

Project Closure Report

40mm Serviflex

NIA_SGN0061

February 2016

A consolidated summary report by Caroline Geddes
on behalf of Angus McIntosh, Innovation & New Technology Manager

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Document control

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Contents

1 Introduction	5
1.1 Summary of recommendations.....	5
1.2 Project background	5
1.3 Network Innovation funding	6
1.4 The 40mm Serviflex	6
1.5 Project objectives	7
2 Investment options	7
3 Project delivery	7
4 Project team structure	8
5 Field trials	8
6 Results of field trials	9
7 Conclusion	9
8 Recommendations	10
9 Radius Systems project scope	10
10 Summary of scheduled deliverables	11
10.1 Learning & development training pack	11
10.2 Manufacture of consumables and tooling and delivery to SGN	13
10.3 Production of a draft standard and method statement.....	15
10.4 Field trial support and documentation.....	15
11 Field trial report	15
12 Discussion topics	17
12.1 Pipe sizing	17
12.2 40mm Serviflex suitability	18
12.3 Lessons learnt – Communication	18
13 Conclusions	19
14 Recommendations	20
Appendix A - Training presentation	21
Appendix B - Trainers manual	22
Appendix C - Training course test paper	23
Appendix D - Course registers	27
Appendix E - Draft GIS/PL5-1:2015	28
Appendix F - SGN draft work instruction	29
Appendix G - Field trial report	30
Appendix H - Cost analysis from ‘The Sunshine’ pub Farlington.	31
Appendix I - Pipe sizing analysis	32

1 Introduction

The objective of the 40mm Serviflex project is to prove the suitability of using a 40mm Serviflex pipe to renew 2" steel on Great Britain's (GB) gas network. The main application that this will be beneficial to is the replacement of the below ground approach mains for network risers.

SGN have almost 200 thousand network risers within multiple occupancy buildings throughout its Scotland and Southern networks. A common factor that results in risers being deemed unsuitable and subject to a full replacement is the deterioration of the below ground approach mains sections of risers, which are commonly found to be constructed from 2" steel. Serviflex is a corrugated dual wall liner manufactured by Radius Systems Ltd that when used with specialist installation equipment can negotiate tight bends without compromising its design life. SGN currently utilises the 20mm Serviflex pipe to renew gas mains services up to 1 ¼" back to the original meter position.

The use of 40mm Serviflex in riser repair applications will allow the partial repair and refurbishment of existing risers as opposed to the full replacement of them, resulting in reduced time required by SGN and minimising disruptions. It will also allow for these activities to be carried out with less disruption (excavations, lifting floor boards etc.) both within and out with consumers premises.

SGN expressed an interest to Radius Systems Ltd to further develop the technology to enable 2" pipes to be renewed via 40mm Serviflex insertion. The technology has been developed to a prototype stage where fitness for purpose evaluation of the pipe and fittings solutions has been performed giving confidence in the suitability for long term installation in a gas network. As part of the initial assessment of the technology, three installations were conducted at the proof of concept stage to confirm the basic insertion principles using specialist operatives supplied by the manufacturers.

Radius Systems carried out field trials of the 40mm Serviflex pipe kits and fitting system in an operational environment, which demonstrated no concerns in regards to the installation or tools acquired. The 40mm Serviflex was able to reach lengths of 2 to 11 metres within 1 to 2 hours with suitable sealants which were identified. Using the field trial results, a Gas Industry Standard was produced by Radius Systems on the use of flexible pipes to repair metallic service pipes, and subjected to industry consultation and peer review. Following the field trials, a next stage has been recommended to continue with the operational implementation of the product on SGN's live gas network.

1.1 Summary of recommendations

- Radius Systems draft Gas Industry Standard is to be reviewed by SGN Engineering Policy prior to submission of the draft to the Technical Standards Forum.
- A further stage is required to test 40mm Serviflex in regards to pressure loss/design flow rate during pipe installations to confirm diameter suitability.
- A review on proceeding with operational implementation of the product in the network is to be carried out.

