

Engineering Justification Paper

016 CPM4845 Lympne (East Kent IPMP)

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2 Introduction

Reinforcement has been identified within East Kent IPMP Grid, specifically relating to anticipated Network Capacity failure at Lympne. This project is part of a wider programme of reinforcement associated with the RIIO-GD2 Business Plan Appendix covering Capacity Management.

2.1 General Background

Our distribution system is built to ensure security of supply for all our customers. Our networks operating at pressures below 7bar are designed to meet a peak six-minute demand level which could be experienced under 1:20 conditions, supporting a safe, secure and reliable service to those customers and meeting requirements in compliance with our Licence Condition, (including, but not limited to, Condition 16 contained therein).

Link: [Gas Transporters Licence – Standard Conditions](#)

Where capacity constraints are identified that are likely to impact on our ability to ensure security of supply to all customers, Network Planning will look to establish optimum cost-efficient reinforcement strategies to mitigate risk. Such constraints may arise as a result of a number of factors, but the most common is increased demand levels, often resulting from new connections.

We have initiated an extensive programme of stakeholder engagement, working closely with Local Authorities, both in Scotland and the South of England, to establish a fully informed and independently sourced picture of planned development.

This engagement has provided us with confidence the sites identified will progress to development, to support this level of growth, we have developed a programme of reinforcement across its network.

2.2 Site Specific Background

Identified drivers for this Reinforcement are associated with maintaining supplies to:

Existing CSEP development at P08119724 Old London Road, Hythe (6 Commercial & 300 Domestic Units), 'GTC' confirmed in January 2014 site had not commenced, however, development is expected within RIIO-GD2.

Otterpool New Garden City Development, which is expected to commence building during RIIO-GD2. Latest build rates highlighted in Figure 1 below, were obtained through engagement with the Local Authority on 15 March 2019.

Figure 1: Otterpool Development

Summary Indicative Development Phasing - Provided by Council in March 2019									
Site - Otterpool Development									
8500 Unit - Application									
Price Control	GD1	GD2					GD3		
Year	2020	2021	2022	2023	2024	2025	2026	2027	2028+
Development Year	1	2	3	4	5	6	7	8	9+
Residential Units Sold	0	0	325	325	325	400	400	400	6325
Cummulative Sales			325	650	975	1375	1775	2175	8500
Notes									
Alternative application would be for 10,000 homes. In this regard sales rate would be at c 400 homes (ignores economic cycles)									
Home sale assumptions based on a mix of tenure types and multiple sales outlets being opened up on site (includes extra care units)									

3 Equipment Summary

The East Kent IPMP Grid is integrated within the South East IPMP Grid; This area of the IP Grid is sourced locally from Folkstone TRS, and subsequently the MP grid is sourced from four DPG's at Folkestone, Hawkinge, Hythe and Hythe Ranges.

Security

Hythe DPG is the principle supply to the MP leg feeding the existing CSEP P08119724 and future Otterpool developments and currently supplies at 1.9bar (with a 2bar MOP).

4 Problem Statement

a) Why are we doing this work and what happens if we do nothing?

New connections to our networks reduce available capacity and when pressures are predicted to fall below minimum acceptable levels it is necessary to reinforce or increase pressures to facilitate increased capacity in the system.

b) What is the outcome that we want to achieve?

Maintain our licence conditions to ensure security of supply, avoid becoming a blocker to development and support the economic prosperity of this area.

c) How will we understand if the spend has been successful?

At a customer level, we will deliver a reinforcement ensuring a safe and secure network, meets stakeholder aspirations and aids developments progress timeously.

On completion of the proposed reinforcement, we will monitor system performance to ensure expected system pressures are maintained. This will take the form of regular system performance checks and localised pressures surveys to ensure the successful outcome is delivered.

4.1 Narrative Real-Life Example of Problem

As a result of the LDP sites and existing committed development, the MP section of the East Kent Grid fed by the Hythe DPG begins to fall below minimum pressure around its western fringes at Lympne, highlighting reinforcement is necessary within RIIO-GD2 period (2021-26).

