GAS INNOVATION FUND (GIF) PROJECT

STATS BISEP Line Stopping Tool

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STATS BISEP LINE STOPPING TOOL

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EXECUTIVE SUMMARY

Gas Networks Ireland (GNI) has identified a pipeline flow stopping operation tool developed by STATS Group, known as the STATS BISEP® (Branch Installed Self Energised Plug). This patented device is certified by DNV GL for pipeline isolation and for dual seal in compliance with offshore standards. It is designed to accommodate pipes ranging from 80mm – 1200mm in nominal pipe size and designed for maximum pressure of 153bar. Although the BISEP® has a proven track record of use both onshore and offshore in the UK and internationally, it has not yet been deployed within GNI's gas network.

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 tool must demonstrate consistent performance during all Factory Acceptance Tests (FATs). This includes successful isolation in all tested scenarios without failure.	Fully meets requirement. (5)	• The FAT using the BISEP® tool successfully achieved the desired result of isolating the pipe at the fixture maximum pressure. • The STATS BISEP® is activated using hydraulic pressure during installation. Once a pressure difference is created across the tool, it becomes self-energising. The pressure from the line acts on the BISEP®, ensuring it can operate safely without relying on the hydraulic system. • The tool is used widely outside of Ireland and has a proven track record of reliability in pipeline gas flow stopping operations.
2	**Viable Alternative** – The tool should provide improvement over traditional Stopple operations. This includes a reduction in the number of fittings required, minimised cost and improve operational safety.	Fully meets requirement. (5)	• The tool requires fewer fittings than traditional single lip seal line stop methods, which helps maintain the long-term integrity of the pipeline. • The tool achieves double block & bleed (DBB) via a single hot tap process offering advantages over traditional gas flow stopping process that requires ten fittings. • The tool is used widely by others outside of Ireland i.e. has proven itself to be viable alternative in other markets for pipeline stopple operation.
3	**Safety –** The solution should adhere to all relevant safety standards and regulations. This includes a risk assessment demonstrating a reduction in operational hazards associated with Stopple operations.	Mostly meets requirement. (5)	• The tool is DNV GL approved for DBB process for zero pipeline leak isolation. • The FAT met the leak test criteria of +/- 2% accuracy. • HAZOP was completed for the use of STATS BISEP®.

[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 pipeline flow stopping operation tool developed by STATS Group, known as the STATS BISEP® (Branch Installed Self Energised Plug). This patented device is certified by DNV GL for pipeline isolation and for dual seal in compliance with offshore standards and pressure vessels (DNVGL-OS-F101, DNVGL-RP-F113, and ASME BPVC Section VIII, Division 2). It is designed to accommodate pipes ranging from 80 mm – 1200 mm in nominal pipe size and designed for maximum pressure of 153 bar. Although the BISEP® has a proven track record of use both onshore and offshore in the UK and internationally, it has not yet been deployed within GNI's gas network.

The innovation funding request was made to cover the costs of a factory acceptance test (FAT) on commonly used pipe sizes and wall thicknesses relevant to GNI projects. The purpose of the FAT was to verify the sealing performance of the STATS BISEP® on these specific pipe dimensions. Additionally, the funding supported the purchase of necessary materials for the FAT and the conduct of a hazard and operability (HAZOP) study concerning the use of the STATS BISEP®.

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

1.2 Problem Statement

When alterations or repairs are required on GNI transmission network, a Stopple Operation is used to isolate the flow of gas for the planned alteration/repair. This process involves welding hot tap tees and vent ports onto the live gas pipeline, which are then drilled out while the pipeline remains under pressure. Stopple equipment is then deployed through the hot tap tees to isolate gas flow using a double block and bleed (DBB) isolation set-up. This procedure allows for the section of the gas pipeline to be degassed and cut-out for the planned repair or alteration.

Currently, GNI's standard stopple operation with bypass requires ten fittings (six bypass tees and four vent ports) to be welded onto the gas pipeline to achieve DBB isolation and bypass the section to be altered/repair.

In contrast, the proposed STATS BISEP® equipment provides DBB isolation via a single full-bore hot tap. Using the proposed STATS BISEP® tool, reduces the number of required fittings for flow stopping operation from ten to four.

