Network Output Measures Health & Risk Reporting Methodology - Change Register

A common methodology framework, adopted by all Gas Distribution Networks, for the assessment, forecasting and regulatory reporting of asset risk.

Title	Network Output Measures Health & Risk Reporting Methodology - Change Register
Version Date	31st July 2017
Current Version Number	V3.0

Confidentiality

Contents

1. Introduction

1.1 Purpose

A common methodology to assess the Health, Criticality and the associated Risk Value of network assets to meet special licence condition 4G (Methodology for Network Output Measures) has been delivered to Ofgem. This methodology is called the Network Output Measures Health & Risk Reporting Methodology & Framework, hereafter referred to as the NOMs Methodology.

In discussion with Ofgem it has been agreed that as the Methodology is new, and that errors and improvements will no doubt arise, such revisions should not necessarily require a revised Methodology to be submitted. However, Ofgem will require a regular update detailing changes to the Methodology and the materiality of such changes. If one or more changes are deemed to be sufficiently material this may trigger a resubmission of the Methodology and/or Health and Risk reports.

Subsequent to the submission of the NOMs Methodology by the Safety and Reliability Working Group (SRWG) to Ofgem in March 2016 and the submissions by individual Gas Distribution Networks (GDNs) of a draft set of outputs consistent with the anticipated table, 7.3, within the Regulatory Reporting Pack (RRP) in July 2016, the SRWG undertook a programme of calibrations, testing and validations of the NOMs Methodology models culminating in the submission of a validation report on 31st March 2017. This version of the change register incorporates any changes to the NOMs Methodology required as part of that validation.

1.2 Structure of Document

Separate change registers are provided for each key section in the Methodology. Namely:

- Main Methodology
- Reporting & Governance
- Mains
- Services
- Governors
- LTS Pipelines
- Offtakes and PRS
- Risers

For each section, the following information will be logged for each agreed change to the Methodology:

- Version of Methodology the change applies against. This is the version where the change has been identified and, subject to agreement, will be changed in future revisions.
- Date change identified.
- Section and page number of identified change.
- Nature of change.
- Reasons for change.
- Implications / materiality of change.
- Date agreed by SRWG.
- Version of the approved Methodology the change has been applied to. Where this information appears against a change, it has been fully incorporated and approved (subject to Ofgem agreement) and can be assumed to be closed.

1.3 Summary of Changes

A record of changes made to this document is provided in the table below. It is recommended that the Change Register is maintained as a live document by SRWG. This table should be completed prior to each submission of the Register to Ofgem.

Version	Summary of Changes	Reviewer	Approver	Issue date
1.0	• Changes to section 2 following Ian Bagworth / Paul Williams review of V3.0 of the Methodology on 24/5/16 • Changes to sections 8 and 9 models required as PRS/Offtakes and Risers risk models were not fully reviewed and signed off prior to submission of V3.0 of the Methodology.	SRWG	SRWG	29th July 2016
2.0	• Changes to sections 2, 4, 5, 6, 7, 8 and 9 as a result of the validation of individual models.	SRWG	SRWG	31st March 2017
3.0	• Review and Update of methodology following comments and feedback received from Ofgem following March 2017 validation submission. • Addition of section 2.8 on Treatment of Asset Interdependence. • Changes to LTS Appendix following implementation of changes identified in post validation review of LTS model.	SRWG	SRWG	31st July 2017

1.4 Glossary

The glossary is reproduced from the NOMS Methodology to aid the reader of this Change Register.

Asset Base - Core asset data records providing specification/configuration and location date.

Asset Cohort – a grouping of individual assets which can be assessed together meaningfully for intervention/investment planning purposes or regulatory reporting purposes. Within the NOMs methodology cohorts are defined specifically for planning and assessing investment interventions to quantify health and monetised risk benefits.

Asset Failure - Any operation or function which the asset fails to correctly perform which gives rise to consequences.

Asset Groups – A collection or class of assets, defined as the primary assets utilised in Event Tree Analysis.

Asset Health – A measure of an asset's current ability to perform its operation or function.

