Engineering Justification Paper

Stent 2

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2 Introduction

This paper is for the next step in implementing the Stent Bag (Stage 2) equipment to help minimise the release of gas escape scenarios. This equipment has been developed from the successful learning gained from Stent Bag (Stage 1) developed for up to 2barg on metallic pipe, where Stent Bag (Stage 2) will focus up to 7barg on up to 12" PE and metallic pipelines.

2.1 General Background

Accidental damage to our pipes by an excavator or mini digger can lead to gas escapes and loss of supply, resulting in significant financial costs and environmental impact. Using an inflatable stent bag to fill and seal a pipe from the inside can extend the critical time window for dealing with gas mains damage, minimise the amount of gas escaping into the environment and prevent the need for a costly customer restoration programme. We've been testing a prototype off-site, so we can evaluate the bag/process before planning live field trials.

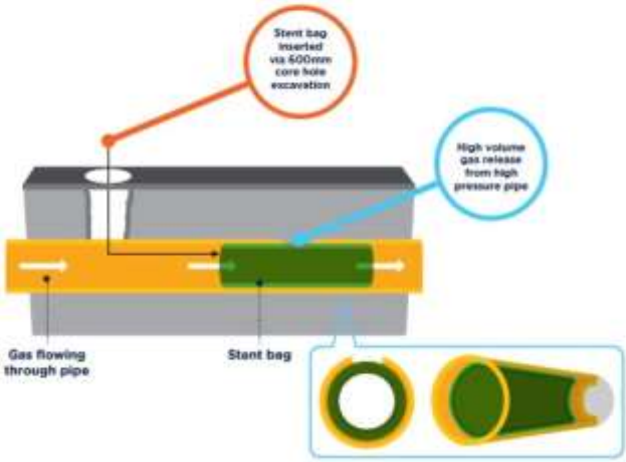
2.2 Site Specific Background

This equipment relates to all of the UK.

3 Equipment Summary

The process developed involves inserting a sealing stent system into the main remotely away from the gas escape. The Stent Bag is then internally pushed along the main and expanded to seal the area around the leakage point. Unlike a traditional flow stop bag the stent maintains the flow of gas to customers downstream of the affected area. This can be seen in the **Figure 1** below.

Figure 1: Stent bag operation overview



The Stent Bag (Stage 2) is currently in development focusing on gas escapes on pipe systems with Maximum Operating Pressure (MOP) up to 7barg and up to 12" PE and metallic pipelines. This offers a safer alternative than conventional means and also maintains security of supply to our customers downstream of the incident. The stent equipment can also be used to remediate bolts found on AVK valves, providing further safety compared to conventional methods.

Stent Bag (Stage 1) developed and proved the stent technology through numerous testing and development on up to 2barg metallic pipe. This ultimately led to the complete unit shown in Error! Reference source not found. below, where the Stent Bag can be expanded to reduce the gas escape.

Figure 2: Stent Bag Design (Left: Stent Bag design. Middle: Deflated Stent Bag below gas escape on metallic pipe. Right: Inflated Stent Bag sealing gas escape.

4 Problem Statement

Impact damage to a pipeline or a gas main from excavators and mini diggers can lead to a significant escape of gas, where a loss of supply can incur a significant financial cost with considerable environmental damage. Recent examples of this are two third party interference damage incidents in Scotland in 2012/13, each of which involved a loss of supply to between 3,000 and 4,000 customers.

An example of damaged metallic pipe can be seen in Error! Reference source not found..

Figure 3: Damaged metallic mains

Depending on the extent of the damage, the first choice option for dealing with third party damage is to try to maintain the gas supply to customers. The current method for achieving this is to temporarily repair/ control the leaking pipe with a repair clamp and/ or sandbags and then construct a bypass around the damage, subsequently cutting out the damaged section. An example of current techniques can be seen in Error! Reference source not found..

Figure 4: Example of current repair technique

The caveat to this method is that it must be carried out within a critical time window before too much gas escapes through the damaged pipe and a loss of supply occurs. If the supply is lost in this way, air can be drawn into the gas system which can create potentially explosive atmospheres within the network. Therefore, often the only available method for safely dealing with network damage is to close a valve upstream and turn off the supply to customers until the damage has been remediated. After the damage has been remediated, supply to customers is restored by means of a purge and relight at every affected household. This is a costly and time consuming operation.

This project specifically aims to provide a solution this problem by developing a method which could be used to extend the critical time window for dealing with gas mains damaged by a third party or otherwise. This solution would also simultaneously mitigate the escape of gas to the environment and negate the requirement for a costly customer restoration programme.

