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Risk Assessment to Support British Gas Review of Supply Licence Condition 12 Relating to Meter Inspection

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Executive Summary

Background

The current licence conditions for gas and electricity suppliers require that all reasonable steps are used to carry out a simple check of the condition of the relevant meter installation at least once every two years (for gas meters only, if a gas meter has not been inspected for two years, a warrant for forced entry should be sought).

An initial assessment prepared for the Energy Retail Association in 2006 suggested that this inspection regime makes a negligible contribution to safety. In 2007/8, GL (then named Advantica) undertook a more detailed quantitative assessment of the risk specifically for British Gas, which found that very few hazardous situations were detected by this process, confirming the conclusions of the ERA assessment that the risk removed by the process was extremely low. However, the study recognised that any relaxation in the inspection regime could result in an increase in risk, however small, unless other measures were taken to reduce the risk.

Subsequently, British Gas commenced a trial involving a focussed activity on the detection of theft, where tampering with the gas or electricity supplies may have occurred. Theft situations would be expected to have an increased potential for generating a serious hazard and this was borne out by initial feedback from the trial.

Objectives

British Gas has prepared a request to Ofgem that seeks permission to inspect meters a minimum of once every five years instead of every two years at present, on condition that British Gas makes a formal commitment to increase dedicated resources for theft detection, thereby targeting situations where serious hazards are considered more likely to arise. GL was commissioned by British Gas to undertake an assessment of the changes in risk (both to workers and the public) predicted to arise as a result of this request being approved.

Summary of Results

The study analysed very large quantities of data supplied by British Gas, in order to identify the numbers of hazardous (e.g. actual gas escapes) and latently hazardous (e.g. damaged installations with the potential to deteriorate) situations identified both through the routine meter reading and inspection processes and through the theft detection activities, and hence the levels of risk removed. The data was broken down by domestic and I&C (Industrial and Commercial) meters, as well as gas and electricity.

Based on this data, an estimate was made of the changes in risk associated with the proposed relaxation in the Must Read and Inspect (MRI) requirement from two years to five years (assuming that this is accompanied by a reduction in the frequency of routine visits) coupled with the increased theft detection activity (assuming that the trial is continued in future). The results are summarised below, expressed as risk removed in terms of annual PLL (Potential Loss of Life), broken down by the different categories of meters.

Risk removed per year by existing processes compared with assumed future scenario

	Total PLL currently removed by existing processes	**Total PLL removed following MRI relaxation with enhanced theft process**
Domestic gas	5.7×10^{-2}	7.3×10^{-2}
I&C gas	1.0×10^{-2}	1.2×10^{-2}
Domestic electricity	1.3×10^{-3}	4.6×10^{-3}
I&C electricity	1.5×10^{-4}	3.1×10^{-4}
Total	6.8×10^{-2}	8.9×10^{-2}

Comparison of the estimates of the risk removed by the existing processes with the risk removed by the enhanced theft detection process and assumed future meter reading and inspection processes shows that the changes in risk are small. Because the estimated levels of risk removed are low, they are consequently difficult to quantify with certainty. However, by using the same methodology to estimate the level of risk removed before and after the change, a direct comparison may be made. Overall, approximately 30% more risk is estimated to be removed following the relaxation in the MRI obligation than before, provided that the theft initiative is maintained (and that metering processes are as assumed). If any additional measures are introduced, for example further enhancements in the theft detection activities, specific inspection regimes for particular customer groups (e.g. customers with special needs), or any other risk mitigation measures, the risk removed would be greater.

An analysis of accident data reported by meter readers and agents carrying out the theft detection processes was also undertaken, to estimate the risk associated with carrying out their duties (comparable to that for postal workers). This found that the risk to the public that is removed per meter inspection made as part of the routine meter reading and inspection process is similar to the risk to the meter reader carrying out the inspection. In terms of the risk to employees, the results indicate that, overall, the risk to workers associated with the meter reading and theft detection activities would be reduced as a result of the revised processes assumed to accompany a relaxation in the MRI obligation from two years to five years.

Conclusions

GL has carried out an assessment of the levels of risk removed by the current meter reading and inspection processes, based on a detailed analysis of large quantifies of data supplied by British Gas. This confirmed that the level of risk removed by the current process is small. Also, the level of risk to workers undertaking the activities was found to be similar to the level of risk removed to the public for each inspection made.

An estimate was made of the changes in risk associated with the proposed relaxation in the MRI obligation from two years to five years coupled with an enhanced theft detection activity (assuming that the trial commenced in 2009 is continued in future). Overall, the assumed changes in processes were predicted to be more effective at removing risk to the public than before, because of the targeted identification of hazardous situations by the theft detection activity. In addition, the risk to workers associated with the meter reading and theft detection activities would be reduced.

Contents

1 INTRODUCTION

1.1 Background

The current licence conditions for gas and electricity suppliers require that all reasonable steps are used to carry out a simple check of the condition of the relevant meter installation at least once every two years. In 2006, British Gas with the other members of the Energy Retail Association (ERA) submitted a recommendation to Ofgem for "…removal, relaxation or replacement of Supply Licence Condition 17 (SLC17)…" SLC17 required a simple check to be made of the condition of the meter installation (gas and/or electric) at least once every two years. In practice, an actual meter inspection is often taken more frequently, thereby exceeding the licence requirements for most premises. However, an initial assessment prepared for ERA suggested that this inspection regime makes a negligible contribution to safety[1].

From 1st August 2007, the licence conditions were revised. In the revised licence conditions the issues associated with meter inspection/examination are included under Supply Licence Condition 12 (SLC12). Under SLC12, suppliers are required to inspect meters for safety and theft detection purposes at least once every two years. However suppliers have argued that the requirement is disproportionately expensive compared to the benefits it brings. Suppliers have also consistently argued that by requiring suppliers to make a site visit, it undermines the business case for smart meters that offer remote reading capability. With regards to the safety implications of this proposal, Ofgem are taking guidance from the UK Health and Safety Executive (HSE). The HSE position is summarised as below (Letter from M Leppard HSE to A Wallace Ofgem 14 September 2006):

"HSE notes the proposal to remove the two yearly inspection of the meter installation. This regime is currently regarded by some in HSE as a key check regarding the on-going safety of a meter installation. Although HSE is not against change to the status quo as such, any changes should be risk and evidence based and should not result in any reduction in existing levels of safety. We understand the ERA has appointed consultants to explore the methodology for a review of existing arrangements. Any resulting risk assessment will need to include the gas fittings associated with the meter installation alongside aspects of the current inspection i.e. safety and theft and the possibility of risks associated with any increase in the replacement of meters.

The key concern of HSE is that none of the suggested changes to the licence conditions should lead to a deterioration in safety standards. Changes should only be introduced when there is a full evidence-based understanding of the risks and the safety implications of the proposals. The aim should be to at least maintain current safety standards and, preferably, improve them."

Subsequently, in 2007, Advantica (renamed GL Industrial Services UK from 1st April 2009) was commissioned by British Gas to carry out a quantified risk assessment to consider the safety benefit of the inspection regime in more detail, largely based on analysis of data provided by British Gas for calendar year 2006, in order to support a review of SLC12.

Relaxing and/or removing the 2-yearly Must Read and Inspect (MRI) requirement completely and/or meter reading processes will tend to increase the level of risk to the occupants of the property housing the meter, however small that increase might be, unless additional mitigating measures are taken to offset that increase in risk. Therefore, the study included consideration of possible risk reduction options that could be adopted alongside a relaxed inspection regime. Subsequently, British Gas commenced a trial involving a focussed activity on the detection of theft, where tampering with the gas or electricity supplies may have

[1] "Review of Supply Licence Condition 17", Philip Rutt, October 2006

occurred. Theft situations would be expected to have an increased potential for generating a serious hazard, and this was borne out by initial feedback from the trial.

British Gas has recently prepared a request to Ofgem that seeks permission to inspect meters a minimum of once every five years instead of every two years at present, on condition that British Gas makes a formal commitment to increase dedicated resources for pro-active theft detection, thereby targeting situations where serious hazards are considered more likely to arise. GL was commissioned by British Gas to undertake an assessment of the changes in risk (both to workers and the public) predicted to arise as a result of this request being approved.

This new work involved an update of the risk analysis undertaken previously using recent data supplied by British Gas for 2009, and estimation of the risk removed by the focussed activity on the detection of theft and the operations to make safe the hazardous situations found as a result. The results are used to make a comparison between the levels of risk removed by the existing arrangements, for comparison with the proposed future arrangements including continuation of the focussed theft activity currently being trialled. For the purposes of this comparison, it is assumed in this report that a relaxation in the MRI requirements from 2 year to 5 years would also be accompanied by meter processes where routine reading and inspection visits are made at least annually. The results from the recent GL analysis and the earlier risk assessment undertaken by GL using the 2006 data are described in this report, with details of the data collection and other pertinent information included as appendices.

1.2 Meters and Meter Readings

In this report a distinction is made where possible between those meters located in domestic premises and those in business environments. A supplier normally operates a routine meter reading and inspection process ranging from a monthly to quarterly basis. Normally a supplier will visit domestic and smaller business premises on a quarterly basis whereas there will be a monthly visit for larger business premises. Definitions used in industry for the different gas and electricity meter supply types are provided in the Glossary (Section 8).

British Gas supplies both gas and electricity, hence the British Gas portfolio comprises:

- Domestic gas meters
- Business gas meters
- Domestic electricity meters
- Business electricity meters

Meter readers used by British Gas are trained to undertake the required inspection of the meter, thus obtaining a meter reading will concomitantly include an inspection.

A visit to a property may not always result in a meter reading being undertaken, for example:

- Access may be denied by the occupant.
- The property may be long term unoccupied.
- The occupant may not be present at the time of the visit.

As the 2-year limit approaches, if a meter has not been read and inspected, the meter is then subject to a 2-yearly meter reading/inspection visit. This visit may be arranged via letter or in more difficult cases via legal action.

1.3 Licensing Requirements

1.3.1 SLC12

The relevant requirements of SLC12 (effective from 1 August 2007) include:

- Licensees are required to take all reasonable steps to ensure that meters are inspected at least once every two years.
- Such inspection must be carried out by a person possessing appropriate expertise and includes taking a meter reading, undertaking an inspection of the meter and installation to check for damage, deterioration or evidence of tampering, and subject to the necessary consent, changing any batteries in the meter.
- In certain defined circumstances, the licensee has an additional 4 months to conduct the 2 yearly meter inspection.

Under these licence conditions it is required that all reasonable steps are taken to inspect the electricity meter every two years. A more onerous condition applies for gas meters whereby the licensee should try "to obtain a warrant under the Rights of Entry (Gas and Electricity Boards) Act 1954 in cases where the licensee could not otherwise comply with its obligation."

1.3.2 Standards

Ofgem has also produced guidance on the reading of gas meters[2]. British Gas has advised that its metering agents have adopted the practices identified in this document.

British Gas uses its "Meter Reading Procedures Manual 2.2" dated 2003 to specify the processes undertaken during meter reading.

British Gas has advised that it undertakes auditing and monitoring of the Meter Reading Agencies (MRAs) employed and the activities of the meter readers to ensure compliance.

[2] Guidance notes on best practice for reading gas meters, Ofgem, July 2004

2 METHODOLOGY

2.1 General Approach

Prior to commencing work, in 2006 GL supported British Gas in presenting the proposed methodology to HSE and Ofgem, in order to share understanding of the proposed methodology in advance of the risk assessment study being undertaken, and to ensure that their specific concerns were addressed as far as possible in the assessment undertaken.

The risk assessment study was undertaken in three stages:

Firstly, a comprehensive data collection exercise was undertaken by British Gas with assistance from the Distribution Networks (DNs - gas) and Distribution Network Operators (DNOs - electricity) encompassing meter reading and inspection activity undertaken on behalf of British Gas during calendar year 2006 (routine and MRI). An essential input to the risk analysis was the frequency with which the current regime detects faults and the nature of those faults, obtained from the data collection exercise.

Secondly, the information was used to predict the increase in Individual Risk associated with gas and electricity supplies arising from a relaxation of the inspection requirements, assuming that faults reported by meter readers remained undetected by other means. It is emphasised that the quantified risk assessment focused on safety issues only (i.e. the risk associated with fires, explosion or electrocution). It is also important to appreciate that the risk assessment aims to provide a view on the level of risk removed by the meter reading and inspection process and not the overall level of risk associated with meter installations. As part of this stage, an estimate was also made of the level of risk to meter readers themselves whilst undertaking their work, based on accident statistics provided by British Gas, for comparison with the level of risk for members of the public predicted to be removed by the meter reading and inspection process.

Finally, possible risk reduction options that could be adopted alongside a possible relaxation of the inspection requirements were considered in order to either maintain current levels of safety or preferably to improve them further.

Subsequently, the analysis was updated following a similar methodology to confirm that risk levels estimated using a sample of data from 2009 remained consistent with the earlier results, and to estimate the risk benefit of targeted activity to detect theft and make safe dangerous installations found as a result.

2.2 2006 Data Collection and Analysis

The data collection exercise encompassed all of the meter reading and inspection activities undertaken by MRAs on behalf of British Gas in 2006. Very large volumes of data were involved, with over 50 million returns. The purpose of the exercise was firstly to gather information on the meter population and the numbers of inspections carried out, and then to identify the proportion of visits where a comment on a safety-related issue was submitted by a meter reader. Where possible, a distinction was made between inspections made in the course of routine visits, and those made as a result of the MRI process (i.e. the multi-visit stage), driven by the 2 year deadline specified in the Supply Licence Condition.

The data obtained from the meter reading organisations over the course of the year were analysed to quantify the:

- Number of visits to meters made per year.
- Total population of meters being visited (the majority of meters had more than one routine meter reading and inspection per meter per year).
- Number of such visits that resulted in the meter reader reading (and concomitantly inspecting) the meter.

- Number of hazardous or latently/potentially hazardous (in terms of risk to the general public) incidents/installations encountered by the meter readers, estimated from the information encoded by the meter reader at the time of the meter reading and any comments added to the meter reading.
- Categorisation of data generated from the general routine meter reading and inspection process or as the result of a multi-visit stage MRI visit.

For those comments that appeared to be safety-related, the DNs and DNOs were requested to supply all available information that they retained on the nature of the hazard encountered and the remedial work required, in order to assess the significance of the hazard if no report had been made. This step in the process proved to be the most difficult because of the lack of information available from the DNs and DNOs. Although the level of detail was not sufficient in most cases to undertake scenario-specific consequence modelling, the information was sufficient for high level upper bound estimates of the level of risk removed directly by the meter reading and inspection regime (as a result of the routine meter readings and MRI meter readings) to be made.

The data collection and classification process for the British Gas population of gas and electric meters is described in detail in Appendix A.

2.3 Measures of Risk

Two key measures of risk are used in the course of this study; Individual Risk and Potential Loss of Life (PLL).

Individual Risk

Individual Risk is a measure of the likelihood of a person becoming a fatality from an identified cause. Individual Risk is generally presented as a frequency in the form of the likelihood of the person becoming a fatality in the course of a year.

Table 1 presents examples of Individual Risks based upon UK statistics.

Table 1: Examples of Individual Risks based on UK Statistics

Cause	Individual Risk (per year)
Death from a traffic accident (a)	$\sim 6 \times 10^{-5}$
Death whilst working in UK construction industries (b)	$\sim 4 \times 10^{-5}$
Death whilst working in UK manufacturing industries (b)	$\sim 1 \times 10^{-5}$
Death from fire (c)	$\sim 5 \times 10^{-6}$
Death whilst at work to an employee in a UK service industry (b)	$\sim 3 \times 10^{-6}$
Death from electrocution (c)	$\sim 6 \times 10^{-7}$
Fatality from natural gas explosion (d)	$\sim 1 \times 10^{-7}$
Death from lightning (a)	$\sim 5 \times 10^{-8}$

Notes: Derived as appropriate from
(a) Reducing Risk, Protecting People, HSE Books 2001
(b) HSE statistics of fatal injuries 2004/5 and 2006/7
(c) Mortality statistics 2005 for England and Wales, Office for National Statistics, 2006
(d) HSE website. Includes all gas escapes.

PLL

The PLL is a parameter that is often calculated to assess how many fatalities could be produced or avoided by a change in risk. This parameter is generally expressed in terms of fatalities per year.

2.4 Risk Assessment Methods

As described above, a comprehensive data collection exercise was successfully carried out for the whole of 2006, to provide the evidence required to underpin an assessment of the level of risk removed by the meter reading and inspection process. The original intention was to gather sufficient detailed information on the potentially hazardous situations reported by meter readers so that mathematical modelling of the hazards could be carried out in order to quantify the extent of the hazard (had the problem remained undetected by other means) and hence the risk to the public. However, although the data collection process obtained large volumes of data, including additional information held by the DNs and DNOs relating to the action taken following the reports by meter readers, the level of detail recorded on most DN and DNO systems was insufficient to allow scenario-specific modelling to be undertaken (possibly because none of the situations was serious enough to merit a detailed record). Nevertheless, the information was sufficient to be able to eliminate the vast majority of reports as irrelevant for the purposes of risk analysis and to separate the remainder into latent safety problems and immediate safety issues (e.g. gas escapes). It was immediately clear from the data that the level of risk involved was extremely small, with little or no evidence that any serious incidents were prevented directly by the meter reading and inspection process.

In the absence of evidence of any significant hazards, an alternative approach was adopted, based on the "incident pyramid" principle; a well-established concept used to relate the predicted numbers of actual fatalities to the numbers of "subsidiary events" (e.g. injuries or near misses). A range of different ratios of fatalities to subsidiary events have been derived in the literature for different applications and industries. Appropriately cautious values of these ratios were selected for the application described in this report, based on consideration of values derived for other comparable activities.

For the electricity meter reading and inspection process (domestic and business supplies) and for the gas meter reading and inspection process for business supplies, the actual numbers of potentially hazardous situations was so small that it was not possible to undertake any more detailed analysis. However, the output from the data collection exercise resulted in considerably more information relating to the routine and multi-visit stages of the domestic gas meter reading and inspection process, and so this was analysed in more detail using a number of alternative approaches in order to provide confidence in the risk estimates made using the pyramid principle.

The risk assessment approaches adopted for domestic gas meters examine the data provided by British Gas at different stages of the data collection exercise from a high level overview analysis, through numerical analyses on the raw data through to analysis based on the feedback on the specific reports by meter readers provided by the DNs. These assessments are described in more detail in Appendix B, and can be summarised as:

- *Generic risk assessments*: Based upon a high level overview of the risk to the UK population from distribution pipes and escapes downstream of the meter and consideration of how this risk could be removed by the meter reading and inspection process.
- *Risk assessment based upon meter reading comments*: The number and type of comments made by meter readers were considered in relation to the hazard associated with the comments. Hazardous events were converted to equivalent number of fatalities by use of an incident pyramid, taking account of latent failures as well as immediate hazards.
- *Risk assessment based upon data from the DNs*: The comments and further information provided by the DNs were analysed to assess the number and nature of the potentially hazardous events that were reported by the meter readers.

The key findings of these assessments are given in the following section.

2.5 2009 Data Collection and Analysis

To update the risk assessment study undertaken earlier, a new data collection exercise was undertaken by British Gas to obtain data on:

- Meter reading activity for January and February 2009
- Theft detection activity for January to March 2009
- Accidents to meter readers in January and February 2009

The objectives of this update were to undertake a risk assessment, following the same principles as the earlier study, in order to:

- Assess whether there were any significant differences between the data analysed from 2006 and the sample of recent data from 2009, as result of any changes in processes being undertaken by British Gas, to confirm if the earlier results were still applicable.
- Estimate the change in risk (to the public and to workers) associated with gas and electricity supplies arising from an assumed change in the meter reading and inspection processes and a relaxation of the inspection requirements, assuming that faults reported by meter readers remained undetected by other means.
- Analyse the new data from the theft detection trial to estimate the level of risk removed by the enhanced 2009 theft detection processes and associated make-safe operations.

3 RESULTS FROM ANALYSIS OF 2006 DATA

3.1 Data Collection and Analysis

A large volume of data was collated and analysed as described in detail in Appendix A, with approximate numbers summarised in Table 2 for gas meters and Table 3 for electricity meters.

Table 2: Summary of 2006 data for domestic and business gas meters

2006	Domestic gas meters		Business gas meters	
	Number	% of readings	Number	% of readings
Readings taken	28,000,000	100	820,000	100
Total comments	245,000	0.9	43,000	5.2
Meter reading comments identified as having a safety impact	1531	0.005	48*	0.006
Suspected escapes reported	548	0.002	12*	0.001
Of which further information obtained from DNs	401	~	6*	~
Latent hazardous installations identified	295	0.001	36*	0.004

* = Annual figures for comments, escapes, DN information and latent hazards obtained from linear extrapolation of a 2 month sample.

