GAS INNOVATION FUND (GIF) PROJECT

PE SERVICE ALTERATIONS

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PE Service Alterations

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EXECUTIVE SUMMARY

Gas Networks Ireland (GNI) has identified a service window cutter (SWC) developed by STEVE VICK International (SVI), a company based in Bradford, United Kingdom, as a potentially useful tool for making alterations to encased polyethylene (PE) pipes. This innovative solution is designed to address the challenges associated with accessing and altering these encased PE pipes.

A Gas Innovation Fund (GIF) funded trial, involving the testing of the SWC tool, was conducted in the field from March 2021 to September 2022. The objectives of the trial were to assess the reliability, viable alternative and ease of use of the SWC on GNI encased PE service mains.

The successful delivery criteria and main outcomes of the evaluation following the field trial are summarised in tabular form below.

No.	Successful Delivery Criteria	Status[1] (Score)	Comments
1	**Reliability** – The SWC should be able to remove a section of the outer pipe (minimum length of 30cm) without penetrating, damaging or scarring the inserted pipe and the SWC should be able to be used on pipe sizes ranging from 1 to 2 inches.	Fully meets requirement. (5)	• The SVI SWC demonstrated accuracy (minimum 30cm cut) in window cutting without damaging or scarring the 2-inches PE pipe during the field trial. • A risk assessment needs to be conducted, and a Safe System of Work (SSW) developed covering each step PE service alteration using SWC.
2	**Viable Alternative** – The SWC should allow engineers to carry out modifications (such as squeeze-offs and alterations) to a customer's service pipe efficiently, without the need for excavation on the main, where the PE pipe is typically not encased and also adhering to relevant industry standards.	Fully meets requirement. (5)	• The SVI SWC provides a practical alternative to traditional methods such as tracing back the pipe to locate bare mains for alteration or excavation of the main. • The SVI SWC enables modifications to be made in accordance with the trial specification and Machinery Directive 2006/42/EC2.
3	**Ease of use –** The design of the SWC should be suitable for a single operator. This includes simplicity in setup, ease of operation, and a manageable learning curve for users.	Mostly meets requirement. (4)	• The tool is user-friendly with a straightforward setup and operation, for quick deployment for a single operator use. • User feedback suggests that while the learning curve is manageable, ongoing support and refresher training could enhance overall proficiency and confidence among new users.

[1] *Evaluation scheme scoring as follows: 0 – Does not satisfy requirement; 1 – Theoretically meets requirement (desk-top study stage); 2 – Potentially meets requirement (field trials not scoped or insufficient data from field trials); 3 – Partially meets requirement (Initial field trials successful, but further trials or design improvement(s) needed); 4 – Mostly meets requirement (mostly satisfies requirement but requires some further testing and / or design refinement); 5 – Fully satisfies requirement (Demonstrably satisfies requirement and is ready for deployment).*

1 INTRODUCTION

1.1 Background

Gas Networks Ireland (GNI) has identified a service window cutter (SWC) developed by Steve Vick International (SVI) as a potentially useful tool for making alterations to steel encased polyethylene (PE) pipes.

GNI's transition to PE pipes for gas distribution has necessitated innovative solutions for service alterations. These PE pipes are encased in redundant metallic pipes filled with grout, making them difficult to access for service alterations. The SVI-SWC is designed to cut precise windows in the steel encasement. This facilitates direct access to the encased PE main so that it can be altered.

This document serves as the Technical Report submission for the PC4 Gas Innovation Fund Governance Process.

1.2 Problem Statement

The transition to PE service pipes inserted within redundant steel service pipes has created a need for a novel approach for making PE service alterations. While the use of PE service pipe insertions allows for quicker installations and reduces the need for large excavations, it also renders the inserted PE pipe inaccessible for service alterations. Thus, any alteration must begin at the parent main where the PE pipe is not encased. This is typically located further away from the connection tie-in. This situation results in increased costs associated with the PE alteration process.

The requirement for PE service alterations arises from GNI customer requests for the relocation of domestic meters or changes in PE service tie-ins. Currently, there is no available solution for altering inserted PE service pipe sizes below a diameter of 50mm (2 inches) without damaging the PE pipe. This limitation complicates the process of making necessary alterations to the inserted PE service pipes.