1.2 Project background

SGN have approximately 188,000 network risers within multiple occupancy buildings throughout its Scotland and Southern networks. There is an inherent risk of incident with this asset group. The majority of network risers are constructed of materials and fittings that are subject to deterioration and ultimately failure. The root cause of failure takes different forms - corrosion, fatigue and stress from thermal expansion, electrical fault conditions, and fire or vandalism. The impact of failure varies significantly based on a number of factors:

- location on the riser that the failure occurs
- where the riser is within the building
- what the building layout is in terms of access and egress
- what the likelihood that escaping gas will result in a PRE
- the occupancy level of the building

- the vulnerability of the occupants
- and other social and environmental factors.

Due to the success of 20mm Serviflex use for diameters of 1 ¼” and below, SGN have expressed an interest to Radius Systems to further develop the technology to enable 2” pipes to be renewed via 40mm Serviflex insertion. An advantage of this is the ability for SGN to replace the above mentioned approach mains without the need for full excavations.

1.3 Network Innovation funding

Innovation is a key element of the new RIIO (Revenue = Incentives + Innovation + Outputs) model for price controls. One of the key innovation proposals was the introduction of both the Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC) for all Network Licensees funded under the RIIO framework.

The purpose of these funding mechanisms is to provide a consistent level of funding to Network Licensees to allow them to carry out Research, Development and Demonstration projects which when at an early stage yield uncertain commercial returns. In addition, where benefits are linked to the decarbonisation of the network, it may be difficult to commercialise the respective carbon and/or environmental benefits and shareholders may be unwilling to speculatively fund such projects.

The 40mm Serviflex project forms part of SGN’s NIA. The NIA funds smaller innovation projects that will deliver benefits to customers as part of a RIIO-Network Licensee’s price control settlement. SGN’s Investment Committee was asked to approve the operating expenditure of £22,690 in 2014/15 to investigate the development and suitability of utilising 40mm Serviflex for 2” steel replacement, consequently reducing the need for large excavations and assisting in the compliance of SGN’s policy of partial replacement of Network Risers.

1.4 The 40mm Serviflex

Serviflex is a corrugated dual wall liner manufactured by Radius Systems that when used with specialist installation equipment can negotiate tight bends without compromising its design life. SGN currently utilises 20mm Serviflex pipe to renew services up to 1 ¼” back to the original meter position. A frequent element of riser repair work is the replacement of the below ground approach main sections, which are commonly found to be 2” steel.

The adoption of 40mm Serviflex will further allow SGN to carry out more partial repairs on risers, especially when used in conjunction with a piece of equipment called Microstop (a project currently underway by SGN), which provides the ability to temporarily isolate and permanently replace sections of Networks Risers subject to risk assessment whilst maintaining the gas supply.

This unique technology has been developed to prototype stage by Radius Systems Ltd in house and seeks to extend on this work by way of analysis and field trials to prove the suitability of 40mm Serviflex use on SGN’s Network. The image below shows the ‘towing head’ of the 40mm Serviflex which leads the pipe along the pathway and ensures it easily travels along tight bends by a “push and pull” insertion technique.



1.5 Project objectives

The objective of this project is to prove the suitability of using 40mm Serviflex pipe to renew 2" steel on the GB gas network. The main application that this will provide benefit to is the replacement of the below ground approach mains for network risers. The use of 40mm Serviflex in these riser repair applications will allow the partial repair and refurbishment of existing risers as opposed to the full replacement of them, resulting in time and cost saving to both SGN and the consumer. It will also allow for these activities to be carried out with less disruption (excavations, lifting floor boards etc.) both within and out with consumers premises.