Table 3: Summary of 2006 data for domestic and business electricity meters

2006	Domestic electricity meters		Business electricity meters	
	Number	% of readings	Number	% of readings
Readings taken	14,500,000	100	967,000	100
Total comments	140,000	1	688	0.07
Hazardous installations identified by electricity meter reader	32	0.0002	0	~
Latent hazardous installations identified by electricity meter reader	23	0.0002	0	~

In the meter reader data provided by British Gas, the vast majority of the safety-related comments were from the domestic gas meter reading and inspection process. There were no cases where it was clear that a significant hazard had been removed as a result of a report from a meter reader (for example requiring evacuation of property, which it would be expected would be recorded) or where the meter readers detected any hazards that could not have been detected by a member of the general public.

British Gas has no record of any incident having occurred, where the meter installation was identified as the cause, at a property where the meter has not been inspected for over two years.

3.2 Risk Removed by Meter Reading and Inspection

Details of the estimates made from the 2006 data of the risk removed through the meter reading and inspection processes in place are given in Appendix B, with the results summarised below for each of the different meter types.

3.2.1 Domestic gas meters

3.2.1.1 Generic risk assessment

Generic calculations examining the Individual Risk removed by the domestic gas meter reading and inspection process in relation to risk to the general population of gas escapes from the distribution network and from downstream pipework were untaken as described in Appendix B. In order to estimate the level of risk removed by a meter reader's visit, historical statistics on numbers of gas in buildings reports, explosions and fatalities were considered (both as external and internal leaks), and combined with an estimate of the likelihood of a meter reader arriving during a gas build-up event in time to influence the outcome. The analysis takes no account of the data obtained from British Gas, and was carried out to provide a sense check on the subsequent analysis.

The main findings of this analysis were:

- The Individual Risk of fatality from a gas escape from the distribution network that is removed by the meter reading and inspection process was estimated to be up to 1.0×10^{-10} per year.
- The Individual Risk of fatality from a gas escape from downstream installations that is removed by the meter reading and inspection process was estimated to be up to 1.8×10^{-10} per year.
- Combining the two gives an estimate for the reduction in Individual Risk of fatality associated with a gas explosion of up to 3×10^{-10} per person per year.
- This corresponds to approximately 0.007 fatalities averted per year for an exposed population of 24.5 million people (i.e. equivalent to 1 fatality averted per 140 years).

3.2.1.2 Risk assessment based upon meter reading comments

Calculations were undertaken based on the number and type of comments made by domestic gas meter readers during the routine readings and during multi-visit stage MRI readings, and using the pyramid principle to relate reports of gas escapes, latent failures and missing ECVs to an equivalent number of fatalities per year in accordance with the following ratios:

- Escapes : Fatality = 10,000:1
- Latent Failures : Fatality = 100,000:1
- Missing ECV : Fatality = 1,000,000:1

These calculations and the reasoning behind the assumed ratios between the subsidiary events and fatalities are presented in Appendix B. They allow an estimate of the fatalities averted per year to be made as follows:

- For 28,000,000 routine readings the risk removed is equivalent to 0.05 fatalities (i.e. 1 fatality averted per 20 years), or 1.8×10^{-9} fatalities averted per reading and inspection.
- For 570,000 multi-visit MRI visits the risk removed was equivalent to 0.009 fatalities (i.e. less than 1 fatality averted per 100 years), or 1.6×10^{-8} fatalities averted per reading and inspection.

Hence, assuming 2.5 people per meter on average, from this analysis, the Individual Risk removed by the meter reading and inspection process for domestic gas meters was estimated to be:

- 2×10^{-9} per year for ca. 10 million meters read during the routine process.
- 6×10^{-9} per year for 570,000 meters read during the multi-visit stage MRI process.

3.2.1.3 Risk assessment based upon data from the DNs

Analysis of the additional information provided by the DNs on the reports made by meter readers indicated that approximately 24 significant leaks would be expected to be reported each year by meter readers. Detailed information was only available from the DNs for three of these cases, of which the most serious was a fractured main in the vicinity (although in this case, no gas was detected in buildings). Based on the conservative assumption that all 24 cases were equivalent to a fractured cast iron main, an upper bound estimate of the associated risk can be made based on historical statistics on the likelihood of a fatality arising from a fractured main (assuming 1.4×10^{-4} fatalities per fracture), noting that it would be expected that a significant gas escape outside a property would also be reported by a member of the public independently from the meter reading and inspection visit.

This method gives a value of approximately 0.003 fatalities per year (i.e. 1 fatality averted per 340 years) prevented by the routine and multi-visit MRI meter reading and inspection process undertaken by British Gas, equating to an Individual Risk removed of up to approximately 1.2×10^{-10} per year.

3.2.2 I&C gas meters

An estimate has been made of the risk removed by the I&C gas meter reading and inspection process using the incident pyramid principle. This estimate indicates that the mean Individual Risk removed is less than 10^{-10} per year.

3.2.3 Domestic electricity meters

The data from the electricity DNOs identified 10 cases in 2006 where a hazardous installation due to tampering with the meter was found as a result of the domestic electricity meter reading and inspection process. Using the incident pyramid concept, the occurrence of each of these events is considered to be equivalent to 0.000001 fatalities. For the purposes of this calculation it was assumed that in all these cases action was undertaken by the DNO to remove the risk immediately (i.e. equivalent to the emergency process followed by the ESP in the gas industry).

Combining the number of events encountered with the number of fatalities per event gives an annual PLL of approximately 0.00001 fatalities per year. This PLL is distributed amongst a population of approximately 15 million people associated with approximately 6 million domestic electricity meters.

The calculated Individual Risk removed as a result of the domestic electricity meter reading and inspection process is thus approximately 8×10^{-13} per year (a level of risk so small that the results may no longer be meaningful).

3.2.4 I&C electricity meters

No events were encountered where it appeared that the I&C electricity meter reading and inspection process was removing any risk. Hence, the risk removed is too small to be reasonably estimated.

However, from the available data, the risk removed would be expected to be less than that calculated for the domestic meter process.

3.3 Occupational Risks to Meter Readers

An important aspect to be considered when assessing very small levels of public risk removed by the meter reading and inspection process is the risk to the meter readers themselves of injury or even fatality in the course of their work. In fact, in contrast to the reports of potentially hazardous situations identified by meter readers, there is significant evidence of actual harm to meter readers from a range of events, from minor slips and trips, to aggressive dogs and road traffic accidents. A number of lost time incidents were reported in 2006, but no fatalities. A summary of the relevant health and safety statistics for meter readers operating on behalf of British Gas in 2006 is provided in Appendix C.

To estimate the risk to the meter readers, the incident pyramid principle was again used to convert the number of relatively minor accidents reported to an equivalent number of fatalities, described in Appendix C. In this case it was considered that approximately 3,000 accidents corresponded to one fatality. For [redacted] million meter readings, [redacted] accidents were recorded (i.e. equivalent to 0.075 fatalities using the above measure). The Individual Risk levels estimated varied slightly between MRAs, but on average the Individual Risk to a meter reader in the course of his work was estimated to be approximately 2.5×10^{-5} per year or an Individual Risk of fatality of 1.7×10^{-9} per reading taken. This simple analysis indicates that the risk removed per reading (see above) is broadly similar to the level of risk to the meter readers.

3.4 Discussion

3.4.1 Risk assessment results

A comprehensive data collection exercise was completed by British Gas, spanning calendar year 2006, whereby considerable quantities of data were collected. The analysis undertaken clearly showed that the level of Individual Risk removed by the meter reading and inspection process is very small, and in the case of business gas meters and all electricity meters at a level which is too small to be meaningful. However, the current DN and DNO systems do not capture the levels of data required to undertake scenario specific analyses and consequently the risk assessment study adopted a more generic, but cautious, approach.

The data received for domestic gas meter readings and inspections suggested that the level of risk could be more significant than for business gas meters (although still very small), with a number of safety-related faults being reported by meter readers each year. It was not possible to carry out scenario-specific predictive modelling of the possible consequences had these remained undetected (due to the lack of detail recorded on the outcome of subsequent investigations by the DN), but the information received was nevertheless sufficient to undertake a conservative assessment of the level of risk removed by the domestic gas meter readings and inspections, using a number of possible approaches. These suggest that the risk removed is at most 5% of the overall Individual Risk associated with the gas-related fires or explosions, and probably much less.

3.4.2 Comparison of risks

The estimated levels of risk removed are very small. Such low values for Individual Risk are comparable with extremely low frequency events, such as the risk of being killed by lightning. For comparison, the risk of death from all causes for women aged 35-44 in the UK based on data from 1999 was approximately 1 x 10^{-3} (i.e. 1 in a thousand) per year and 1.5 x 10^{-3} for men[3].

The figures below illustrate the level of risk compared with other everyday risks, for both the public and workers, in the context of the acceptability framework for Individual Risk published by HSE.

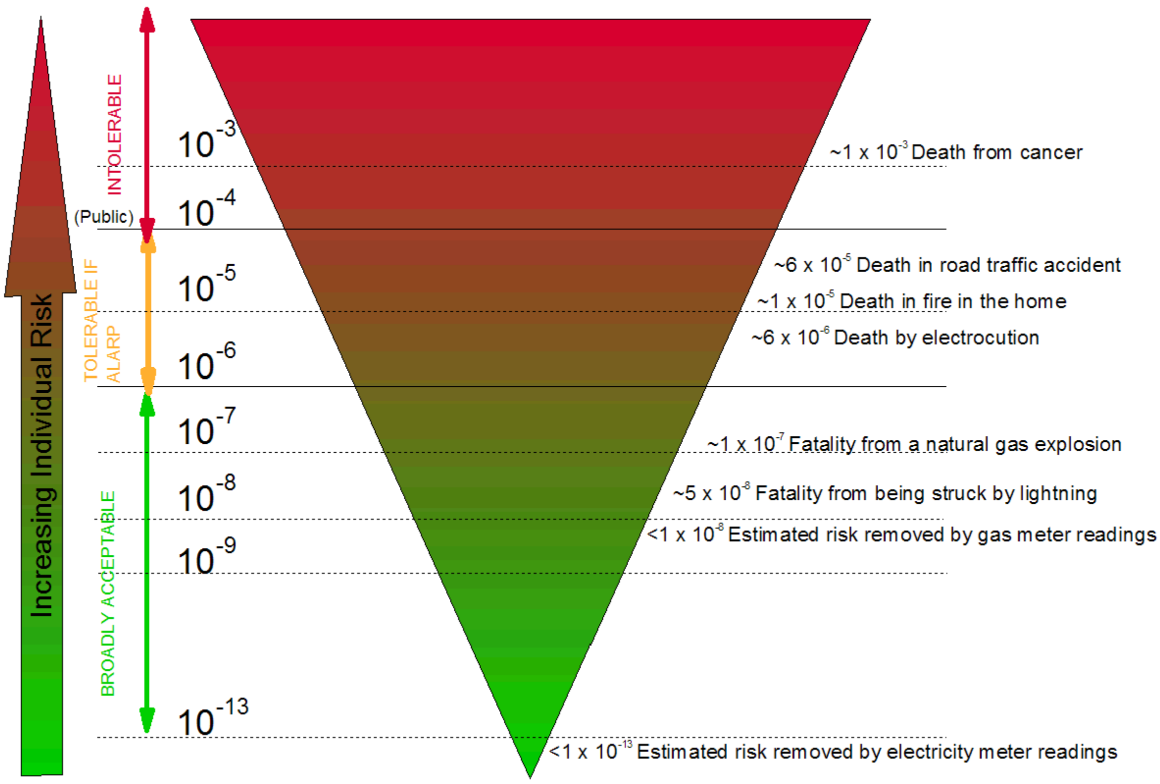

Figure 1: Comparison of Individual Risk Levels (Members of the Public)

[3] "Reducing Risks, Protecting People: HSE's decision making process", HSE Books (2001)

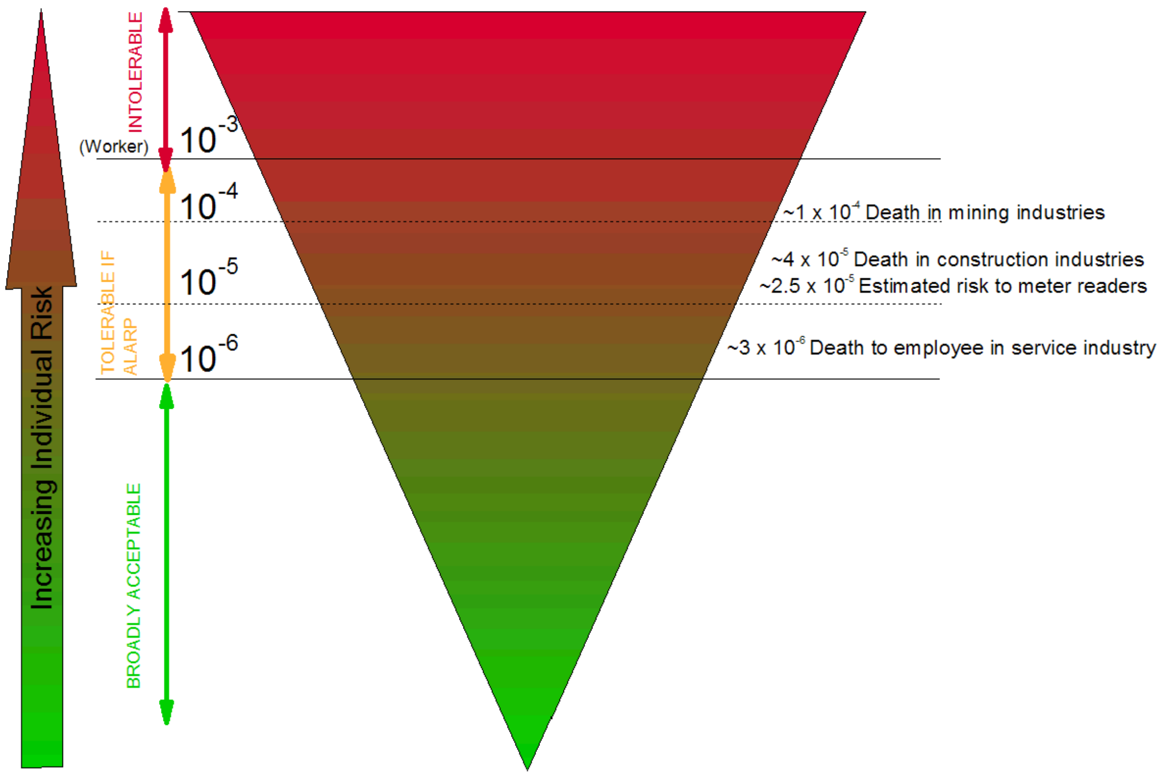

Figure 2: Comparison of Individual Risk Levels (Workers)

It is important to note that the levels of risk to the meter reader from undertaking a meter reading and inspection are broadly comparable with the estimated levels of risk removed. The Individual Risk level of 2.5.x 10^{-5} per year estimated for meter readers may be compared with that for postal workers, who undertake work of similar nature. In fact, meter readers may be exposed to a slightly higher level of risk because of the requirement to enter properties with internal meters, where they may be more likely to be attacked (by occupants or dogs) or to slip/fall in unfamiliar circumstances. Statistics on accidents suffered by US postal workers indicate a level of Individual Risk in the region of 2.1 x 10^{-5} per annum.

3.4.3 Comparison with the 2006 ERA report

The results from the analysis of the 2006 data are consistent with the earlier ERA qualitative assessment, confirming the ERA view that the risk levels associated with a relaxation of the MRI requirements are extremely low.

ERA reported of the order of 8 to 20 gas escapes reported per million reads for different suppliers, consistent with the data analysed in the current study, which indicated ~20 escapes per million domestic gas reads for British Gas alone.

However, this report takes the ERA assessment a step further, by quantifying the levels of Individual Risk removed by the meter reading and inspection process, in order to inform a decision on appropriate mitigation actions to be taken in order to ensure that existing safety levels are not compromised by any relaxation of the regime (see below). Unlike the ERA assessment, this study is based on evidence supplied by British Gas alone, and not from any other suppliers.

4 RESULTS FROM ANALYSIS OF 2009 DATA

4.1 Meter Populations

In the analysis of the 2009 data, it was assumed that the 2009 population of British Gas domestic gas meters is essentially the same as in 2006. However, the number of I&C meters has approximately trebled since 2006.

Similarly, it was assumed that the 2009 population of British Gas domestic electricity meters is essentially the same as in 2006. However, the number of I&C meters has approximately doubled since 2006.

4.2 Meter Readings

The 2009 data provided by British Gas comprised a two month sample of the number of meter readings and inspections obtained and the number of no access visits. This has been converted to an equivalent annual value by linear extrapolation for the purposes of comparison with the results from 2006.

Table 4: Summary of meter readings undertaken in 2009 (in millions)

	Gas domestic	**Electricity domestic**	**I&C gas**	**I&C electricity**	**Totals**
January and February 2009					
Read	4	2.3	0.27	1	7.57
N/A	1.5	1.1	0.07	0.18	2.85
Extrapolated annual value					
	Gas domestic	Electricity domestic	I&C gas	I&C electricity	Totals
Read	24	13.8	1.62	6	45.42
N/A	9	6.6	0.42	1.08	17.1
Combined					62.52

The equivalent annual values for the 2006 data were:

Table 5: Summary of meter readings undertaken in 2006 (in millions)

	Gas domestic	**Electricity domestic**	**I&C gas**	**I&C electricity**	**Totals**
Read	28	14.5	0.82	0.97	44
N/A	10	~7.5	0.09	0.43	18
Combined					62

NB: The 2006 totals are slightly different to those in presented earlier in this report, where the totals were ~45 million meter readings from 62 million visits. This difference is a consequence of various rounding in the data at different stages in the processing.

Overall, the meter reading workload was similar in 2006 and 2009. However, there is an increase in I&C meter readings, which is approximately balanced by a slight reduction in the number of domestic meter readings.

4.3 Comparison of Meter Reader Datasets

The most direct way of comparing the 2006 and the 2009 datasets in terms of the safety implications is to consider the number of potentially hazardous situations identified by the different processes in each period, as presented in Table 6. The analysis is described in detail in Appendix D.

Table 6: Hazardous situations identified (nationally per year)

	Meter reader data 2006	Meter reader data 2009
Domestic gas		
Gas escapes	548	534
Gas latently hazardous	295	318
ECV missing	585	174
I&C gas		
Gas escapes	12	84
Gas latently hazardous	36	156
ECV missing	0	54
Domestic electricity		
Ongoing electricity hazardous	38	48
Latent electricity hazardous	28	204
I&C electricity		
Ongoing electricity hazardous	0	30
Latent electricity hazardous	0	498

In order to compare the risk removed by the different processes in each period, the above values were converted to PLL using the same methodology as for the 2006 data. Specifically:

- A gas escape corresponds to 10^{-4} fatalities
- A latently hazardous gas situation corresponds to 10^{-5} fatalities
- A missing ECV corresponds to 10^{-6} fatalities
- A hazardous electricity situation corresponds to 10^{-6} fatalities
- A latently hazardous electricity situation corresponds to 10^{-7} fatalities

In this analysis, no distinction is made between the consequences associated with different locations (domestic or I&C). It is also assumed that where a meter reader makes a comment that has been classified as identifying a gas latently hazardous situation, a missing ECV, an electrically hazardous situation, and an electrically latently hazardous situation that action is taken to rectify the situation.

The PLL values estimated in this way are presented in Table 7.

Table 7: Calculated annual PLL averted nationally

	Meter reader data 2006	Meter reader data 2009
Domestic gas	5.8×10^{-2}	5.7×10^{-2}
I & C gas	1.6×10^{-3}	1.0×10^{-2}
Domestic electricity	4.1×10^{-5}	6.8×10^{-5}
I&C electricity	0	8.0×10^{-5}

The results in Table 7 show that in comparing the 2006 data to the 2009 sample:

- For the gas domestic meter reader data the PLL averted from the 2009 data is very similar to 2006.
- For the electricity domestic meter reader data the PLL averted from the 2009 data is slightly higher than in 2006.
- For the I&C gas and electricity meter reader data the PLL averted is higher for the 2009 data than in 2006, probably due to the larger population of I&C meters in 2009 compared to 2006.

4.4 Risk Removed by Theft Detection Initiative

4.4.1 Changes in theft detection processes

For a trial period commencing in January 2009, British Gas increased the workforce associated with full time theft of energy activities from 25 to 50. As part of this trial period, the focus of the theft of energy activities changed from being reactive (mainly associated with DNO related activity) in relation to electricity meters to proactively detecting and investigating possible cases of theft in both the gas and electricity sectors. Another important change during this trial was that as part of the reactive process, the cases of potential theft notified by the DNOs were investigated by British Gas staff, whereas as part of the new proactive process, these investigations are predominantly outsourced, enabling more proactive investigation activity to be undertaken by British Gas staff.

It is noted that it is not practicable to initiate a change of this size almost overnight. Thus there was an induction period towards the end of 2008 where the relevant processes were being put in place and staff were trained for the new role. British Gas anticipates that as the process beds down further and experience and expertise is accumulated then their effectiveness in the detection of theft will improve.

