

Review of the Health and Safety Executive's 2002-2007 enforcement policy for the replacement of iron gas mains.

Health & Safety Executive's Gas & Pipelines Unit - September 2005

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Background

1 In September 2001, the Health and Safety Executive [HSE] published its [enforcement policy for the replacement of iron gas mains](#)¹ within 30m of property within 30 years. HSE considered it realistic and practicable for Transco to speed up its rate of mains replacement over the 5 years from March 2002 so as to be in a position to complete the replacement of all the remaining 'at risk' iron mains by December 2031². (The 30/30 programme.)

2 In June 2005 Transco completed the sale of four of its original eight Distribution Networks [DN]. The four new DN operators [Scotland Gas Networks Ltd, Northern Gas Networks Ltd, Wales & West Utilities Ltd, and Southern Gas Networks Ltd] are now responsible for complying with the policy in their networks.

3 HSE agreed to review the policy as implementation proceeded and before the end of the 5-year period. This interim review sets out HSE's position at this time.

Legal requirements

4 The Health and Safety at Work etc. Act 1974 (HSWA), section 3(1), requires pipeline operators to conduct their undertakings to ensure, so far as is reasonably practicable, that persons not in their employment are not exposed to risks to their health and safety.

5 In addition, the Pipelines Safety Regulations 1996 (PSR), regulation 13 requires the operator to ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair. This duty is absolute, with a limited defence if a breach is caused by a third party.

6 In respect of iron gas mains there is no alternative to maintaining the network in a safe condition other than to decommission it and replace it with a more suitable material, usually polyethylene. In setting the timetable for decommissioning the iron network, HSE's judgment was on historical replacement rates and the potential for accelerating that rate. HSE concluded it was practicable to speed up the rate of replacement over the first five years to reach a level where the whole of the 'at-risk' iron mains population could be replaced within a total of 30 years at most.

7 HSE then developed proposals for amending the Pipelines Safety Regulations 1996 to give legal underpinning to the replacement programme. [The Pipelines Safety \(Amendment\) Regulations 2003](#)³ came into force on 3 November 2003 allowing HSE to approve annual replacement programmes. So far these have been approved for 2004/5 and 2005/6.

8 The arrangements for meeting the replacement programme now form part of each DN's safety case prepared under the Gas Safety (Management) Regulations 1996 [GSMR]. The DNs have a duty to follow these arrangements.

Baseline replacement programme

9 [Annex 1](#) shows the baseline replacement programme for the five-year period 1 April 2002 – to 31 March 2007. The profile describes the ramp-up rate required over the first five years to a plateau to enable decommissioning of all iron mains within 30m of buildings within a maximum of 30 years. At the start of the programme, records showed there were some 91 000 kms of iron mains requiring decommissioning.

1 The Health and Safety Executive's enforcement policy for the replacement of iron gas mains, September 2001 [<http://www.hse.gov.uk/gas/domestic/gasmains.pdf>].

2 This is commonly known as the 30/30 programme, referring to the decommissioning of mains within 30 m of buildings within 30 years.

Medium pressure (75 mbar – 2 bar) ductile iron mains [MPDI]

10 There are serious concerns about the integrity of medium pressure ductile iron mains [MPDI]. As a result, HSE required Transco to decommission all MPDI mains within 30m of property by 30 April 2003, resulting in excess of 2800 km of MPDI being decommissioned.

11 Any additional lengths of MPDI which are found or become 'at risk' since April 2003 must be replaced as soon as reasonably practicable and in any case within 12 months of being found.

Prioritising mains replacement

12 Having established the overall timetable, the replacement of mains is prioritised using a model developed by Transco in consultation with HSE. The model provides a risk score for each main so that higher risk mains can be targeted earlier in the replacement programme. The policy and procedures and use of the model are described in two documents³ which have been adopted by all the DN operators and are referred to in their GSMR safety cases.

13 The model has been reviewed regularly since 2001.

14 Initial estimates of the achievable risk reduction rates were based on decommissioning mains in a top-down risk ranking order. However, in 2002, Transco proposed an alternative approach to the selection of mains for replacement to enable an appropriate balance to be struck between operational efficiency and risk reduction.

15 The new approach was based on allocating network's annual replacement workloads within seed and secondary risk project areas in the proportions: highest risk 'seed' pipes - 20% of workload; medium-risk 'secondary' pipes - 70% of workload; and lower-risk pipes - 10% [20:70:10 methodology]. This approach allowed Transco some efficiency gains in deploying resources and would reduce the potential for repeated disruption of gas supplies and traffic movements.