2 Investment options

Following SGN's expression of interest, Radius Systems proposed to develop a prototype system for the renewal of 2" nominal diameter house entry pipework installations development and suitability of utilising 40mm Serviflex for 2" steel replacement, thus reducing the need for large excavations and assisting in the compliance of SGN's policy of partial replacement of Network Risers.

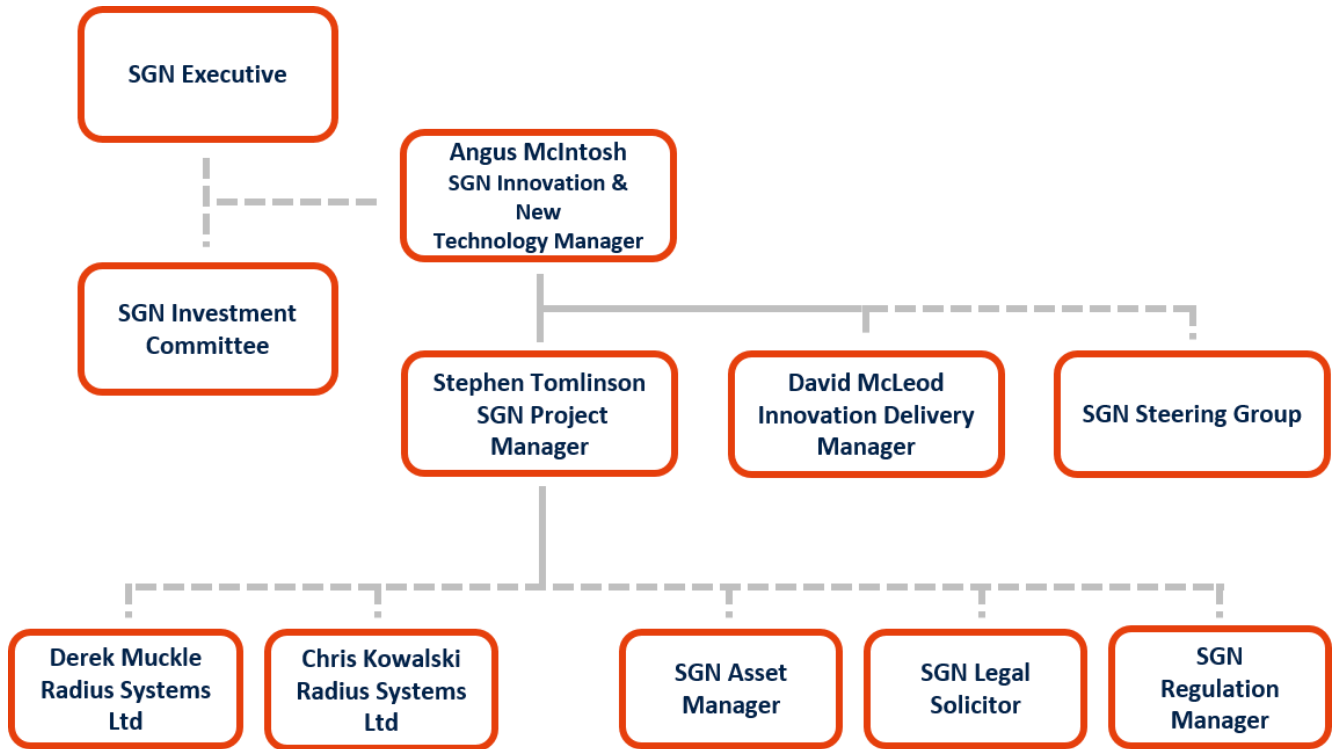
3 Project delivery

The project plan allowed five months for the field trial stage, ending in July 2015. However, as only 30% of the required number of field trials had been undertaken due to lack of suitable opportunities at appropriate sites, an extension to the project end date was required to February 2016. This change was beneficial as it enabled the field trials to be completed and provided time for the proper assessment of the equipment, which

benefited the accuracy of the project outcomes and implementation recommendations. The project costs, objectives and success criteria remained unchanged.