It is also noted that in all theft cases detected where the installation has been illegally tampered with, British Gas will have initiated make safe actions.

4.4.2 Annual data comparison

The numbers of potentially hazardous situations identified through the theft trial are compared with those detected by the routine meter reading and inspection processes in Table 8 (extrapolated to an annual equivalent as described in Appendix E).

Table 8: Hazardous situations identified by theft trial and meter reading and inspection process (nationally per year)

	Annual theft data 2009	Meter reader data 2009
Domestic gas		
Gas escapes	471	534
Gas latently hazardous	1179	318
ECV missing	0	174
I & C gas		
Gas escapes	56	84
Gas latently hazardous	100	156
ECV missing	0	54
Domestic electricity		
Ongoing electricity hazardous	4624	48
Latent electricity hazardous	0	204
I&C electricity		
Ongoing electricity hazardous	266	30
Latent electricity hazardous	0	498

In order to compare the risk removed by the different processes in each period, the above values were converted to PLL using the same methodology as for the 2006 data. The PLL values estimated in this way are presented in Table 9.

Table 9: Calculated annual PLL averted nationally by theft trial and routine meter visits

	Annual theft data 2009	Meter reader data 2009
Domestic gas	5.9×10^{-2}	5.7×10^{-2}
I & C gas	6.6×10^{-3}	1.1×10^{-2}
Domestic electricity	4.6×10^{-3}	6.8×10^{-5}
I&C electricity	2.7×10^{-4}	8.0×10^{-5}
Total	7.0×10^{-2}	6.7×10^{-2}

Thus, comparing the 2009 theft trial data to the 2009 meter reading data:

- For gas domestic meters, the risk removed by the theft process is slightly more than the risk removed by the meter reading and inspection process.
- For gas I&C meters, the risk removed by the meter reading and inspection process is greater than the risk removed by the theft process.
- For electric domestic meters and electric I&C meters, the risk removed by the theft process is much greater than the meter reading and inspection process.
- Overall, the risk removed by the theft process is slightly higher than the risk removed by the routine meter reading and inspection process.

It is noted that the two activities are not completely independent, because meter readings are one possible source of potential leads in the theft process. However, their contribution is a relatively small part of the total (approximately 5% of the total), and therefore this contribution has been ignored for the purpose of these simple estimates.

4.4.3 Improvement due to trial theft processes

In order to estimate the risk removed due to the trial theft processes introduced in 2009, an estimate needs be made of the numbers of hazardous situations that would have been identified had the process remained unchanged from earlier years. In the absence of data to make a direct comparison with previous years, two factors were considered in making this estimate; firstly the change in the numbers of people employed to undertake the activity, and secondly the changes in the type of theft detection work and working practices.

It is estimated that the fundamental change in focus has approximately doubled the detection of hazardous situations for electricity meters. Similarly it is estimated that doubling the workforce approximately doubled the detection of hazardous situations for electricity meters. From this, it is estimated that 75% of the hazardous and latently hazardous situations identified and made safe for electricity meters as a result of the theft initiative in 2009 are "new" cases that would not have been identified under the previous arrangements (i.e. a four-fold increase in detection rates). Conversely, it is estimated that 25% of the hazardous and latently hazardous situations identified and made safe for electricity meters as a result of the theft initiative in 2009 would have been detected through the existing processes prior to the 2009 trial.

For gas meters, British Gas advised that virtually all of the hazardous and latently hazardous situations found in 2009 as a result of the theft initiative are "new" cases, because no equivalent arrangements to the electricity arrangements were in place for theft of gas detection and investigation prior to this initiative. From this, it is assumed that 100% of the hazardous and latently hazardous situations identified and made safe for gas meters as a result of the theft initiative in 2009 are "new" cases that would not have been identified under the previous arrangements.

4.5 Occupational Risks

4.5.1 Meter readers

An analysis of the relevant health and safety statistics for meter readers operating on behalf of British Gas in 2006 was presented in Section 3.3. From the available data in 2009, linear extrapolation leads to an estimated [redacted] during 2009 as described in Appendix F. In the 2006 data analysis, each lost time accident was considered to be equivalent to a PLL of 3.3×10^{-4} fatalities. Thus for the estimated 2009 total annual number of [redacted], the calculated PLL would be ~0.1 fatalities per year (approximately one fatality every ten years). This result is similar to that for 2006, such that the risk that is removed by each inspection as part of the meter reading and inspection process is comparable to the risk to the meter readers in making the visit.

4.5.2 Other agents

In addition to the potential hazards to meter readers in undertaking meter readings, there is the possibility of accidents and injuries to other agents attending the meter, for example:

- Agents inspecting meters following cases of suspect theft.
- Debt recovery agents executing warrants of entry

It might be expected that the risk to agents attending properties where there is ongoing theft of energy would be greater than for visits undertaking for routine meter readings and inspections (for example the likelihood of assault could be greater in such cases). However, Lost Time Accident (LTA) data from the meter reader agents and DRS indicate that the likelihood of injury per year is approximately the same for the two processes.

4.6 Summary of 2009 Data Collection and Analysis

The key findings from the collection and analysis of data for 2009 were:

Meter populations

- The 2009 domestic meter populations are broadly similar to 2006.
- The 2009 I&C meter populations are significantly greater than in 2006 (by a factor of 2 for electricity and 3 for gas).

Meter reader data

- The 2009 dataset for domestic gas meters is similar to the 2006 dataset in terms of hazardous situations identified.
- For domestic electricity meters and both I&C gas and I&C electricity meters, the 2009 dataset suggests that more risk is being removed in 2009 by the meter reading and inspection process than in 2006, although the risk removed is small compared with domestic gas meters.

Theft data

- Significant numbers of hazardous and latently hazardous installations were identified and made safe as a result of the theft detection trial in 2009.
- Overall, more risk to the public was removed as a result of theft detection activities than by the routine meter reading and inspection processes.
- The trial theft initiative identified significantly more hazardous and latently hazardous electricity meter installations than the meter reading and inspection processes.
- The trial theft initiative identified similar numbers of hazardous and latently hazardous gas meter installations than the meter reading and inspection processes.
- The hazardous and latently hazardous meter installations identified as part of the theft initiative would not be expected to have been identified as part of the meter reading and inspection process.

Occupational risks

- The 2009 dataset is broadly similar to that obtained in 2006 in terms of accidents to meter readers.
- As with the 2006 data, the risk to the public that is removed by the meter reading and inspection process is comparable to the risk to meter readers in carrying out the visit.
- The likelihood of injury per year appears to be similar for workers carrying out theft detection activities to meter reading and inspection activities.

5 ESTIMATED IMPACT OF PROPOSED CHANGE TO METER INSPECTION OBLIGATIONS

5.1 Assumed Changes to Meter Reading and Inspection Processes

British Gas' 2009 populations of meters are outlined in Appendix D. In order to estimate the risk impact on this population of a relaxation in the MRI obligation from 2 years to 5 years, it is also necessary to make assumptions about how the relaxation may affect the frequency of routine meter readings and inspections.

The following working assumptions were agreed with British Gas for the purposes of this analysis, in the event that a relaxation in the MRI obligation from 2 years to 5 years is granted:

- The current 2-yearly Must Inspect regime is relaxed to a 5-yearly Must Inspect.
- Routine reading visits for domestic meters are made at least annually.
- Routine reading visits for "Annual Read" I&C meters are made at least biannually.
- Routine reading visits for "Monthly Read" I&C meters remain unchanged.

5.2 Risk Impact

In general, the more frequently a meter reader attends a property, the more opportunities they have to be able to detect and mitigate the consequences of a gas escape, detect latently hazardous gas meter installations, detect hazardous electricity meter installations and detect latently hazardous electricity meter installations. In theory, if meter reader visits were to be abandoned totally, all of the risk currently removed by the meter reader visits would be restored to the public. Because there is no data available on the numbers of hazardous and latently hazardous installations that would be detected by any assumed future process, it is necessary to estimate the effect on risk removed by the new process using judgement. One option that was considered was to obtain data from other countries, where the existing meter processes are comparable with those that are assumed to be in place following a relaxation of the MRI obligation from 2 years to 5 years. Although initial approaches identified wide variations in the obligations and processes followed in different countries, which confirmed that the current meter inspection obligations and processes are relatively onerous compared with other countries, no firm data was available for detailed analysis.

Hence, judgement has been applied based on consideration of the possible impact of a reduction in the frequency of meter inspections. It is possible that a reduced frequency of routine meter visits and concomitant inspections would encourage tampering with the gas and electrical installations, thereby possibly increasing the levels of risk. On the other hand, it would be expected that the same hazardous and latently hazardous situations would still be detected as before, but that the time to detection would, on average, be increased. To a first approximation it was considered justified to assume that the risk removed by the meter readers is proportional to the number of visits. Hence:

- A routine reading and inspection visit made at least annually for domestic meters (accompanying a relaxation in the MRI obligation from 2 years to 5 years) would remove at least 25% of the risk currently removed.
- A routine reading and inspection visit made at least biannually for "Annual Read" I&C meters (accompanying a relaxation in the MRI obligation from 2 years to 5 years) would remove at least 50% of the risk currently removed.
- The risk removed associated with "Monthly Read" I&C meters would remain unchanged.

In the table below, the PLL calculated for the current process is multiplied by a scaling factor to estimate the risk removed by the assumed future process. Although no change is assumed to the process for Monthly Read I&C meters, the data provided did not allow the numbers of Monthly Read I&C meters to be identified separately and so the PLL estimated for all I&C meters has been cautiously multiplied by the same ratio to estimate the revised PLL.

Table 10: Change in PLL with change in meter reading and inspection processes

	PLL currently removed by meter reading and inspection process	Fraction remaining following change in process	PLL removed by meter readers following assumed future processes
Domestic gas	5.7×10^{-2}	25%	1.4×10^{-2}
I & C gas	1.1×10^{-2}	50%	5.3×10^{-3}
Domestic electricity	6.8×10^{-5}	25%	1.7×10^{-5}
I&C electricity	8.0×10^{-5}	50%	4.0×10^{-5}
Total	6.7×10^{-2}	~	1.9×10^{-2}

Based on the results of the data collection and analysis described above, and the routine reading visit assumptions accompanying a relaxation of the MRI obligation, an estimate of the total risk removed by the assumed future processes can be made as presented in Table 11.

Table 11: Estimated risk removed in assumed future scenario following MRI relaxation

	PLL removed by enhanced theft process	PLL removed by meter readers following assumed future processes	Total PLL removed by enhanced theft process and meter readers
Domestic gas	5.9×10^{-2}	1.4×10^{-2}	7.3×10^{-2}
I & C gas	6.6×10^{-3}	5.3×10^{-3}	1.2×10^{-2}
Domestic electricity	4.6×10^{-3}	1.7×10^{-5}	4.6×10^{-3}
I&C electricity	2.7×10^{-4}	4.0×10^{-5}	3.1×10^{-4}
Total	7.0×10^{-2}	1.9×10^{-2}	8.9×10^{-2}

There are many more domestic meters than I&C meters. Hence, the number of accidents to meter readers associated with domestic meter reading and inspection activities will dominate the accident statistics and so changes to the domestic meter reading and inspection activities will have the greatest impact. From the meter readers' accident data, it was estimated that the PLL imposed to meter readers would be reduced to about 25% of the current level based upon the assumed meter reading and inspection process. In Table 12 below, a conservative value of 50% has been used. This is the value that would be obtained based upon the analysis of the assumed "Annual Read" I&C routine meter reading and inspection process and its usage also incorporates an allowance for the "Monthly Read" I&C meters remaining as monthly read.

Table 12: Estimated annual risk to workers in assumed future scenario following MRI relaxation

	Meter readers	Theft workers
PLL to workers	0.05	3.3×10^{-4}
Total PLL all workers	0.05	

5.3 Comparison of Risks

The above results allow the risk removed following a relaxation of the MRI obligation from 2 years to 5 years to be compared to the level of risk removed previously. In order to make a direct comparison, the level of risk removed by the existing theft processes for electricity meters prior to the trial in 2009 was conservatively estimated to be 25% of the risk removed by the enhanced theft processes as described in Section 4.4, and included in the estimates of the total risk removed, as presented in Table 13, together with the estimated risk removed by the enhanced theft process and assumed meter reading and inspection processes following a relaxation of the MRI obligation.

Table 13: Risk removed by existing processes compared with assumed future scenario

	PLL removed by existing theft process	PLL currently removed by meter readers (2009 data)	Total PLL removed by existing theft process and meter readers	Total PLL removed by enhanced theft process and meter readers
Domestic gas	-	5.7×10^{-2}	5.7×10^{-2}	7.3×10^{-2}
I & C gas	-	1.0×10^{-2}	1.0×10^{-2}	1.2×10^{-2}
Domestic electricity	1.2×10^{-3}	6.8×10^{-5}	1.3×10^{-3}	4.6×10^{-3}
I&C electricity	6.8×10^{-5}	8.0×10^{-5}	1.5×10^{-4}	3.1×10^{-4}
Total	1.3×10^{-3}	6.7×10^{-2}	6.8×10^{-2}	8.9×10^{-2}

Comparison of the estimates of the risk removed by the existing processes with the risk removed by the enhanced theft detection process and assumed future meter reading and inspection processes (the two right hand columns in Table 13), shows that the changes in risk are small. Because the estimated levels of risk removed are low, they are consequently difficult to quantify with certainty. However, by using the same methodology to estimate the level of risk removed before and after the change of inspection regime, a direct comparison may be made.

Overall, it is estimated that approximately 30% more risk would be removed following the relaxation in the MRI obligation than before, provided that the theft initiative is maintained and that routine meter reading and inspection processes are as assumed. If any additional measures are introduced, for example further enhancements in the theft detection activities or any other risk mitigation measures, the risk removed would be greater.

In terms of the risk to employees, Table 14 below shows the predicted impact of the revised inspection regime following a relaxation on the MRI obligation. Concerning employees working on the theft detection initiative, it is assumed that the risk to workers associated with these activities was negligible prior to the 2009 trial. The results indicate that, overall, the risk to workers associated with the meter reading and theft detection activities would be reduced by a factor of approximately two by the change to the revised processes following a relaxation in the MRI obligation.

Table 14: Comparison of annual PLL for meter readers and other employees associated with the processes

	Current processes	Revised processes	
	PLL to meter readers	**PLL to meter readers**	**PLL to theft workers**
	~	0.05	3.3×10^{-4}
Total	0.1	0.05	

6 SUMMARY

The study analysed very large quantities of data supplied by British Gas, in order to identify the numbers of hazardous (e.g. actual gas escapes) and latently hazardous (e.g. damaged installations with the potential to deteriorate) situations identified both through the routine meter reading and inspection processes and through the theft detection activities, and hence the levels of risk removed. The data was broken down by domestic and I&C (Industrial and Commercial) meters, as well as gas and electricity.

Based on this data, an estimate was made of the changes in risk associated with the proposed relaxation in the Must Read and Inspect (MRI) supply licence requirement from two years to five years (assuming that this is accompanied by a reduction in the frequency of routine visits) coupled with the increased theft detection activity (assuming that the trial is continued in future). The results are summarised in Table 15 below, expressed as risk removed in terms of annual PLL (Potential Loss of Life), broken down by the different categories of meters.

Table 15: Risk removed per year by existing processes compared with assumed future scenario

	Total PLL currently removed by existing processes	**Total PLL removed following MRI relaxation with enhanced theft process**
Domestic gas	5.7×10^{-2}	7.3×10^{-2}
I & C gas	1.0×10^{-2}	1.2×10^{-2}
Domestic electricity	1.3×10^{-3}	4.6×10^{-3}
I&C electricity	1.5×10^{-4}	3.1×10^{-4}
Total	6.8×10^{-2}	8.9×10^{-2}

Comparison of the estimates of the risk removed by the existing processes with the risk removed by the enhanced theft detection process and assumed future meter reading and inspection processes shows that the changes in risk are small. Because the estimated levels of risk removed are low, they are consequently difficult to quantify with certainty. However, by using the same methodology to estimate the level of risk removed before and after the change, a direct comparison may be made. Overall, approximately 30% more risk is estimated to be removed following the relaxation in the MRI obligation than before, provided that the theft initiative is maintained (and that metering processes are as assumed). If any additional measures are introduced, for example further enhancements in the theft detection activities, specific inspection regimes for particular customer groups (e.g. customers with special needs), or any other risk mitigation measures, the risk removed would be greater.

An analysis of accident data reported by meter readers and agents carrying out the theft detection processes was also undertaken, to estimate the risk associated with carrying out their duties (comparable to that for postal workers). This found that the risk to the public that is removed per meter inspection made as part of the routine meter reading and inspection process is similar to the risk to the meter reader carrying out the inspection. In terms of the risk to employees, the results indicate that, overall, the risk to workers associated with the meter reading and theft detection activities would be reduced as a result of the revised processes assumed to accompany a relaxation in the MRI obligation from two years to five years.

7 CONCLUSIONS

GL has carried out an assessment of the levels of risk removed by the current meter reading and inspection processes, based on a detailed analysis of large quantifies of data supplied by British Gas. This confirmed that the level of risk removed by the current process is small. Also, the level of risk to workers undertaking the activities was found to be similar to the level of risk removed to the public for each inspection made.

An estimate was made of the changes in risk associated with the proposed relaxation in the MRI obligation from two years to five years coupled with an enhanced theft detection activity (assuming that the trial commenced in 2009 is continued in future). Overall, the assumed changes in processes were predicted to be more effective at removing risk to the public than before, because of the targeted identification of hazardous situations by the theft detection activity. In addition, the risk to workers associated with the meter reading and theft detection activities would be reduced.

8 GLOSSARY OF TERMS AND ACRONYMS

CO = Carbon Monoxide

DN = Distribution Network (gas)

DNO = Distribution Network Operator (electricity)

DRS = Debt Recovery Service

ECV = Emergency Control Valve

ESP = Emergency Service Provider

GIB = Gas in Building

GSMR = Gas Safety (Management) Regulations

HHT = Hand Held Terminal

HSE = UK Health and Safety Executive

I&C = Industrial and Commercial

LEL = Lower Explosive Limit

LPG = Liquefied Petroleum Gas

LTA = Lost Time Accident

MI = Must Inspect

MOP = Meter OPerator

MRA = Meter Reading Agency

MRI = Must Read and Inspect

PLL = Potential Loss of Life

PRE = Public Reported (gas) Escape

RPO = Revenue Protection Officer

RTA = Road Traffic Accident

SVCC = Site Visit Completion Code

TGB = Tariff Gas Billing

TOG = Theft Of Gas

Individual Risk = Likelihood of an individual becoming a fatality (usually expressed in terms of a likelihood per year)

“Monthly Read” I&C meters as defined in Section M of the Uniform Network Code (visited monthly)

“Annual Read” I&C meters as defined in Section M of the Uniform Network Code (currently visited quarterly)

Latent failure = situation that is not currently hazardous but could change to become hazardous

Meter reader = meter reading agent employed by the MRA

Appendix A 2006 Data Collection

A.1 Overview

This section provides a brief overview of the data collected by British Gas as part of the risk evaluation exercise. The data collected is described in more detail in the following sections.

A.1.1 Domestic gas

Data has been provided on:

- Population of meters
- Number of routine and multi-visit MRI inspections
- Listings of comments associated with meter readings

Following examination of the comments produced by the meter readers, 491 cases were identified as meriting further investigation. Requests for detailed information on the outcome following these reports were submitted to DNs.

Responses have been obtained from DNs with information on the vast majority of these. However, in general, the information was very limited and provided insufficient information on the nature of the hazard to allow any scenario-specific modelling to be carried out.

A.1.2 I&C gas

Data has been provided on:

- Population of meters
- Number of routine and multi-visit MRI inspections
- Comments made during the meter reading and inspection process

A.1.3 Domestic electricity

Data has been provided on:

- Population of meters
- Routine visits including SVCC distribution
- Comments made during the meter reading and inspection process
- Comments from other sources (e.g. engineers undertaking maintenance)

Following examination of the comments produced by the meter readers, 55 cases were identified as meriting further investigation. Requests for detailed information on the outcome following these reports were submitted to DNOs. Information received from the DNOs was insufficient to allow identification of the nature of the hazards associated with the installations.

A.1.4 I&C electricity

Data has been provided on:

- Population of meters

- Routine visits including SVCC distribution.
- Comments associated with routine visits

N.B. Data from readings obtained as part of the multi-visit MRI process could not be distinguished from those made during other processes such as maintenance, repairs etc.

A.1.5 Incident data

British Gas has examined its data on previous incidents and has found no record of any incident associated with a meter installation occurring at a property where the meter has not been inspected for over two years.

A.2 Domestic Gas Meters

A.2.1 Overall meter population

The British Gas population of gas meters comprises approximately 10 million meters, which includes:

- Approximately 9.8 million domestic meters
- Approximately 250,000 I&C meters

Some of the 9.8 million domestic (U6 and equivalent) gas meters are installed in small commercial premises (e.g. shops, factory units etc). However, for simplicity of analysis these meters have been assumed to be equivalent to domestic premises.