This existing CSEP site was connected in 2008, however development has been slow to take place on the site with first phase not starting until 2017/18, with full development expected by 2027.

Reinforcement is required within RIIO-GD2 period (2021-26), to maintain Security of Supply to existing and proposed developments.

A recent example of good planning to meet customer expectation, whilst also ensuring security of supply, occurred following the acceptance of a quotation to supply a new development at Milton Heights, Milton, Abingdon, Oxfordshire (P18143337).

Network analysis confirmed a requirement to reinforce SGN's system in advance of connecting the fully developed site load. However, network analysis also confirmed an interim load/connection of 72 new properties in advance of reinforcement, thereby meeting the GT/Developer's schedule of works.

Reinforcement to supply the full development was subsequently planned and completed in advance of connections beyond the interim load, ensuring security of supply to approximately 500 new/existing customers.

4.2 Spend Boundaries

The spend associated with these reinforcement works (CPM4845) provides sufficient capacity at the Lympne leg to support projected development during RIIO-GD2.

Included within this spend are costs to ensure the proposed reinforcement has sufficient capacity to supply future network extension for proposed new development at Otterpool Garden Town.

Not included within this spend are the costs for any future extension of this reinforcement to supply demand outside of RIIO-GD2 at Otterpool.

5 Probability of Failure

The existing South East IPMP model predicts a failure to maintain minimum system pressures on the on the Lympne MP leg >94% of 1:20 demand conditions during 2023/24 & in >92% of 1:20 demand condition during 2025/26, both within the RIIO-GD2 period (2021-26), due to expected build up at existing / proposed developments (see Figure 2 for Old London Road CSEP / proposed Otterpool Development locations).

Table 1. Showing Failing Pressure on Lympne MP System, as Development growth increases.

Demand Year	Link Park, Lympne (360mbar Min.)	Turnpike Hill DG (345mbar Min.)	Hythe CGS	Reinforcement Requirement
2019/20 (GD1)	1436mbar	1835mbar	1900mbar	n/a
2021/22 (GD2)	1198mbar	1821mbar	1900mbar	n/a
2023/24 (GD2)	0mbar (1173mbar)	1774mbar	1900mbar	CPM4845 PH1
2024/25 (GD2)	708mbar	1735mbar	1900mbar	n/a
2025/26 (GD2)	0mbar (1672mbar)	1688mbar	1900mbar	CPM4845 PH2

5.1 Probability of Failure Data Assurance

Model Validation

To ensure the accuracy of Network Analysis models, validation is carried out in line with the published requirement under Section 17 of our Safety Case and is a fundament of our Licence to Operate.

Validation ensures the current models are an accurate representation of the actual gas transportation system and can be used to predict network behaviour under a variety of conditions, including the 1 in 20 design condition.

In addition to the Validation Programme, a robust model maintenance process and annual system performance checks ensures the models continue to be accurate and fit for purpose.

The existing modelled data within East Kent IPMP section of South East IPMP model, was sense checked using existing 22 DG Inlet Loggers as well as charts taken from our DNCS (Distribution Network Control System), after the extreme weather seen at the end of February – early March 2018, known colloquially as “The Beast from the East”.

Table 2: System Performance Review – 1st March 2018 (99% peak demand) where *HYTHE CGS Setting was 1730mbar.

System	Site	System Pressure (99%)		System Pressure (1 in 20)	
		PMAC Recorded (Actual)	Modelled (Predicted)	Min. Pressure Required (Acceptable)	Modelled (Predicted)
East Kent MP	TURNPIKE HILL DG	1630mbar	1663mbar	345mbar	1847mbar
East Kent MP	LINK PARK, LYMPNE GT	n/a	1275mbar	360mbar	1450mbar
East Kent MP	THE GREEN DG	1724mbar	1724mbar	345mbar	1895mbar
East Kent MP	HYTHE CGS	1730mbar	1730mbar*	n/a	1900mbar
East Kent MP	SANDGATE DG	780mbar	881mbar	345mbar	1094mbar

Security

During 1 March 2018 ‘Beast from the East’ demand scenario, South East demand levels were considered to be commensurate with our 1:20 Demand scenario used in our worst-case modelling and in some areas a 1:50. Yet a demand event occurred beyond our worst-case models.