See Figure 1-1 for a typical gas main PE pipe connection.

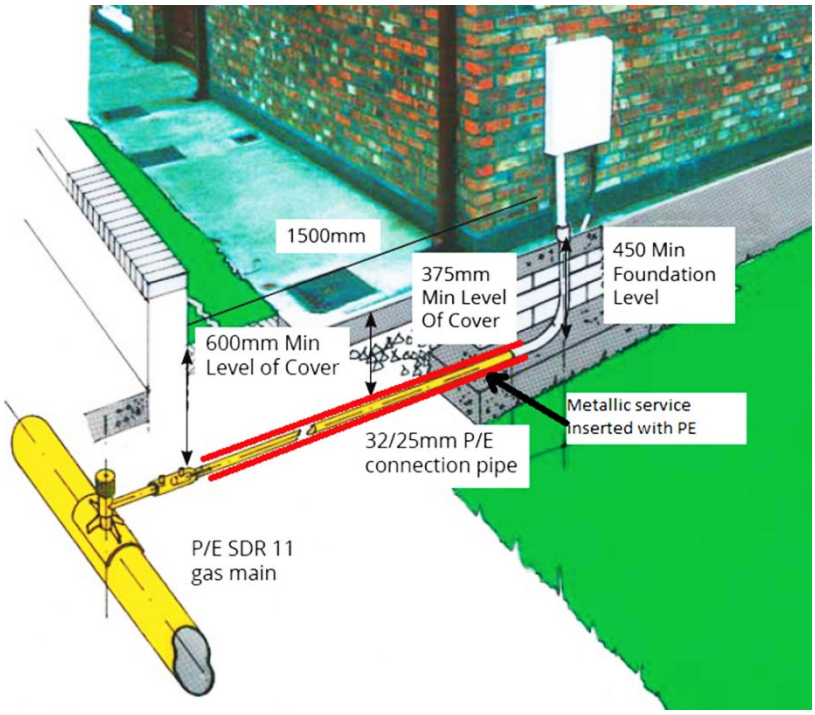

Figure 1-1:Typical Service Insertion.

1.3 Description of Proposed Solution

The Service Window Cutter (SWC) developed by Steve Vick International (SVI) has been proposed as a solution to aid in the alteration of inserted PE services below a diameter of 50mm (2 inches). The proposed solution involves safely removing a section of the steel pipe and grout sheath, without damaging the PE pipe inside. The window is cut-out with two longitudinal cuts at the 3 and 6 o'clock positions on the pipe (see Figure 1-2 & Figure 1-3 for the SVI-SWC.

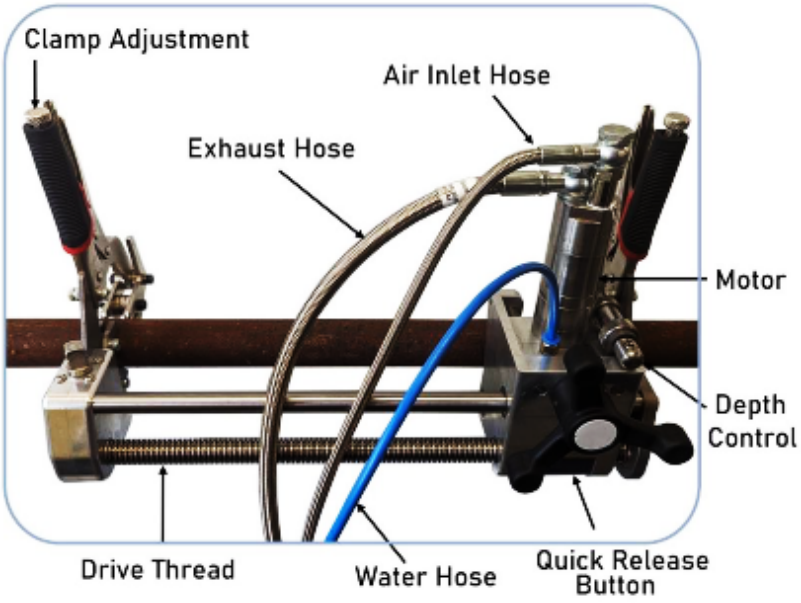

Figure 1-2:Service Window Cutter.