16 HSE accepted this approach providing an equivalent amount of risk was removed from the network as when using the top-down approach. In reality this meant typically 10% more per annum would have to be replaced than the original agreed baseline targets. HSE had this new approach reviewed independently and concluded that over 5 – 7 years, an equivalent risk would be removed⁴. Given the inherent uncertainties in the risk models used to develop the projects, HSE were satisfied the new approach was both sensible and would in reality lead to a potential shortening of the 30 year programme.

17 Having agreed this approach, 'baseline + 10%' replacement targets were established as shown in [Annex 1](#).

18 In March 2004, Transco completed a re-survey of the mains population and identified that at the start on the 30 year programme there was actually 101 800 km requiring decommissioning, some 10% above the original 91 000 km estimate.

19 Therefore, even with the extra length of mains requiring decommissioning, with the 10% improvement on the baseline replacement targets, HSE believes the 30 year programme is still practicable.

³ T/PL/REP/1 Policy for Distribution Pipe Replacement (May 2004)

T/PM/REP/2 Management Procedure for Distribution Pipe Replacement (October 2004)

⁴ A review of the uncertainties attached to the risk predictions forming the basis of Transco's mains replacement policy, P Kinsmann, March 2003

Monitoring Transco's mains replacement performance

20 HSE's monitoring requirements and associated enforcement action criteria for the iron mains replacement activity is set out in HSE document '[Monitoring and Reporting of the Transco Distribution Mains Replacement Programme 2002-2007](#)'⁵. This includes a series of ongoing audits in the DNs to ensure the policy is being followed properly.

21 HSE are satisfied that the mains replacement targets for the first two years (2002-3, 2003-4) of the 5-year programme were met. There was a shortfall of 35 km (~ 1%) in meeting the 2004-5 target (2847 km decommissioned against the 2882 km target). This shortfall has been included in the targets for 2005-6.

22 In addition to this key performance indicator, HSE also monitors trends in risk reduction, major incidents and 'Gas in buildings' [GIB] events [[Annex 2](#)].

23 When submitting replacement programmes for approval, DNs estimate the quantity of risk [in incidents/annum] to be removed nationally and in each network. While HSE recognises there are potentially significant uncertainties in these figures, they believe they are of value in giving an indication of the effectiveness of the programme and that higher risk mains are being targeted properly.

24 With a GIB event, an external main has failed and gas has subsequently entered a property. In the vast majority of cases, a fire/explosion does not occur because either the concentration of gas does not reach the lower explosive limit of 5% gas in air or there is no source of ignition. The occupier usually detects (smells) the escaping gas and the DN operator is called to the scene and undertakes a repair.

25 In recent years, Transco worked to improve the processes by which GIB data is captured. The improvements made are designed to ensure, so far as reasonably practicable, that future data will be recorded consistently. For the reasons described above, the increase in GIBs recorded for 2003 – 2004 should not be taken as any indication of general system deterioration or any shortcoming of the mains replacement policy. However, now that the quality of the data has been improved, HSE will look carefully at future trends to inform its enforcement policy.

Large diameter (>12") cast iron mains

26 At the start of the 30 year programme, HSE accepted that the policy towards the replacement of >12 " diameter mains [~6127 km] required further development. This was mainly because of a very low failure rate history meaning that the data in the risk model could contain large errors.

27 HSE agreed that, in the first five year of the programme, 90 km/annum of >12" diameter mains should be replaced nationally while Transco developed the policy for either prioritising the replacement of these mains or mitigating the risk arising from them by other means. This decision was based in part on there being greater possibilities with the larger diameter mains for alternative ways of maintaining integrity (e.g. condition monitoring). Additionally, the cost of risk reduction by replacement of the larger diameter mains is disproportionately greater than for the smaller diameter mains that were in reality responsible for the significant proportion of the failures in the network. Replacement of the larger diameters also results in major disruption to gas supplies and highways.

28 However, over the winter period in the winter of 2001 - 2 there were 4 failures of >12 " diameter mains in the North West region which made HSE and Transco review this policy following concerns that there could possibly be an acceleration of failures in this population.

⁵ Monitoring and Reporting of the Transco Distribution Mains Replacement Programme 2002-2007, <http://www.hse.gov.uk/gas/supply/transco/index.htm>

This was supported by Transco undertaking detailed examinations over the period September 2002 – May 2003 of a sample of >12" diameter mains failures to identify common causes or trends. The outcome of that review was that there did not appear to be a significant change in the way >12" cast iron mains were behaving requiring an immediate change in policy. HSE agreed that Transco should concentrate its programme on replacing larger diameter mains in the 12" to 18" diameter range. This was based on failure history and structural integrity analysis.

29 HSE also commissioned independent research into the factors that contributed to the failure of large diameter cast iron mains. The findings fed into work Transco were carrying out in parallel on their large diameter model.