Similarly some of the I&C gas meters may be large houses that have business scale gas meters. Again, for simplicity, all I&C meters are assumed to be installed in non-domestic environments. Additionally, some of the domestic gas meters may be domestic scale meters located in business premises of customers that have other large scale gas supplies.

Meter readings are taken as a result of routine visits, MRI visits and other visits (e.g. customer requested meter readings and meter exchanges). For the purposes of this study it is assumed that the number of meters read and inspected as result of the routine visits plus the MRI visits comprise the vast majority of the meter population. British Gas estimates that approximately 99.5% of meters have been inspected in the previous 2 years.

The 2006 split of 87% credit meters and 13% prepayment meters, corresponds to approximately 8.6 million credit meters and 1.2 million prepayment meters.

A.2.2 Domestic gas meter reading and inspection process in 2006

Credit meters

The process for reading and inspecting domestic gas credit meters in 2006 is summarised in Figure 3. In essence, the meter readers undertook an initial period of routine meter readings (4 visits per year). If after 15 months a meter reader has not been able to visit the meter for a reading and concomitant inspection, the frequency of visits to the property would be increased. This is known as the multi-visit stage of the process. If after ~6 visits in the multi-visit stage the meter has still not been read and inspected, the process is escalated further to include writing to/contacting the customer, making appointments to visit the meter etc. If after this process has been exhausted, the meter still had not been read/inspected the process was escalated, to apply for and execute warrants to force entry to the property. It should be noted that, as well as undertaking meter readings/inspections under the 2-yearly SLC12 criterion, properties would also have been attended for a variety of other reasons.

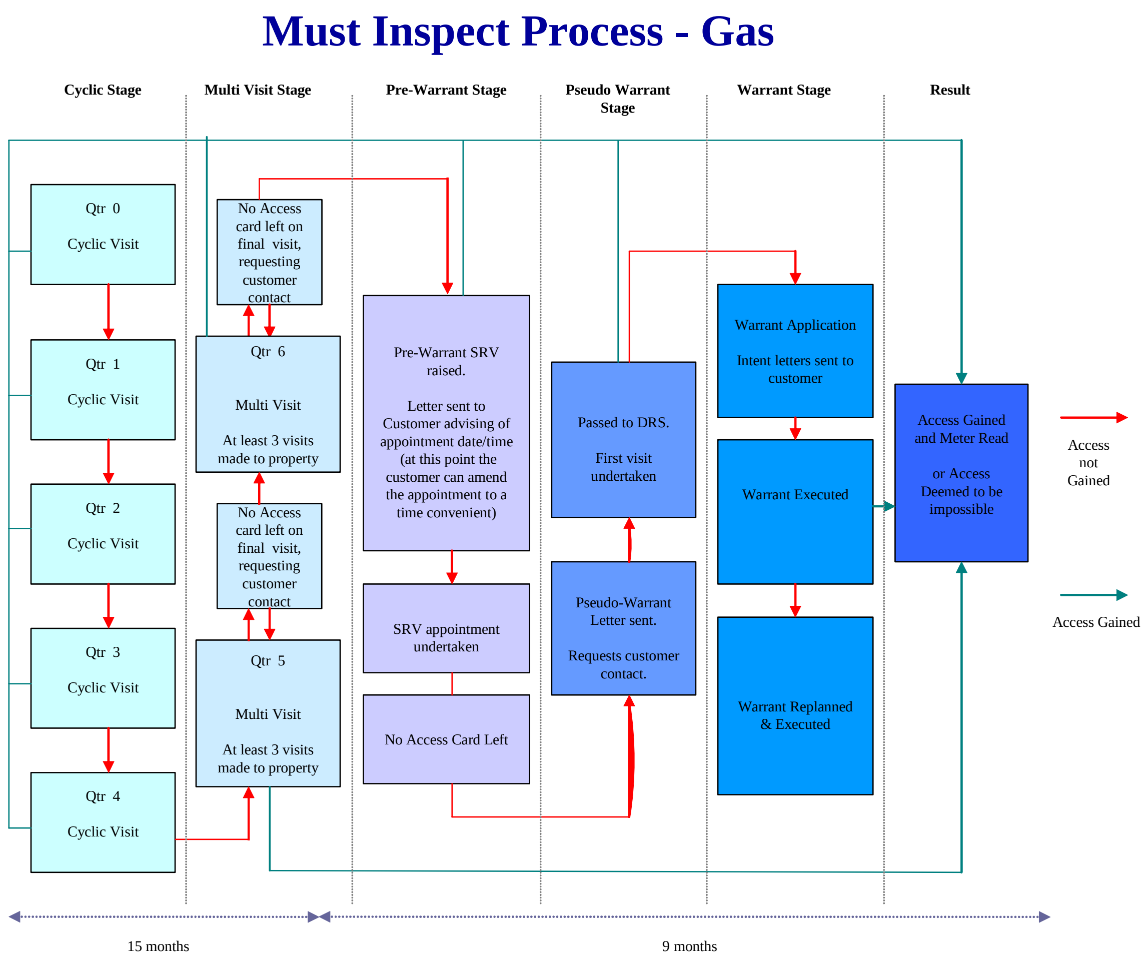

Figure 3: Meter reading and inspection process map for domestic gas meters

Prepayment meters

In 2006, prepayment domestic gas meters were not read as part of a billing process. The process whereby prepayment meters were read/inspected varied during the course of 2006 as follows:

- In early 2006 (whilst the TGB billing system was operational) the prepayment meters were introduced into the reading and inspection process at the 15 month stage. They then went through a single routine reading/inspection visit. If not read at this stage the meter entered the multi-visit stage of the MRI process. From this point the process is as described above for the credit meters.
- In late 2006 (following the introduction of the SAP billing system) prepayment meters were introduced into the meter reading and inspection process 18 months after the previous meter reading/inspection, at which time they entered the multi-visit stage of the MRI process.
- In December 2006 the SAP system was modified so that prepayment meters entered the process in the same way as had occurred on the TGB system.

A.2.3 Data extraction

The data obtained in regard to the reading and inspection of domestic gas meters can be represented as three stages:

- Routine meter reading and inspection activities as undertaken by the MRAs
- Multi-visit stage MRI meter reading and inspection activities undertaken by the MRAs
- The warrant stage processes undertaken by the DRS.

These processes will be examined in two parts, firstly data provided by the MRA and secondly data provided by the DRS.

A.2.4 2006 data extraction by the MRAs

Table 16 summarises the number of meter readings and inspections undertaken in 2006 by the MRAs. British Gas examined the data obtained during domestic gas meter readings (for both credit and prepayment meters) in 2006 to determine how many of these readings have comments associated with them. These comments were manually filtered by British Gas to give those which may have some impact on the current analysis. The protocol for this filtering was to initially exclude those generic classes of comments that had no obvious health and safety implication (e.g. name changes) until a list of comments was obtained where most of the comments appeared to have a relevance to this study. This list was then correlated against the monthly Health and Safety reports generated by the MRAs for meter readings.

British Gas has advised that they have not found any occasion where a gas escape has been reported during/following a "no access" visit to a domestic gas meter.

Table 16: Summary of domestic gas meter reading data from 2006

Total number of domestic scale gas meters	~9.8million
Number of quarterly routine returns (reads+ no access)	38,000,000
Total domestic gas routine reads in 2006	28,000,000
Total domestic gas routine returns with free form comments 2006	245,040
Number of MRI stage returns (reads+ no access)	1,033,391
Number of MRI stage reads	568,779

A.2.4.1 Identification of gas escapes

The basic process that British Gas meter readers follow on identifying a possible gas escape is to:

- In all cases, report gas escape to ESP and record report on their HHT.
- If no customer is present, close the ECV to gas supply and leave a no access card before continuing with their work schedule.
- If a customer is present, close the ECV to the gas supply and advise the customer of the escape and appropriate safety information before continuing with their work schedule.

At the warrant stage (for MRI visits) British Gas would wait at the property (to allow access to the ESP) or until the customer arrives at the property.

A.2.4.2 Classification of comments

The comments were then examined and divided into six categories as described below and summarised in Table 17. In addition, the numbers of comments corresponding to the routine visits and the MRI visits were determined.

The six categories were:

Gas escapes: Primarily reports of smells of gas.

Latent dangerous situations: These were comments that indicated that there could be a gas escape some time in the future if the problem was not addressed. Such indicators included:

- Corroded pipe work and meters
- Meters supported by gas pipes
- Tilted meters
- Missing ECVs (where distinct from the handle being missing)
- Suspected/actual theft of gas
- Suspected/actual tampering with meter

Also included in this category were meter installations that were not earthed.

Missing ECV handles: This has been included because this prevents/hinders mitigation of any gas escape downstream of the ECV and because meter readers should report missing ECVs to the ESP.

Meter faults: This category of miscellaneous faults included:

- Blank screens
- Broken meter boxes
- Ancient meters (oldest meter noted in the 2006 data dated from 1947, others noted from 1950s and 1960s)
- Broken/damaged dials
- Meters showing flags (nature of flag not analysed further)

ESP reported events: Meter readers should report gas escapes and missing ECV handles directly to the ESP and record the ESP reference number in the comment field. This category of records covers those comments where only the ESP reference number has been recorded. Where the context can be identified (i.e. escape or missing ECV handle) the comment has been categorised as such.

Other: All other records, including:

- Hazardous meter locations
- Dogs
- Asbestos
- Hazardous customers
- Indecipherable comments

Table 17: Classification of comments

	ALL	ROUTINE	MRI
Escapes	548	475	73
Latent failures	295	174	121
Missing ECV handles	585	500	85
Meter faults	1344	1213	131
ESP generic ECV/escape reports	103	94	9
Other	387	359	28
Totals	*3261*	*2814*	*447*

A.2.4.3 Data received from the DNs

An overall listing was made of those cases where the comments may include an ESP job number that can be used to identify the report under the categories of escapes (about 388 events of the 546 cases identified above) and unknown events (about 103). This then produced a total of 491 cases for further examination. British Gas then circulated the appropriate portions of this listing to the DNs that provide the ESP function for different parts of the UK. The responses are summarised below for each of the different DNs.

[redacted]

[redacted] provided information on 260 cases:

- In 23 cases [redacted] had no record.
- In 12 cases the data had been archived and no further information was available.
- In 225 cases further information was provided in the form of outcome codes, of which 192 items contained further text based information.

In most cases data were provided on the nature of the escape using codes to describe the nature of the escape and the outcome of the resultant visit.

The nature of the escape codes are given in Table 18 below:

Table 18: Escape code key

P	Priority Gas Escape
O	Outside Gas Escape
U	Uncontrolled Gas Escape
C	Controlled Gas Escape
SOG	Smell of Gas
MTR	Meter
O/S	Outside

In summary:

- There were 8 reported priority escapes (however this may relate to the nature of the consumer (e.g. elderly or vulnerable consumer) rather than the nature of the leak).
- There were 144 uncontrolled leaks.
- There were 75 controlled leaks (presumably the escape had been halted by closing the ECV to the meter).
- There were 7 escapes reported outside the property.

In 225 cases, further information was given related to the outcome, using the following codes:

Table 19: Outcome key

1	Job Complete
2	Made Safe
3	No Trace
4	Complete repaired
5	Archived No details available

In summary:

- There were 37 visits categorised as #1 – Job complete.
- There were 44 visits categorised as #2 – Made safe.
- There were 20 visits categorised as #3 – No trace.
- There were 124 visits categorised as #4 – Complete repaired.

In some cases, further information was provided by [redacted]. This information generally related to the nature of the rectification work rather than the nature of the leak. In none of the above cases was it possible to estimate the size of the leak encountered (if any) but none of the descriptions suggest that a significant gas escape was encountered.

In seven cases the job was described as "complete repaired" or "job complete" with the text comment that an engineering team was required/requested.

In examining this data it was noted that:

- Replacement of the regulator and inlet flex could be a routine task for replacement of certain classes of regulator and in such cases would not imply that any leak was encountered.
- A smell of gas (SOG) can be detected at concentrations well below the flammable range.
- The job may be "made safe" by isolating the gas supply at the meter ECV and attaching a warning notice (the meter ECV may also be known as the meter control valve (MCV)).

[redacted]

Further information was requested from [redacted] on 27 cases.

The information provided by [redacted] on these 27 cases was as follows:

- In 5 cases, no further information was available.
- In 2 cases, no gas leak was detected.
- In 15 cases a gas leak was found in the meter area. The information did not indicate the size of the leaks, but none of the information indicates that a large leak was found.
- In one case a leak was found at a neighbouring property.
- In one case a leak was found on the ECV and the attendance of an engineering team was required to affect a repair.
- In one case a leak was found on the cooker. Whilst in the property the engineer noted a smell associated with the central heating that was of concern to the engineer (presumably CO related).
- In one case the carcass pipe work was repaired before the credit meter was refitted.
- In one case the neighbours reported smelling fumes from a flue outlet (i.e. a CO issue).

[redacted]

Further information was requested from [redacted] on 20 cases.

Of these 20 cases, [redacted] reported that:

- They had no records relating to 2 cases.
- The data for 15 cases had been archived and was not immediately available.

Of the other 3 cases:

- One was where no escape of gas was found.
- One was a leak on the meter.
- One was a leak on a LP main about 11m from the property (gas not detected inside the property).

[redacted]

Further information was requested from [redacted] on 94 cases.

In general, the additional information provided was limited to simple text identifying possible location of the leak (e.g. meter) and outcome (e.g. repaired, made safe). In no cases was additional descriptive texts provided to allow estimation of leak size.

In 11 cases no information was available (no record, wrong address etc). Of the remaining 83 cases:

- There was no further information in 23 cases.
- No trace of gas was found in 3 cases.
- The outcome was described as repaired/make safe in 56 cases.
- A theft of gas was found in one case.

A.2.4.4 Summary of responses to meter reader reports

The numbers of responses received from DNs to requests for detailed information on the outcome of follow-up investigations as a result of reports made by meter readers are summarised in Table 20 below:

Table 20: Summary of responses received from DNs

	Total Replies to requests	No report	Archived / other system	Additional information (i)	Detailed information
[redacted]	20	2	15	0	3
[redacted]	260	23	12	225 (192)	0
[redacted]	27	6	0	21	0
[redacted]	94	11	0	83	0
Totals	401	42	27	329	3

Notes:

The further information provided by [redacted] was generally codified. Subsequent data requests provided additional text based information. The numbers related to text based information are included in the above table in parentheses. The additional information provided by [redacted] was generally codified. In some cases, the additional data provided by the DN was simply to identify that there was no further information available in regards to the incident.

Combining the data requested and received from the DNs produces a total of 491 records. Of which:

- 90 cases had no response from the DN.
- 104 cases where the DN indicated that there was no further information (e.g. no record found, blank record, archived record data inadequate to identify event etc.) This leaves a total of 296 cases where there was further text-based information provided by the DN. Of which:
- 19 cases had no trace of a gas escape.
- 40 cases where a leak was found upstream of the meter (primarily a leaking ECV).

- 162 cases where a leak from the meter area was encountered.
- 24 cases where a leak was found on the downstream appliances and/or pipe work.
- 7 cases where unidentified leaks were repaired.
- 33 cases where other issues had been addressed, primarily replacement of inlet connector and regulator.

The information on these cases did not suggest that any presented a significant hazard (for example there were no records indicating that properties had to be evacuated, or that open ended internal pipe work was encountered, the gas escape could not be isolated by closing the ECV etc.). Consequently it is assumed that these reports were not related to potentially hazardous occurrences.

It is possible that the above assumptions are slightly non-conservative. However, it is considered that this is at least balanced by the conservatism in the approach taken for the remaining cases, as outlined below.

This leaves 11 cases where it is possible that a potentially large or significant leak was reported:

- One leak on an LP main 11m from property, no entry of gas into property.
- One leak on an ECV requiring a repair by an engineering team.
- One leak reported at another property next door to the report location.
- 8 other cases where an engineering team was requested/required (indicating that non-routine remedial action may have been needed) but no further details were available.

In none of these cases did the descriptions suggest any unusual hazard to members of the public. For example, in no cases was there any suggestion that property had been evacuated following a report, which would be expected to have been recorded.

On this basis, it is considered that approximately 11 situations were encountered by the meter readers where their report initiated action by the ESP/DN to address a potentially significant gas escape.

Estimate of hazardous events

This analysis can then be related to the overall population of readings undertaken by the meter readers.

It s assumed that:

- The data for these 296 cases (where text based data was obtained) is representative of the data for the whole population of 649 comments, comprising 546 comments indicating a gas escape and 103 comments identifying a missing ECV handle/escape report to the ESP.
- Overall these 296 cases identified 11 hazardous situations for response by the ESP/DN.

Consequently, by simple extrapolation, the total number of such potentially hazardous events reported per year would be approximately 11 x (649/296) = 24 events per year.

A.2.5 Data from previous years

To check that the data obtained for 2006 is broadly representative, data from 2004 and 2005 relating to British Gas were also obtained for comparison purposes and summarised in Table 21 below. Assuming that reporting and recording criteria did not change in the period, the data suggests that the total number of reports of suspected gas leaks and missing ECVs remained approximately constant over the period, giving confidence that the detailed analysis of the data from 2006 would be expected to be representative.

Table 21: Comparison of data from 2004, 2005 and 2006

		2004	2005	2006
Routine meter visits	All	44 million	40.6 million	38.9 million
	Domestic	N/A	38.9 million	38 million
	Business	N/A	1.7 million	0.9 million
Successful routine inspection/reading visits	All	Est 31 million	Est 28 million	Est 29 million
	Domestic	N/A	N/A	28 million
	Business	N/A	N/A	0.8 million
MRI visits	All	1.3 million	1.2 million	1.1 million
	Domestic	N/A	1.1 million	1 million
	Business	N/A	0.1 million	0.05 million
Gas leaks	All	792	798	558 (608) (i)
	Domestic	N/A	N/A	546 (596) (i)
	Business	N/A	N/A	Est 12
Missing ECV	All	223	306	N/A
	Domestic	N/A	N/A	586 (639) (i)
	Business	N/A	N/A	N/A

Notes (i) A further 103 cases related to the readings of domestic gas meters were identified as being potentially a gas leak or a missing ECV. Incorporating these pro rata produced the value in parentheses.

A.2.6 Post multi-visit MRI meter readings and inspections

After the meter reading agency has completed the multi-visit stage MRI visits there are three further stages to consider.

A.2.6.1 Special Read Visits (SRVs)

Following from the multi-visit stage MRI process contact is made with the customer to arrange an appointment to read/inspect the meter, such a visit is known as a special read visit (SRV). However SRVs can also be initiated for other reasons.

A.2.6.2 Pre-warrant visits

Following the multi-visit stage undertaken by the MRAs and contact with the customer through SRVs, those domestic gas meters that still have not been read/inspected would have a preliminary visit before seeking and executing an entry warrant.

Data on the warrant stages of the meter reading and inspection process were supplied by British Gas for 2007. Table 22 gives British Gas' analysis of the data for the pre-warrant visits undertaken in 2007.

Table 22: Analysis of the data for the pre-warrant visits undertaken in 2007

	Q1	Q2	Q3	Q4	Total
Cancelled before call	4009	17246	10074	9163	40492
Read	3574	6291	4699	6472	21036
No access (Not progressed to warrant)	588	1941	8168	11210	21907
No access (progressed to warrant)	8004	10194	2989	1765	22952
Incorrect Address	542	1096	290	333	2261
Meter query (serial number does not match paperwork)	217	165	226	315	923
Demolished property	552	583	802	548	2485
Change of tenancy	9	52	1	0	62
Bricked/boarded up	308	447	58	145	958
Unable to locate property	158	155	174	194	681
Vacant property	138	154	334	642	1268
Address	10	7	1	0	18
Total	18109	38331	27816	30787	115043

This data indicates that in 2007, 115,000 domestic gas meters were passed from the routine and multi-visit MRI meter processes to the warrant stages, of which approximately:

- 40,000 cases were resolved before the warrant first visit was undertaken.
- 21,000 meters were read/inspected.
- 22,000 meters had no access but the meter was not progressed to the warrant stage.
- 23,000 meters were progressed to the warrant stage.
- 9,000 were not read for a range of reasons.

A.2.6.3 Analysis of warrant data for September to December 2007

Forty archive boxes of warrant data covering the four-month period September to December 2007 were examined to analyse the number of Must Read Warrants (MRW) that were executed resulting in a DRS field agent reading a gas meter and concomitantly inspecting the meter.

Amongst the data were warrants related to electricity debt issues and gas debt issues. These warrants were not examined.

In the documentation recording the site visit there was a section that allowed the DRS agent to make additional comments related to the job. In general these comments related to:

- The method of entry (e.g. lock drilled, picked etc.).
- Why the job was no access (e.g. security locks, padlocks, unable to force entry without causing damage etc.).
- Why the job had been cancelled (e.g. meter already read, court refused warrant, warrant not obtained hence treated as cold call, problem with warrant hence treated as cold call etc.).
- Issues with the building (vacant, demolished, burnt down etc.).
- Health and safety issues (unsafe to enter building etc, property unhygienic rat infested, rotting bin liners etc.).
- Issues with the meter (corrosion of pipes, gas leaks etc)

A summary of the MRWs for this period is given in Table 23.