4.1 Narrative Real-Life Example of Problem

In the past five years SGN have had 48 incidents that have resulted in fires and explosions and a total of 187 high volume gas escapes. These incidents result in a loss of downstream supplies to customers. The period of loss is variable but has an effect not only on our customers but also on our planned work as; inevitably, additional resources are required to make the situation safe before re-establishing the supplies.

Furthermore, SGN require to replace the bonnet on approximately 624 AVK valves. Although the main benefit using the Stent Bag for AVK remediation would be from a safety perspective, the Stent Bag would require approximately 3 times smaller excavation area when compared to the ground anchor process. Due to the large excavation cost of the ground anchor and the machinery required to mobilise the weights, the Stent Bag for valve bonnet remediation does offer a cost saving.

Utilising the Stent Bag will require less resources being deployed as the system will secure supply downstream resulting in substantial cost savings and decreased disruption to our customers and stakeholders.

4.2 Spend Boundaries

The proposed spend focusses on the list of tool concepts detailed in this paper. Funding is proposed via the uncertainty mechanism as this is an Innovation project and the costs are not yet certain.

5 Probability of Failure

There is a possibility that in the event of a gas escape the damage to the piping system could be so significant that the Stent Bag equipment cannot be used to create a permanent repair, therefore conventional methods would be referred to.

5.1 Probability of Failure Data Assurance

No current failure data is known so assurance is not possible at this time as the uncertainty level is high.

6 Consequence of Failure

In the event of the Stent Bag equipment not being suitable, conventional methods would be referred to. These techniques are tried and proven and therefore would still be able to resolve gas escapes.

7 Options Considered

The two options considered within the EJP are listed below:

- **Option 1 – Do nothing (base case option)**

This option would mean we would continue with existing techniques for responding to gas escapes and for carrying out repairs. Current methods put the response team, operatives and customers in a dangerous environment. The current method also takes more time to apply compared to the Stent Bag method.

- **Option 2 – Invest in Stent Bag equipment (Preferred Option)**

This is the preferred option to improve safety on the HVGE sites and respond to escapes quicker. This also provides environmental benefits by being able to respond to HVGE in a more effectively. Please see Environmental Action Plan Appendix 3.

Due to each incident's individual nature, it is difficult to accurately estimate the savings therefore a conservative analysis was carried out which outlines the minimum savings of the Stent Bag. The information outlined below has been gathered and supported from within the business.

7.1 First Option Summary - Current Method

a. Gas escape

As mentioned in Section 0in the past five years SGN have had 48 incidents that have resulted in fires and explosions and a total of 187 high volume gas escapes, which is an average of 37 per year.

These incidents result in a loss of downstream supplies to customers and the period of loss can vary, affecting SGN's planned work requiring additional resources to deal with the gas escape situation.

These events have an implicit loss of supply and reconnection costs. The more effectively that these events can be dealt with the greater the financial impact. The cost of such incidents can vary enormously from £5k to £250k.

The estimated man hour per gas escape is equates to **£19,000** as shown **Table 2.**

As mentioned in Section 2 below, focusing on 20 incidents per year using Stent Bag would equate to **£380,000** per year.

b. Valve Bonnet Replacement

Where valves are located underground, we currently use a Ground Anchor (GA) to ensure the valve bonnet is held in position whilst the ground above the valve is excavated to allow bolt replacement.

The average cost remediation using the GA is approximately **£8,555** per valve. Being conservative assuming SGN were to replace 20 of the AVK valves per year, the cost would be **£171,100** per year.

7.2 Second Option Summary - Stent Bag

c. Gas Escape

Utilising the Stent Bag will require less resources being deployed as the system will secure supply downstream resulting in substantial cost savings. The Stent Bag would reduce the time taken to resolve an incident and negate labour required to manage the incident.

Incidents can range from minor to severe depending on the number of premises involved. Analysing the last 5 years of incidents and consulting with Operational experts within business, it was found that the Stent Bag could be used on an average of 20 incidents per year.

The estimated man hours to repair a gas escape using Stent Bag is **£4,320**. Using the Stent Bag technique on the 20 incidents described above would cost **£86,400** per year.

d. Valve Bonnet Replacement

Although the main benefit using the Stent Bag for AVK remediation would be from a safety perspective, the Stent Bag also offers financial savings as a much smaller excavation area is required when compared to the GA process. Also, having the mobile weights requires machinery which is another expense the stent bag would not require.

It is estimated that the Stent Bag equipment would equate to **£4,052** per job. Being conservative assuming SGN were to replace 20 of the AVK valves per year, the cost would be **£81,040** per year.

The above costs are based on assumed costs, as an innovation project there is a degree of uncertainty. For this reason, we are requesting a total of £1 million for the roll out of the project via Ofgem's uncertainty mechanism which will be split across years 3 and 4 of GD2 as shown in the Asset spend profile in **Table 3** below.