4 Project team structure

To ensure the project was delivered efficiently with adequate internal support from within SGN, the project team shown was developed.



5 Field trials

To ensure 40mm Serviflex was suitable for SGN gas mains, field trial installations were carried out. Radius Systems and SGN identified nine sites which contain 2” metallic service pipes suitable for relining. The condition of the old steel service pipe needed to be assessed to confirm its condition permits the Serviflex insertion, which included pressure testing.

Suitable properties were also identified, which were connected along the SGN gas mains. The property types best suited for this trial were multi-occupancy, listed buildings, hotels and flats. The pipes needed to include a gas meter and valve, a steel service in house, buried steel service pipe and a local supply main pipe. Any pipes found with notch damage were excluded from these trials.



6 Results of field trials

During the field trials there were no issues encountered in regards to the 40mm Serviflex pipe installation or the tooling used. The insertion was able to reach distances of 2 to 11 metres and each installation was carried out quickly and efficiently (within 1 to 2 hours). The annular sealants which proved sufficient were the 'Annerseal' and 'Fullseal' products.

7 Conclusion

As per the success criteria of this project, Radius Systems have produced a draft Gas Industry Standard. This has been reviewed by independent authors and third party stakeholders, however further review is required by SGN Engineering Policy prior to submission to the Technical Standards Forum.

As requested by SGN, 40mm Serviflex pipe kits and fitting systems have also been produced by Radius Systems. The products were tested in an operational environment with the performance reviewed and agreed with the Engineering Policy in preparation for field trials. During the installations there were no problems encountered. However, it is yet to be confirmed whether a 40mm circa controlled pipe is more suitable for a 2" gas pipe replacement procedure. A theoretical model of the suitability of the 40mm Serviflex shows that a 44mm system designed for this application would allow a 39% increase in installed length for a given pressure drop and there would be a reduced requirement for annular sealant of a 0.26 litre/metre.

8 Recommendations

Once SGN have reviewed the Gas Industry Standard, Radius Systems recommend that a further stage would be required to assess the theoretical model of the 40mm Serviflex suitability, which has been designed around pressure reductions and flow rates encountered when carrying out installations. This would enable an assessment to be made on the suitability of the Serviflex diameter and confirm if the design could be altered to a 44mm circa at the same time a commercial production facility is established.

Following the completed testing of the equipment in an operational environment, Radius Systems propose continuing with the operational implementation of the product on SGN's live gas network, following completion of a viable commercial review.

9 Radius Systems project scope

Flexible pipe, or corrugated twinwall pipe, is routinely used within gas networks for rehabilitation of gas service pipes. The most readily identified form is the Serviflex pipe supplied by Radius Systems, which in the 20mm form is used for the rehabilitation of 1" and 1 ¼" gas service pipes.

A particular need associated with multi-occupancy dwelling houses, such as blocks of flats, has been identified as needing a technology solution to be delivered and this technology is seen as a candidate that can meet the industry needs. To evaluate this, a solution for the rehabilitation of 2" gas service pipes had been requested for assessment.



Figure 1: A sectioned sample of 40mm Serviflex pipe.

Radius Systems have the ability to offer a 40mm Serviflex pipe which is close to/able to meet the requirements. This is not currently offered commercially but can be obtained in trial quantities to inform decisions on suitability of a technique and whether it is appropriate to encourage investment to supply. A key consideration within the project scope is the assessment of whether such a pipe offers sufficient capacity for the rehabilitated pipes to enable routine use within the network, or whether a pipe of alternative dimensions to fill more of the available space would be required to make the technique viable.