The sense check results prove the suitability of our current year models, for reinforcement design purposes.

6 Consequence of Failure

Loss of Supply to Customers

The East Kent MP network will be unable to support both committed growth as well as proposed developments identified at Otterpool Garden Town west of the Lympne MP leg, beyond 2022, in direct violation of our license obligations to maintain Security of Supply of committed customer development.

Ultimately this will result in insufficient inlet pressure and the loss of supply to approximately 2500 existing/new customers and a failure to meet our Licence Conditions, attracting adverse publicity and damage to the company's reputation.

Affected customers will include 800 domestic premises and 6 Commercial sites within Link Park GT site and proposed 1775 houses in initial phase of Otterpool Garden Town, within RIIO-GD2.

Financially, after the first 24 hours, affected householders will be compensated for time without gas. Domestic customers will receive £41 for each 24-hour period without gas, small businesses will receive £69 for each 24-hour period without gas.

Failure to invest in reinforcement would also prevent gas from becoming a part of the energy mix at any growth areas identified within the Local Development Plans. We would be deemed to have blocked local development, effecting the growth of the local economy.

Safety Impact of Failure

Reinforcement of the East Kent IPMP system is necessary to meet the requirements of our Licence Condition.

In this instance, a failure to reinforce will result in a system failure during peak winter conditions. The resulting loss of supply may have serious health and safety implications for vulnerable customers who rely on gas for essential heating and cooking facilities.

Environmental Impact

A system failure on this scale will result in a major recovery exercise. Environmental impacts will include increased travel to site by our employees, leading to an increase in greenhouse gas emissions and disruption to the public.

On site, the use of fossil fuels to power plant and equipment required in the restoration of supplies will further increase greenhouse gas emissions, as will subsequent travel/plant in use for the reinstatement of public highways following the conclusion of these works.

Table 3: Projected Pressures (2025/26) without Reinforcement

Location	Min Required Pressure (bar)	Min. Modelled Pressure (bar)
Lympne	0.35	-3.29

Security

7 Options Considered

7.1 Options

In accordance with the guidelines set out in the Ofgem guidance document ‘Engineering Justification Paper Frameworks for RIIO-GD2 and RIIO-GT2’ – Appendix B (Section 7), the following options have been considered:

Replace on Failure

Wait until the network fails then replace the system. This option has been discounted as it is impracticable to replace Thanet MP system.

Repair on Failure

Mains reinforcement after the network has failed. This option has been discounted due to non-compliance with our Licence Condition.

Pre-emptively Replace

This option has been discounted as asset replacement does not inherently provide additional capacity.

Pre-emptively Repair

Mains reinforcement based on model data prior to network failure, four options considered for further investigation: *(See Sections 7.1, 7.2, 7.3 & 7.4 for details)*

Do Nothing

Discarded as the existing network cannot meet minimum pressure requirements of the accepted CSEP P08119724, Old London Road, Hythe. In direct contravention of our Licence Conditions relating to maintaining Security of Supply.

Security

The technical detail of option i.e. capacity, system rating, availability etc.

Reinforcement of approximately 1724m x 355mmPE MP PH1 (2023/24) & 1351m x 355mmPE MP PH2 (2025/26).

The basis for cost estimate/unit cost

Cost estimate for the replacement CGS is based on average contracted rates supplied by depot, validated against known costs for similar, completed projects.

The perceived benefits of the option

Maintains Security of Supply to known development in compliance with our Licence conditions for RIIO-GD2 period 2021-2026.

Delivery timescales

Reinforcement to maintain minimum pressures at CSEP & Otterpool Park development, to be completed in two parts, PH1 by winter 2023/24 & PH2 by Winter 2025/26 within GD2 to accommodate phased nature of development.

Key assumptions made

It is assumed known potential demand growth both within RIIO-GD2 and beyond will require the same level of gas supply as currently experienced.

