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Independent Review of Service Leakage Estimation Methodology

GL Industrial Services Restricted

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Executive Summary

Distribution Network Operators (DNOs) utilise a spreadsheet based leakage model to estimate leakage from their networks, and the establishment of this model is an obligation within the 2008 – 13 Gas Transporters' Licences. The outputs from this model have an impact on DN performance under both the Shrinkage and Environmental Emissions incentives.

Once established, any modifications to the leakage model must comply with a modification process defined within the Special Conditions of these licences. This includes the requirement that when proposing a modification to the leakage model, the licensee shall, together with other DN operators, appoint an independent expert who shall review the leakage model and the proposed allowed leakage volumes and provide a report of that review.

This report has been produced in order to provide an independent review to comply with the requirements of the modifications process.

Following completion of the review of the proposed service leakage estimation methodology, the following opinions can be stated:

A] When compared with the service leakage estimation methodology that is currently applied within Version 1 of the leakage model, the proposed methodology enables the annual service replacements within both an individual network and LDZ to be reflected within the leakage estimate.

B] Based upon the leakage rates associated with the various service categories defined by the 2002/03 National Leakage Tests, the proposed methodology would reflect an actual annual leakage reduction that is resulting from service replacements.

C] The proposed service leakage methodology is correctly reflected within the calculations and formulae contained within Version 1.3 of the leakage model.

D] When compared with the service leakage estimation methodology that is currently applied within Version 1 of the leakage model, the accurate calculation and reporting of gas leakage would be better facilitated by the proposed service leakage estimation methodology.

Contents

1 Introduction

Distribution Network Operators (DNOs) utilise a spreadsheet based leakage model to estimate leakage from their networks, and the establishment of this model is an obligation within the 2008 – 13 Gas Transporters' Licences. The outputs from this model have an impact on DN performance under both the Shrinkage and Environmental Emissions incentives.

The current leakage model was used as a basis for setting the LDZ specific leakage baselines for both the Shrinkage and Environmental Emissions incentives. The DNOs used the latest leakage assessment details available at the time of the Price Control Review negotiations, which was that for the 2006/07 formula year, to produce forward leakage projections for the 2008 -13 Price Control Period. These projections were used by the Regulator to determine appropriate baseline leakage values for the two incentives.

Once established, any modifications to the leakage model must comply with a modification process defined within the Special Conditions of these licences. This includes the requirement that when proposing a modification to the leakage model, the licensee shall, together with other DNOs, appoint an independent expert who shall review the leakage model and the proposed allowed leakage volumes and provide a report of that review.

On 31 March 2009, the DNOs initiated a consultation on two proposed modifications to the leakage model; AGI Working Losses and Low Pressure Service leakage calculations. Subsequent to the consultation, the DNOs withdrew the AGI Working Losses modification as it became apparent that insufficient detail was available to facilitate the changes. Therefore, only the Low Pressure Service leakage modification is being progressed and this is the subject of this review.

This report has been produced in order to provide an independent review to comply with the requirements of the modifications process.

2 Current Leakage Model

The current leakage model that is used by DNOs includes estimates of leakage that arise within the following categories:

- Low pressure mains
- Low pressure services
- Medium pressure mains and services
- Above ground installations
- Working losses associated with above ground installations
- Interference damage

Statistically robust leakage rates for low pressure mains and services were originally established in 1992 by undertaking National Leakage Tests that provided leakage rates for all representative material types and diameter groupings. These leakage rates were updated in 2002 when a further National Leakage Test programme was undertaken, and these rates are used for leakage calculations within the current leakage model.

3 Estimation of Service Leakage

3.1 Current Service Leakage Estimation Methodology

The current leakage model includes estimates of leakage from low pressure services for each individual network that is based upon the number of services that exist and the leakage rates for various categories of these services.