Additionally, GNI currently has only one approved supplier for flow stopping operations. Introducing a second approved operator would encourage competition in this area.

Another advantage of the STATS BISEP® tool is its smaller operational footprint compared to the traditional stopple method. This reduced footprint is particularly beneficial in urban areas where space is limited.

1.3 Description of Proposed Solution

Stopple operations are primarily conducted on GNI Gas Transmission Networks, where operating pressures range from 19barg to 85barg. Given that these operations involve welding fittings onto and drilling into a live pressurised gas line, they are classified as high-risk activities.

The STATS BISEP® tool has been proposed as a solution for GNI stopple operation to isolate transmission pipeline that requires alteration or repair. The equipment is designed to deliver dual seal and bleed isolation when deployed through a single full-bore branch or hot tap penetration.

The STATS BISEP® head, which contains the primary and secondary seals is launched from a pressure-rated launcher through a slab valve and rotated into position against the upstream flow of the pressure to be isolated (see Figure 1-1 below). The pressure differential acting across the head of the tool ensures that seal pressure is maintained against the pipe wall, providing a fail-safe isolation that is independent of the hydraulic system.

Additionally, the STATS BISEP® tool also allows for pressure testing and verification of each of seal before proceeding with the operation. This is achieved by manipulating the pressure within the annulus between the two seals.

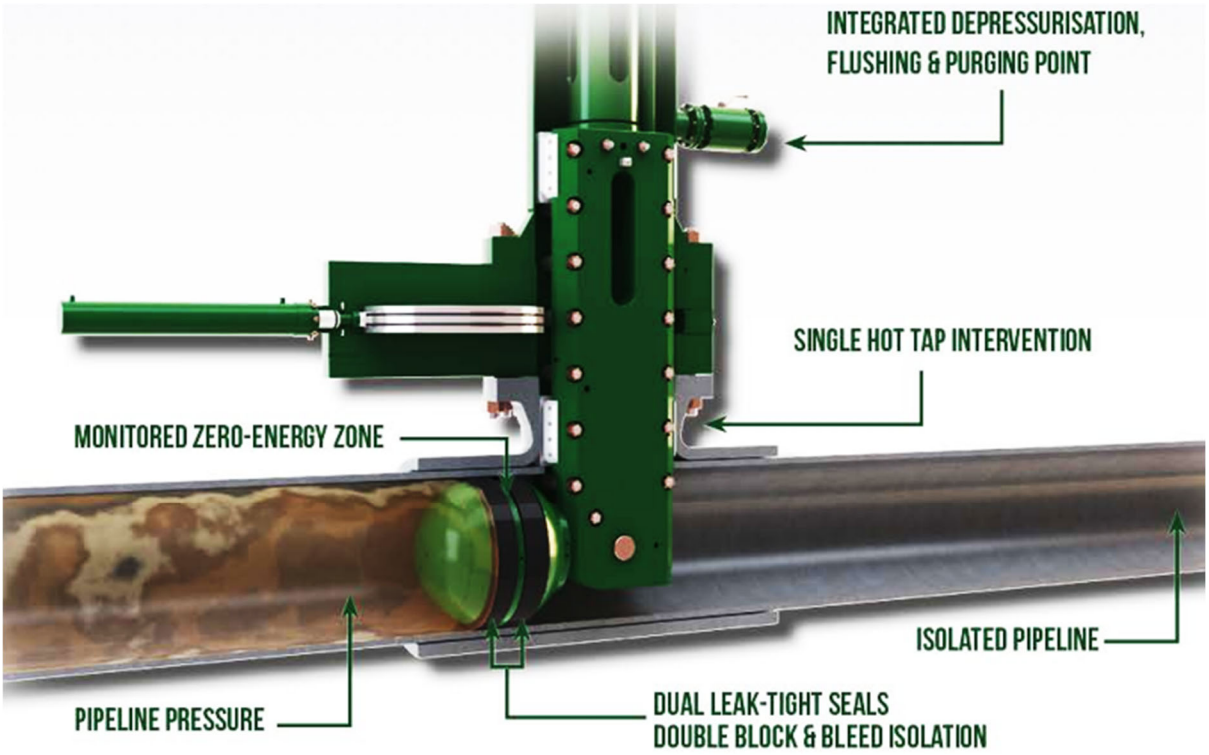

Figure 1-1: STATS BISEP® Stopple Deployed.
Source: STATS BISEP®.