Any other items that differentiate the option from the others considered

Multi-phase Option allows flexibility in delivery to suit any changes in the rate of development growth.

Security

The technical detail of option i.e. capacity, system rating, availability etc.

Reinforcement of approximately 3570m x 250mmHDPE IP in one phase (2023/24).

The basis for cost estimate/unit cost

Cost estimate for the replacement CGS is based on average contracted rates supplied by depot, validated against known costs for similar, completed projects.

The perceived benefits of the option

Maintains Security of Supply to known development in compliance with our Licence conditions for RIIO-GD2 period 2021-2026.

Delivery timescales

Reinforcement to maintain minimum pressures at CSEP & Otterpool Park development, to be completed in by winter 2023/24 within GD2 to accommodate development.

Key assumptions made

It is assumed known potential demand growth both within RIIO-GD2 period and beyond will require the same level of gas supply as currently experienced.

Any other items that differentiate the option from the others considered

Single phase Option which is required to be delivered in its entirety to maintain system extremity pressures, cannot be deferred once works commence, to suit any changes in development growth.

7.4 Third Option Summary - Raise Pressures

Discarded as Hythe DPG would have to exceed its MOP of 2bar to maintain the minimum negotiated pressure at the CSEP without any reinforcement.

7.5 Fourth Option Summary – Interruption.

In addition to the above, consideration was given to Interruption. As part of Interruption Reform, also known as the Mod 90 process, we have the option to offer a tender for interruptible contracts to customers to offset the need to invest for capacity.

Interruptible consumers receive discounted transportation charges for the flexibility they provide to the system for demand side management at times of high demand.

There are currently no interruptible customers on the east Kent grid of the south-eastern IP/MP system. This will be monitored going forward and should any interruptible loads be identified in the future, tendering for interruption shall be considered as a viable option.

7.6 Options Technical Summary Table

Table 4 – Options Technical Summary

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment / Investment Design Life	Total Cost (£m)
Two Phase MP Reinforcement	2023	2025	1724m x 355mmPEMP PH1 (2023) 1351m x 355mmPEMP PH2 (2025)	10 Years	1.870
Single Phase IP Reinforcement	2023	2023	3570m x 250mmHDPE IP (2023/24)	10 Years	1.658
Raise Pressures	n/a	n/a	n/a	n/a	n/a
Interruption	n/a	n/a	n/a	n/a	n/a

7.7 Options Cost Details

Table 5: Cost Summary

Option	Cost Breakdown (£m)	Total Cost (£m)
Two Phase MP Reinforcement	PH1 & PH2 Materials = <input type="text"/> PH1 & PH2 Labour = <input type="text"/> Traffic Management = <input type="text"/>	1.870
Single Phase IP Reinforcement	Material = <input type="text"/> Labour = <input type="text"/> Commercial Confidentiality Traffic Management = <input type="text"/>	1.658

*Costs for the options considered have been prepared using average contracted rates at depot level and validated against known costs for similar, completed projects. Costs inclusive of Overheads and Efficiencies.

8 Business Case Outline and Discussion

Validation of the network analysis model, a robust model maintenance process and system performance checks have confirmed the accuracy of the East Kent IPMP model for use in network analysis.

A full review of the relevant Local Development Plans and associated documents, followed by close engagement with stakeholders, has provided confidence in the level of development expected during RIIO-GD2.

The development outputs have been applied to the validated network model which predicts a failure at 95% peak demand by winter 2023/24, putting at risk supplies to 2,500 customers.

To mitigate this risk and meet Licence Conditions it will be necessary to pre-emptively reinforce the network during the RIIO-GD2 period.

There have been no external costs incurred in assessing the options considered as these have been prepared by the in-house Network Planning and Design teams.

8.1 Key Business Case Drivers Description

Pre-emptively Repair: Option 1 – Two Phase MP Reinforcement.

Involves significant mains laying within verge of rural Old London Road, Hythe to Lympne Village. Significant lengths involved, allied to multiple phasing of Otterpool development over 25years, requires mains to be laid in two phases within GD2.