Asset Risk – The product of the Probability of Failure and the effective quantity of consequence. The expected number of consequence events.

Asset Risk Value - The product of the Probability of Failure and the consequence of failure. Expressed in monetary terms.

Asset Stratification – a grouping of asset attributes that statistically define the asset in terms of (for example) current of future performance/risk

Asset Sub-group – a sub-division of the above, predominantly where a specific asset attribute is considered material to be reporting separately (e.g. Iron Mains)

Attribute – A piece of information which determines the properties of the PoF or CoF calculations

Cost of Consequence – The per unit monetary cost of a consequence.

Consequence Quantity – The potential quantity of consequence "units" that could be generated from an asset failure (e.g. lives lost through a gas explosion in a property)

Consequence of Failure – Any unintended impact which results from an Asset Failure expressed in monetary terms. Calculated from the product of the quantity, probability of consequence, and the cost of consequence.

Criticality – A measure of an asset's safety, reliability and environmental impact resulting from an Asset Failure

Data Reference Library – A Data template detailing the node name/reference, a description, unit of measure and potentially the value used including source or calculation.

Deterioration Rate – The rate at which the Probability of Failure changes over time.

Discount Rate – The rate at which future costs are expressed in their net present value terms.

Effective Quantity – The product of the quantity and the probability of consequence.

Event Tree – An approach to mapping Failure Modes and their affect in a structured manner. Event Tree Analysis (ETA) is a graphical technique for representing the mutually exclusive sequences of events following an initiating event (an asset failure) according to the various events that may mitigate/influence its consequences.

Expert Elicitation – The synthesis of opinions of authorities of a subject where there is uncertainty due to insufficient data or when such data is unattainable because of physical constraints or lack of resources. Expert Elicitation is essentially a scientific consensus methodology.

Failure Mode – Failures associated with a particular Asset Group, categorised by the nature of the failure.

Financial Risk– The direct financial costs to the business for without-Intervention work to the assets such as such as repair.

GDN – Gas Distribution Networks (Distribution network operators).

Industrial & Commercial (I&C) – supply to an industrial/commercial premises

Innovation – New technology or techniques used as an alternative to current intervention activities.

Intervention - Any activity which is carried out, beyond the scope of Maintenance that changes either the probability or consequence of asset failure, or extends the life of the asset.

LTS – Local Transmission System (pipeline network)

Monetised Risk – The total Asset Risk Value based on the required output metric.

NOMs Methodology – Network Output Measures Health & Risk Reporting Methodology and Framework

Non-repairable Assets – Assets failure result in the asset being replaced and returned to 'as good as new'.

PE – polyethylene mains pipe

PoF (Probability of Failure) – The probability an asset will fail at a given point in time, conditional that it has survived to that time. Units are expressed per year. This is also known as the hazard rate.

PoF (Failure Rate) – For an asset this is the rate of occurrence (frequency) of failures at a given point in time, typically measured as the number of failures over a year.

PRS – Pressure Reduction Station

Planned Maintenance - Any activity which is normally and routinely carried out to maintain an asset in good working order, or extend the life of the asset. This does not change the ongoing Probability of Failure.

Primary Asset – A defined list of assets as per Table 1.

Private or company risk – The cost of dealing with the failure such as the cost of lost gas, the requirements to undertaken network inspections, the cost of restoring supplies.

Probability of Consequence (PoC) – The probability or proportion of quantity (usually between 0 and 1) that ends up being affected.

Public risk – Indirect environmental and societal costs associated with health and safety, traffic disruption etc.

Reliability Block Diagram (RBD) – A simulation technique for estimating system availability taking the connectivity of multiple assets within a system into account.

Repairable Assets – Assets that when fail can be repaired and generally returned to '**as bad as old'**. The Probability of Failure is identical immediately before and after failure

RIIO-GD1 – A price control sets out the outputs that the eight Gas Distribution Networks (GDNs) need to deliver for their consumers and the associated revenues they are allowed to collect for the eight-year period from 1 April 2013 until 31 March 2021.