Figure 1-2 below shows the configuration used when deploying the STAT BISEP® for isolating a section of pipeline with separate temporary bypass tees.

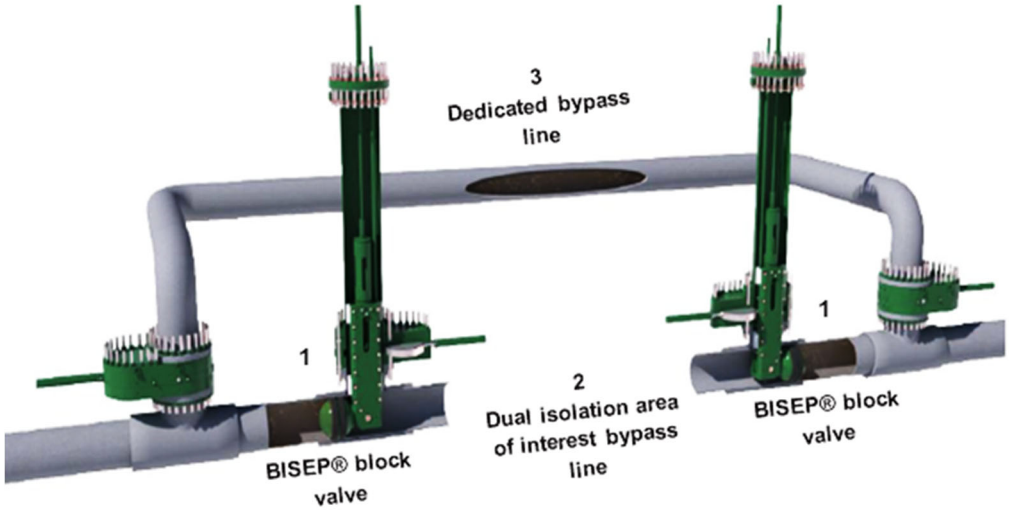

Figure 1-2: BISEP®. Deployment – Dual Isolation and Dedicated Bypass.
Source: STATS BISEP®.

The approval process for initial and subsequent use of the STATS BISEP® on GNI's network will involve conducting factory acceptance tests (FATs) for different scenarios involving various internal diameters, wall thicknesses, and pipe pressures to demonstrate its suitability for GNI network deployment. Details of the specific tests carried out for this project are outlined in Section 2 below.

1.4 Gas Innovation Fund (GIF) Application

A Gas Innovation Fund (GIF) application was submitted in 2019 to carry out HAZOP, material procurement and FAT of STATS BISEP® double block and bleed (DBB) tools.

1.4.1 Timeline

GNI's application included an overall timeline for the project of 5 months.

1.4.2 Success Delivery Criteria

The objective of the factory acceptance test (FAT) is to pre-qualify the STATS BISEP® line stopping tool for use against the following criteria:

1. **Reliability** - The tool must demonstrate consistent performance during all Factory Acceptance Tests (FATs). This includes successful isolation in all tested scenarios without failure.
2. **Viable Alternative** - The tool should provide improvement over traditional Stopple operations. This includes a reduction in the number of fittings required, minimised cost and improve operational safety.
3. **Safety** - The solution should adhere to all relevant safety standards and regulations. This includes a risk assessment demonstrating a reduction in operational hazards associated with Stopple operations.

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

In September and October 2021, hazard and operability (HAZOP) studies were conducted for the following scenarios, assuming that the STATS BISEP® isolation tool would be used:

- Replacement of a faulty 4” valve at Caherlag AGI, Co. Cork
- Replacement of a faulty pig trap valve at Ballynaclose AGI, Co. Meath.