PH1. 2023/24 = 1724M x 355mmMDPE MP.

PH2. 2025/26 = 1351M x 355mmMDPE MP.

Pre-emptively Repair: Option 2 – Single Phase IP Reinforcement.

Involves significant mains laying within verge of rural Old London Road, from Fort Road, Hythe to Lympne Village = 3570M x 250mmHDPE /219mmST IP.

This IP option must be laid in one phase as parallel mains are MP, preventing phasing.

Table 6 – Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	Two Phase MP Reinforcement	Despite higher cost this multi-phase MP Reinforcement allows flexibility in delivery to suit any changes in the rate of development growth. Possibly allowing PH2 to be deferred beyond GD2 or even dispensed with should demand growth not be required in later years.
2	Single Phase IP Reinforcement	Least cost reinforcement which is required to be delivered in its entirety to maintain system extremity pressures, cannot be deferred once works commence, to suit any changes in development growth.

8.2 Business Case Summary

This project is driven by the requirement to maintain Security of Supply to our existing and proposed customers, throughout the RIIO-GD2 period 2021- 2026.

Table 7 - Business Case Matrix

	Two Phase MP Reinforcement	Single Phase IP Reinforcement
Capex (£m)	1.870	1.658
Number of Interventions	3075m x 355mmMDPE MP main laid in 2 phases	3570m x 250mmHDPE IP main laid in one phase
Design Life	10 Years	10 Years
Positive Benefit (Pros)	Maintains SGN licence Obligations to maintain Security of Supply to existing developments whilst accommodating notified growth at Otterpool Garden Town both within GD2, mains sized to provide spare capacity for additional growth beyond GD2. Multiphase Option allows flexibility for PH2 to be deferred should development slow or make a change in energy requirements.	Least cost reinforcement maintains SGN licence obligations to maintain Security of Supply to existing developments whilst accommodating notified growth at Otterpool Garden Town both within GD2, mains sized to provide spare capacity for additional growth beyond GD2.
Negative Impact (Cons)	Most expensive reinforcement due to two phases of work being delivered in different years (2023 then 2025).	IP mains will incur greater expense and requires to be laid deeper into Hythe Town to reach IP mains connection. Must be laid in One Phase as parallel mains are MP.

All Costs inclusive of Overheads and Efficiencies.

9 Preferred Option Scope and Project Plan

9.1 Preferred option

Pre-Emptively Repair: Option 1 – Two Phase MP Reinforcement.

Lay 3075m x 355mmMDPE MP mains reinforcement in Two phases

1724m laid in 2023/24 under PH1 with additional 1351m laid in 2025/26 as PH2.

9.2 Asset Health Spend Profile

Next phase of development is expected at existing CSEP P08119724, by end of 2023. This next phase will require the completion of reinforcement prior to winter 2023/24, to ensure Security of Supply.

Subsequently PH1 reinforcement spend is expected within Financial Year 2023/24, with all 1724m of mains workload laid by end of 2023.

PH2 reinforcement spend is expected within Financial Year 2025/26, with all 1351m of mains workload laid.

Table 8: Asset Health Spend Profile (£m)

Asset Health Spend Profile (£m)						
Pre GD2	2021/22	2022/23	2023/24	2024/25	2025/26	Post GD2
0	0	0	1.001	0	0.869	0

All costs inclusive of Overheads and Efficiencies.

9.3 Investment Risk Discussion

Gas demand growth has been based around current Local Plan projections for new housing within RIIO-GD2 period 2021-26, with new CGS design providing for future capacity needs beyond 2026 to the limit of the Local Plan in 2031.

Risk exists when the planned development does not materialise or proceeds more slowly than anticipated. As reinforcement will not be required until the midpoint of RIIO-GD2, the progress of development will be modified to suit at that time.

We have prepared costs using average contracted rates at depot level and have validated them against known costs for similar, completed projects. Nevertheless, whilst all reasonable steps have been taken to ensure accuracy of costs outlined in this paper, it is recognised external variables may change and subsequently impact on actual costs at the time of construction. Examples of such could include unforeseen increases in contractor rates driven by a surplus of market demand for labour or cost increases for materials.