Secondary Asset – An asset that supports or impacts a primary asset

2. Main Methodology

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	3/6/2016	3.7.2	F_Legal_Penalty (and F_Compliance) to be aligned across risk maps.	Currently there are inconsistencies between some asset risk maps due to agreed changes not being fully aligned across deliverables.	Minor, as monetised risk values for these nodes are low. Methodology to be updated.	13/6/2016	Yes
3.0	3/6/2016	3.7.2	F_Building_Damage) to be aligned across risk maps.	Currently there are inconsistencies between some asset risk maps due to agreed changes not being fully aligned across deliverables.	Minor, as monetised risk values for these nodes are low. Methodology to be updated.	13/6/2016	Yes
3.0	3/6/2016	3.7.2 F_Carbon. MRS Mains, Services and Governor models	F_Carbon value has been changed to reflect most recent DECC guidelines. There is currently an inconsistency between the Methodology and the MRS risk models	Change in DECC guidance identified part way through the project which has not been fully aligned.	F_Carbon in Global Values to be changed. The Methodology and MRS models should all use the F_Carbon calculation: **IF(2015+DYear <= 2030,2015+DYear-1953,7.3587*(2015+Dyear)-14860)** The calculation below appears in the Methodology and the Mains and Services models, which is incorrect. **IF(Dyear+2015<2030,Dyear+2015-1956,6.9606*(2015+Dyear)-14056)**	13/6/2016	Yes (version 3.1)

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
					For Governors, F_Carbon will also need to be changed (currently '..<2013..' when should be '..<=2013..')		
3.0	24/5/2016	All Methodology	Clarify Probability of Failure versus Failure Rate throughout the document	Clarity and clear definition of rate of failure versus probability that an asset will fail.	All document to be reviewed and Probability of Failure replaced with Failure Rate wherever applicable.	24/5/2016	No PoF (probability of failure) referenced only three times in document and on each occasion the differentiation between PoF (failure rate) is clear and useful
3.2	19/06/2017	Section 2.8	Addition of section specifically detailing interdependence of Network Asset	Following review from Ofgem and guidance received Methodology was updated to specifically address interdependence of network assets	None. Greater demonstration of how methodology accounts for interdependence of Assets.	19/06/2017	Yes
3.2	30/07/2017	General	Removal of reference to national grid gas and replaced with Cadent Gas	National Grid gas was sold and rebranded as Cadent gas	None	30/07/2017	Yes

*** Methodology document will be updated for change in next version**

3. Reporting & Governance

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated

4. Mains

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	07/02/2017	F_Leakage_mgm: Leakage management costs (e.g. profiling)	Nil costs captured for mains	Costs of leakage management captured under the Governors model	Methodology to be updated	31st March 2017	Yes (version 3.1)

5. Services

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	07/02/2017	B2.5 Services Data Reference Library	Probability of Supply Interruptions given failure - This states it is GDN-specific data although a common value of 100% has been agreed for the services model	This was agreed by the GDN working group as it was discussed and agreed that all failures will result in a supply interruption in order to repair and restore or replace the supply	Methodology to be updated	31st March 2017	Yes (version 3.1)
3.0	07/02/2017	Leakage management costs (e.g. profiling)	Nil costs captured for services	Costs of leakage management captured under the Governors model	Methodology to be updated	31st March 2017	Yes (version 3.1)

6. Governors

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	30/03/2017	C3.4 Governors Intervention Definitions	The 'with investment activities' column needs to be updated with the activities listed in the validation report	Adds consistency across GDN's for reporting purposes	Methodology to be updated	31/03/2017	Yes (version 3.1)