The HAZOP study aims to identify the primary hazards associated with the installation, deployment, and removal of the BISEP® equipment. The HAZOP study for the Caherlag 4” valve replacement project yielded 4 medium-risk and 10 low-risk recommendations. The HAZOP for the Ballynaclose pig trap valve replacement resulted in 21 recommendations, comprising 11 low-risk and 10 medium-risk suggestions.

Subsequently, three Factory Acceptance Tests (FATs) were carried out at STATS UK facility – Workshop Test Bay 1. The purpose of the FATs was to validate the integrity of the STATS BISEP® isolation tool under maximum working pressure, in accordance with the test fixture's capacity.

See Figure 2-1 and Figure 2-2 for the Caherlag AGI LVC valve repair and the Ballynaclose AGI Temporary Pig Trap faulty valve respectively. These figures show the potential location where the STATS BISEP® isolation tool would be deployed.

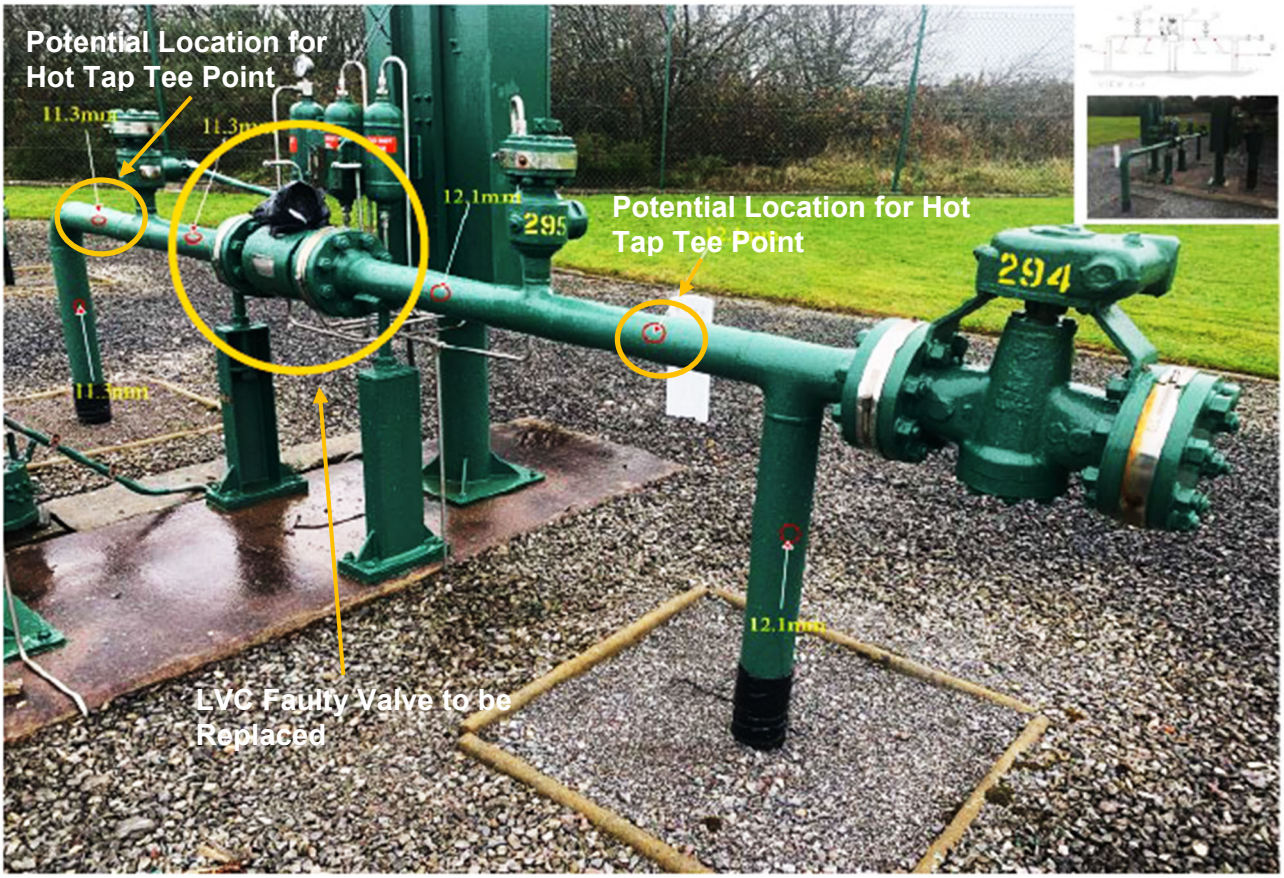

Figure 2-1:Caherlag Caherlag AGI LVC Valve.