To evaluate the issues it was proposed that a limited production run of prototype parts be made and the suitability of the technique evaluated in the operational environment. Specific objectives of the project included:

- The manufacture of prototype pipes, transition fittings and fireproof fittings for inside the dwelling houses in sufficient quantities for large scale trials in 3 networks
- The approval of the pipe and fittings to the satisfaction of SGN Engineering Policy, together with installation method statement, installation design guidance and risk assessments

- The production and supply of tools required for installation of the system along with development and delivery of a training package to SGN personnel
- The development of a draft industry standard (Gas Industry Standard) to support the qualification processes for new pipe and fitting combinations of this type
- The undertaking and recording of field trial installations to assess the ability to install the product offering
- Provision of end of trial reports and recommendations for review by SGN Networks

At inception of the project, 40mm Serviflex as a system is TRL6 (Technology Readiness Level; system model or prototype demonstration in a relevant environment).

10 Summary of scheduled deliverables

10.1 Learning & development training pack

Radius Systems personnel drafted a training presentation approved by SGN project personnel that provided both product guidance and a step by step guide to the correct installation procedure. A training manual was written to support the trainer with the delivery of the training presentation.

A copy of the training presentation can be found in Appendix A, the trainer's manual to accompany the course is provided in Appendix B.

As part of the delivery of the Training, a portable 2" pipe training rig was manufactured to facilitate practical training of the 40mm Serviflex pipe installation. This was successfully used in the training delivered.

The familiarisation training was delivered to SGN personnel in two separate sessions to cover both the Scottish network and Southern network of SGN.

- Southern gas network training delivered at Aldershot, 9th March 2015
- Scotland gas network training delivered at Livingston, 19th March 2015

The training courses delivered consisted of a conference session explaining the pipe technology and the installation procedure. This was followed by a test paper to gauge the attendees understanding. A copy of the question paper and answers can be found in Appendix C.

The installation personnel were then given an opportunity to familiarise themselves with the installation tooling and complete a pipe installation on the practical training rig.

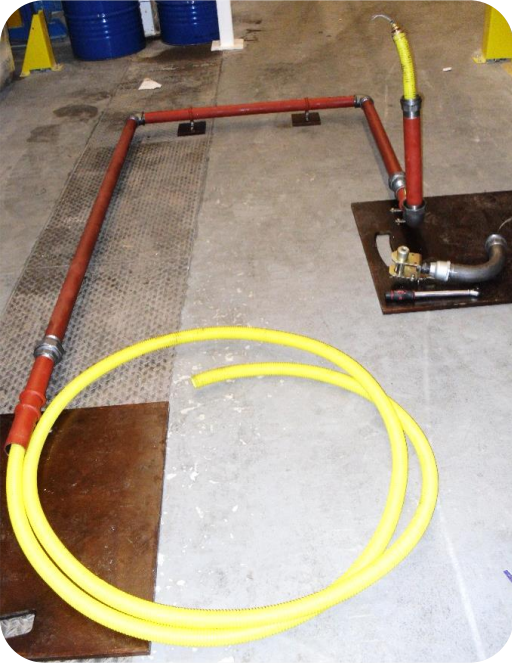


Figure 2: Training Rig



Figure 3: Training Rig demonstration

Figure 2 and Figure 3 show the Training rig consisted of a 2" pipe over 4m long with 3 knuckle bends and a short riser pipe section to allow the correct installation procedure to be demonstrated and practised by the service personnel.

Feedback provided by the attendee's was generally very positive. There were concerns that the manual push may be more difficult on site over a longer length of service. Otherwise they commented that they felt comfortable with the installation procedure with the tooling provided. A pipe pushing aid was considered ahead of the trial, however the feedback received regarding the manual pusher has not been considered as an issue. The use of the PE pushing machine could be developed if the need is identified as part of any commercial offering.

At the time that the training was delivered, Radius Systems also provided each network with the 40mm Serviflex pipe kits and the installation tooling kits required to complete the 'field trial' pipe installations.



Figure 4: The 40mm Serviflex installation toolkit contained all the tooling identified by Radius Systems to complete the pipe installation.

The complete tooling list is detailed in the following section.

