Future Billing Methodology

NIC04 Future Billing Methodology Project Progress Report 4 December 2020

Our vision

Report contents

Future Billing Methodology

1. Executive Summary

The twelve months since the last Project Progress Report in December 2019 has been a successful year for the Future Billing Methodology project, despite encountering some operational challenges due to the Covid-19 pandemic. The main achievements for the year are as follows:

1. Successful completion, testing and commissioning of 34 site installations for the two field trials in the East of England.
2. Successful tracking of biomethane across local gas networks, using molecular oxygen sensors (Milestone 10).
3. Gathering data from the field trials and commencing validation of the network models in preparation for milestones 12 and 13.
4. Successful transfer and initiation of the smart meter laboratory trial to DNV GL's headquarters in Loughborough, and data flows for Milestone 11.

The majority of the installations were completed early in the year, but due to the Covid-19 pandemic, operational activities were impacted for several months, until it was safe and practical to resume works in late summer.

Although the delays have resulted in a staggered commissioning of sensors, with some having been transmitting data for longer than others, there has been a substantial amount of good quality data capture across a broad range of demand conditions. Early indications suggest the data is correlating well with the model predictions as expected.

Alongside the main field trials, the smart metering laboratory trial, delayed in line with the main sensor installations, has been relocated from Peterborough to DNV GL's UK headquarters in Loughborough due to organisational changes in the business. The trial is now fully operational and successfully receiving data from selected sites in the two field trial areas.

Cadent and our project partner DNV GL are now working to deliver the project reports on milestones 11, 12 and 13, in line with SDRCs 9.2, 9.3 and 9.4 by the end of 2020 and will re-engage with the industry early in the first quarter of 2021, as we work towards delivering final recommendations and an updated cost benefit analysis in line with SDRC9.5 at the end of March 2021.

An FBM roadside kiosk installation in Cambridge

2. Project Manager's Report

Introduction

The Future Billing Methodology (FBM) NIC Project is being undertaken by Cadent, working in partnership with DNV GL. The FBM Project commenced in April 2017 and explores three evolutionary options to provide a "proof-of-concept" model for a more specific way of attributing the energy content (calorific value or CV) of gas to volumes in GB's gas distribution networks for billing purposes.

Field Trials in East of England

Central to the project are two field trials which are being conducted in Cadent's East of England Network to track the presence of biomethane from two injection points across local gas networks under varying demand conditions, to validate the use of network planning models to create CV zones for billing. The project also includes a laboratory-based smart metering trial to explore the possibility of CV transmission to gas smart meters.

Unlocking decarbonisation of heat

An FBM zonal CV billing framework could provide a robust, cost-effective way to unlock the decarbonisation of heat in Great Britain, by enabling our existing gas distribution and gas transmission networks to transport renewable and other low carbon gases without the need to add in carbon-rich, fossil-based gases to standardise energy content for billing, as required by the existing regime.

Field trial site optimisation

The population of field trial sites was optimised in 2018 as a result of the need to change from the original solar-PV power source to DNO unmetered power connections, which then raised land ownership issues on cable routes and other technical difficulties which would exceed the project budget and planned timeframe.

The site optimisation was carried out working alongside DNV GL's network modelling specialists to ensure critical network coverage was maintained, and an additional battery-power option was developed to retain eight[1] selected sites where room on site was available for this.

A range of additional measures were required, such as site-specific hazardous area assessments and a range of detailed site adjustments were undertaken to facilitate safe installation of the FBM instruments and comms modules.

[1] One of the eight planned battery sites later became unfeasible, due to site encroachment by new development works.

Other site issues

During the construction and commissioning phase in 2020, One of the planned battery-powered installations at a gas governor site in Cambridge became unfeasible due to large-scale construction works in the proximity of the gas governor. Cadent's Plant Protection team and Land Services teams were informed and have been in contact with the developer. An alternative site could not be arranged within project budget or timescales, and components for this installation are being retained as spares for the project. However, the loss of this site has a low impact on the trial, as it is located in an area of the Cambridge network which is unlikely to receive gas from the Chittering biomethane plant.

A summary of changes to the FBM target site population, which was achieved whilst maintaining critical network coverage, is provided in Table 2-1 below.