Factors such as market driven demand linked to the economy, the UK's potential exit from the European Union, emerging decarbonisation strategies and industry innovation can potentially impact on the scope of works outlined in this paper. We have proposed a volume driver funding mechanism to de-risk underspend/overspend for these works. Further details of this proposal can be found in Section 6.2 in the RIIO-GD2 Business Plan Appendix for Capacity Management.

As stated in our Environmental Action Plan, and in line with current UK Governments targets, our long-term target is to achieve Net Zero emissions by 2045. This means a decarbonisation of the energy network and supporting the transition to an environmentally sustainable low-carbon energy system. Indeed, we recognise there have been preliminary government targets set facilitating a move toward a renewable or low carbon heat solutions by the end of the RIIO-GD2 period. As such, throughout RIIO-GD2 we will continue to closely monitor this emerging heat strategy with a view to refining any potential impact on current growth forecasts.

Appendix A - List of Acronyms

Acronym	Backronym (spelled out acronym)	Definition / explanation
Pressure Tiers ○ HP ○ IP ○ MP ○ LP	○ High Pressure ○ Intermediate Pressure ○ Medium Pressure ○ Low Pressure	○ High Pressure i.e. above 7bar LTS (NTS) ○ Intermediate Pressure i.e. 2 – 7bar ○ Medium Pressure i.e. up to 2bar ○ Low Pressure i.e. up to 75mb
CSEP	Connected System Exit Point	Third party connection to Gas network from an iGT or UIP
DG	District Governor	Pressure regulator primarily used for reducing pressures from IP and MP tiers to LP.
DPG	Distribution Pressure Governor	Pressure regulator primarily used for reducing pressures from IP tier to MP.
HDPE	High Density Polyethylene	Material standard for plastic pipe – High density allows for use at > 2bar operation due to thicker pipe wall. Reduced internal diameter increases weight of pipe, is not suitable for use < 2bar. Cheaper material and jointing than Steel.
iGT (GT)	Independent Gas Transporter	Third party supplier of gas and infrastructure to closed developments, not generally adopted by SGN.
LTS	Local Transmission System	High Pressure system feeding from National Offtakes to P(T)RS Inlets
MDPE	Medium Density Polyethylene	Material standard for plastic pipe – Medium density allows for greater internal diameter for extra capacity required at lower tiers, but thinner pipe wall thickness is not considered safe for operation at >2bar. Cheap material and jointing due to electro fusion welding.
MOP	Maximum Operation Pressure	Highest design pressure for a mains system, however regulator may be set lower than this but not higher.
NTS	National Transmission System	High Pressure system feeding National Offtakes from Terminals
PMAC	Pressure Management and Control	Third Party monitoring system which communicates live data via BT Comms link, facilitates remote control of pressure settings and profiles on SGN Plant, used at all Plant levels.
P(T)RS	Pressure (Transmission) Regulator Station	Pressure regulator primarily used for reducing pressures from HP (LTS/NTS) tier to IP / MP or LP.
UIP	Universal Infrastructure Provider	Provides and connects infrastructure to gas network but does not supply gas. UIP infrastructure is generally adopted by SGN.
RIIO-GD1	Revenue=Incentives + Innovation + Outputs – Gas Distribution 1	8-Year price control period (2013-2021)
RIIO-GD2	Revenue=Incentives + Innovation + Outputs – Gas Distribution 2	Proposed 5-Year price control period (2021-2026)
SHP	SHP File Format	SHP is a file extension for a Shapefile shape format used in geographical information systems (GIS) software.
ST	STEEL	Steel pipe material is used where PE cannot i.e. protection from heavy traffic or bridge crossings, Regulator outlets where excessive gas cooling may be experienced at pressure reduction. Steel pipe laying can be expensive due to welded joints.
1:20	1:20 Demand Conditions	Designing a network to operate whilst experiencing demand conditions historically only seen every 20 years, during severe weather events.