10.2 Manufacture of consumables and tooling and delivery to SGN

Radius Systems manufactured a number of 40mm pipe installation kits complete with the consumables required to enable trained SGN service personnel to install 40mm Serviflex. The 40mm Serviflex pipe installation kit comprised of:-

- 12metres of 40mm Serviflex corrugated pipe terminated at one end with a 40x63mm PE spigot and a section of 63mm SDR11 PE80 pipe.
- A mechanical 'anchor' fitting pre-assembled to the 63mm PE pipe section
- A 40mm Service Head Adapter (SHA) complete with pipe insert – two halves of adaptor are connected via an intumescent "Fire Washer" which expands and seals when heated. In the event of a fire no gas would escape.

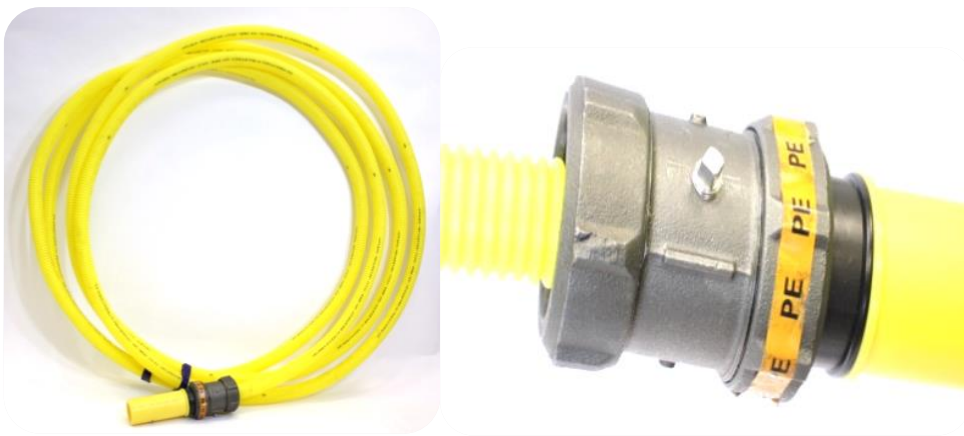


Figure 5: Complete pipe coil with pre-assembled 'anchor' fitting.



Figure 6: A 40mm Serviflex service head adaptor was supplied for use on each completed installation

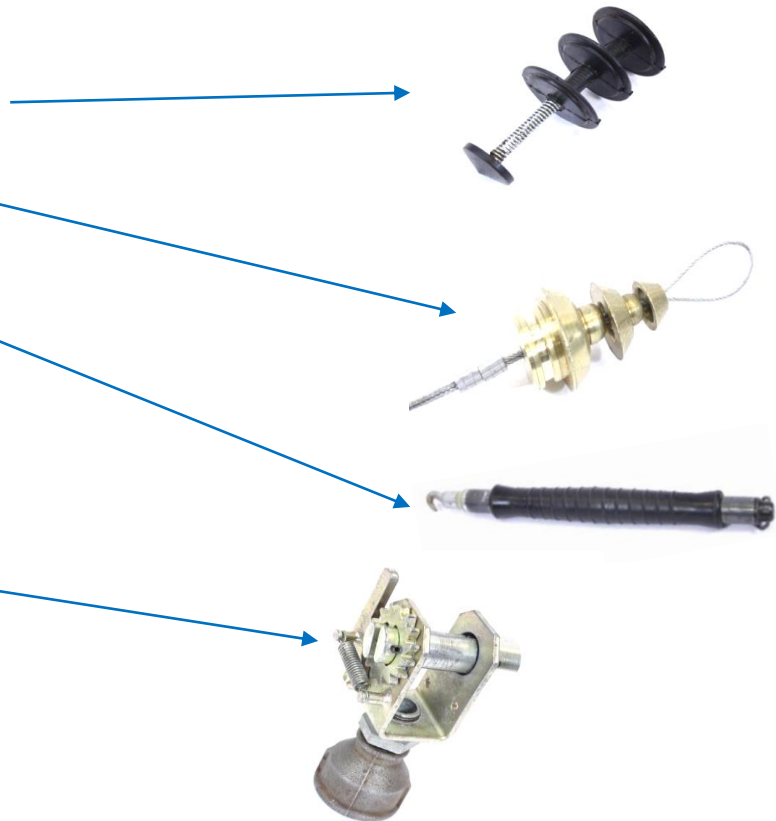
The 40mm Serviflex installation pipe kits were manufactured and assembled by Radius Systems. For the trial, each pipe kit (comprising the pipe and PE welded below ground transition piece) was subject to 100% visual inspection and pressure testing for leak tightness in addition to normal batch release testing.