FBM Field Trial Site Population Change Summary	**Gas Governor Sites**		**Street Kiosks**	**Total**
	EM	**EA**	**EA**	**FBM**
Original Target Population	23	17	15	55
Deselected due to DNO connection cost / complexity / land issue	-10	-8	-2	-20
Deselected due to site encroachment		-1		-1
Final Population	**13**	**8**	**13**	**34**

Table 2-1: FBM field trial site population summary

Field trial site installations

The field trial installations carry a range of equipment, designed to track the movement of biomethane from each of the two field trial input points across the relevant local network. The equipment deployed is summarised by site type in Table 2-2, below.

FBM Field Trial Installation Equipment	**Gas Governor**	**Street Kiosk**
Wireless digital telecoms unit & programmable controls	✓	✓
Oxygen sensor	✓	✓
Pressure sensor	✓	✓
Flow transducer	✓	-
GasPT device (infers gas CV)	✓*	-

** Two selected sites in each trial area feed CV data to smart meter trial*

Table 2-2: Field trial equipment summary by installation type

Each of the field trial installations follows three basic stages as follows:

i. **Installation (dead state) –** involving physical installation of the gas connection (isolated), electrical earthing, sensors and telecoms kit (for street sites all above-ground equipment is pre-built into the kiosk and factory-tested[2] as a unit prior to installation on site.

ii. **Commissioning –** which involves installation of the electrochemical oxygen sensor cell, powering-up the FBM equipment, priming and calibration of sensors.

iii. **Site acceptance testing –** testing powered components, telecoms equipment and validating data flows from site to the project data cloud administered by DNV GL.

For most sites, which are powered via an unmetered low voltage electricity supply from the regional DNO, the commissioning stage must await completion of the DNO connection first. For battery-powered sites, the batteries are installed as part of the stage (ii) commissioning process and batteries are refreshed every 3 weeks.

Site safety and works control

Each of the street kiosks has a gas-tight subdivision between the gas compartment containing the gas supply and sensor array, and the electrical compartment, which houses the power supply, programmable controls and telecoms unit. For the gas governor installations, the sensor equipment is designed and manufactured to work safely inside the governor kiosk, with electrical supply, telecoms and programming components located in a designated safe area on the exterior of the governor housing. For governor sites which have the GasPT equipment, the governor housing ventilation arrangement is modified, in line with the site-specific hazardous area assessment, to ensure a safe working atmosphere for that component. Electrical components at every installation have a dedicated local earthing arrangement.

Site construction works for the FBM Project has followed the Construction Design and Management Regulations 2015, with DNV GL in the role of Principal Designer and Principal Contractor and Orbital Gas Solutions as Designer and Contractor. Siteworks programmes in each area were notified to the HSE. Cadent has undertaken Client Monitoring throughout the installation programme.

For installations on live gas sites such as the gas governors, work on site is controlled by Cadent's Network Control function which administers the Safe Control of Operations (SCO) framework, using a works permit system. The SCO permit system includes a rigorous process for registration of competent workers. Wherever it has not been practicable to register third-party technicians to carry works permits, they have been accompanied on site at all times by registered Cadent Operations staff, who observe and can intervene to prevent any unsafe actions.

For the street kiosks, connection to the low-pressure gas network was undertaken by an established gas connections provider, registered with Cadent under the Gas Industry Registration Scheme (GIRS). Street works arrangements and lifting operations were fully risk-assessed and Client Monitored by qualified Cadent staff.

[2] Gas governor installations are also fully factory-tested using a model-design "rig".

Field trial installation plans

Plans for the field trial installations have been subject to dynamic revision as the project has worked to overcome each of the range of challenges encountered. At the point of issuing the December 2019 Project Progress Report, the ambition was to have the bulk of sites fully commissioned and tested early in 2020 to allow six months' data capture available for production of final project reports in December 2020.

COVID-19 Pandemic

Commissioning of street kiosk sites was largely completed during January and February 2020, and installation works were progressed at a number of gas governor sites. However, in late March, the UK was placed under lockdown due to the rapidly spreading Covid-19 pandemic.

In response, Cadent urgently reprioritised operational resource deployment, to ensure that network-critical and customer-critical activities could continue uninterrupted. As a result, project works could not be supported and this, together with a moratorium on multi-party siteworks, due to difficulties with maintaining social distancing at gas governor sites, where space is typically limited, meant that the FBM installation activity effectively came to a halt for three months, April to June inclusive.

