the total numbers of faults found upon CO incident appliances.

Table D3 - Incident appliance faults

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	0	Failed spillage test	1
Linting	1	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	1
Flue		Bad siting	1
Blockage	1	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	1	**Ventilation**	
Installation defect	2	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	1	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	1
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	1
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Note: In Table 3 the numbers quoted are the number of appliances found with the fault listed.

CO was proven to be able to enter the incident property when tested in the as-found condition and to be the likely cause of the incident in 2 instances - these were incidents A and B. It was not proven/unknown in the remaining incident (C). Incident appliance C also had a legible Transco safety label attached to it.

Details of each incident including the appliance make and model are given in Table D4.

The Falcon commercial range / grill, involved in incident C, was less than 3 years old, the ages of the other appliances were unknown. None of the incident appliances were condensing units. Appliance C, the commercial range / grill, was fitted as new and was installed in 1994, although it was fitted by persons unknown. This same unit was known to have no regular service contract although both the appliance and the installation had been inspected following a report of fumes on a previous occasion. Occupants at this property had also previously experienced symptoms typically associated with CO poisoning. There are no further details provided for the other incident appliances.

Table D4 - Appliance, Installation, Standards and Cause of Incident

Incident	Appliance type	Appliance make & model	Installer and if CORGI Regist'd	Flue to Standards	Ventilation to standards	Fault
A	Central heating: floor standing boiler	Potterton kingfisher 2rs40	Unknown	Current	-	Boiler in shop - combustion performance of boiler impaired by obstruction of flue by persons unknown. Combustion leakage from flue system when no flue obstruction, which rose into flat above. When flue obstructed it was worse with increased leakage.
B	Central heating: wall mounted combi boiler	Vokera 18-72 dmcf	Unknown	-	-	Poor flue terminal location and lack of servicing, plus cold weather conditions
C	Other: commercial range / grill	Falcon	Unknown	Current	-	Lack of servicing, not on service contract

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