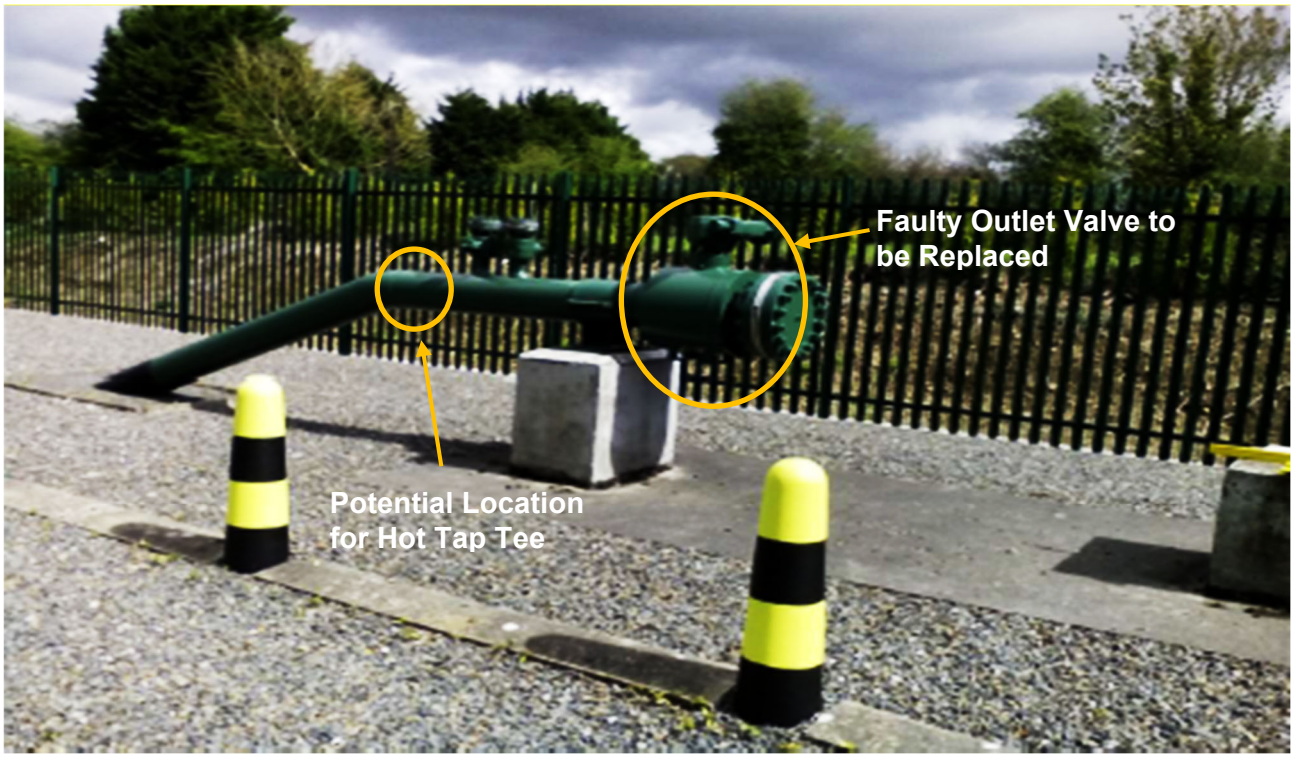

Figure 2-2: Ballynaclose Faulty Valve.

