Engineering Justification Paper

Campbeltown Ambient Vaporiser Replacement

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Classification: Highly Confidential

1. Table of Contents

2 Introduction

At the Campbeltown SIU location there are 145 tonnes of LNG on site to supply the local distribution system which is not integrated into the wider gas distribution network due to the remote location. LNG is a cryogenic liquid (circa -160 °C) and the stored liquid is heated as required by gas demand to process the cryogenic liquid into natural gas at a temperature suitable for carbon steel and P.E. pipework systems, typically 4°C. The heat for vaporisation is supplied by ambient vaporisers (from the atmosphere) and hot water vaporisers (HWVs) from modular boilers. This project is to replace the ambient vaporisers and does not include new boilers.

2.1 General Background

Campbeltown was originally supplied by a traditional coal gasification plant. This was superseded by the current LNG plant in 1971. The site experienced incremental development to increase capacity and replace obsolete equipment as required but still incorporates a significant proportion of original pipework and equipment. Replacement and upgrade of equipment is an ongoing activity as dictated by increased gas demand and asset condition calling for replacement or refurbishment due to condition or availability of spares. Condition assessment is primarily carried out by means of site-specific condition assessment using VS02 inspection and annual maintenance.

2.2 Site Specific Background

Campbeltown LNG plant operates as a satellite LNG facility supplied by a fleet of road tankers. The plant stores LNG which is vaporised and distributed locally via a medium pressure network (1.05 barg). The plant as built was designed for a maximum load of 1,130 scmh. Since then the local network peak demand has more than doubled to approximately 1,837 scmh.

Figure 1:
Campbeltown SIU, ambient vaporisers in centre

Figure 2:
Campbeltown SIU aerial view

3 Equipment Summary

A number of enhancements have been incorporated into the plant over the years, notably the addition of ambient vaporisers, to complement the HWV's. By drawing heat from the air, the ambient vaporisers reduce fuel gas used to vaporise the LNG and heating the gas to a suitable inlet temperature (10°C) for the plant governor system. This temperature allows for some cooling due to Joule-Thompson effect in the pressure reduction system. The ambient vaporisers (when iced) do not have

capacity to meet peak demand. During the winter period, high gas demands may cause the ambient vaporisers to carry over a not fully vaporised gas supply. Full vaporisation is then achieved using the HWVs. Another more recent upgrade has been the replacement of the hot water boilers and HWVs. These were replaced approximately seven years ago. The ambient vaporisers are also obsolete with no new spares available.

The LNG is stored at a pressure of around 5.5 barg and during vaporisation mode will reach the HWVs at this pressure. Each HWV has a first stage governor at its outlet which reduces line pressure to 2.5 barg. The pressure is subsequently further reduced to 1.05 barg in the plant governor and issued to the local network. District governors reduce the pressure to low pressure prior to distribution to customers.

The ambient vaporisers have been installed to match load growth and are presently four banks of eight vaporisers.

Figure 3: Campbeltown ambient vaporisers.

4 Problem Statement

The current ambient vaporisers are obsolete and inefficient. If this work is not undertaken supply to 2095 customers could be lost and there is the risk of a failure leading to high volume gas escape. The outcome of this project would be to replace the ambient vaporisers with new ambient vaporisers ensuring security of supply and customer safety.

4.1 Narrative Real-Life Example of Problem

Campbelltown's vaporisers are obsolete and inefficient. This means while the hot water vaporisers can maintain supply, this is not desirable as this is costly due to burning gas which results in increased carbon emissions. As the vaporisers are obsolete, spare parts are no longer available for this model of vaporiser.

4.2 Spend Boundaries

This spend is only required at Campbeltown and does not include the hot water vaporisers as these were replaced in 2015 along with the boilers.

5 Probability of Failure

The NARMs methodology and the method of using the Commercial C System to calculate monetised risk values and their impacts on the CBA cannot be applied to the SIUs as the SIUs were omitted from the methodology and model. However, the principals of NARMS Commercial Confidentiali are attempted to be aligned with the SIUs.

5.1 Probability of Failure Data Assurance

The ambient vaporisers have been assessed annually under PSSR and have been assessed as obsolete.

6 Consequence of Failure

Table 1: Consequence of failure vs failure mode

	Failure Consequence		
Failure Mode	**Safety Impact**	**Security of Supply**	**Environmental Impact**
Liquid Leaks (rapid release of liquid)	If liquid escape significant, risk of ignition with large area consumed with gas due to rapid vaporisation. Proximity to public is major concern	Security of supply can be impacted if one or more vaporisers were out of operation, leaving the site with no redundancy to maintain security of supply to 2095 customers	Carbon emissions proportionate to the volume of escape

Gas Leaks (Over pressurisation)	If liquid escape significant, risk of ignition with large area consumed with gas due to rapid vaporisation. Proximity to public is major concern	Security of supply can be impacted if one or more vaporisers were out of operation, leaving the site with no redundancy to maintain security of supply	Carbon emissions proportionate to the volume of escape

7 Options Considered

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

This is not being considered as this could result in a cessation and death if failure occurs in winter.