3.1.1 Service Leakage Rates

The service leakage rates established in the 2002 National Leakage Tests were categorised within 4 individual categories based upon the material of the service and the material of the main. These are identified as follows:

- Metal service connected to metal main
- Metal service connected to PE main
- PE service connected to metal main
- PE service connected to PE main

The leakage rates associated with these service categories are defined as 'per service' rates and are therefore not dependent upon the individual length of each service.

3.1.2 Assumptions within the current leakage model

There are a number of assumptions relating to individual network populations of services that enable an estimate of the number of services within the 4 individual service categories to be included within the leakage model. These assumptions are identified as follows:

- The number of services within a network is deemed to be the same as the number of connected consumers.
- For an 'all PE' mains network, all services are PE
- For mixed material networks, two thirds of services are PE
- The number of metallic services attached to PE mains is calculated by multiplying the assumed number of metallic services by 0.187097.
- PE services are evenly distributed between PE and metallic mains on a length weighted basis.

Within the leakage model, the number of services attached to 'all PE' networks are identified as 'excluded services' and are not included within the subsequent service split calculation.

Each year when the model is used to produce a leakage estimate, the same data sources and assumptions are applied to determine the service populations within the 4 individual service categories for each network.

3.2 Proposed Service Leakage Estimation Methodology

A revision to the existing service leakage estimation methodology has been proposed that identifies the impact of service replacements that have been undertaken since the previous year's leakage estimation was carried out. The proposal would only include the impact of service replacements that have been undertaken since 2006/07.

The current method of service leakage estimation does not identify and take into account the service replacements that have been undertaken since the previous years estimate. A proposed methodology has been suggested that would more accurately identify the metallic service population within each network and would reflect the level of service replacements that have been undertaken since the previous year's estimate.

The proposed methodology would account for the reduction in metallic services within the service leakage estimate for each year as follows:

A] Establish a fixed number of metallic services for each LDZ when the baseline numbers were applicable (i.e. 31st March 2007) based upon the assumption that one third of all services on a mixed material network are metallic.

B] Establish a fixed number of metallic services for each network when the baseline numbers were applicable (i.e. 31st March 2007) based upon the assumption that one third of all services on a mixed material network are metallic.

C] Based upon the number of metallic services replaced within the LDZ since the baseline value was established, calculate the percentage of metallic services replaced for the LDZ for the year.

D] Apply this percentage reduction in services to the fixed metallic service population of each network to determine a revised total of metallic services within each network.

E] Calculate the PE service population for each network by subtracting the value determined in D] from the total number of services within the network.

F] Apply the same assumptions as within the current estimation methodology to determine the service populations within the 4 individual service categories for each network.

3.3 Validation of calculations within revised leakage model

As part of the review process, the revised service leakage estimation methodology outlined within 'Leakage Model Modification Consultation No.01' has been compared with the formulae contained within Version 1.3 of the leakage model. This comparison has identified consistency with the proposed methodology.

4 Modification Impact Assessment

In order to assess the impact of the proposed changes to the services leakage estimation methodology with regard to the Shrinkage and Environmental Emissions incentives for the DN operators, a leakage model modification impact assessment has been undertaken to compare outputs and assess the potential annual changes that are likely to arise.

This assessment has been undertaken by comparing the following leakage models for each LDZ:

- 2007/08 leakage data for each LDZ within V1 of the leakage model.
- 2007/08 leakage data for each LDZ within V1.3 of the leakage model.

V1.3 of the leakage model for 2007/08 represents the proposed modification to the model to accommodate the changes to the service leakage estimation methodology.

The outputs from these models have been produced on the basis of data provided by DNs for each LDZ within Table 1.