7.3 Options Technical Summary Table

Table 1: Technical summary overview

Option	First year of Spend	Final year of spend	Volume of Interventions	Equipment Design life	Total cost (£m)
Option 1: Do Nothing	Pre GD2	TBC	Medium	N/A	0.551
Option 2: Stent Bag	2023	2025	Medium	1 off use	1.00

7.4 Options Cost Summary Table

Table 2: Comparison cost and savings

Option	Cost Breakdown	Total Cost (£m)
Option 1 – Do nothing (base case option)	£551,100 pa (£380,000 + £171,100) using current methods for gas escapes and Valve Bonnet Replacement	0.551
Option 2 – Invest in Stent Bag Equipment (Preferred Option)	We are requesting a total of £1 million for the roll out of the project via Ofgem's uncertainty mechanism	1.00

8 Business Case Outline and Discussion

8.1 Key Business Case Drivers Description

The key business drivers are:

- Remove personnel from the hazardous area.
- Reduce time of gas escape.
- Reduce disruption to customers who are heavily reliant on gas supplies for heating during the winter months, therefore maintaining a safe supply to the customers is critical.

8.2 Business Case Summary

Currently there are no efficient ways of resolving HVGE. The Stent Bag (Stage 2) equipment looks to provide the operative with equipment to help minimise the release of gas escape scenarios.

9 Preferred Option Scope and Project Plan

9.1 Preferred Options

The preferred option for the GD2 period is to apply a minimum of 2 Stent Bag (Stage 2) with ancillary equipment within each Depot site.

9.2 Asset Health Spend Profile

Based on the cost model, the spend profile for GD2 is highlighted in the **Table 3** below.

Table 3: Asset Health Spend Profile

Asset Health Spend Profile (£m)						
Pre GD2	2021/22	2022/23	2023/24	2024/25	2025/26	Post GD2
0	0	0	0.75	0.25	0	0

9.3 Investment Risk Discussion

Project de-risked by Ofgem uncertainty mechanism.

9.4 Uncertainty Mechanism

Due to the nature of NIA projects there is a level of uncertainty of the delivered outputs. From our extensive experience on NIA projects, engagement with the wider business and experience with HVGE, we believe the information outlined within this report to be accurate. Our justification is as follows:

What is the issue/risk that the proposed mechanism addresses?

The Stent Bag equipment tackles the issue of HVGE, where SGN have a lot of experience, and policies in place to respond and resolve a range of different HVGE scenarios. With this experience the risk of introducing new kit is minimised.

The NIA project is in the development phase, therefore there is a risk that the project may not meet the set project deliverables. Agreements are in place with all parties to mitigate any issues occurring, therefore we request the sums above to support the uncertainty associated.

Where does the ownership of risk lie in relation to the uncertainty?

Ownership of the risks lies with both project partner and SGN as both rely on each other to achieve project outputs. With both parties wanting to achieve the set project deliverables the risk is minimised.

Materiality of issue

The issue of HVGE can incur large costs, for example outlined within Section **Error! Reference source not found.**based on the 20 incidents could cost over **£0.5m** in man hours and equipment. The Stent Bag equipment looks to reduce this cost to **£0.167m**, resulting in a **£0.38m** saving (outlined in Section **Error! Bookmark not defined.**).

Frequency and probability of issue over the price control period

Safety is critical for our staff and customers, the number of HVGE cannot be determined.

What is the proposed mechanism?

The proposed mechanism of investing in Stent Bag equipment is critical to maximise our performance against HVGE within GD2. Therefore, the proposed method for the GD2 period is to apply a minimum of 2 Stent Bag (Stage 2) with ancillary equipment within each Depot site.

What are the justifications for the mechanism?

The mechanism will allow us to improve our performance against HVGE, increasing safety for our staff and customers and reduce the environmental impact associated with HVGE. Therefore, the mechanism within this report is critical for our safety and environmental performance for GD2.

What are the drawbacks of the proposed mechanism?

With our extensive knowledge on HVGE and on NIA projects there are limited drawbacks to the proposed mechanism.

Can the drawbacks be reduced?

N/A

Explanation of how on balance, the mechanism delivers value for money while protecting the ability to finance efficient delivery.

The benefits of being able to respond to HVGE safely and efficiently, whilst reducing the environmental impact outweigh the drawbacks.

Treatment in Business Plan Data Templates (BPDTs)

The project described has been included in **3.05 (Other Capex)** BPDT.

Appendix A - Acronyms

Acronym	Description
HVGE	High Volume Gas Escape
NIA	Network Innovation Allowance
MP	Medium pressure (up to 2bar)
pa	Per annum
PE	Polyethylene