Repair on failure

This is not technically possible as the vaporisers are obsolete with no part available.

Pre-emptively replace

Campbelltown's vaporisers are obsolete and inefficient. This means that while the hot water vaporisers can maintain supply, this is not desirable as this is costly due to burning gas which results in increased carbon emissions.

Pre-emptively repair

This is not technically possible as the vaporisers are obsolete with no part available.

Do nothing

Not being considered as the components are obsolete, with no new spares available).

7.1 Option 1 summary - Replace Ambient Vaporisers

The only option for Campbeltown is to replace the ambient vaporisers with new ambient vaporisers.

The new ambient vaporisers operate below 10 bar and must operate at -160 °C to ambient conditions. SGN major projects have costed this option based on the hot water vaporizer replaced in 2015 and estimates in reports by PM Projen and Doosan Babcock. Major projects have also included other work at the SIU for cost estimates. This option would ensure the security of supply to customers in Campbeltown This project should be delivered by 2023.

Ambient vaporisation is the backbone of LNG vaporisation and are critical to maintain security of supply.

New Campbeltown Ambient Vaporisers will cost £970,000.

7.2 Options Technical Summary Table

Table 2 – Options Technical Summary

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment / Investment Design Life	Total Cost (£m)
Do Nothing	2022	2022	0	0	0.01
New Ambient Vaporisers	2022	2022	1	40	0.96

7.3 Options Cost Summary Table

Table 2 – Options Cost Summary Table

New Ambient Vaporisers	Cost Breakdown
Planning & Design	
Environmental	
Project Management	
Land & Legal	
Materials	Commercial Confidentiality
Main Works Contractor	
Project Management and Administration	
Construction Works	
Final Tie-Ins & NRO Works	
Direct Company Costs	
Total Directly Estimated Cost	£775,975

Total installed costs of £0.96 m have been derived by combining directly estimated costs with allowance for efficiencies, overheads and other project specific factors.

8 Business Case Outline and Discussion

8.1 Key Business Case Drivers Description

Due to the complexity of LNG sites, the range of options is limited and are listed below:

Table 4 – Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	New Ambient Vaporisers	Security of Supply
2	Repair and Refurbish	Not technically feasible
3	Replace on Failure	Could result in a cessation and death if in winter

Table 5 – Summary of CBA Results

NPVs based on Payback Periods (absolute, £m)								
Option No.	Desc. of Option	Preferred Option (Y/N)	Total Forecast Expenditure (£m)	Total NPV	2030	2035	2040	2050
Baseline	Do Nothing	Y	-0.01	-0.80	**-0.30**	**-0.44**	**-0.58**	**-0.70**
1	Replace Ambient Vaporisers Absolute NPV	Y	-0.97	-1.01	**-0.75**	**-0.84**	**-0.90**	**-0.97**
1	Replace Ambient Vaporisers NPV relative to Baseline	Y	-0.97	-1.01	**-0.45**	**-0.40**	**-0.32**	**-0.27**

8.2 Business Case Summary

This project is driven by the obligation to maintain security of supply at the SIUs. By replacing the ambient vaporisers at Campbeltown SGN be complying with the licence condition to maintain security of supply.

Table 6 - Business Case Matrix

	Replace Ambient vaporiser
GD2 Capex (£m)	0.96
Number of Interventions	1.00
Carbon Savings ktCO2e (GD2)	1316.27
Carbon Savings ktCO2e /yr	263.25
Carbon Emission Savings (35yr PV, £m)	0.37
Other Environmental Savings (35yr PV, £m)	0.00
Safety Benefits (35yr PV, £m)	0.00
Other Benefits (35yr PV, £m)	0.33
Direct Costs (35yr PV, £m)	-0.95
NPV (35yr PV, £m)	-0.25
High Carbon Scenario	
Carbon Emission Savings (35yr PV, £m)	0.55
High Carbon NPV (35yr PV, £m)	-0.07

9 Preferred Option Scope and Project Plan

9.1 Preferred option

The preferred option is to install new ambient vaporisers at Campbeltown.

9.2 Asset Health Spend Profile

Table 7 Asset Health Spend Profile

Asset Health Spend Profile (£m)						
Pre GD2	2021/22	2022/23	2023/24	2024/25	2025/26	Post GD2
	0.193	0.183	0.183	0.197	0.210	0

9.3 Investment Risk Discussion

Some Investment Risks exist that could influence projects being delivered within the defined timescales and budget.

SGN does not have direct control over market forces that can cause contractor and material costs to fluctuate (these can be influenced by national events including Brexit).

A reasonable allowance for uncertainty has also been included to mitigate against the remainder of this risk.

Sensitivities have been applied to the SIU CBAs as follows:

- Variations in Capex project cost have been applied for the range -10% to +20%. These are considered realistic ranges based on our experience in GD1 and the likely pressures on cost in relation to the procurement of materials and main contracts.
- Variations in methane levels (and therefore environmental impact) have been considered to take account of the anticipated introduction of hydrogen. SGN have committed to a 'net zero' carbon network by 2045. In practice that means no methane by that date. Also, while the use of hydrogen in distribution is being actively investigated and hydrogen is currently being introduced into a network for the first time since the conversion to natural gas, it is considered very unlikely that hydrogen will be injected on a wider scale until RIIO-GD3. For these reasons, methane levels have been considered in three ranges: aggressive early transition, mid-case and late transition.