Source: Steve Vick International – Service Window Cutter.

The SVI-SWC measures approximately 520mm X 264mm in overall length and height and weighs approximately 40kg (complete SVI-SWC kit plus case). The tool is designed ideally for use by a single operator.

When deployed in the field, the SWC is placed in the excavated area and then securely clamped onto the pipe. Once in position, the tool is activated to perform the necessary cuts. After the cuts are completed, the tool is removed, allowing for access to the PE pipe for further inspection, maintenance and alteration(s).

Figure 1-3:Service Connection using SWC.

1.4 Gas Innovation Fund (GIF) Application

A Gas Innovation Fund (GIF) application was submitted in 2021 to develop a tool and to carry out field trials of Service Window Cutter (SWC).

1.4.1 Timeline

GNI's application included an overall timeline for the project of 19 months. Funding for the project was granted in March, 2021. The target completion date for the project was September, 2022.

1.4.2 Success Delivery Criteria

The objective of the field trials was to assess the Steve Vick International (SVI) Service Window Cutter (SWC) against the following criteria:

1. **Reliability –** The SWC should be able to remove a section of the outer pipe (minimum length of 30 cm) without penetrating, damaging or scarring the inserted pipe and the SWC should be able to be used on pipe sizes ranging from 1 to 2 inches.
2. **Viable Alternative –**The SWC should allow engineers to carry out modifications (such as squeeze-offs and alterations) to a customer's service pipe efficiently, without the need for excavation on the main, where the PE pipe is typically not encased and also adhering to relevant industry standards.
3. **Ease of use –** The design of the SWC should be suitable for a single operator. This includes simplicity in setup, ease of operation, and a manageable learning curve for users.

1.5 Evaluation Scheme

A simple scheme has been developed for evaluating innovation projects against the successful delivery criteria. This is indicated on **Table 1-1** below.

Table 1-1:Evaluation Scheme used for Innovation Projects

Score	Status	Comments
0	Does not satisfy requirement.	Demonstrably does not satisfy requirement through desk study and / or field trial.
1	Theoretically meets requirement.	Desk-top study stage. Available documentation provides evidence that proposal has potential and can be brought forward to field trials.
2	Potentially meets requirement.	Field trials not scoped or insufficient data available from field trials to determine if innovation will satisfy requirement having regard to the full scope indicated at desk-top study stage.
3	Partially meets requirement.	Initially scoped field trials have been completed and are successful. Likely to satisfy requirement but will require further field testing in specific areas or for longer duration. Scope of additional field trials to be designed to close gaps identified. Requires design improvement(s) in order to be considered suitable for deployment.
4	Mostly meets requirement.	Satisfies most aspects of requirement but will require some further testing and / or design refinement(s) to optimise performance prior to deployment.
5	Fully meets requirement.	Demonstrably satisfies requirement. Ready for deployment without further field testing or design refinement.

2 FIELD TRIALS

During the field trials, eight prototype designs of the Steve Vick International (SVI) Service Window Cutter (SWC) were developed to optimise functionality and safety.

The trials were conducted on a 2-inch steel pipe encasing the PE pipe. The trial was at a private residence gas service. See Figure 2-1 for the trial set up specification and Figure 2-2 for the field trial demonstration, which shows two circumferential cuts and two longitudinal cuts used to remove the steel outer casing.