	Leakage Model V1	Leakage Model V1.3	Reduction (GWh)	Leakage Model V1	Leakage Model V1.3	Reduction (Tonnes)
	Service Leakage (GWh)	Service Leakage (GWh)		Service Leakage (Tonnes)	Service Leakage (Tonnes)	
East Anglia	55.53	53.99	1.54	3,732.82	3,629.59	103.23
East Midlands	82.15	80.10	2.05	5,508.21	5,371.06	137.15
North Thames	82.55	81.24	1.31	5,560.59	5,472.22	88.37
North West	89.24	86.59	2.65	5,978.64	5,801.14	177.51
West Midlands	70.01	68.11	1.90	4,696.10	4,568.65	127.45
Northern	46.07	44.32	1.75	3004.37	2890.29	114.08
North East	53.43	51.21	2.22	3492.77	3347.88	144.90
Wales North	11.84	11.47	0.37	677.25	655.91	21.34
Wales South	37.11	36.10	1.01	2143.87	2085.76	58.11
South West	54.93	53.38	1.55	3167.85	3078.45	89.40
Southern *	54.50	53.50	1.00	3653.87	3586.82	67.05
South East *	81.94	77.34	4.60	5507.63	5198.24	309.39
Scotland *	54.22	50.90	3.31	3579.93	3361.05	218.88

* Values for V1.3 include 2 year's service replacement

Table 1

During this review, it has not been possible to determine accurate predictions for service replacements for future years, as the service replacement rates will be dependent upon the locations of projects relating to mains replacement and also service replacements that take place following emergency disconnections. However, the level of service replacement that is driven by the 30 year mains replacement programme will be the key determinant of future service replacement rates.

5 Environmental Emissions Incentive

The potential annual emissions reduction for applying the revised methodology for each LDZ has been estimated assuming that the values in Table 1 will be representative in relation to service replacement that will be undertaken for each year up to 2013. These potential reductions have been compared with the total LDZ emissions within Version V1 of the model in order to estimate the percentage emission reduction per annum that could be expected when applying the revised methodology. As these potential reductions would be cumulative, the potential reduction for 2012/13 would be a multiple of 5 times this annual percentage. Table 2 shows the potential annual and 5 year values for each LDZ.

	Leakage Model V1 Total Leakage (GWh)	Reduction per year for revised methodology (GWh)	Percentage benefit per year from revised methodology (%)	Potential 5 year percentage reduction from revised methodology (%)
East Anglia	253.57	1.54	0.61	3.03
East Midlands	364.84	2.05	0.56	2.80
North Thames	372.12	1.31	0.35	1.76
North West	482.83	2.65	0.55	2.74
West Midlands	416.50	1.90	0.46	2.28
Northern	227.59	1.75	0.77	3.84
North East	282.83	2.22	0.78	3.92
Wales North	69.40	0.37	0.54	2.69
Wales South	174.44	1.01	0.58	2.88
South West	315.77	1.55	0.49	2.45
Southern *	286.84	0.50	0.17	0.87
South East *	426.57	2.30	0.54	2.70
Scotland *	269.01	1.65	0.61	3.07

* Reduction per year is average of 2 year service replacement values

Table 2

6 Additional Observations

During the review, some additional observations have been made regarding the service leakage estimation process, and these have been included within the report. These observations do not undermine the consistency between the current leakage model and the model that was used to establish the baselines, and therefore do not affect the validity of the proposed modification.

6.1 Individual reporting network boundary changes

A potential issue may arise in relation to baseline fixing of metallic service populations if an individual reporting network boundary is redefined for any reason, and an appropriate consistent methodology would need to be established to address any proposed network boundary change.

6.2 Service Category Assumptions

6.2.1 Historical Assumptions

During the review of the assumptions associated with the service leakage estimation methodology, a comparison of the current assumptions was made with a previous version of the leakage model (NLRMM V2.7) that is believed to be the version of the model that immediately preceded the current leakage model. The methodology that was used to determine the service split for mixed metallic networks differs from the current methodology, primarily in relation to the 4 service categories having a fixed percentage split as follows:

- Metal service connected to metal main 25.2%
- Metal service connected to PE main 5.8%
- PE service connected to metal main 22.0%
- PE service connected to PE main 47.0%

These values do not match all the assumptions within the current model and the following observations have been made:

The total percentage of metallic services assumed within NLRMM V2.7 is 31% compared with 33.333% (the one third assumption) within the current leakage model.