7. LTS Pipelines

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	31/03/2017	2.3	Risk map changed to have Defect node leading into Corrosion	Need Defects to provide a starting value for corrosion failure curve	Increase TMR by varying degrees over time as allows the defects to deteriorate	31/3/2017	Yes
3.2	31/07/2017	P129	Defect node changed to Faults with more detailed definition.	Changes implemented based on review and update of model by ICS and PIE	Impact Monetised risk to varying degrees	31/07/2017	Yes
3.2	31/07/2017	P132-38	DRL updated with new fault definition(rather than Defects) and F_Defects removed	Changes implemented based on review and update of model by ICS and PIE	Impact Monetised risk to varying degrees	31/07/2017	Yes
3.2	31/07/2017	D3.2.1	Defects changed to faults and the new approach outlined.	Changes implemented based on review and update of model by ICS and Pie	Impact Monetised risk to varying degrees	31/07/2017	Yes
3.2	31/07/2017	D3.2.5	Pipe Corrosion updated and sections of corrosion and CP deterioration added. Scaling to defects has been removed as it is now its own node in the risk map.	Changes implemented based on review and update of model by ICS and PIE	Impact Monetised risk to varying degrees	31/07/2017	Yes

8. Offtakes & PRS

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	15/3/2016	Odorant & Metering E2.3.1 & E2.4.1 & E2.5.1	Additional risk nodes and associated descriptions to be added to risk maps and Data Reference Library. Namely: • PRS Site Failure • Props_Domestic • Props_Com_small • Props_Com_large • Props_Critical • Props_SI • F_Domestic • F_Com_small • F_Com_large • F_Critical • F_Restore_Supply	Potential for supply interruptions resulting from failure of odorant control missing from model.	These risk nodes have now been added to the Odorant & Metering model. Methodology to be updated.	15/3/2016	Yes (version 3.1)
3.0	10/6/2016	Odorant & Metering E2.3.1 & E2.4.1 & E2.5.1	Additional risk nodes and associated descriptions to be added to risk maps and Data Reference Library. Namely: • L_Odorant • H_Odorant	Added to model to allow High/Low Odorant failures resulting from both odorant and meter reading failures to be summed	These risk nodes have now been added to the Odorant & Metering model. Methodology to be updated.	15/3/2016	Yes (version 3.1) References not added to data table E2.5.1 due to these being summation nodes only
3.0	10/6/2016	Filters & Pressure Control E2.3.3 & E2.4.3 & E2.5.3	F_OUG has been renamed F_Own_Use in current version of risk model	Renamed for clarity	Methodology to be updated.	13/6/2016	Yes (version 3.1)
3.0	10/6/2016	Filters & Pressure Control	F_Props Surrounding has been renamed F_Props_Surrounding	Adds clarity to definition of risk node.	Methodology to be updated.	13/6/2016	Yes (version 3.1)

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
		E2.3.3 & E2.4.3 & E2.5.3 Pre-heating E2.3.2 & E2.4.2 & E2.5.2	_PRS in current version of risk model				References within E2.5.3 already consistent with current risk map
3.0	21/6/2016	E3.2.2 Elicited Failure Results	A line needs to be added under Table E2 to say that individual Age Thresholds (the point at which noticeable deterioration may be observed) have only been applied at the Asset Group level e.g. an individual gamma value exists for: • Meters • Odorant • Filters & Pressure Control • Pre-heaters	Table E2 implies that individual Age Thresholds have been applied for each sub-asset listed in the table. In practice, individual Age Thresholds have only been applied for each Asset Group within the model. Sub-asset values can be applied in the future should there be deemed to be a benefit in doing so.	Methodology to be updated.	24/6/2016	Yes (version 3.1)
3.0	30/03/2017	Offtake & PRS E3.2.3 (P.195)	A line needs to be added under table E3 to say that any assets where visual condition is not known then a condition factor of 3 should be used	Adds consistency across GDN's	Methodology to be updated	31/03/2017	Yes (version 3.1)
3.0	30/03/2017	E3.4 Offtake/PRS Intervention Definitions	The 'with investment activities' column needs to be updated with the activities listed in the validation report	Adds consistency across GDN's for reporting purposes	Methodology to be updated	31/03/2017	Yes (version 3.1)

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	30/03/2017	E1.6 Pre-Heating	The below paragraph needs adding below Figure E5 – Electrical Heating System To ensure consistency in determining the population of pre-heating systems across the GDNs, the following definition will be used (this approach is consistent with the other asset systems on >7bar installations): • Any pre-heating systems feeding into one pressure reduction system on site will be deemed as one pre-heating system with the number of heaters deemed as streams to ensure redundancy is considered • Any installation that has one heating system followed by a pressure reduction system, then followed by another pressure reduction system that is not pre-heated again can be classed as one pre-heating system, with the number of relevant streams. This system will be assigned to the highest pressure level from an installation type.	Adds consistency across GDN's	Methodology to be updated	31/03/2017	Yes (version 3.1)