During this time, we were able to make some progress at two of the gas governor sites, by utilising SCO-registered technicians equipped and trained for enhanced hygiene and social distancing measures. However, the main programme of works could not be resumed until July 2020, following the easing of restrictions.

Having overcome the many challenges, the installation of the FBM field trial sites was completed across the two field trial networks, including commissioning and site acceptance testing (SAT), in October 2020.

With the optimised population of sites now in full operation, the focus of the FBM Project has now switched to the analytical work and delivering outputs.

Novel tracking of biomethane using oxygen sensors

The FBM Project is the first project in Great Britain to successfully track the flow of a gas source through the gas distribution network, giving insight into how different gases interact and in response to supply and demand.

Preparatory work before and during the field trial had confirmed that the Chittering and Hibaldstow plants were injecting biomethane into Cadent's networks with an oxygen concentration of around 1,000 to 2,000 ppm (0.1 to 0.2 mol%) oxygen content. For novel tracking to succeed it was vital that the oxygen sensors could reliably discriminate between oxygen at these levels and gases at NTS specification, for which System Entry Agreements specify an upper limit of 10 ppm (0.001 mol%), with the critical point of differentiation being at this lower level.

Factory testing of the original oxygen sensor device in late 2018 identified that it was not sufficiently accurate in the critical range, contrary to the manufacturer's data sheet. The replacement device has been subject to long-term factory testing over a period of 17 months and has proved to be robust and accurate across its specified operating range. For each site, installation of the sealed

electrochemical oxygen cell occurs only at the commissioning stage, to avoid risk of contamination and to maximise operational life during the trial.

Field trial measurements and validation

The initial data analyses carried out by DNV GL indicate that the project has a self-consistent, meaningful and novel set of measurements that track the flow of biomethane through the gas network.

Whilst the observation of peak and minimum demand conditions cannot be guaranteed within any set time frame, the key aim is to demonstrate that the network model can reflect the behaviour of the physical network across a range of demand conditions and can therefore be used to determine how the network will perform at any demand level, including peak day.

Early indications reported by DNV GL's analytical team are that the field trial measurements confirm the predictions of the network model across a range of demand conditions. As the project progresses, the team will anticipate and address any questions and uncertainties that may arise due to the constrained period of data collection.

The team are collating and analysing the data to inform proposed CV zone modelling for the FBM Pragmatic and Composite options in readiness for issuing the Milestone 12 and 13 reports, in line with SDRCs 9.2 and 9.3.

Smart meter trial

Owing to changes in DNV GL's business, the laboratory for the smart meter trial has been relocated from Peterborough to DNV GL's UK headquarters in Loughborough. Data on CV and background gas composition is flowing from GasPT installations at selected field trial gas governors (up to 2 installations in each trial area) to the data cloud for the smart meter laboratory trial and is being evaluated by DNV GL analysts for the Milestone 11 report, pursuant to SDRC 9.4.

External view of FBM installation at a gas governor station

3. Business Case Update

Supporting the Government's Ten Point Plan

The UK Government's Ten Point Plan for a Green Industrial Revolution was released in November this year. Point Two in this plan sets out a vision for driving the growth of low carbon hydrogen. A zonal CV billing framework such as that being explored by the FBM project will be pivotal to enabling the increased uptake of renewable-source or "green" gases, such as biomethane, and could also be vital to facilitating full implementation of hydrogen blending and other hydrogen initiatives. As such, Cadent regards the FBM Project as a potential key enabler to delivery of the government's commitment to achieve net zero. The government document can be accessed here: https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution

FBM Project CBA

The first annual Project Progress Report in December 2017 provided details of the initial Cost-Benefit Analysis (CBA) undertaken as part of Phase 1 of the FBM Project. The Project CBA will be fully updated for the final Project Recommendations, to be submitted under SDRC 9.5.

Internal view of the FBM instrument array at a gas governor

4. Progress against Plan

The many challenges overcome in delivering the FBM Project have effectively delayed the field trials by two years. At the point of issuing the December 2019 Project Progress Report the revised ambition was to have the bulk of sites fully commissioned and tested early in 2020 to allow a full six months' data capture available for production of final project reports in December 2020.

In the event, work delivery became impacted by the Covid-19 lockdown, which further delayed progress during the second quarter of this year. Installation, commissioning and testing of the remaining sites resumed as soon as it became safe and practical to restart siteworks, with completion of the field trial late summer and autumn this year.