Table 23: Summary of MRWs for September to December 2007

Total Number of Boxes	40
Total Number of Record Bundles	1894
Total Number of MRWs	7668
Total Number of MRWs classified as no access and/or cancelled	2955
Total Number of MRWs where reading obtained	4713
Of which	
Number of gas escapes detected	0
Number of potential theft of gas detected	1
Number of meter installations with condition issues	2

It is noted that:

- The identified potential theft of gas was related to damage to the meter index (thereby preventing the meter being read) rather than tampering with the pipe work. As such, in this case, it would not be considered to be a safety issue.

- In one case the comments indicated that the meter box cover was missing and some pipe work was rusty and in poor condition.
- In one case there was no cross-bonding on the meter, the customer was advised and a card was left.

For virtually all the warrants where the meter was accessed, the meter was located inside the property, e.g. kitchen, hallway, lounge. These are locations where:

- Obtaining access could be difficult if the occupant was out and/or reluctant to assist in the meter reading and inspection process.
- It would be considered likely that the occupant would detect a gas escape through a smell of gas.
- It would be possible for an escape to accumulate within the property, for example within an understairs cupboard. Indeed an escape of gas from a meter installation within a property would be considered more hazardous than the equivalent escape in a meter box outside the property.

A.3 I&C Gas Meters

A.3.1 Meter population

In 2006, there were two databases for larger scale business customers known as the CGABS and the Service Desk Gas (SDG) systems. These systems contain a mixture of monthly read and quarterly read meters.

CGABS Database:

- Monthly Read 19,000 meters, of which about 18,000 are read each month.
- Annual Read 26,000 meters, of which about 22,000 are read each quarter.

SDG Database:

- Monthly Read 24,000 meters, of which about 22,800 are read each month.
- Annual Read 72,000 meters, of which about 61,000 are read each quarter.

There are no significant differences between the populations of meters on the two databases and so the data on the two business scale databases (CGABS & SDG) have been aggregated as summarised in Table 24 below.

In total, there are 141,000 I&C customers, of which 43,000 have monthly scheduling of readings and inspections (making a total of 516,000 scheduled visits per year) and 98,000 have quarterly scheduling of readings and inspections (making a total of 392,000 scheduled visits per year). 83,000 quarterly meter readings are obtained each quarter making a total of 332,000 per year. 40,800 monthly meter readings are obtained each month making a total of 490,000 per year.

Table 24: Summary of I&C gas meter reading data from 2006

Total number of I&C gas meters	141,000
Total number of visits (estimated)	908,000
Total I&C gas readings in 2006	822,000
Number of Monthly Read I&C meters	43,000
Number of I&C Monthly Read routine monthly returns	332,000
Number of I&C Annual Read meters	98,000
Number of I&C Annual Read routine quarterly returns	490,000

Data are available for MRI visits on the SDG database. British Gas considers that the same ratios would also apply to those meters on the CGABS database.

It is noted that all the meter readings associated with the MRI protocol are related to the pre-warrant stages of the process.

For those meters read monthly, a MRI job is generated after 2 months of failed reads, whereas for those read quarterly a MRI job is generated after 18 months of failed reads. The jobs remain classified as a MRI until an actual read is taken.

The data from the SDG database were applied at the same ratio to the meter population from the CGABs database to give overall numbers (to the nearest thousand) for the British Gas population of I&C meters, as summarised in Table 25; noting that:

- The SDG data base holds 24,000 of the 43,000 Monthly Read I&C meters.
- The SDG database holds 72,000 of the 98,000 Annual Read I&C meters.

Table 25: Breakdown of routine and MRI readings for I&C gas meters

	SDG total for the year 2006	SDG & CGABS calculated total for 2006
Routine quarterly reads (Annual Read meters)	193,833	264,000
MRI quarterly reads (Annual Read meters)	24,089	33,000
Routine monthly reads (Monthly Read meters)	231,601	415,000
MRI monthly reads (Monthly Read meters)	7,807	14,000
Total routine		679,000
Total MRI		47,000

A.3.2 Classification of comments

Comments were obtained from I&C gas meter readings and visits for April 2006 and October 2006. British Gas holds no data related to visits made as part of the MRI process for I&C gas meters. In order to make some estimate of the comments made as part of the routine and MRI processes a division was made into readings likely to be associated with routine visits and those likely to be associated with multi-visit MRIs as follows.

Those with the following codes were treated as comments obtained by part of the routine reading and inspection process:

CYQR - Cyclic Quarterly Read

CYSM - Cyclic Monthly Read

OPNT - Opening Meter Read (on acquisition)

Those with the following codes were treated as comments obtained by part of the MRI process.

SP24/48 - Special Read Visits including visits specific to Must Inspects

MRQR - Multi Visit Quarterly

MRSM - Multi Visit Monthly

British Gas estimates that less than 10% of ad hoc jobs (SP24 & SP48) relate to Must Inspect jobs.

Comments were obtained for both visits where a reading was not obtained and visits where a reading was obtained. The comments were divided into three categories:

- Immediate hazardous event (e.g. gas escape)
- Latently hazardous event (e.g. heavily corroded meters)
- Other (meter details, customer comments, address queries etc.)

Two data sets were supplied by British Gas, from two separate databases, specifically the SDG database and the CGABS data base, summarised in Table 26 below:

Table 26: Classification of comments for business gas meters

Database	Month	Type	Hazardous	Latent	Other
CGABS	April 06	No read	0	0	806
		Routine	0	1	188
		MRI	0	0	33
	October 06	No read	0	0	853
		Routine	0	1	205
		MRI	0	0	18
SDG	April 06	No read	0	0	1631
		Routine	0	1	314
		MRI	0	1	109
	October 06	No read	0	0	2643
		Routine	2	2	347
		MRI	0	0	102
Sub Totals			2	6	7249

Examination of the comments obtained for the “no access” visits during April 2006 found no occasion where a smell of gas had been reported. It is assumed that this pattern was typical of the whole year and that in 2006 no gas escapes were reported during “no access” visits.

It is assumed that the data from these two months are typical of the overall pattern for the year, in which case the estimated number of relevant MRA comments for the whole of 2006 are:

Table 27: MRA comments for I&C gas meters in 2006

I&C gas meter	Hazardous installations	Latently hazardous installations
2006 Routine	12	30
2006 MRI	0	6
2006 Total	12	36

These values can then be related to the number of readings taken for the two processes:

Table 28: Summary of numbers of comments from I&C gas meter readings

I&C gas meter	Readings 2006	Hazardous installations		Latently hazardous installations	
		Number of comments	Occurrence per reading	Number of comments	Occurrence per reading
Routine	679,000	12	1.8×10^{-5}	30	4.4×10^{-5}
MRI	47,000	0	~	6	1.4×10^{-4}

The two reports of business hazardous installations encountered were forwarded to the gas DNs for further information. Data was received from the DNs for the [redacted]. This data was then combined with data held by British Gas to give:

[redacted]

- [redacted]
- Meter reading was categorised as "CYSM"
- Meter_Reading: 168360:
- General_Notes: gas escape ref: [redacted]
- Outcode: NW2
- Nature of escape: U Uncontrolled Gas Escape
- Outcome: 1 Job Complete
- Reason: No details
- Meter was located "outside".

[redacted]

- Meter reader closed ECV
- Meter reading was categorised as "OPNT"
- Meter was a G4 located in the cellar

A.3.3 Summary of domestic gas data

The available data does not allow risk removed as part of the routine reading and inspection process to be clearly differentiated from readings undertaken as part of a MRI regime.

In no case was evidence found that a meter reader contacting the gas ESP had resulted in a DNO Engineer attending a property and rectifying a hazardous or potentially hazardous situation. This could be a result of the quality of the data held by the DNs or the work processes being examined. In this context it is noted that in one of the cases the meter reader closed the ECV; however, it is not known if this action actually stopped an ongoing gas leak.

Given this caveat, the conclusion from this piece of work is that the meter reading and inspection process for business gas meters removes a level of risk that is too small to be determined accurately.

A.4 Domestic Electricity Meters

A.4.1 Meter population

In 2006, British Gas had approximately 6 million domestic scale electricity meters comprising:

- 5.9 million domestic electricity meters
- 120,000 small business sites with domestic scale meters

Some of the domestic meters are installed in small commercial premises (e.g. shops, factory units etc). However, for simplicity of analysis these meter installations are assumed to be in domestic premises.

Similarly some of the I&C supplies may be large houses that have business scale meters. Again, for simplicity, all I&C meters are assumed to be installed in business environments.

The British Gas population for domestic electricity meters comprise both prepayment and credit meters. In 2006 there were approximately 4.8 million credit meters and 1.1 million prepayment meters.

During most of 2006, domestic electricity prepayment meters were visited/read quarterly (same as credit meters). In October 2006, the frequency of reading of prepayment meters was reduced. However, for the purposes of the following data collection and analysis exercise, credit and prepayment meters are treated as being equivalent, with both types being visited quarterly.

A.4.2 Meter reading and inspection process

The process for reading domestic electricity credit meters in 2006 is summarised in Figure 4. In this process the credit meter is initially in the routine meter reading and inspection process for 18 months, if after this time it has not been read or inspected by a meter reader it enters the multi-visit and customer contact stages. It is understood that in 2006 British Gas did not execute warrants for must inspect visits to domestic electricity meters (there being no legal requirement for British Gas to seek warrants for electricity meter inspections). If a meter had not been inspected in the previous 2 years it reverted to the routine visits process.

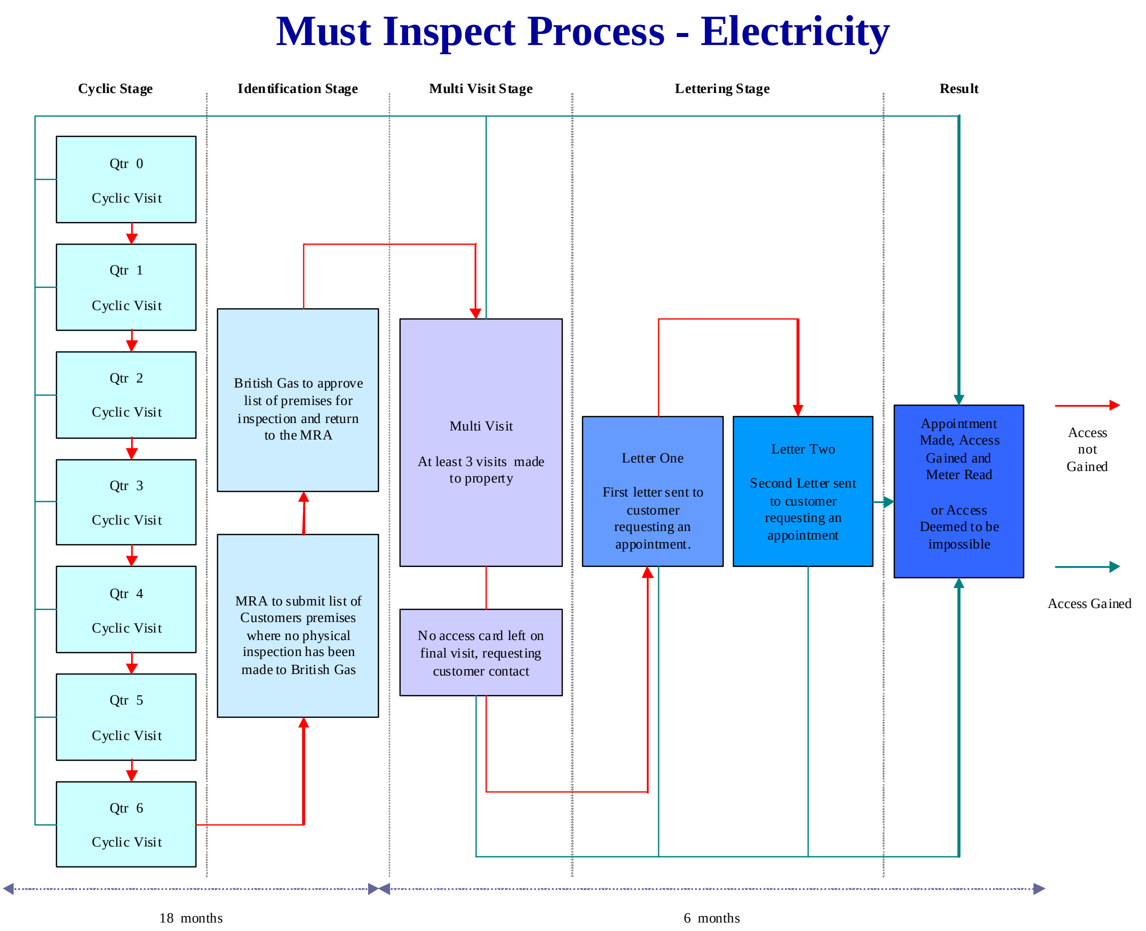

Figure 4: Meter reading and inspection process map for domestic electricity meters

A.4.3 Data extraction for 2006

In 2006, there were approximately 14.5 million meter reads, resulting in 139,538 free form comments input. Typically, domestic electricity meter reading has a success rate of 67 readings per 100 visits, from which it is estimated that these readings were the result of ~22 million visits.

Some electricity meters record consumption at two different rates (for example a day time rate and a night time rate). Such meters would be considered to be a single meter that requires the two readings to be taken in order for it to be classified as a single successful visit.

It is not known how many meter readings/visits were undertaken as part of the MRI process. It was not possible to differentiate between readings made as part of the routine process and those made as part of the MRI process. It is also not known how many of these meter readings were made as the result of engineers (MOPs) working at the property.

Each MRA has its own training material, so specific wording and instructions may vary. However, in general, the scenarios where it could be expected that the meter reader would make an "emergency" phone call to the distributor to initiate action are as follows:

- Smoke or sparks coming from the installation
- Cut Out Hot
- Cut Out loose or unsupported and hanging

- Exposed contacts, cable covers missing
- Signs of heat staining on wires or meter equipment
- Fresh pitch or tar leaking from the cut out
- Crackling noises coming from the meter installation
- Meter installation exposed to the elements
- Loose cables
- Unconnected cables
- Dampness on trunking

The only way the meter reader has of identifying/reporting a hazardous installation to the Supplier is through the input of free form comments. These data were manually filtered by British Gas to exclude routine comments that did not have a health and safety implication thereby leaving ~1700 comments. The remaining comments were then filtered by type of meter reading. It was found that many of the comments having a health and safety implication had been made by MOPs as part of engineering work on the meter area.

It was found that [redacted] meter readers had made most [redacted] of the comments that had been made by meter readers and MOPs. Hence British Gas examined only the [redacted] data in more detail.

Consequently, 55 hazardous and potentially hazardous events had been identified by the [redacted] meter readers using the free form comments. For the domestic scale electricity data it is not possible to distinguish between meter readings taken as part of the MRI process and the routine quarterly visits.

These comments were then divided into immediately hazardous situations and latently hazardous, summarised in Table 29. Examples of immediately hazardous conditions include:

- Bridged meters
- Evidence of burning on meter
- Live wires exposed

Examples of latently hazardous conditions include

- Back board rotten
- Meter tilting on back board

Table 29: Summary of domestic electricity meter reading data from 2006

Total number of domestic meters	~6,000,000
Total electricity returns in 2006	14,500,000
Total electricity returns with free form comments 2006	139,538
Comments deemed to have some HSE / Other impact	~1700
[redacted] MRA comments	55
Immediately hazardous	32
Latently hazardous	23

It is assumed that should an electricity meter reader detect a gas escape, it would be reported to the ESP in the same manner as would be undertaken by a gas meter reader. It is noted that none of the comments made by the electricity meter readers referred to a gas escape.

For completeness it is noted that amongst the comments made by MOPs were one case of a gas escape and one case where a corroded gas pipe was noted (this comment was associated with two meters at the same location).

A.4.4 Data received from the DNOs

A request was made to the appropriate DNOs to ascertain what information they held regarding those cases identified as being potentially immediately hazardous or latently hazardous; for example, further information on the nature of the hazardous installation and/or the work done to rectify the situation.

It is understood that only "loss of supply" events would initiate a rapid response from the DNO, there being no requirement for the DNO to immediately investigate hazardous and/or potentially hazardous electrical meters/installations. Other responses, which could prompt action by the distributor, include scenarios such as:

- Holes & Slots in Meter Case & Glass, inc. tape, paint loose glass, etc
- Scratches on wheel/wheel moving correctly
- Meter Case Seals Missing/Damaged
- Fuse seal missing or damaged
- Terminal block cover sealed
- Scorch Marks
- Black boxes
- Smell or signs of burning
- Other wires or devices attached, e.g. Black Box
- Illegal Bypass or wiring connections

- Altered Wiring
- Crossed tails
- Meter corroded or showing signs of wear or damage
- Meter housing/premises unsafe

A summary of the number of comments by DNO is presented in Table 30 below.

Table 30: Summary of comments for domestic electricity meter readings

Area	MPAN's starting	2006 Number of comments	Percentage of comments	2006 Number of meters	Percentage of meters
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	~	55		6million	

Requests for detailed information on these 55 sets of meter reading comments were forwarded to the DNOs. Replies were received in relation to 53 meter readings, of which:

- 31 cases had no associated SAP code and no further information was available.
- In 1 case the account had been cancelled.
- In 1 case there was a SAP code but no further information.

There were 20 cases with associated comments, of which:

- 10 cases were reported bypasses
- In 5 cases the reported installation was found to be "non-illegal" (i.e. suspected interference was found not to be the case).
- There were 5 "other" comments.

Subsequent data requests to the DNOs did not reveal any further information on the nature of hazards associated with these installations.

A.4.5 Summary of domestic electric data

The available data does not allow risk removed as part of the routine reading and inspection process to be differentiated from readings undertaken as part of a MRI regime.

In no case was evidence found that a meter reader contacting a DNO had resulted in a DNO attending a property and rectifying a hazardous or potentially hazardous situation. This could be a result of the quality of the information held by the DNO or the work processes in the electricity supply industries. Given this caveat, the conclusion from this data collection exercise is that the meter reading and inspection process for domestic electricity meters reduces a level of risk that is too small to be determined accurately.

A.5 I&C Electricity Meters

A.5.1 Meter population

In 2006 there were approximately 300,000 I&C electricity meters, of which approximately 25,000 were read monthly.

- Of those read monthly approximately 85% were read each month
- Of those read quarterly approximately 65% were read each quarter.

A.5.2 Data extraction for 2006

In 2006, there were approximately 1.4 million visits to I&C electricity meters resulting in approximately 967,000 meter readings undertaken by meter readers, summarised in Table 31 below. These routine meter readings had 688 cases where free form comments were also input. The 688 meter reading comments from 967,000 visits figures indicate a comments return rate of approximately 0.1% (~7.1 x 10^{-4}) comments per I&C electric return.

Table 31: Summary of I&C electric meter reading data from 2006

	Number of meters	Annual number of visits	Number of routine readings in 2006	Number of routine readings with free form comments
Monthly	275,000	1.1 million	715,000	~
Quarterly	25,000	300,000	252,000	~
Total	300,000	1.4 million	967,000	688

The 688 comments from readings undertaken by meter readers were manually filtered by British Gas to exclude routine comments that did not have an obvious health and safety implication, leaving two comments. On inspection it was found that both of these comments referred to faults with the meter (identified by a SVCC code of 5) and examination of the comments showed that they both related to a problem with the display on the meter. Thus the overall analysis did not find any record of a meter reader's comment that had any safety implication.

For the population of business electric meters, it is not possible to distinguish between visits/readings undertaken specifically as part of the MRI protocol and other special visits, including MOP and SRV/D5 visits, where:

D5 = Electricity special read

The British Gas data does not allow identification of the number and nature of readings and/or comments associated with the MRI process.

Table 32: Summary of comments for I&C electricity meter readings

Total number of I&C meters	300,000
Total I&C electricity meter reader routine returns in 2006	967,000
Total I&C meter reader routine returns with free form comments 2006	688
Routine comments where initial filtering indicated some HSE / Other impact	2
Routine comments where extended examination indicated some safety implication	0

A.5.3 Summary of I&C electricity meter data

The data does not allow risk removed as part of the routine reading and inspection process to be differentiated from readings undertaken as part of a MRI regime. In no case was evidence found that a meter reader contacting a DNO had resulted in a DNO attending a property and rectifying a hazardous or potentially hazardous situation. The conclusion from this piece of work is that the meter reading and inspection process for business electricity meters removes a level of risk that was too small to be determined accurately.

Appendix B Risk Removed by Meter Reading and Inspection 2006 Data

B.1 Assumptions

B.1.1 Utility interdependence

In the following assessments it has been assumed that the reading of gas meters and electricity meters are essentially independent events and that an electricity meter reading would not identify faults on a gas installation and vice versa.