Each of the pipe kits was individually numbered for traceability with 15 kits provided to SGN for installation.

The installation tools required for 40mm Serviflex make use of existing invested tooling in the networks from installing 20mm Serviflex. An additional toolkit is required that is suited to the larger pipe size and the forces required for its insertion. Radius has developed the tooling and worked with reputable third parties to realise this for the field trial.

The required 40mm Serviflex tooling is listed below. Some of the installation specific tools are highlighted:-

- 15 metres of sprung cable
- 15 metres of wire cable
- 2" pipe flexible proving head
- Pipe de burring tool
- Flexible towing head
- Towing head tightening tool
- Wire ties
- Wire tie tensioner
- Wire cable grip
- Tube of silicon grease
- Pipe cutter
- Tape measure
- Marker pen
- Hack saw
- Quick link connector
- 2" pipe winch mechanism
- 90 degree 2" pipe extension
- ½" drive Torque spanner
- 1 off 75mm Spanner
- 1 off 18" Stilsons



Additional tools and equipment required by Service personnel to complete the installation operation and network connections:

- Electro Fusion (EF) jointing equipment to connect to 63mm tail piece
- 63mm EF Socket fitting
- Equipment for pressure testing the installation
- Approved annular sealant
- Annular sealant applicator gun and hose connectors
- Approved jointing thread paste
- 18" Stilsons

As part of the NIA Project agreement between Radius Systems and SGN a total quantity 5, tool kits were provided by Radius Systems.

At the time that the training was delivered, Radius Systems also provided each network with the 40mm Serviflex pipe kits and the installation tooling kits required to complete the pipe installations.

- Delivered to Aldershot, 9th March 2015
Principal contact at Southern Gas Networks was Tom Neavyn
- Delivered to Livingston, 19th March 2015
Principal contact at Scottish Gas Networks was Steven Tomlinson

The register of course attendees on both of the Training days can be found in Appendix D.

10.3 Production of a draft standard and method statement

To provide a degree of independence and to facilitate peer review for bias, the development of a draft Gas Industry Standard (GIS) was awarded via contract to Plastic Pipes Consultancy. The principle author of the standard was Dr Martyn Grieg. Senior Partner, Dr Jeremy Bowman, provided technical contributions.

A draft GIS/PL5-1:2015 “Flexible pipe and fittings for natural gas and suitable manufactured gas Part 1: PE Flexible Twin-walled Corrugated Pipes for Use at Pressures up to 75 mbar” has been produced and can be found in Appendix E.

10.4 Field trial support and documentation

As per the NIA Project agreement, Radius Systems agreed to provide actual site support to the 40mm installations on an as required basis. On satisfactory completion of the training to the Scottish and Southern networks, personnel were confident that the procedures to complete the installations correctly could be followed.

A draft ‘40mm Serviflex’ Work instruction was completed for circulation around the installation teams, as a guidance document when considering Serviflex suitability and to ensure the correct procedures were applied at a live site. A copy of this document can be found in Appendix F.