The chart in Figure 4-1 below tracks the month-to-month progress of the field trial installation from commencement in May 2019 to completion in October 2020.

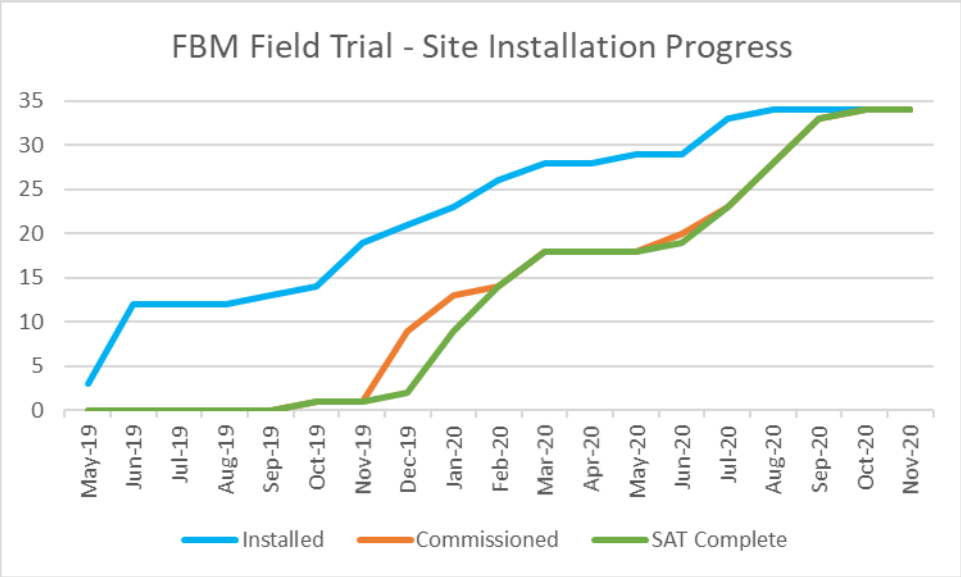

Figure 4-1: FBM field trial site installation progress

In the above chart, the physical installation of the FBM instruments is denoted by the blue curve. The commencement of data flow is shown by the orange curve, followed by site acceptance testing, denoted by the green curve, confirming data validity.

Although the measurement period for the FBM field trial has had to be constrained, good quality data has been captured across a range of network demand conditions and is confirming the predictions of the network model used to set up the field trial.

The project reports for Milestones 11, 12 and 13 are due to be issued at the end of this year, in line with SDRCs 9.2, 9.3 and 9.4. Plans are in hand for a phased industry engagement during the first quarter of 2021, as we work towards delivering final recommendations, high-level implementation plan and an updated cost benefit analysis in line with SDRC9.5.

5. Progress against Budget

Table 5-1 reports the position against the project budget in GBP as at end of October 2020.

TOTAL PROJECT	ACTUAL	BUDGET	VARIANCE
LABOUR	2,382,137	2,402,076	19,939
CONTRACTORS / EQUIPMENT	2,591,463	2,680,448	88,985
IT	43,206	62,801	19,595
IPR COSTS	-	-	-
TRAVEL AND EXPENSES	8,030	28,500	20,470
CONTINGENCY	-	-	-
DECOMMISSIONING	-	206,976	206,976
TOTALS	5,024,836	5,380,801	355,966

Table 5-1: Actual costs v budget to P7 2019-20 and v total project budget

Commentary

Note that due to the delays to the project field trial, decommissioning of field trial sites will not now commence until April 2021, following completion of the project outputs due under SDRC 9.5.

FBM Flow transducer (upper centre) installed on gas governor regulator plate

6. Project Bank Account

Arrangements are in hand to provide Ofgem with Project Bank statements, in line with Section 8.15 of the Gas Network Innovation Competition Governance Document. Due to the confidential nature of the project bank statements, they have not been included in this report.

Gas PT equipment being calibrated for FBM smart meter trial

7. Successful Delivery Reward Criteria

Table 7-1 below sets out the project Successful Delivery Reward Criteria (SDRC), each under a subsection labelled 9.1 to 9.5. The SDRC are actions linked to outputs of the project with a realistic but challenging deadline. The following subsections set out each criterion and clearly state the evidence that it is proposed Ofgem should use to assess performance against criterion. All SDRC delivery dates refer to the end of the calendar month. The delivery dates for future SDRCs have been adjusted to reflect the 12-month Project extension agreed in December 2018.