B.1.2 Number of meters

In the following assessments it has generally been assumed that for the domestic meter reading and inspection process there is one meter associated with each premise. This assumption would generally be considered valid for domestic gas meters to houses and flats (whilst noting that in some cases flats may have centralised meter compounds). This assumption is also considered to be valid in the case of domestic electricity meters (whilst noting where the same meter recorded electricity at two different rates the two readings combined would be a single successful reading for that meter).

B.2 Gas Meter Reading and Inspection Process

This section presents estimates for the level of risk to the public that is removed by the domestic gas meter reading and inspection process. Three different approaches have been followed; a high level assessment based on national data, an analysis based on the number of gas escapes (and other latently hazardous installations) identified by meter readers in 2006, and an analysis of the data provided by the DNs in relation to the gas escapes identified by the 2006 meter reading and inspection process.

An estimate is also made of the risk removed by the I&C gas meter reading and inspection process.

B.2.1 Domestic gas upper bound generic assessment

High level estimates of the risk removed have been undertaken using UK wide data to provide a simple scoping check on subsequent analysis based on British Gas data.

The key premise of this approach is that the estimates retain a significant degree of conservatism through out the analysis, thereby producing an estimate of the level of risk removed that is an upper bound.

For a visit by a meter reader to mitigate/prevent an incident resulting from large escape (e.g. from a fractured main, corroded service pipe, appliance left on inside the property) it would be necessary that:

- The meter reading and inspection visit takes place shortly after the gas escape was initiated.
- No Public Reported Escape (PRE) is reported by other sources.

This approach essentially relates the degree of risk removed by the attendance of a meter reader to the number of visits the meter reader makes to the property.

- For external releases from the distribution network it is assumed that the attendance of the meter reader is sufficient to result in an escape being reported (i.e. the meter reader does not need to enter the property in order to detect the escape).

- For releases downstream of the meter, it is possible that the simple attendance at the property could result in an escape being detected and reported (i.e. the meter reader does not need to enter the property in order to detect the escape) but it is also possible that the meter reader would only detect an escape on those visits where a reading is taken from an internal meter (i.e. the meter reader must enter the property in order to detect the escape).

Based on this, estimates have been made for the risk removed by the meter reading visits in relation to escapes from the distribution system (upstream of the meter) and for internal leaks (from the meter installation or downstream of the meter).

B.2.1.1 Escapes from the distribution network

Meter reading visit shortly after escape initiated

In general, steady state concentrations of flammable mixtures inside a property are typically produced within a few hours of the gas accumulation starting (up to say 3 hours). Once the steady state concentration has been achieved, the determining factor of when (or whether an explosion occurs) is the likelihood of the flammable mixture encountering an ignition source. In this analysis it is assumed that there is a period of up to 6 hours between the onset of the escape and the ignition of the flammable mixture in which the meter reader could detect the escape and initiate mitigating measures.

There are about 500 to 1000 gas in buildings (GIB) events reported per year in the UK following escapes on gas mains and service pipes. Given that GIBs from service pipes would be more likely to be related to corrosion holes rather than fractures but the source of the escape would be closer the building than the main, it has again been conservatively assumed that all GIBs can be treated as being equally hazardous. Not all of these GIB events would result in sufficient gas entering the building to produce a flammable mixture.

HSE statistics[4] indicate that from distributed natural gas (i.e. mains or services) in 2005/6 there were:

- 954 GIB incidents in the UK
- 6 serious explosion incidents resulting in death, major injury or significant structural damage (up to an annual maximum of 8 in the period 1990 to 2006, with an average of 4.3 serious per year during this period)
- No fatalities (up to an annual maximum 5 in the period 1990 to 2006, with an average of 1.25 fatalities per year during this period)

It is assumed that in the UK there are 20 million domestic gas meters and 50 million people associated with these meters.

The basis for the assessment assumes 1000 GIBs per year and that ca. 10% of all such GIBs result in an explosion in a single property. For a UK population of 20 million meters, at random there would be a likelihood of a GIB occurring at a property of about of 5×10^{-5} per year. Past incident data indicates that there are typically 0.3 fatalities per gas explosion (from Table 33), making an estimated annual likely number of fatalities of 3. However, as noted above, on average fewer than 5 incidents per year result from escapes from the overall UK distribution network, resulting in less than 2 fatalities per year.

[4] Major Hazard Safety Performance Indicators in the UK onshore gas and pipeline industry, annual report 2006/7, HSE HID

Table 33: Numbers of serious incidents and fatalities in the UK related to distributed natural gas

Year	Incidents	Fatalities
1990/91	7	1
1991/92	1	0
1992/93	3	0
1993/94	3	0
1994/95	3	1
1995/96	6	2
1996/97	6	3
1997/98	3	0
1998/99	6	0
1999/00	8	5
2000/01	5	4
2001/02	4	1
2002/03	3	3
2003/04	3	0
2004/05	2	0
2005/06	6	0
Total:	69	20
Average	4.3125	1.25

Based on the above, the calculated Individual Risk associated with the 30 explosions following GIB is therefore approximately:

$$3 / (20 \times 10^6 * 2.5) = 6 \times 10^{-8} \text{ per year}$$

for a property occupied by 2.5 people (i.e. assuming each meter of the 20 million meters is associated with 2.5 occupants).

Routine read and inspection visit to a credit meter

The likelihood of the gas meter reader arriving at the property in the window (estimated as up to 6 hours) where it is possible to mitigate/prevent the explosion is 6.9×10^{-4} per visit assuming the release could be initiated at random at any time of the year. It is assumed that in all such cases the meter reader detects a smell of gas, recognises it as a gas leak, and takes the appropriate action (i.e. reports the escape etc.). It is assumed that there are up to 4 meter reader visits per year to a typical credit meter based upon 2006 processes.

Hence, following this simple conservative analysis, the level of Individual Risk that could be removed by meter reader visits to credit meters is very conservatively calculated as being of the order of up to 6 x 10^{-8} x 6.9 x 10^{-4} x 4 = 1.7 x 10^{-10} per year for each person in the UK population of 50 million.

PRE not reported through other sources

There are no data relating sources of PRE and number of people reporting the same PRE by the type of escape. It is assumed that for over 50% of the escapes from the distribution network reported by the meter reader a second report would have been made before the report by the meter reader (for example by people going to work earlier in the day). In such a case the report by the meter reader would not reduce risk further.

Overall risk removed

Using all the above assumptions, the Individual Risk removed by the meter reader visits made on behalf of British Gas related to escapes from distribution pipelines would be of the order of 1.7 x 10^{-10} per year.

Assuming that over 50% of reports were reported by another person as well as the meter reader, the risk removed by routine visits to credit meters would be of the order of up to 1 x 10^{-10} per year.

SLC12 implied minimum

The SLC12 requirement that the meter is inspected once every 2 years implies that at this minimum inspection level the risk removed would be of the order of up to 1 x 10^{-11} per year.

MRI multi visits

Based on 2006 processes, it is assumed that for the MRI multi visits to credit meters the number of visits increases from 4 per year to ~8 per year. In all cases it is assumed that a leak from the distribution network would be detected even if the meter reader does not enter the property. In such a case the risk removed by the visit at the MRI multi-visit stage would be considered to remove risk of the order of up to ~2 x 10^{-10} per year.

Prepayment MI visits

In 2006, the British Gas policy was to attempt to take a reading by visiting the property as part of the routine readings at the 18 month stage. For the purposes of this analysis, it is assumed that typically one visit per year would be undertaken by a meter reader to simply inspect a prepayment meter. In such a case the risk removed by the Prepayment MI visits would be considered to remove risk of the order of up to ~2.5 x10^{-11} per year.

Summary

In this context it is noted that the overall Individual Risk to members of the public in the UK from explosions following escapes of gas from the distribution network is of the order of 2.5 x 10^{-8} (risk from 1.25 fatalities per year spread over UK population of 50 million). Hence, the risk removed by the meter reading and inspection process is less than 1% of the background level of risk associated with the gas supply, and probably much lower.

The level of risk being removed by routine visits and MRI multi-visit stage visits remove more risk than would be implied to be required by the SLC12 inspection requirement.

B.2.1.2 Escapes from appliances and pipe work downstream of the meter

HSE statistics[5] for fires and explosion related to flammable gas including LPG and distributed natural gas indicate that there are on average 39.5 incidents per year involving 6.7 fatalities per year. Removing the 4.3 incidents attributed to upstream gas escapes and 1.25 fatalities per year leaves ~35 incidents and ~5 fatalities per year. This corresponds to a ratio of approximately 0.15 fatalities per incident.

Some of these incidents would refer to LPG and bottled gas supplies as well as escapes from the distribution network, however for conservatism it will be assumed that all these fatalities and explosions result from escapes from gas meters, domestic appliances and pipework.

Taking an average of 5 fatalities per year as above, gives an Individual Risk of:

$$5/(50 \times 10^{6}) = 1 \times 10^{-7} \text{ per year.}$$

In the analysis below it is assumed that:

- The escape/leak occurs at a random time throughout the year.
- The meter reader would detect a smell of gas, recognise it as a gas leak and take the appropriate action (i.e. reports the escape, closes ECV etc.). This is conservative because in some cases an escape inside the property may not be detected by a meter reader located outside the property. It would be expected that in virtually all cases where a meter reader entered a property where a gas leak was present it would be detected.
- In this case it is considered that the time window where the meter reader could take some preventive/mitigative action is up to 4 hours following the onset of the escape (i.e. the approximate time window between the onset of the escape, the accumulation to a flammable mixture and the flammable mixture encountering an ignition source).

HSE statistics[6] suggest that in the UK there are approximately 50 events per year related to releases of natural gas from points downstream of the ECV that are GSMR reportable. These events include:

- A release inside the building where the concentration has exceeded 20% LEL or more than 10kg was released inside the building.
- An escape of gas from either within the building or the network has resulted in a fire or explosion.

Assuming these 50 events are shared at random between the 20 million meter installations the likelihood of a significant downstream release is 50/20 million = 2.5×10^{-6} events per year. In this instance it is noted that the number of GSMR reported events are of a similar value to the estimated 35 explosions a year from causes excluding distribution network (but including LPG etc.).

Visit to read a credit meter

It is noted that the meter reader would be less likely to detect an escape from the internal pipe work and appliances if the property had an external meter box compared to a meter reader visiting an internal

[5] Gas Safety Statistics 2007, available from www.hse.gov.uk

[6] Major Hazard Safety Performance Indicators in the UK onshore gas and pipeline industry, annual report 2006/7, HSE HID

meter, which would tend to reduce the risk removed by the meter reading and inspection process. Nevertheless, for the purpose of a simple estimate it is assumed that in all cases a meter reader would detect the internal leak.

The likelihood of the meter reader arriving during the prevention/mitigation window (estimated as up to 4 hours for an escape inside the property) is therefore 4.6 x 10^{-4} and up to four visits are made per year. Hence, using the assumptions above, the Individual Risk removed by the meter reader visits is estimated to be less than approximately 1.8 x 10^{-10}.

If it were assumed that the meter reader would only detect escapes downstream of the meter if he entered the property (assumed ~75% of visits produces a meter reading) and that ~50% of meters are external to the property, the level of risk removed would be reduced (by a multiplication factor of 3/8). As the level of conservatism in the above estimates is considered to be less than an order of magnitude, the more conservative estimate has been retained.

SLC12 implied minimum

The SLC12 requirement that the meter is inspected once every 2 years implies that at this minimum inspection level the risk removed would be of the order of up to 2.5 x 10^{-11} per year for releases downstream of the ECV.

MRI multi visits

Based on 2006 processes, it is assumed that for the MRI multi visits to credit meters the number of visits increases from 4 per year to ~8 per year. In all cases it is assumed that a leak from the distribution network would be detected even if the meter reader does not enter the property. In such a case the risk removed by the visit at the MRI multi-visit stage would be considered to remove risk of the order of up to ~4 x 10^{-10} per year.

The estimate of the risk removed could be reduced further through consideration of the data from the meter readers' comments whereby no occasion was found where a meter reader had reported a gas escape during the course of a "no access" visit to a meter. Thus it could be considered that only for those cases where the meter reader actually gets access to the meter would a gas escape be detected. In such a case the likelihood of a leak being detected is related to the frequency of successful visits, which would be effectively be once every two years or the SLC12 implied minimum.

Prepayment MI visits

In 2006, the British Gas policy was to attempt to take a reading by visiting the property as part of the routine readings at the 18 month stage. For the purposes of this analysis, it is assumed that on average one visit per year would be undertaken by a meter reader to simply inspect a prepayment gas meter. In such a case the risk removed by the Prepayment MI visits would be considered to remove risk of the order of up to ~5 x 10^{-11} per year.

Again if only one successful visit is made every two years the risk removed equals the SLC12 implied minimum.

Summary

In this context it is noted that the overall Individual Risk to members of the public in the UK from explosions following escapes of gas from internal pipe work and appliances is of the order of 1 x 10^{-7} (risk from 5 fatalities per year spread over UK population of 50 million). Hence, the risk removed by the meter reading and inspection process is less than 1% of the background level of risk associated with the gas supply, and probably much lower.

The level of risk being removed by routine visits and MRI multi-visit stage visits to credit gas meters remove more risk than would be implied to be required by the SLC12 inspection requirement.

B.2.1.3 Summary

The estimated upper bound for the Individual Risk removed by the overall routine domestic gas meter reading and inspection process is

- Less than 1×10^{-10} per year in relation to leaks from the distribution network.
- Less than 1.8×10^{-10} per year in relation to leaks from locations downstream of the ECV.

This gives an upper bound for the combined reduction in risk of under 3×10^{-10} per year.

It is noted that the estimated upper level of risk removed is about the same for internal leaks compared to leaks from the distribution network. The reasons behind this could include the historical data that suggests that for releases downstream of the meter there are more explosions, but fewer fatalities per explosion.

Table 34 below, presents the estimated upper bounds of the level of risk removed by the routine, MRI multi-visit, prepayment MI and SLC12 minimum.

Table 34: Estimated risk removed for domestic gas meter reading and inspection process

Process	Visits per year	Estimated risk removed for escapes from distribution pipework	Estimated risk removed for escapes downstream of the ECV	Combined
Routine	~4	$<\sim 1 \times 10^{-10}$	$<\sim 2 \times 10^{-10}$	$<\sim 3 \times 10^{-10}$
MRI – multi-visit stage	~8	$<\sim 2 \times 10^{-10}$	$<\sim 4 \times 10^{-10}$	$<\sim 6 \times 10^{-10}$
Prepayment MI	~1	$<\sim 5 \times 10^{-11}$	$<\sim 5 \times 10^{-11}$	$<\sim 1 \times 10^{-10}$
SLC12 implied minimum	0.5	$<\sim 2 \times 10^{-11}$	$<\sim 2.5 \times 10^{-11}$	$<\sim 5 \times 10^{-11}$

In this analysis, the nature of the visits is assumed to be essentially identical for the different processes; the main difference in the risk removed being the frequency of visits. In all cases the frequency of visits to the property is considered to be greater than the minimum required to meet the SLC12 2-yearly inspection obligation.

B.2.2 Analysis of 2006 domestic gas meter readers comments

This section estimates the risk removed by meter readers during the routine meter reading and inspection and MRI processes based upon the number and type of comments produced by the meter readers.

In the period studied there were no reported fatalities or events identified where it was considered credible that an incident resulting in a fatality could have occurred. Hence in order to make some estimate of the risk removed, the incident pyramid concept was used.

The general principle of the incident pyramid is that for each fatality there are certain numbers of serious injuries, minor injuries, near miss incidents and hazardous events. Pyramids published in different sources have different ratios of the subsidiary events per fatality. The HSE website identifies that the nature of the pyramid will depend upon the nature of the industry and the type of accidents been considered.

For this piece of work the following pyramid has been used as the basis of calculating the equivalent number of potential fatalities averted. This pyramid is based upon the one developed by Dresser Rand[7] and was selected based upon engineering judgement of the available data on the near miss and hazardous situations data that was obtained during the data collection exercise.

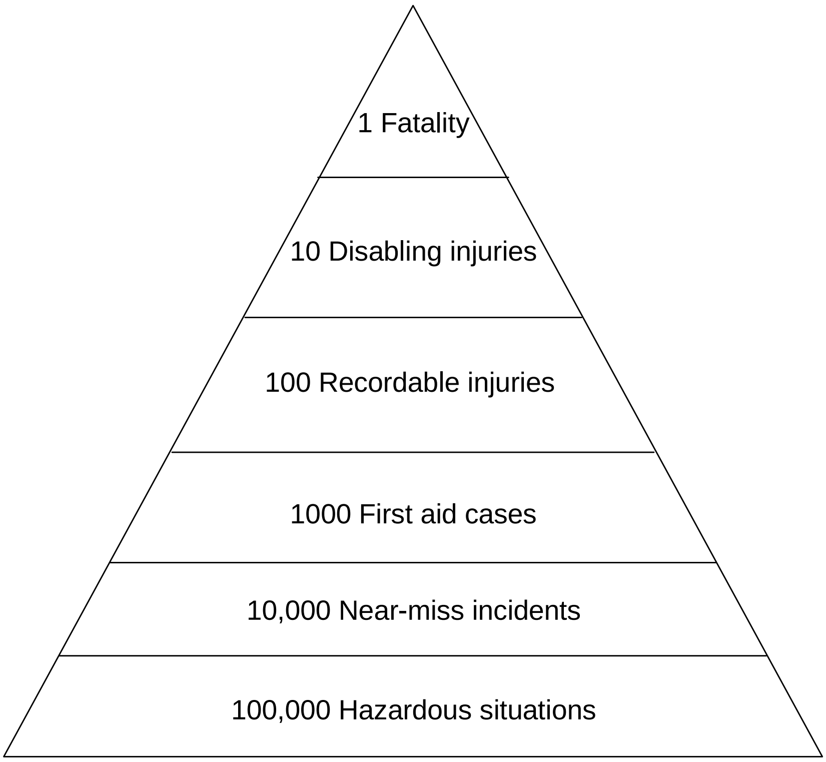

Figure 5: Incident pyramid

B.2.2.1 Risk removed estimate

An initial estimate of the risk removed was obtained by assigning a fatality equivalent to escapes, latent failures and missing ECV handles.

As a first approximation it was estimated that each escape reported by a meter reader corresponded to 0.0001 fatality averted. This value was selected because:

- It is likely to be conservative (i.e. it over estimates the risk removed by the actions of the meter reader).
- Many public reported gas escapes are not actually an escape of distributed natural gas, rather it is some other source of an unusual or sulphurous odour.

[7] www.dresser-rand.com

- It is considered likely that any large scale escape of gas such as a failed gas main or service pipe could also be reported by occupants of the property, passers-by and other members of the public. Thus, the risk associated with these events could be mitigated by other actions not associated with the meter reading.
- It is considered likely that the meter reader could identify gas escapes from the meter area and inside the property (assuming the meter was inside the property).
- A gas escape from a meter in an external location would be unlikely to produce an explosion in the associated property and any ignition of a flammable mixture produced by such a leak would tend to produce a flashback type explosion (and possible a subsequent fire). Assuming that the gas cloud was ignited by some human activity in the vicinity of the meter box; then although this could lead to flash burns it is unlikely that the injuries would be fatal.
- It is considered most likely that the type of gas leak that would be detected by the meter reader (but not occupants or other members of the public) would be small escapes from the meter area. It would be unlikely that anybody would be killed by ignition of a flammable mixture produced by such a small escape.
- A gas accumulation inside a property (from the upstream distribution pipe work, meter area, and downstream internal pipe work) would be the event most likely to produce fatalities. For the meter reader to remove the risk it would have to be considered that no other action had been undertaken to mitigate the escape (e.g. reported to the ESP, supply isolated at ECV, ventilation to property increased etc,). It would be considered highly unlikely for a meter reader to arrive at a property whilst there was an ongoing unreported gas escape outside or inside the property.

The likelihood of a latent defect leading to a fatality is pessimistically assumed to be 10% of the likelihood of the gas escape leading to a fatality, because only a small proportion of the latent defects have the potential to deteriorate sufficiently to produce relatively large gas escapes (e.g. for example a meter being supported by the service pipe only).

The likelihood of the missing ECV handle preventing mitigation of a gas escape, which subsequently results in a fatality occurring is pessimistically assumed to be 10% of the likelihood of a latent defect becoming a fatality.

This is likely to be a significant overestimate because for this to reduce the likelihood of fatality it would require a scenario where isolating the gas supply at the ECV was the only mitigating measure whereby the fatalities associated with an explosion or fire would be prevented. In the case of a detected gas leak (for example the property could be evacuated and ventilation increased if the gas leak were detected), the main advantage of the ECV would be to prevent any gas-fuelled fire occurring following the incident.

Using these assumptions, the fatalities averted per year can be calculated for the routine meter reading visits and just those meter readings associated with the MRI multi-visit stage.