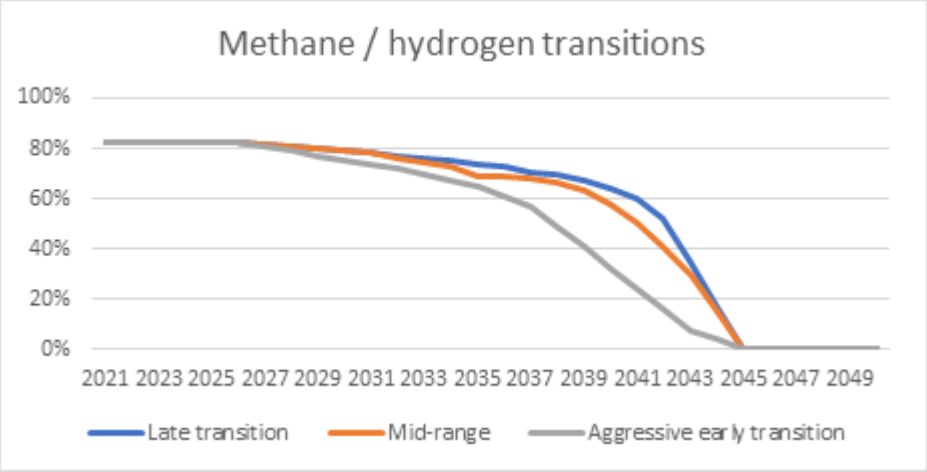

Figure 4 Methane / Hydrogen Transitions

The current version of the CBA template, version 4, already acknowledges that methane is estimated to be 28 times more damaging than CO_2. This figure is taken from the IPCC Fifth Assessment Report published in 2014. Since this figure is derived from the latest science, it is not considered prudent to test for sensitivity in this area.

Sensitivity in the value / cost of carbon is already included within the CBA template with base-case and high-case scenarios mapped out. These sensitivities are considered sufficient in our CBA.

Table 8 Sensitivity Results

	Low	Mid	High
GD2 Capex (£m)	0.87	0.96	1.16
Number of Interventions	1	1	1
Carbon Savings ktCO2e (GD2)	1,316	1,316	1,316
Carbon Savings ktCO2e /yr	263	263	263
Carbon Emission Savings (35yr PV, £m)	0.3	0.4	0.4
Other Environmental Savings (35yr PV, £m)	0	0	0
Safety Benefits (35yr PV, £m)	0.0	0.0	0.0
Other Benefits (35yr PV, £m)	0.3	0.3	0.3
Direct Costs (35yr PV, £m)	-0.9	-0.9	-1.1
NPV (35yr PV, £m)	-0.2	-0.3	-0.4

Project payback has not been carried out as part of this analysis due to the effect of the Spackman approach. For a cash-flow traditional project payback period please see scenario 4 of our Capitalisation Sensitivity table.

Consumers fund our Totex in two ways – opex is charged immediately though bills (fast money – no capitalisation) and capex / repex is funded by bills over 45 years (slow money – 100% capitalisation). The amount deferred over 45 years represents the capitalisation rate. Traditionally in 'project' CBA's the cashflows are shown as they are incurred (with the investment up front which essentially is a zero capitalisation rate). Therefore, we have developed scenarios that reflect both ways of looking at the investment – from a consumer and a 'project'.

The scenarios are summarised as follows:

- Scenario 1 - we have used the blended average of 65%, used in previous iterations of this analysis.
- Scenario 2 - we have represented the Capex and Opex blend for the two networks, as per guidance.
- Scenario 3 - addresses our concerns on capitalisation rates whereby Repex and Capex spend is deferred (100% capitalisation rate) and Opex is paid for upfront (0% capitalisation rate).
- Scenario 4 - this reflects the payback period in 'project' / cash-flow terms and provides a project payback.

We have taken a view of the NPV in each of the scenarios, with the exception of scenario 4, at the 20, 35 and 45 Year points, to demonstrate the effect of Capitalisation Rate on this value.

Table 9 - Capitalisation Rate Variation

Scenario	1	2 SC	3	4
Capex (%)	65	46	100	0
Opex (%)	65	46	0	0
Repex (%)	100	100	100	0
Output				
NPV (20yr PV, £m)	-0.28	-0.31	-0.21	
NPV (35yr PV, £m)	-0.25	-0.25	-0.23	
NPV (45yr PV, £m)	-0.21	-0.21	-0.21	
Payback	50.00	50.00	49.00	50.00

Appendix A - Acronyms

Acronym	Description
E&I	Electrical and Instrumentation
LNG	Liquefied Natural Gas
scmh	Standard Cubic Meters per Hour
HWVs	Hot Water Vaporisers