30 In view of this, the policy towards large diameter cast iron mains is still developing.

Ductile iron risk model

31 In 2003 HSE and Transco reviewed the model for developing the risk scores for the ductile iron mains and concluded that it should be revised. This resulted in a new model in 2004 that produces risk scores comparable to the cast iron model. The new model was used for work planning for the year 2004/5.

Future considerations.

32 There are a number of initiatives currently under consideration that may influence HSE's enforcement policy and how the DNs meet their mains replacement programmes.

33 One option is to move from the current 20:70:10 methodology (see [paragraph 15](#)) for prioritising mains replacement. This may allow significantly larger replacement projects that could achieve greater efficiency gains and faster replacement rates. However, to do this, HSE has to be satisfied that the high scoring mains are being dealt with appropriately. After the first few years of the 30 year programme, the very high scoring mains should have been removed and the order in which the remainder are replaced may not be as significant. HSE see potential safety benefits for increased efficiency to allow higher annual decommissioning targets and improve the effectiveness of the 30 year programme.

34 Technological advances, such as lining of gas mains, also offer opportunities of greater replacement rates. HSE is also open to considering other approaches to ensuring pipeline integrity such as condition monitoring. There may be options for this in the larger diameter mains.

Conclusions

35 There remains uncertainty about the exact condition and future integrity of the network, and it is conceivable that within the next 20 years parts of the network may reach the end of their reliable mechanical life.


36 The policy to-date has succeeded in ensuring the number of major incidents remains low, and whilst it is too early to draw firm conclusions, there appears to be no significant deterioration in the network.

37 The replacement targets have substantially been met and shown to be practicable.

38 The models used for prioritising replacement are satisfactory but require continual review.

Recommendations

39 HSE's enforcement policy on iron mains replacement is fit for purpose and should continue for at least the next 6-year price control review period from March 2007 – March 2013 at a minimum rate of 3500 km/annum.

- 40 The policy should be reviewed again before the end of 2013 period.
- 41 HSE should consider and encourage proposals for increasing replacement rates and improving the effectiveness of the 30-year programme.
- 42 That Ofgem are informed of the outcome of this review.
- 43 [HSE's enforcement policy](#)  and [monitoring arrangements](#) should be revised to reflect recent structural changes in the gas distribution industry.

Further information

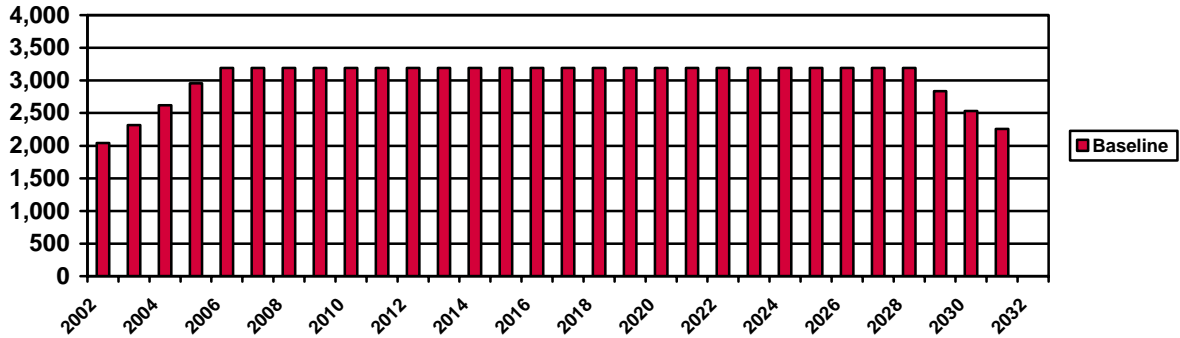
For further information, contact Steve Chatfield, Head of Operational Policy, Gas & Pipelines Team, 0115 971 2911 or steve.chatfield@hse.gsi.gov.uk.

ANNEX 1

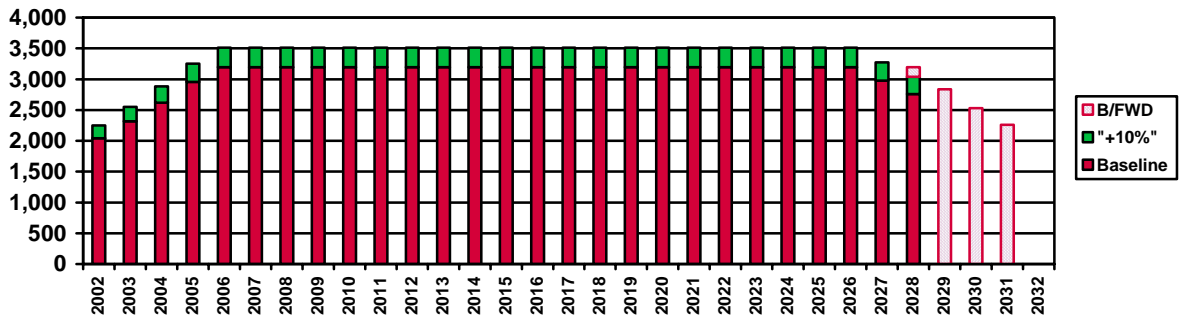
Iron mains decommissioned within 30m of buildings:

30/30 iron pipe to be decommissioned [km]	2002/03	2003/04	2004/05	2005/06	2007/07	TOTAL
Baseline	2043	2317	2620	2956	3193	13 128
Baseline +10%	2247	2549	2882	3252	3512	14 442

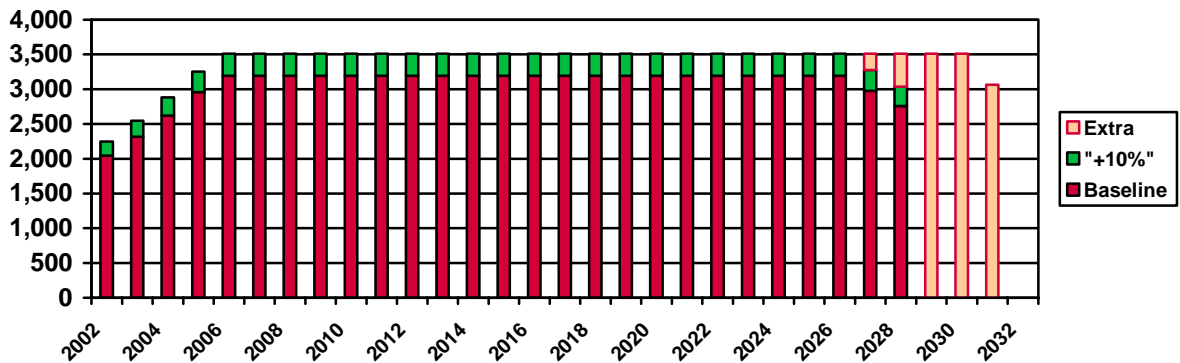
30/30 Baseline profile – 91 000 km



Current plan (April 2005) based on replacing 91 000 km



Potential profiles for replacing 101 800km



ANNEX 2

Risk reduction

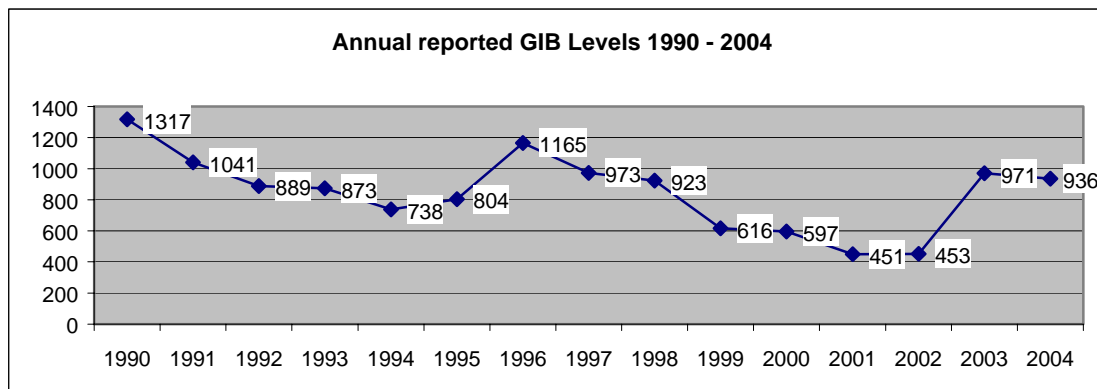
	Year	Sco	NoE	NW	EoE	WM	W&W	Lon	SoE	Total
Risk reduction (Incidents/annum)	2003/4	0.085	0.124	0.145	0.129	0.116	0.057	0.048	0.089	0.793
	2004/5	0.048	0.095	0.079	0.093	0.057	0.046	0.034	0.089	0.541

As the highest risk mains are removed from the networks, it is expected that the risk removed per km of main decommissioned will reduce throughout the 30-year programme.

Mains failure history

Prior to the 30 year programme, Transco reported on average about 23 000 fractures and corrosion failures per annum leading to about 600 GIB. This led to an average 3 – 4 major incidents (fire or explosion) resulting in the deaths of 1 – 2 people annually; but with potential for multiple fatalities [Putney, 1985 – 8 fatalities; Rutherglen, 1985 – 5 fatalities; Larkhall, 1999 – 4 fatalities].

In the year 1 April 2004 – 31 March 2005, 11468 fractures and corrosion failures were reported leading to 936 gas in buildings [GIB] events.



Mains and service related incidents