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	30/03/2017	Offtake & PRS E3.3 (P.198)	A line needs to be added under table E8 to say that: Until internal processes can be put in place across GDN's to capture E&I condition has per the above table, the below default should be used which will take into consideration the reliability of the electrical, instrumentational and telemetry systems as the adjustment factor to the consequences of failure. This is agreed to be a more robust method for measuring the impact of any loss of telemetry. 99% Uptime = A factor of 1 <98% Uptime = A factor of 2	Adds consistency across GDN's in the absence of detailed E&I condition data	Methodology to be updated	31/03/2017	Yes (version 3.1)

9. Risers

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	26/7/2016	F3.4.8 Health & Safety	Probability of Minor Injury should be 90%, not 100%	Misalignment between final versions of risk models and Methodology	Methodology to be updated.	26/7/2016	Yes (version 3.1)
3.0	9/1/2017	Risers Data Reference Library F2.5	F_Domestic – to include the cost of customer buy-out in the event of supply interruption	Based on GS1 Reg 7 – Supply Restoration. Average of 5 domestic properties per riser at domestic building (WWU figures), cap for payments under GS1 is £1000. 5 properties x £1000 each = £5,000	Change from £150 to £5000	20/2/2017	Yes (version 3.1)
3.0	9/1/2017	Risers Data Reference Library F2.5	F_Com_small – to include the cost of customer buy-out in the event of supply interruption	As above.	Change from £200 to £5000	20/2/2017	Yes (version 3.1)
3.0	13/12/2017	Risers Probability of Failure Assessment F3.2	DNV GL provided amended probability of failure analysis of GDN leak and population data to provide new POF formula (see below). New replacement risers to 'reset' probability to half the start probability of existing risers.	Initial Failure rates vary considerably between networks.	Increase £TMR by approx. 16%	13/3/2017	Yes (version 3.1) Formulas not originally included, but added in latest version

Joint Nr/Asset/Yr	IF(ASSET_MATERIAL="PE",0.000002403,0.000013265)*ASSET_LENGTH*exp(DYear*IF(ASSET_MATERIAL="PE",joint_det_pe,joint_det_nonpe))

Interference Nr/Asset/Yr	ASSET_LENGTH*IF(ASSET_MATERIAL="PE",0.00001,0.00000365)
Corrosion Nr/Asset/Yr	IF(ASSET_MATERIAL="PE",0,0.00027562)*ASSET_LENGTH*exp(DYear*IF(ASSET_MATERIAL="PE",corrosion_det_pe,corrosion_det_nonpe))
General Emissions m3/Year	LEAKAGE_RATE*exp(DYear*emissions_det)

Version	Date identified	Reference	Change details	Reasons	Implications	Date agreed	Methodology updated
3.0	9/1/2017	Explosions F3.4.6	Expected number of explosions was calibrated for all GDNS using the model coefficients score_param_haz_a and score_param_haz_b. Output frequencies approximately Y0: 1in 100; Y5: 1 in 80; Y45: 1in 10.	Consistent calibration of model based on expected outputs. DNV GL reviewed and agreed reasonable based on research.	Consistent application of model across GDNs.	13/3/2017	No Changes applied to the MRS models used within individual DNs via consistent calibration. No changes required to methodology.
3.0	13/12/2017	Unsurveyed MOB Riser population	GDNs agreed to exclude from Table 7.3 but include in commentary. Risk quantification to be based on Risk per unit of known Riser population, weighted by unknown population MOB number of storeys; and historic transition rate into known population (if available).	Inconsistent approach to the calculation of risk and inclusion in reporting of unsurveyed MOB Risers.	Consistent approach of Risk and methodology across GDNs.	13/3/2017	No Changes relate to consistent population of asset data within MRS models. No changes required to methodology.