3 EVALUATION

On the basis of the factory acceptance tests (FATs), RPS's evaluation of the performance of the STATS BISEP® 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 tool must demonstrate consistent performance during all Factory Acceptance Tests (FATs). This includes successful isolation in all tested scenarios without failure.	Fully meets requirement. (5)	• The FAT using the BISEP® tool successfully achieved the desired result of isolating the pipe at the fixture maximum pressure. • The STATS BISEP® is activated using hydraulic pressure during installation. Once a pressure difference is created across the tool, it becomes self-energising. The pressure from the line acts on the BISEP®, ensuring it can operate safely without relying on the hydraulic system. • The tool is used widely outside of Ireland and has a proven track record of reliability in pipeline gas flow stopping operations.
2	**Viable Alternative** – The tool should provide improvement over traditional Stopple operations. This includes a reduction in the number of fittings required, minimised cost and improve operational safety.	Fully meets requirement. (5)	• The tool requires fewer fittings than traditional single lip seal line stop methods, which helps maintain the long-term integrity of the pipeline. • The tool achieves double block & bleed (DBB) via a single hot tap process offering advantages over traditional gas flow stopping process that requires ten fittings. • The tool is used widely by others outside of Ireland i.e. has proven itself to be viable alternative in other markets for pipeline stopple operation.
3	**Safety –** The solution should adhere to all relevant safety standards and regulations. This includes a risk assessment demonstrating a reduction in operational hazards associated with Stopple operations.	Mostly meets requirement. (5)	• The tool is DNV GL approved for DBB process for zero pipeline leak isolation. • The FAT met the leak test criteria of +/- 2% accuracy. • HAZOP was completed for the use of STATS BISEP®.

[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 factory acceptance test (FAT), it appears that the STATS BISEP® appears to have achieved a Technology Readiness Level (TRL) of 9. The FAT demonstrated that the STATS BISEP® is functional and ready for deployment across GNI network.

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 reviewed GNI's high-level Cost-Benefit Analysis for this project. The analysis indicates that implementing the STATS BISEP® has the potential to improve business continuity by enabling more efficient stopple operation.

4 CONCLUSIONS

The key conclusions from the Hazard and operability (HAZOP) studies and factory acceptance test (FAT) of the STATS BISEP® tool are listed below:

- HAZOP studies and FATs were successfully carried out by STATS BISEP® personnel and GNI project team. The HAZOP studies were conducted for Caherlag AGI 4" isolation valve and Ballynaclose pig valve replacement projects.
- The FAT assessment indicates that the stopple operation has met all predefined performance and safety standards criteria that were set-out for the tests, with no significant issues reported.
- The STATS BISEP® tool achieves double block and bleed (DBB) via a single hot tap process offering advantages of a reduced number of fittings compared to traditional gas flow stopping process.
- The tool's smaller operational footprint compared to traditional flow stopping operations is a significant advantage, particularly in urban environments where space is limited and this reduction in footprint will contribute to lower construction costs.
- The STATS BISEP® will reduce manhours spent in GNI stopple operations. This tool will result in a more efficient spend with a real expectation for reduced cost.
- Based on the FAT results, the STATS BISEP® tool has achieved a Technology Readiness Level (TRL) of 9, confirming that it is commercially proven and ready for deployment across GNI network.
- The STATS BISEP® tool has been approved by DNV GL for pipeline isolation. This approval verifies that the design criteria satisfy the requirements for pipeline isolation plugs to provide dual seal and isolation in accordance with offshore standards DNV-OS-F101 (Submarine Pipeline Systems**)** and Recommended Practices DNV-RP-F113 (Subsea Pipeline Repair) as well as compliance with ASME BPVC Section VIII, Division 2.

5 RECOMMENDATIONS

On the basis of available information and GNI FAT of the BISEP® tool, RPS recommends the following next steps for the project:

- Subject to GNI's company processes, proceed with field trial of the BISEP® tool on GNI network. This approach allows for gradual integration and assessment of the tool's effectiveness on the network.
- Include the STATS BISEP® tool as a standard option within the Network Services Works Contract (NSWC) contractor toolkit for flow stopping operations. This will ensure contractors are properly equipped and trained to use the tool, facilitating consistent and widespread adoption across the network.
- GNI to consider completing Factory Acceptance Testing (FAT) and Hazard and Operability (HAZOP) studies specifically for the dual set STATS BISEP® with integrated bypass, to validate its performance and safety and assess its potential inclusion as a tool for flow stopping operations within the GNI network.