Successful Delivery Reward Criterion	Evidence
9.1a. Industry Engagement – Phase 1 11 August 2017 **ACHIEVED**	The Industry Engagement Phase 1 will take place in Work Pack 1a and this SDRC will provide Ofgem with evidence of the following: • The Terms of Reference for the Industry Engagement • The numbers and types of participants in the Industry Engagement • A compilation of the output from workshops, questionnaires and meetings held during the Industry Engagement (Phase 1) • Initial cost benefit analysis • Requirement for the validation of the network modelling This SDRC will be based on milestone 9a of the Full Submission. Submit Phase 1 report to Ofgem in line with condition 2 set out in section 3 of this Project Direction. Do not proceed on to the remaining SDRC until Ofgem consent is given in line with condition 2.
9.1b. Industry Engagement – Phase 2 31 March 2018 **ACHIEVED**	The Industry Engagement Phase 2 will take place in Work Pack 1b and this SDRC will provide Ofgem with evidence of the following: • Phase 2 industry engagement report to include an update on continuing industry liaison following Phase 1 This SDRC will be based on milestone 9b of the Full Submission.
9.2. Novel tracking of unconventional gases by measurement **31 December 2020**	The novel tracking of unconventional gases by measurement will involve the installation and collation of field trial measurements. This SDRC will provide Ofgem with evidence of: • The installation of additional sensors on the gas network in governor stations and at street level • The efficacy of measuring oxygen content, pressure and flow to support the validation of network modelling for determining the distribution of biomethane in LP and MP networks This SDRC will be based on milestone 12 of the Full Submission.

9.3. Report on novel validation of network modelling for embedded and network charging areas **31 December 2020**	The novel validation of network modelling for embedded and network charging areas will use zonal analysis of pressure, flow and oxygen tracking measurements from the field trials. This SDRC will provide Ofgem with evidence of: • How to analyse oxygen, pressure and flow data from the field trials using network modelling techniques • Options and methods for assigning CV to charging areas for the Pragmatic and Composite scenarios This SDRC will be based on milestone 13 in the Full Submission.
9.4. Report on Smart Metering Laboratory Trials **31 December 2020**	The smart metering laboratory trials will be carried out at the DNV GL Technical Assurance Laboratories in Peterborough. Several CV measurement devices will be installed in the network field trial which would transfer CV to the smart meters. This SDRC will provide Ofgem with evidence of: • The transfer of CV to smart meters via a mimic of DCC • Options and further developments required for the future transmission of CV from smart meters to the billing process This SDRC will be based on milestone 11 of the Full Submission.
9.5. Future Billing Methodology Recommendation **31 March 2021**	The Project will report on Future Billing Methodologies and cost benefits of the three scenarios Pragmatic, Composite and Ideal concluding with a recommendation and high-level implementation plan. This SDRC will provide Ofgem with evidence of: • The Project findings through a collation of the outputs from Work Packs 1 to 4 • The Project recommendations and how these were derived including cost benefit analyses • High-level implementation plan of the recommendations This SDRC will be based on milestone 15 of the Full Submission.

Table 7-1 Successful Delivery Reward Criteria reflecting amended delivery dates.

8. Data Access Details

All project information, including project submissions, reports, project findings and analysis has and will be published on the FBM Project web site, which can be accessed using the following link: https://futurebillingmethodology.co.uk/

The web site has a web feed facility (RSS) that has been taken up by over 160 individual stakeholders and as we progress with the project, we are seeking opportunities to widen the web site readership, especially among key stakeholders who would be directly impacted by implementation of FBM. The web site is maintained annually and updated at each reporting stage.

However, we will also be utilising a range of existing industry channels such as the UNC Workstreams, ENA and IGEM to actively share project findings.