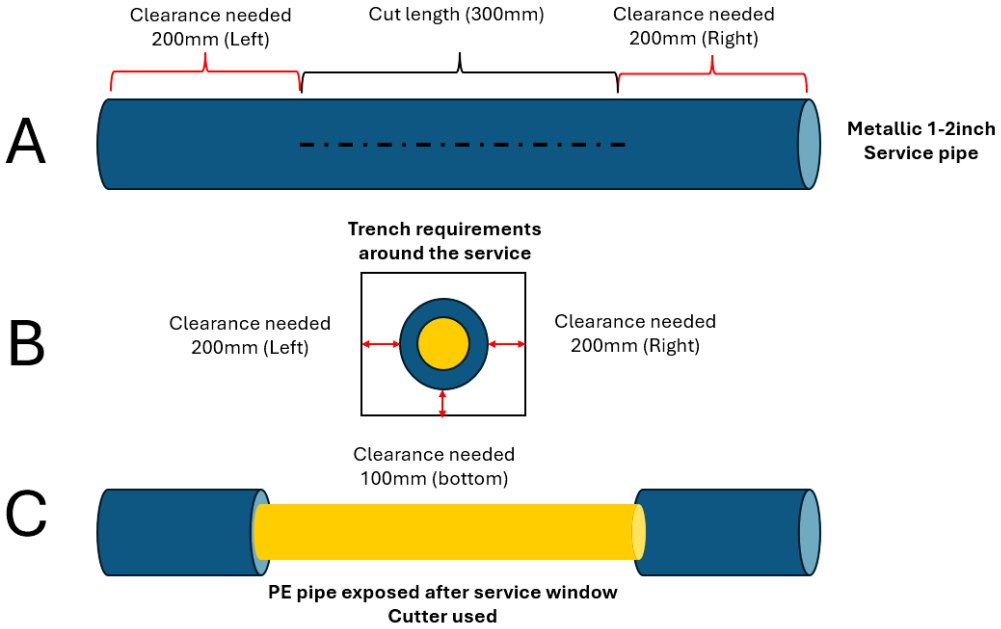

Figure 2-1:Field Trial Set-up Specifications.

Figure 2-2:Field Trial – PE Service Main.

The following observations were made during the trials:

- The SVI-SWC successfully created access windows without damaging the inserted PE service pipe.
- Field operators reported that the SVI-SWC was easy to use, requiring minimal training to achieve competence.
- It was reported that a single operator could operate the SVI-SWC for a PE service alteration.

3 EVALUATION

On the basis of the field trial, RPS's evaluation of the performance of the Steve Vick International (SVI) Service Window Cutter (SWC) tool is summarised on Table 3-1 below.

Table 3-1:Field Trial Assessment.

No.Successful Delivery Criteria	Status[2] (Score)	Comments
1 **Reliability** – The SWC should be able to remove a section of the outer pipe (minimum length of 30cm) without penetrating, damaging or scarring the inserted pipe and the SWC should be able to be used on pipe sizes ranging from 1 to 2 inches.	Fully meets requirement. (5)	• The SVI SWC demonstrated accuracy (minimum 30cm cut) in window cutting without damaging or scarring the 2- inches PE pipe during the field trial. • A risk assessment needs to be conducted, and a Safe System of Work (SSW) developed covering each step PE service alteration using SWC.
2 **Viable Alternative** – The SWC should allow engineers to carry out modifications (such as squeeze-offs and alterations) to a customer's service pipe efficiently, without the need for excavation on the main, where the PE pipe is typically not encased and also adhering to relevant industry standards.	Fully meets requirement. (5)	• The SVI SWC provides a practical alternative to traditional methods such as tracing back the pipe to locate bare mains for alteration or excavation of the main. • The SVI SWC enables modifications to be made in accordance with the trial specification and Machinery Directive 2006/42/EC2.
3 **Ease of use –** The design of the SWC should be suitable for a single operator. This includes simplicity in setup, ease of operation, and a manageable learning curve for users.	Mostly meets requirement. (4)	• The tool is user-friendly with a straightforward setup and operation, for quick deployment for a single operator use. • User feedback suggests that while the learning curve is manageable, ongoing support and refresher training could enhance overall proficiency and confidence among new users.

[2] *Evaluation scheme scoring as follows: 0 – Does not satisfy requirement; 1 – Theoretically meets requirement (desk-top study stage); 2 – Potentially meets requirement (field trials not scoped or insufficient data from field trials); 3 – Partially meets requirement (Initial field trials successful, but further trials or design improvement(s) needed); 4 – Mostly meets requirement (mostly satisfies requirement but requires some further testing and / or design refinement); 5 – Fully satisfies requirement (Demonstrably satisfies requirement and is ready for deployment).*

3.1 Technology Readiness Levels (TRLs)

Based on the GNI trials, it appears that the Steve Vick International (SVI) Service Window Cutter (SWC) for pipes below 2-inch diameter appears to have achieved a Technology Readiness Level (TRL) of 7. The trial demonstrated that the SVI SWC is functional and ready for deployment across GNI service mains.