Table 35: Estimated fatalities averted (domestic gas)

	Fatalities averted per event	Fatalities averted per year	
		Routine	MRI
Escapes	0.0001	0.0475	0.0073
Latent failures	0.00001	0.00174	0.00121
Missing ECV	0.000001	0.0005	0.000085
Totals		0.04974	0.008595

These figures would suggest that approximately 1 fatality is averted every 20 years as a result of the routine meter reading and inspection visits to the population of British Gas meters.

As a sense check it is noted that:

- There are approximately 20 million domestic meters in the UK, hence British Gas comprises just under half the UK total.
- In the period 1990 to 2002 there were no fatalities in the UK arising from an unintended escape of gas from the meter area (i.e. excluding those fatalities in incidents where pipe work in the meter area was deliberately damaged and/or theft of the meter has resulted in open-ended pipe work).

From the calculated number of fatalities averted, the Individual Risk can be calculated by estimating the population at risk of becoming a fatality. British Gas data indicate that there are 28 million meter reading visits per year. It is estimated that each meter is seen about 3 times per year on the routine routine visits.

From the available data it is estimated that approximately 570,000 2-yearly MRI meter readings and inspections are undertaken per year (this is approximately 2% of the total number of readings). It is estimated that it would take one visit (where the meter was actually seen and read) to obtain this reading.

In these cases, it is assumed that only the occupants of the property would be included in the population at risk from an explosion from the meter area.

In both cases it is assumed that on average 2.5 people (typical UK household size) are at risk of becoming fatalities should a flammable mixture become ignited.

Table 36: Estimates of Individual Risk removed for routine and MRI visits (domestic gas meters)

		Routine visits	MRI
Total visits to meters per year		2.8×10^{7}	5.7×10^{5}
Visits per meter per year		3	1
People per meter		2.5	2.5
Population affected		23 million	1.4 million
Individual Risk removed (per year)	Escapes	2.0×10^{-9}	5.2×10^{-9}
	Latent failures	7.5×10^{-11}	8.6×10^{-10}
	Missing ECV	2.1×10^{-11}	6.1×10^{-11}
	Total	2.1×10^{-9}	6.1×10^{-9}

B.2.3 Analysis based on DN responses to 2006 domestic gas meter reader comments

From the analysis of the comments made by domestic gas meter readers (See Appendix A above), it is estimated that in one year approximately 24 significant leaks would be reported by the meter readers. Assuming that all of these events were only reported by the meter readers then all the risk associated with these events could be ascribed to risk reduction by the meter reading and inspection process.

Although numerous leaks were reported as PREs that subsequently required repair/replacement of the ECV, meter inlet pipe work, meter governor, and meter itself, in none of these cases did the information supplied by the DNs suggest that the leak was large enough to produce an explosive mixture within a room in house.

The most significant leak found following a reported PRE was a fractured main near to the property. From this data collection exercise it can be assumed that this would be worst case scenario that would generally be encountered by a meter reader.

Assuming that all 24 events were equivalent to a fractured main an upper bound estimate can be made of the equivalent PLL. Data on fatalities following fracture of gas mains indicate that there are approximately 1.4×10^{-4} fatalities per mains fracture. Thus these 24 events could be considered to a PLL of ($1.4 \times 10^{-4} \times 24 =$) 0.003 fatalities per year.

Sharing this PLL of 0.003 fatalities per year across an exposed population of 25 million people equates to an Individual Risk of under approximately 1.2×10^{-10} per year.

B.2.4 Overview

The Individual Risk removed has been calculated by three different methods for the domestic gas meter reading and inspection process. From comparison of the Individual Risk calculated from the generic data and from the DN responses with those calculated using the meter readers' comments, it is considered that the values of PLL ascribed to the various hazardous events identified by the meter readers (as based upon the incident pyramid) would be a cautious over-estimate of the hazard associated with these events.

B.2.5 Risk removed by I&C gas meter readers

Using the pyramid principle outlined above for domestic gas meters, an estimate of the risk removed can be undertaken for the number and type of comments made by the meter readers during the course of visiting I&C meters.

In this estimate it is assumed that the risk is shared throughout the entire population of people affected by British Gas' population of gas meters (i.e. approximately 25 million). If a reduced population were considered (for example it could be estimated that 2.5 million people worked at or could be present at the establishments serviced by the I&C meter) the calculated Individual Risk would increase accordingly.

Table 37: Estimates of Individual Risk removed for routine and MRI visits (I&C meters)

	Fatalities per event	Routine		MRI	
		Number	PLL	Number	PLL
Hazardous installation	0.0001	12	0.0012	0	0
Latently hazardous	0.00001	30	0.0003	6	0.00006
Total PLL			0.0015		0.00006
Population affected			25 million		25 million
Individual Risk (per year)			6.0×10^{-11}		2.4×10^{-12}

From these calculations, it is estimated that the Individual Risk removed by the I&C gas meter reading and inspection process is less than 10^{-10} per year.

B.3 Electricity Meter Reading and Inspection Process

B.3.1 Domestic electricity meters

Meter readers comments

Using the whole 2006 data set of comments from the [redacted] meter readers 32 immediately hazardous and 23 latently hazardous situations were identified. If this were to be extrapolated to cover the whole population of meter readers, it would be estimated that the number of comments should be increased by approximately 20%.

Using the incident pyramid concept described in the previous Section, the immediately hazardous situations for electricity meters are considered to be equivalent to 0.000001 of a fatality averted, and the latently hazardous situations are considered to be less hazardous by a factor of 10.

Table 38: Estimated fatalities averted (domestic electricity)

	Fatalities averted per event	Events reported per year	Fatalities averted per year
Hazardous installations	0.000001	32 x 1.2	3.8×10^{-5}
Latently hazardous installations	0.0000001	23 x 1.2	2.8×10^{-6}
Total			4.1×10^{-5}

Thus the estimated PLL was 4.1×10^{-5} fatalities per year, which for an affected population of 15 million (6 million meters multiplied by 2.5 people per meter) results in a level of Individual Risk being removed of 2.8×10^{-12} per year.

Comments from the DNO

The data from the electricity DNOs identified 10 cases in 2006 where an illegal installation was found as a result of the domestic electricity meter reading and inspection process undertaken by [redacted] However, in none of these cases is it clear that the report from the meter reader prompted the DNO to undertake remedial action immediately (e.g. inspect and repair the installation).

Using the incident pyramid concept, the occurrence of each of these events is considered to be equivalent of 0.000001 fatalities. For the purposes of this calculation it is considered that in all these cases action was undertaken by the DNO to immediately remove the risk (i.e. a process is in place approximately equivalent to that provided in the gas industry). However, the data provided by the DNOs suggest that no such action was undertaken by the DNO to remove the risk, in which case the estimate of the risk removed would be an upper bound

Combining the events per year (10 for [redacted] readers correlating to an estimated 12 for all meter readers) and fatalities per event gives an annual PLL of approximately 0.000012 fatalities per year.

This PLL is distributed amongst a population of approximately 15 million people associated with the domestic electricity meters.

The calculated Individual Risk removed as a result of the meter reading and inspection process is thus up to approximately 8×10^{-13} per year (a level of risk so small that the results may no longer be meaningful).

B.3.2 I&C electricity meters

There was no evidence that in 2006 any risk was being removed by the reading and inspection process for British Gas' population of I&C electricity meters, indicating that the level of Individual Risk removed by this process is less than was calculated above for the domestic electricity meters.

Appendix C Occupational Risks 2006

C.1 Data Collection

Three sets of data on accidents and injuries to meter readers have been received from the MRAs along with the summary accident Health and Safety Summary Report spreadsheet for MRAs in 2006. These data have been examined individually and then compared to the HSE spreadsheet.

These data do not differentiate between the nature of the meters being read (gas/electric domestic/business) nor the meter reading protocol being used at the time (routine/MRI).

No information was supplied on the number of meter readers accident data applied to. However, from the Health and Safety Summary Report spreadsheet it is assumed that there were [redacted].

[redacted] spreadsheet data –

- Comprised [redacted]
- Does not provide any useful quantitative information (No record of time lost etc). The general descriptions suggest all accidents were minor.
- Does not include road traffic accidents (RTAs) [redacted]
- May data was a replica of the April data.

[redacted] spreadsheet data–

- Comprised [redacted]
- Includes RTA - same total as reported in Health and Safety Summary Report spreadsheet.

[redacted]

[redacted] spreadsheet data-

- Comprised [redacted]
- Does not include RTA [redacted]

C.2 Analysis

Using the Health and Safety Summary Report spreadsheet containing data for 2006, the key totals of accidents are:

Table 39: Accident summary for meter readers in 2006

Category	*Total*
Dog bites	[redacted]
Slips/ falls	[redacted]
Road traffic accidents (RTA's)	[redacted]
Other	[redacted]
TOTAL	[redacted]

Using the same pyramid principle developed for the analysis of meter reader comments made during examination of domestic gas meters, it is possible to ascribe a fractional fatality to each accident. In the literature there are a range of possible correlations between accident rates associated with fatality rates. In this case the accident statistics supplied by British Gas suggest that in some cases there could be a reasonable likelihood of fatality/serious injury to a meter reader following an accident but in many cases the description was more appropriate to a near miss to a serious injury. Hence it is estimated that there could be 1 fatality per 3000 accidents being intermediate to the ratio of 1 fatality per 10,000 near misses and 1 fatality per 1000 first aid cases (or 1 fatality per 100 recordable injuries).

Using a simple estimate of 3.3×10^{-4} PLL per accident (1 fatality in 3000 accidents) for [redacted] accidents gives a total PLL incurred per year of 7.5×10^{-2} fatalities.

Assuming that each accident is approximately equal to a PLL of 3.33×10^{-4} (1 in 3000), the Individual Risk to a meter reader (per year) is calculated as (3.33×10^{-4} x [redacted] = 2.5×10^{-5} per year.

Appendix D Meter Reading and Inspection Data 2009

D.1 Gas Meters

D.1.1 Meter population

In 2009, British Gas had ~9.4 million domestic gas meters, of which all the credit meters are assumed to be read/visited quarterly by routine readings by meter readers, and ~0.4 million I&C gas meters. Some of these meters are read quarterly ("Annual Read") and some monthly ("Monthly Read") and the data are recorded on two different systems (Servicedesk and SAP).

Table 40: Population of I&C gas meters in 2009

	Monthly	**Quarterly**	**Total**
Service desk (SD) Gas	32,288	128,245	160,533
SAP Gas	23,447	222,623	246,070
Total	55,735	350,868	406,603

In 2006, British Gas had ~10 million gas meters of which about 9.8 million would be classified as domestic and 0.14 million as I&C. In 2006 the domestic meters were split in the ratio 87% credit meters and 13% prepayment meters, which corresponds to approximately 8.6 million credit meters and 1.2 million prepayment meters.

Overall, the 2009 population of British Gas domestic gas meters is similar to the 2006 population. However, it is noted that in 2009 the number of I&C gas meters has approximately trebled.

D.1.2 Domestic gas meters

British Gas supplied the following analysis of domestic meter readings and inspections undertaken and comments recorded during January and February 2009.

Table 41: British Gas analysis of comments

Gas				
Read:	**Comments?**	**January**	**February**	**Total**
	Yes	401	313	714
	No	2,079,656	1,964,240	4,043,896
	Total	**2,080,057**	**1,964,553**	**4,044,610**
	Comment %	0.02%	0.02%	0.02%
	H&S Comment	16	17	33
	H&S %	3.99%	5.43%	4.62%
No Access:	**Comments?**	**January**	**February**	**Total**
	Yes	7,970	8,103	16,073
	No	780,120	691,911	1,472,031
	Total	**788,090**	**700,014**	**1,488,104**
	Comment %	1.01%	1.16%	1.08%
	H&S Comment	451	506	957
	H&S %	5.66%	6.24%	5.95%
Combined:	**Comments?**	**January**	**February**	**Total**
	Yes	8,371	8,416	16,787
	No	2,859,776	2,656,151	5,515,927
	Total	**2,868,147**	**2,664,567**	**5,532,714**
	Comment %	0.29%	0.32%	0.30%
	H&S Comment	467	523	990
	H&S %	5.58%	6.21%	5.90%

[redacted] data

[redacted] advised British Gas that in the seven month period August 2008 to February 2009, nine gas escapes have been reported to [redacted]. Given that [redacted] comprises 22% of the meter readings undertaken, these nine escapes correlate to a national annual total of approximately 70 gas escapes reported per year.

In a separate spreadsheet [redacted] reported finding 1 missing ECV (corresponding to 55 per year nationally)

[redacted] data

[redacted] advised British Gas that in February 2009 there were 14 gas escapes reported to National Grid (13 in the gas escapes spreadsheet and 1 in the theft of gas spreadsheet). [redacted] have also reported 13 gas escapes reported in both January and February 2009 in a different spreadsheet.

Given that [redacted] of the domestic meter readings undertaken, these 14 escapes correspond to a national total of approximately 336 gas escapes reported per year.

[redacted] also reported 18 missing or stuck ECVs in February 2009, corresponding to an estimated national total of 432 per year. In a different spreadsheet [redacted] have also reported a combined 19 gas escapes for January and February 2009 (7 January and 12 in February), corresponding to an estimated national total of 114 per year.

All meter reading spreadsheet

A spreadsheet was provided that contained 29,972 records where comments were associated with meter readings. These data covered January and February 2009. These data should not include comments made during “no access” visits.

Initial examination indicated that these comments were associated with

- Meter readers
- Visits to pre-payment meters (putting credit on meter/winding on meter)
- Must inspect visits
- SRVs (Special Read Visits)

These records were then manually examined to identify those associated with gas escapes, latent hazards, missing ECVs etc.

Of these 29,972 records;

- 29,805 had no apparent significance
- There were 84 gas escapes (with two further possible gas escapes)
- 5 possible gas escapes/missing ECV
- There were 43 latent failures
- There were 28 missing ECV (with a further 5 cases concerns about ECV condition)

The records of significance were then examined to ascertain if the comment was clearly NOT associated with a meter reader undertaking a routine meter reading, in which case it was excluded from the analysis. It was not possible to differentiate between comments made during a routine reading or the multi-visit stage of MRI.

Thus for the purpose of this analysis, the comments made by meter readers include:

- 89 gas escapes
- 44 latent failures
- 29 missing ECVs

Linear extrapolation to an annual value gives:

- 534 gas escapes
- 264 latent failures
- 174 missing ECVs

Gas "no access" visits

British Gas supplied a spreadsheet containing the comments from the no access meter reader visits for the period January and February 2009. In this spreadsheet there were 957 records, of which:

- None were zero gas escapes
- 9 were latent failures
- None were missing ECVs
- 948 had no significance

Effectiveness of meter readers at identifying dangerous and latently dangerous situations

In the 2006 risk calculation it was assumed that all potential latently hazardous events identified by the meter reader were actually latently hazardous. However, the 2009 theft data indicated that in only 42% of the cases that would have been ascribed as being latently hazardous based upon meter reader comments, the follow-up visit found that the installation was actually latently hazardous. However it should be noted that almost all of the risk removed in the 2006 assessment arose from gas escapes and so the effect of this is marginal.

Based upon the data provided by the DNs, the 2006 data indicated that of 296 cases where the meter readers' comments indicated that a gas escape had occurred, 19 of these resulted in a "no trace" (i.e. no escape of gas was subsequently identified). Thus in 94% of cases the Meter Reader had correctly identified a gas escape.

D.1.3 I&C gas meters

British Gas supplied the following analysis of I&C meter readings and inspections undertaken and comments recorded during January and February 2009.

Table 42: British Gas analysis of comments

Gas (SAP)				
Read:	Comments?	January	February	Total
	Yes	1,674	1,580	3,254
	No	73,637	68,148	141,785
	Total	**75,311**	**69,728**	**145,039**
	Comment %	2.22%	2.27%	2.24%
	H&S Comment	160	143	303
	H&S %	9.56%	9.05%	9.31%
No Access:	Comments?	January	February	Total
	Yes	9,697	8,883	18,580
	No	19,150	16,003	35,153
	Total	**28,847**	**24,886**	**53,733**
	Comment %	33.62%	35.69%	34.58%
	H&S Comment	988	916	1904
	H&S %	10.19%	10.31%	10.25%
Combined:	Comments?	January	February	Total
	Yes	11,371	10,463	21,834
	No	92,787	84,151	176,938
	Total	**104,158**	**94,614**	**198,772**
	Comment %	10.92%	11.06%	10.98%
	H&S Comment	1148	1059	2207
	H&S %	10.10%	10.12%	10.11%

Gas (Servicedesk)				
Read:	**Comments?**	**January**	**February**	**Total**
	Yes	1,850	1,583	3,433
	No	64,830	57,633	122,463
	Total	**66,680**	**59,216**	**125,896**
	Comment %	2.77%	2.67%	2.73%
	H&S Comment	188	156	344
	H&S %	10.16%	9.85%	0.00%
No Access:	**Comments?**	**January**	**February**	**Total**
	Yes	5,399	3,849	9,248
	No	6,514	4,135	10,649
	Total	**11,913**	**7,984**	**19,897**
	Comment %	45.32%	48.21%	46.48%
	H&S Comment	659	468	1127
	H&S %	12.21%	12.16%	12.19%
Combined:	**Comments?**	**January**	**February**	**Total**
	Yes	7,249	5,432	12,681
	No	71,344	61,768	133,112
	Total	**78,593**	**67,200**	**145,793**
	Comment %	9.22%	8.08%	8.70%
	H&S Comment	847	624	1471
	H&S %	11.68%	11.49%	11.60%

Comments made during meter readings and inspections - SAP data

The spreadsheet contained 303 comments identified by British Gas as having a health and safety component; of which there were:

- 5 reported gas escapes
- 11 potential hazardous situations identified

- 6 missing ECV handles
- 281 other comments

Comments made during meter readings - Servicedesk data

The spreadsheet contained 344 comments identified by British Gas as having a health and safety component; of which there were:

- 5 reported gas escapes
- 4 potential hazardous situations identified
- 3 missing ECV handles (and one corroded)
- 331 other comments

Comments made during "no access" visits

These comments clearly indicate that the dataset includes visits made outside of the routine meter reading and inspection process, e.g. missed appointments etc. These data included contributions from the SAP data and Servicedesk data.

This spreadsheet contained 3031 records, of which:

- 4 cases involves a reported smell of gas
- 11 cases involved a latently hazardous situation
- 0 cases identified a missing ECV
- 3016 were not relevant to this study (loose dogs, unable to locate address etc.).

Combined total

Thus the combined number of potentially hazardous situations identified during Servicedesk access, SAP access and "no access" I&C gas meter readings are:

- 14 reported gas escapes
- 26 potential hazardous situations identified
- 9 missing ECV handles

D.2 2009 Electricity Meters

D.2.1 Meter population

In 2009 British Gas had 6.1 million domestic electricity meters. In 2006, there were approximately 6 million domestic meters, of which approximately 4.8 million were credit and 1.1 million were prepayment meters.

In 2009, British Gas had ~0.6 million I&C electricity meters, of which ~35,000 were read and inspected monthly. In 2006, there were approximately 0.3 million I&C electricity meters, of which ~25,000 were read and inspected monthly.

Overall, the 2009 population of British Gas domestic electricity meters is similar to the 2006 population. However, it is noted that in 2009 the number of I&C meters has approximately doubled since 2006.

D.2.2 Domestic electricity meters

British Gas supplied the following analysis of meter readings undertaken and comments recorded during January and February 2009.

The data is divided into visits where there was no access and those where the meter was read. The comments produced were then screened by British Gas to determine those comments that could have some form of health and safety implication.

Table 43: British Gas analysis of comments

Read:	**Comments?**	**January**	**February**	**Total**
	Yes	8,969	6,737	15,706
	No	1,162,978	1,101,460	2,264,438
	Total	**1,171,947**	**1,108,197**	**2,280,144**
	Comment %	0.77%	0.61%	0.69%
	H&S Comment	1589	1173	2762
	H&S %	17.72%	17.41%	17.59%
No Access:	**Comments?**	**January**	**February**	**Total**
	Yes	25,975	18,320	44,295
	No	547,763	513,418	1,061,181
	Total	**573,738**	**531,738**	**1,105,476**
	Comment %	4.53%	3.45%	4.01%
	H&S Comment	2186	2055	4241
	H&S %	8.42%	11.22%	9.57%
Combined:	**Comments?**	**January**	**February**	**Total**
	Yes	34,944	25,057	60,001
	No	1,710,741	1,614,878	3,325,619
	Total	**1,745,685**	**1,639,935**	**3,385,620**
	Comment %	2.00%	1.53%	1.77%
	H&S Comment	3775	3228	7003
	H&S %	10.80%	12.88%	11.67%

Comments made during meter readings

Data in this spreadsheet comprised five reading types

- I - Initial
- F - Final
- S - Special
- R – Routine
- W - Withdrawn

Of these, only type R readings are considered to apply to those made by meter readers undertaking routine meter readings. Thus of the 2762 comments in this spreadsheet only one referred to comments made by meter readers (type R); specifically “cut out dangerous called sp to replace cutout”.

Of the 1 comment made by meter readers:

- 1 electrically hazardous situation was identified.