FBM smart meter trial lab rig at Loughborough

9. Learning Outcomes

Learning from the FBM project field trial

Having overcome numerous challenges (including delays due to the Covid-19 pandemic), which are covered in detail in Section 2 of this report, 2020 has also been a year of successes, with the completion of the field trial installations across two local gas networks in the East of England. The learning outcomes from the field trial will be covered in more detail in the main project reports to be issued at the end of December, but at this point can be summarised as:

- Successful novel tracking of biomethane across local gas networks using oxygen sensors
- Indications that the field trial measurements confirm the predictions of the network model under a range of demand conditions
- Capture and transmission of CV data from the field to the smart meter laboratory trial

Cadent and its project partner DNV GL are working to deliver final project reports in line with SDRCs 9.2, 9.3 and 9.4 by the end of 2020 and plans are in hand for a phased industry engagement during the first quarter of 2021, as we work towards delivering final recommendations, high-level implementation plan and an updated cost benefit analysis in line with SDRC9.5.

Future implementation

Section 9 of the December 2018 Project Progress Report summarised the initial thoughts gathered from liaison with Xoserve and National Grid NTS on the potential impacts of implementing a future CV zone-based billing framework. The full version of these findings was published in Cadent's SDRC 9.1b Report on 28th March 2018, which can be accessed via the link below.

https://futurebillingmethodology.co.uk/wp-content/uploads/2018/04/SDRC-9-1b-Report-Final.pdf

As the FBM project generates its findings from the field trials, for which early indications are positive, Cadent is engaging with Xoserve and fellow GDNs to begin the conceptual work which will support the delivery of a high-level implementation plan, updated cost-benefit analysis and industry recommendations, which are to be delivered under SDRC 9.5 in late March 2021.

10. Intellectual Property Rights

The Project team will comply with the default IPR Provisions. The purpose of the project is to provide a proof-of-concept for a new billing methodology. Since there must necessarily be a common billing regime across the country there is no intention or opportunity to exploit arising IPR commercially in GB. Copyright will exist on the reports produced as part of this work, but they will be published in the public domain where required for effective knowledge dissemination.

Background IPR, such as that within equipment supplied for the purposes of executing the project (e.g. oxygen sensors) will remain owned by the suppliers as Commercial Products. This will include, but not limited to DNV GL's background IPR in the network modelling tools Synergi Gas, GBNA and Graphical Falcon. These tools are already licenced and used by the GDNs to underpin their network planning and operational analysis. The modelling and analysis work carried out in the Project is to develop the understanding of CV changes and affected zones and will be delivered on the software versions currently available. No additional software capability will be developed as part of the Project. Any modelling procedures that are developed as part of the final recommendation will be software agnostic to allow ready implementation by any gas network operator.

11. Risk Management

The updated project risk summary is provided below:

FBM Project - Summary of Key Risks			
Ref	**Risk description & impact**	**Risk Mitigation(s)**	**Status**
1	Smart metering trial MS11 - Risk that delays in the GasPT site installation due site issues and Covid-19 may impact on the completion of MS11 trials.	1. Smart metering trial duration has been reduced 2. Report development being monitored by DNV GL / Cadent project managers	Open
2	MS13 Report on novel validation of network modelling - Risk that compression of report review timeframe due to delays in the field trial will impact project output.	Report development being monitored by DNV GL / Cadent project managers	Open

12. Accuracy assurance Statement

This report has been prepared in accordance with the Gas Network Innovation Competition Governance Document published by Ofgem. The project has been subject to review and challenge by the Cadent Project Manager and signed off by Damien Hawke, Future Networks Manager, who is Project Sponsor for this NIC project.

Damien Hawke has confirmed that the processes in place and steps taken to prepare this Project Progress Report are sufficiently robust, and that the information provided is accurate and complete.

13. Glossary of Terms

Term	Meaning
CBA	Cost-Benefit Analysis
CV	Calorific Value – expressed in mega Joules per cubic metre of gas (mJ/m^3) at standard temperature and pressure
DNO	(Electricity) Distribution Network Owner
DNV GL	Project partner of Cadent
EA	The LDZ known as East Anglia
EM	The LDZ known as East Midlands
ENA	Energy Networks Association
FAT	Factory Acceptance Testing
FBM	Future Billing Methodology
FWACV	Flow Weighted Average Calorific Value
GB	Great Britain
GDN	Gas Distribution Network
GS(M)R	Gas Safety (Management) Regulations – governs the safety of the GB gas supply
IGEM	Institute of Gas Engineers and Managers
LDZ	Local Distribution Zone (gas distribution networks in GB comprise 13 LDZs)
NIC	Network Innovation Competition
RTU	Remote Telemetry Unit
SAT	Site Acceptance Testing
SDRC	Successful Delivery Reward Criteria
UMS	Unmetered (electricity) Supply

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