Within the current leakage model, PE services are assumed to be distributed between PE and metallic mains on a length weighted basis, whereas these were previously fixed percentages within NLRMM V2.7.

During the period of this review, it has not been possible to establish the reason for these differences in assumptions or identify a documented audit trail that identifies their derivation from the previous assumptions.

6.2.2 Service Category Leakage Rates

The service category leakage rates contained within Leakage Model Modification Consultation No.01 Appendix B2 are not consistent with the leakage rates contained within the current versions V1 and V1.3 of the leakage model, as two of the categories have been transposed. The service leakage rates within V1 and V1.3 are as follows:

TYPE	Rate
Metal - Metal	**10.59**
Metal - PE	**0**
PE - Metal	**2.19**
PE - PE	**0**

Appendix B2 and Section 3.2 of Leakage Model Modification Consultation No.01 both contain the statement that the leakage rate for all PE services is zero which is an incorrect statement. The assumption relating to the split of PE services between PE mains and metallic mains will therefore have an impact on the final leakage estimate.

6.3 Network Service Populations

Individual network service populations may vary annually due to additional services being included within the network, e.g. new housing estates, but also due to property demolitions that may take place within the network. The effect of these potential changes can be demonstrated as follows:

6.3.1 Increase in total network service population

Version 1 of the leakage model would apply the one third assumption for metallic service population to the increased network service population, which would therefore result in an increase in the number of assumed metallic services within the network.

Version 1.3 of the model would take into account the effect of metallic service replacements undertaken within the network, and therefore would correctly reflect any additional services relating to an increased network service population as PE.

6.3.2 Service disconnections due to property demolitions

Neither Version 1 nor Version 1.3 of the leakage model would correctly reflect the leakage reduction effect of cutting off services to demolition properties that may be in the categories ‘metal service connected to metal main’ or ‘PE service connected to metal main’.

6.4 Service renewal following main replacement

Within Section 3.2 – Low Pressure Service Leakage, of the Leakage Model Modification consultation No.01, it is indicated that the replacement, rather than reconnection, of metallic services following work on a main has been policy, and that it is believed that this has been the case since mains replacement began in 1976. While the routine replacement of unprotected and bitumen/hessian wrapped steel services had been undertaken during this period, PE clad steel services had routinely been tested and reconnected to the replaced main. It is known that this policy of testing and reconnecting PE clad services continued into the 1990s, although it has not been possible to establish the date when all steel services affected during mains replacement would have been replaced with PE.

7 Conclusion

Following completion of the review of the proposed service leakage estimation methodology, the following opinions can be stated:

A] When compared with the service leakage estimation methodology that is currently applied within Version 1 of the leakage model, the proposed methodology enables the annual service replacements within both an individual network and LDZ to be reflected within the leakage estimate.

B] Based upon the leakage rates associated with the various service categories defined by the 2002/03 National Leakage Tests, the proposed methodology would reflect an actual annual leakage reduction that is resulting from service replacements.

C] The proposed service leakage methodology is correctly reflected within the calculations and formulae contained within Version 1.3 of the leakage model.

D] When compared with the service leakage estimation methodology that is currently applied within Version 1 of the leakage model, the accurate calculation and reporting of gas leakage would be better facilitated by the proposed service leakage estimation methodology.

E] The proposed service leakage methodology utilises assumptions relating to the populations of metallic services and the distribution of PE services that, although they are consistent with the current service leakage estimation methodology, are neither consistent with the assumptions contained within NLRMM V2.7 nor have a documented audit trail that identifies their derivation from the previous assumptions.

F] Neither Version 1 nor Version 1.3 of the leakage model correctly reflects the leakage reduction effect of cutting off services to demolition properties that may be in the categories ‘metal service connected to metal main’ or ‘PE service connected to metal main’.