Table 3-2:Technology Readiness Levels (TRLs)

TRL	Description	Explanation
9	Actual system commercially proven through successful deployment.	Fully integrated with operational hardware/software systems. Actual system has been thoroughly demonstrated and tested in its operational environment. All documentation completed. Successful operational experience. Sustaining engineering support in place.
8	Actual system complete and commercially ready through test and demonstration in an operational environment (ground or space)	End of system development. Fully integrated with operational hardware and software systems. Most user, training and maintenance documentations completed. All functionality tested in simulated and operational scenarios. Verification and Validation (V&V) completed.
7	System prototyping demonstration in an operational environment.	System is at or near scale of the operational system, with most functions available for demonstration and test. Well integrated with collateral and ancillary systems. Limited documentation available.
6	System/subsystem model or prototyping demonstration in a relevant end to end environment.	Prototyping implementations on full-scale realistic problems. Partially integrated with existing systems. Limited documentation available. Engineering feasibility demonstrated in actual system application.
5	System/subsystem/component validation in relevant environment.	Through testing of prototyping in representative environment. Basic technology elements integrated with reasonably realistic supporting elements. Prototyping implementations conform to target environment and interfaces.
4	Component/subsystem validation in laboratory environment.	Standalone prototyping implementation and test. Integration with technology elements. Experiments with full scale problems or data sets.
3	Analytical and experimental critical function and/or characteristic proof-of concept	Proof of concept validation. Active research and development (R&D) is initiated with analytical and laboratory studies. Basic demonstration of technical feasibility using representative data.
2	Technology concept and/or application formulated	Applied research. Theory and scientific principles are focused on specific application area to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.
1	Basic principles observed and reported	Transition from scientific to applied research. Essential characteristics and behaviours of systems and architectures. Descriptive tools are mathematical formulations and algorithms.

3.2 Business Case

RPS has conducted a review of GNI's high-level Cost-Benefit Analysis for this project. The analysis suggests that implementing the Service Window Cutter (SWC) could enhance business continuity by facilitating more efficient and reliable polyethylene (PE) service alterations.

GNI carries out approximately 700 domestic gas service alterations each year. Of these, about 15% involve inserted services, which necessitate excavation in the public roadway. This practice poses safety risks, including potential damage to other utilities, as opposed to performing the work on the customer's private property.

4 CONCLUSIONS

The key conclusions from the field trials of the Steve Vick International (SVI) Service Window Cutter (SWC) tool are listed below:

- The field trials were successfully conducted using SVI SWC, providing valuable insights into the capabilities of this tool.
- The SVI prototype SWC is successful in performing linear cuts on pipe sizes up to 2 inches and demonstrating its adaptability for use in confined workspaces for service alterations.
- The SWC should allow engineers to carry out modifications (such as squeeze-offs and alterations) to a customer's service pipe efficiently, without the need for excavation 'on the main'.
- The SWC effectively created access windows without damaging the underlying PE pipe, demonstrating its reliability in field conditions. It is concluded that 'in the right hands', the SWC can be 'the right tool' for the job of safely exposing inserted PE mains to facilitate alterations.
- The implementation of the SWC tool improves the safety of PE service alterations by reducing the risks associated with large excavations and potential damage to PE service mains, while also expediting service alterations in emergency situations.
- The SWC provides a practical alternative to traditional methods such as tracing back the pipe to locate bare mains for alteration. By reducing the amount of digging and heavy work, it contributes to lower carbon emissions.
- The SWC was found to be user-friendly during the field trials, featuring a straightforward set-up and operation that allows for quick deployment for a single operator use.
- The Service Window Cutter tool will reduce the number of manhours spent on GNI service alterations and will result in very significant cost savings.

5 RECOMMENDATIONS

On the basis of available information and GNI field trial of the Steve Vick International (SVI) Service Window Cutter (SWC) tool, RPS recommends the following next steps for the project:

- Proceed with the deployment of the Service Window Cutter (SWC) across GNI sites. This approach allows for gradual integration and assessment of the tool's effectiveness on different GNI PE service alterations.
- Develop operator training programs and operating instructions to ensure effective use of the SWC, particularly the cutting depth setting for the service window cut.
- A risk assessment should be carried out for the use of the SWC and a Safe System of Work (SSW) / procedure developed, covering each step of the PE service alteration using SWC.