Comments made during “no access” visits

These “no access” readings also include cases where access has been obtained to the meter, but for some reason the meter could not be read.

The spreadsheet contained 4241 records, of which 4100 related to type R meter reader readings. The others being type F and type S.

These comments associated with these 4100 records were then examined to identify potential hazardous conditions and latently hazardous conditions. Examples of ongoing immediately hazardous conditions include:

- Bridged meters
- Evidence of burning on meter
- Live wires exposed

Examples of latently hazardous conditions include

- Back board rotten
- Meter tilting on back board

Of these 4100 readings:

- 3669 were not relevant (boarded up properties, wrong address, refused access etc.)
- 388 related to blank screens on the meter.
- 34 indicated a latently hazardous electrical installation.
- 7 indicated an ongoing hazardous electrical installation.

The electrically hazardous situations comprised the following (unedited) comments:

- meter waterlogged
- METER HAD NO NUMBERS AND WAS A DIFFERENT SERIEL NO ALSO BARE WIRES
- TAMPER METER TO DANGEROUS TO TOUCH ...... HEATH/SAFTY ISSUE
- PRE-PAY METER NOT WORKING,DISCONNECTED

- LIVE WIRES LEFT LOOSE. NOT SAFE.
- wire and black box but no meter
- MTR SMASHED

D.2.3 I&C electricity meters

British Gas supplied the following analysis of meter readings undertaken and comments recorded during January and February 2009.

Table 44: British Gas analysis of comments

Total Electricity (Servicedesk only)				
Read:	**Comments?**	**January**	**February**	**Total**
	Yes	964	1,087	2,051
	No	493,382	527,599	1,020,981
	Total	**494,346**	**528,686**	**1,023,032**
	Comment %	0.20%	0.21%	0.20%
	H&S Comment	208	176	384
	H&S %	21.58%	16.19%	18.72%
No Access:	**Comments?**	**January**	**February**	**Total**
	Yes	22,207	20,156	42,363
	No	69,830	65,382	135,212
	Total	**92,037**	**85,538**	**177,575**
	Comment %	24.13%	23.56%	23.86%
	H&S Comment	2698	2661	5359
	H&S %	12.15%	13.20%	12.65%
Combined:	**Comments?**	**January**	**February**	**Total**
	Yes	23,171	21,243	44,414
	No	563,212	592,981	1,156,193
	Total	**586,383**	**614,224**	**1,200,607**
	Comment %	3.95%	3.46%	3.70%

	H&S Comment	0	0	0
	H&S %	0.00%	0.00%	0.00%

Comments made during meter readings

All I&C electricity meter readings are held on the Servicedesk system.

The spreadsheet contained 384 comments. From the data in the spreadsheet it was not possible to clearly identify which comments were associated with meter readers and which were associated with engineers.

Of the 384 comments identified by British Gas as having a health and safety component; there were:

- 103 cases where the comment had obviously been made by an engineer rather than a meter reader
- 199 comments that were not relevant to this study
- 5 blank screens on meters or meters otherwise faulty
- 77 latently hazardous situations identified
- Zero electrically hazardous situations identified

Comments made during "no access" visits

These "no access" readings also include cases where access has been obtained to the meter, but for some reason the meter could not be read.

This spreadsheet contained 5359 records, of which:

- 5255 were not relevant to this study (loose dogs, unable to locate address etc.)
- 93 cases where the meter display was blank
- 6 cases where the comments indicated a latently electrically hazardous situation
- 5 cases where the comments indicated an ongoing electrically hazardous situation

The electrically hazardous situations comprised the following (unedited) comments:

- meter under water
- METE IS MELTED DUE TOO FIRE DAMAGE
- METER IS MELTED DUE TO FIRE DAMAGE
- fire
- fire damaged

The electrically latently hazardous situations comprised the following (unedited) comments:

- WIRING SLICED THROUGH .AFTER METER.MAIN FUSE FOUND TO BE REMOVED.
- due to fire
- display reads error 02
- due to fire
- MTR HAS BEEN BROKEN AND CANNOT BE READ.

- main fuse removed

In a number of the comments classified as electrically hazardous and electrically latently hazardous, an alternative, non-hazardous or less hazardous interpretation of the comment could be made. As elsewhere in the reports, the comments have generally been interpreted to over-estimate the hazard associated with the comment.

Appendix E Theft Data 2009

For a trial period commencing in January 2009, British Gas increased the workforce associated with full time theft of energy activities from 25 to 50. As part of this trial period, the focus of the theft of energy activities changed from being reactive (mainly associated with DNO related activity) in relation to electricity meters to proactively detecting and investigating possible cases of theft in both the gas and electricity sectors. Another important change during this trial was that as part of the reactive process, the cases of potential theft notified by the DNOs were investigated by British Gas staff, whereas as part of the new proactive process, these investigations are predominantly outsourced, enabling more proactive investigation activity to be undertaken by British Gas staff.

For gas meters, British Gas advised that virtually all of the hazardous and latently hazardous situations found in 2009 as a result of the theft initiative are "new" cases, because no equivalent arrangements to the electricity arrangements were in place for theft of gas detection and investigation prior to this initiative.

The data analysis is conducted in two stages; firstly analysis of a spreadsheet summarising the theft data for early 2009 and secondly a review of theft of gas records held by Revenue Protection officers (RPOs) during early 2009. The spreadsheet data is considered in Sections E.1 to E.6 and the data from the RPOs in E.7.

Following on from the analysis of the theft data, an estimate is made of the risk removed by the current theft process and the change in risk removed associated with the enhancements made to the process.

E.1 Theft Dataset Overview

The dataset in this spreadsheet covers the period 1 January 2009 to 9 March 2009. This 68 day period comprises approximately 18.6% of a calendar year.

The spreadsheet comprises 2067 records (plus four fragmentary records), including 636 confirmed illegal installations. The data was grouped into two fuel types and two consumer types, making a total of four overall categories:

- *Fuel* : Gas or electricity
- *Customer type*: Domestic or I&C

Table 45: Gross number of records by fuel and meter category

	Gross total	Domestic	I&C
Gas	945	824	121
Electricity	1113	1056	57

However, it is noted that in some fields there was spurious data (e.g. field blank, fuel type entered as [redacted] etc). Hence, in the following analysis only those records where the appropriate data fields are correctly identified are used.

In extrapolating these records to annual values the following numbers have been used for the net number of valid records for the different fuel types and meter class. Extrapolating to a full year gives the values in parentheses for the number of cases per year.

Table 46: Net number of records by fuel and meter category

	Net total	Domestic	I&C
Gas	941 (5952)	820 (5645)	121 (307)
Electricity	1107 (5060)	1050 (4409)	57 (651)

E.2 Hazards Associated with Theft of Energy

Because the data provided was focussed on theft issues, any information on the safety or otherwise of the installation was incidental, and therefore it was necessary to apply some judgement to the safety implications of different modes of theft.

The spreadsheet provided by British Gas contained 2052 records covering a period from 1 January 2009 to 9 March 2009 (~18.6% of the year), making an extrapolated total of approximately 11,000 cases per year.

Theft of gas

The British Gas revenue protection unit have advised that:

- Where a TOG (theft of gas) situation is found with a gas leak, the investigator will contact the emergency service and wait on site until resolved. The investigator will turn off the ECV and provide normal safety advice to customer. Ultimately, the situation will be resolved by meter removal and making the supply safe.
- Where no leak is identified, again the ECV will be turned off and advice provided to the customer and the investigator will remain on site. The investigator will contact the local Meter Operator for British Gas and request a 3 hour visit. Again the meter will be removed and the supply made safe.

This theft data does not record cases where a gas escape was found (see later section regarding analysis of records from Revenue Protection Officers (RPOs)).

For the purposes of this analysis the following classification has been used to differentiate between latently hazardous and non-hazardous theft cases for gas:

Latently hazardous thefts of gas:

- Meter by-pass installed
- Substitute meter installed
- Meter reversed

Non-hazardous theft of gas:

- Tampering with meter index (including seal missing on meter)
- Applying magnets to ETM meters
- Shipperless meter

N.B. It is considered that a seal missing on the regulator does not imply that the pipe work etc. has been altered and/or there has been a potential theft of gas, and so this is considered as a non-hazardous event.

From an initial review of the domestic gas data, it appeared that the vast majority of cases involved unauthorised work on the gas installation (pipe work and fittings). For the types of theft involving changes to gas pipe work (such as reversing gas meters, installing substitute meters, illegal connections) the likely source of a smell of gas would be a weep at a joint. However, there is the possibility that an illegal meter bypass involving home-made pipe work could fail resulting in a large gas escape.

There is also the additional hazard associated with bypassing a regulator resulting in mains gas pressure being delivered to the appliances, with a concomitant potential increase in carbon monoxide and carbon dioxide production. For a significant proportion of the UK, applying mains pressure to the internal installation would not involve a significant change in carbon monoxide production at the appliances. However, it is not possible to discount the possibility that in some cases an increased level of carbon monoxide production in conjunction with poor flue extraction and/or poor ventilation could lead to a hazard from carbon monoxide poisoning. If the regulator had been by-passed it would be considered that the level of carbon monoxide/carbon dioxide hazard would be intermediate to the latently hazardous and immediately hazardous situations for unignited gas releases. Thus, the overall hazard rating for a by-passed regulator would be approximately equivalent to the immediately hazardous classification for gas meters. The information provided in the spreadsheets did not specifically indicate when a regulator on the meter had been by-passed.

Overall, if there was no clear evidence to the contrary, the assumption was made that the theft of gas was latently hazardous.

Theft of electricity

For the purposes of this analysis the following classification has been used to differentiate between latently hazardous and non-hazardous theft cases for electricity:

Hazardous theft of electricity:

- Meter by-pass installed
- Internal installation directly connected to incoming distribution cable

Non-hazardous theft of electricity:

- Tampering with meter index

From an initial review of the domestic electricity data, it appeared that the virtually all thefts of electricity involved unauthorised work on the electricity installation (cabling and fittings). Hence if there was no clear evidence to the contrary, the assumption was made that the theft of electricity was hazardous.

Relative hazards

It should be noted that the consequences for a hazardous situation identified for an electricity meter may be much less severe than for a gas meter. For example a bridged meter may cause an electric shock, whereas a large escape of gas could result in an explosion and multiple fatalities. It is considered that the relative risk associated with a gas installation classified as hazardous would be considerably greater than for electricity.

As before, for the purposes of assessing the potential loss of life (PLL) averted through the theft processes, it is considered that:

- Each gas escape (hazardous) situation identified corresponds to a PLL averted of 10^{-4} (0.0001) fatalities

- Each latently hazardous gas meter situation identified corresponds to a PLL averted of 10^{-5} (0.00001) fatalities
- Each hazardous electricity meter situation identified corresponds to a PLL averted of 10^{-6} (0.000001) fatalities

E.3 2009 Theft Data for Domestic Gas

The dataset comprises 824 entries, of which 10 were largely incomplete, leaving 814 usable entries, of which:

- 556 cases were pending clarification
- 150 cases where the installation was found to be legal
- 108 cases where the installation was found to be illegal

However, as noted above, not all cases of illegal installations involve a latently hazardous situation. In this dataset:

- Of the 108 cases of illegal installations, 96 were found to also involve a latently hazardous situation.

Extrapolation to an annual value

In order to extrapolate the 2009 sample to an annual value the following assumptions were made:

- The 556 cases that have yet to be clarified will be split in the same ratio as those already clarified.
- The sample for this period is representative of those for the whole year

Thus, the 556 yet to be clarified cases correspond to 96/258 * 556 = 211 additional latent failures for this time period.

Consequently the estimated number of latent failures in this period is 96 + 211= 307.

Extrapolating to the full year the number of latent failures identified would be 307/0.186 = 1650.

These data are discussed in more detail below where an estimate is made of how many of the cases identified as latent failures would actually be associated with a gas escape (a factor not recorded in this dataset) and thus should be classed as an ongoing dangerous situation.

E.4 2009 Theft Data for I&C Gas Meters

The dataset comprises 121 entries, of which:

- 50 cases were pending clarification
- 54 cases where the installation was found to be legal
- 17 cases where the installation was found to be illegal

However, as noted above, not all cases of illegal installations involve a latently hazardous situation. In this dataset

- Of the 17 cases of illegal installations, 4 were found to also involve a latently hazardous situation.

E.4.1 Comparison to 2006 data for meter readers

For 2006, I&C gas meter reader comments identified and extrapolated:

- 12 were hazardous installations
- 36 were latently hazardous situations

In order to compare the 2009 sample to the 2006 dataset the following assumptions were made:

- The 50 cases that have yet to be clarified will be split in the same ratio as those already clarified.
- The sample for this period is representative of those for the overall year.

Thus in this period it is estimated that zero gas escapes and 29 latently gas hazardous situations were identified, corresponding to 156 latently gas hazardous situations for the full year.

E.5 2009 Theft Data for Domestic Electricity Meters

The data-set comprises 1050 entries, of which:

- 442 cases were pending clarification
- 110 cases where the installation was found to be legal
- 498 cases where the installation was found to be illegal

However, as noted above, not all cases of illegal installations necessarily involve a hazardous situation. In this data-set

- Of the 498 cases of illegal installations, all 498 were found to also involve an electrically hazardous situation

E.5.1 Comparison to 2006 data for meter readers

For 2006, domestic electricity meter reader comments identified:

- 32 electrically hazardous installations

In order to compare the 2009 sample to the 2006 data-set the following assumptions have to be made:

- The 442 cases that have yet to be clarified will be split in the same ratio as those already clarified.
- The sample for this period is representative of those for the overall year.

Thus in this period it is estimated that 860 electrically hazardous situations were identified, corresponding to 4624 for the full year.

E.6 2009 Theft Data for I&C Electricity Meters

The dataset comprises 57 entries, of which:

- 42 cases were pending clarification
- 2 cases where the installation was found to be legal
- 13 cases where the installation was found to be illegal

However, as noted above, not all cases of illegal installations necessarily involve a latently hazardous situation. In this data-set

- Of the 13 cases of illegal installations, all 13 were found to also involve an electrically hazardous situation.

E.6.1 Comparison to 2006 data for meter readers

For 2006, I&C electricity meter reader comments identified:

- Zero electrically hazardous installations

In order to compare the 2009 sample to the 2006 data-set the following assumptions have to be made:

- The 42 cases that have yet to be clarified will be split in the same ratio as those already clarified
- The sample for this period is representative of those for the overall year

Thus in this period it is estimated that 49 electrically hazardous situations were identified, corresponding to 266 for the full year.

E.7 2009 RPO Data (Gas)

A survey was undertaken of 11 of the 44 RPOs active during January and February 2009. In this period 84 theft cases resulted, comprising:

- 20 gas escapes being detected and 50 latently hazardous situations being encountered on domestic gas meters
- 5 gas escapes being detected and 9 latently hazardous situations being encountered on I&C gas meters

In this context it is noted that gas escapes as well as latently hazardous situations (i.e. no ongoing gas escape) were encountered for example; reversed meters, illegal connections, substitute meters on supply and bypass on supply.

From the theft spreadsheet data it was estimated that during the course of a year, theft work identified 1650 latently gas hazardous situations on domestic gas installations. Using the data from the RPOs, these 1650 situations would be split into gas escapes and latently hazardous installations in the ratio 20:50, giving:

- 471 gas escapes identified per year
- 1179 latently hazardous situations identified per year

From the theft spreadsheet data it was estimated that during the course of a year theft work identified 156 latently gas hazardous situations on I&C gas installations. Using the data from the RPOs, these 156 situations would be split into gas escapes and latently hazardous installations in the ratio 5:9, giving:

- 56 gas escapes identified per year
- 100 latently hazardous situations identified per year

Appendix F Occupational Risks 2009

British Gas provided a spreadsheet outlining the Lost Time Accidents (LTAs) to meter readers for the early part of 2009. Additional information was provided in order to relate the risk imposed upon meter readers to other employees that may need to visit the meter; specifically meter engineers and personnel addressing theft issues.

F.1 Domestic Meter Readers

The split across the meter reading agent for the domestic population of meters is:

- [redacted]

[redacted]

[redacted] provided data indicating that [redacted] accidents occurred in January 2009 during domestic meter reading. These comprised

- [redacted]

In the spreadsheet it is not clear if these are Lost Time Accidents (LTAs) or a mixture of LTAs and near misses. If it is assumed that they are all LTAs and that this accident rate can apply to all domestic meter readers throughout British Gas' portfolio, this corresponds to [redacted] accidents per year.

[redacted] provided data indicating that [redacted] during domestic meter reading. These comprised

- [redacted]

and occurred during the following type of meter reads

- [redacted]

Assuming that the [redacted] data can apply to all domestic meter readers throughout British Gas' portfolio, this corresponds to [redacted] accidents per year. Thus, this is slightly higher than would be anticipated (based upon the 2006 data).

[redacted]

[redacted] have not reported any accident for this period.

F.2 I&C Meter Readers

The split per reading agent for the I&C population of meters is:

- [redacted]

[redacted]

[redacted] reported that there were no recorded accidents reported in January and February 2009 during I&C meter reading.

This is contrary to the data in the domestic meter reading spreadsheet recorded above where one LTA in February 2009 occurred at a commercial meter. For the purposes of this assessment it is assumed that the LTA reported above actually occurred at a domestic meter.

[redacted]

No issues were recorded in either January or February 2009.

[redacted]

[redacted] had no actual reported accidents, but recorded [redacted] near misses.

[redacted]

F.3 Comparison with 2006 Data

The 2006 data indicated that there approximately [redacted] meter readings undertaken resulting in [redacted] reported accidents to meter readers. This is an accident rate of 5×10^{-6} accidents per reading.

Domestic

In the 2006 data, [redacted] visits were undertaken to gas and electricity domestic meters combined. At a rate of 5×10^{-6} accidents per reading it would be expected that this number of readings would produce [redacted] accidents per year.

The current [redacted] sample of one month has [redacted] LTAs. In this period ~3.6million domestic meter readings would be undertaken of which [redacted] Assuming similar accident rates for [redacted] in 2009, the expected [redacted] accidents per year equates to an expected [redacted] accidents for the one month period reported by [redacted]. Thus the currently reported number of accidents is higher than would be anticipated (based upon the 2006 data).

I&C meters

In the 2006 data, ~1.8 million visits were undertaken to gas and electricity I&C meters combined. At a rate of 5×10^{-6} accidents per reading it would be expected that this number of readings would produce [redacted] accidents per year.

The current [redacted] sample of 2 months has [redacted] reported accidents. In this time period it would be expected that [redacted] I&C meter readings would be undertaken of which [redacted] Assuming similar accident rates for [redacted] in 2009, the expected [redacted] accidents per year equates to an expected [redacted] accidents for the two month period reported by [redacted]. Thus the currently reported number of accidents is approximately the same as would be anticipated (based upon the 2006 data).

PLL

In the 2006 data analysis, each lost time accident was considered to be equivalent to a PLL of 3.3 x 10^{-4} fatalities. Thus for a total annual number of [redacted] LTAs, the calculated PLL would be ~0.1 fatalities per year.

Assuming that the number of meter readers in 2009 was essentially the same as were used in 2006 (i.e. [redacted] the average calculated Individual Risk was 3.5 x 10-5 per year.

Summary

Overall, the number of injuries experienced by meter readers appears to have increased slightly since 2006. The number of meter readers exposed to these injuries was not known; however, assuming that the number of meter readers in 2009 is broadly similar to those in 2006, it can be inferred that the risk has also increased slightly.

F.4 Comparison with Other Agents

In this comparison an overview of accident statistics was undertaken to establish if there had been any fatalities or serious injuries to meter readers and to meter engineers and to personnel investigating theft issues. This gives an estimate of PLL based upon a working year.

From the earlier data an estimate of PLL based on visits made to properties to investigate theft issues can also be made.

F.4.1 Annual accident statistics

Meter readers

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Theft related activities

[redacted]

Conclusion

There is no evidence to indicate that the likelihood of injury per year is greater for theft agents, or for operatives working on meters in comparison to meter readers.

F.4.2 Visits to properties

Hazard associated with suspected theft visits

Based upon the 2009 data, it would be estimated that during the course of a year, there would be ~11,000 cases where a meter would need to be examined as part of an investigation into the suspected theft of gas. Assuming that the rate of access of meters for the suspected theft inspections was 50% that of normal routine meter readings then the 11,000 inspections would require approximately 30,000 visits.

Rephrasing the 2006 meter reader accident data in terms of accidents per visit, the [redacted] visits resulted in [redacted] LTAs or (3.6×10^{-6} accidents per visit), which at a PLL of one fatality equivalent per 3000 LTA equates 1.2×10^{-9} fatalities per visit.

Applying this ratio to the 30,000 suspected theft visits in 2009, the associated PLL is 3.6×10^{-5} fatalities in the year.

Even assuming that there would be more visits required to gain access to the property and that the likelihood of injury is greater for the theft visits, the estimated PLL for the 30,000 theft visits would be a small fraction of the PLL associated with [redacted] meter visits.