The SGN appointed Construction Managers and Supervisors witnessing the installations were advised to record details of the installation with regards to the location and installation details, whether they were within the scope of the normal procedure or where the installation procedure deviated from normal operating procedures, that the steps taken were risk assessed and documented.

The Field trial report form was originally drafted by Chris Kowalski of Radius Systems and was formatted in accordance with SGN documentation.

11 Field trial report

Completed reports from actual site installations were returned to Chris Kowalski who has completed the ‘Field Trial Final Report’ November 2015 that detailed the completed installations and their success. This was then updated in February 2016 as more completed field reports were communicated by SGN. A copy of the report can be found in Appendix G.

The conclusions of the field trial report were that nine installations have been reported as completed. Some of the returned reports were not delivered in the agreed format. However, all installations attempted were completed successfully.

Conclusions to note

- Of the installations that were completed none of the field reports raised concerns with regards to the Serviflex pipe installation procedure or the tooling provided
- Service lengths between 2metres and 11metres completed
- 40mm Serviflex pipe installation is normally completed within 1 to 2 hours of the 2” Service being available for rehabilitation
- The installation of the pipe was quick and easy. The only concerns raised regarded the length of towing wire included in some kits due to kit assembly issues. In these cases string was used as an extension.
- The current procedure could be changed to accommodate ancillary technology, such as a camera survey on the installed pipe.
- Completed installations have used Annerseal or Fullseal as annular sealants.
- Radius Systems were disappointed not to be invited to more of the completed installations to complete more detailed reports and gauge feedback from the installation teams, which has not been captured on the forms received.

In Appendix H, a cost analysis can be found from the 2” service installation at ‘The Sunshine pub’ in Farlington. This details the consumables and work required to renew the 2” gas service if a renewable solution is not available. This analysis was provided by the site team as part of the returned installation feedback.

The images below were taken on the installation at Farnborough fire station on the 1st July 2015.



Figure 7: Show Inserting the sprung probe from the meter position. Figure 8: it arriving in the outside location service pit.



Figure 9: Fitting the flexible towing head to the end of the cut pipe length.

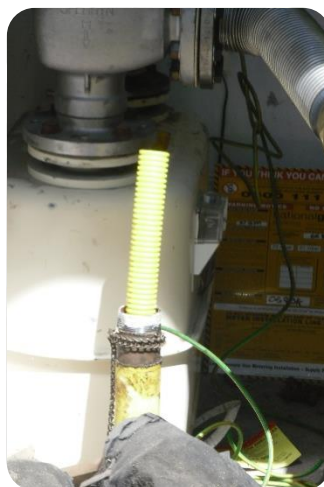


Figure 10: Serviflex pipe installation and with service head adapter fitted.



Figure 11: Pressure test on the installed Serviflex pipe at the outside connection point.

12 Discussion topics

12.1 Pipe sizing

An objective of the project has been to identify whether a 40mm pipe size would offer sufficient gas capacity to enable installation of viable lengths in the operational environment. The 40mm size was initially offered as some production tooling already existed for this pipe size, as used in other applications. The pipe though can be modified to optimise the product for this application if this improves its suitability. The potential benefits are summarised below;-

- Increasing the diameter of the pipe from 40mm to 44mm will still allow the pipe to be inserted within a 2" NB steel pipe where the majority of steel used has a 53mm internal bore, occasionally 49mm on the heavier gauge pipe installations.
- An increase of diameter to this size reduces the annular space needing to be filled with sealant after the pipe is inserted. This amounts to some 0.26 litres/metre of sealant which would be a direct cost reduction to the network.
- In terms of gas carrying capability, a design flowrate of 12 SCMh has been assumed for the inserted pipe form (based on the sizing of gas meters normally used with pipes of this diameter, at this design flowrate the following effects have been calculated:
 - The head loss for gas flowing through the pipe would reduce from 0.112 millibar per metre to 0.080 millibar per metre.
 - In practical terms this would allow an increased installation length of 39% for a given head loss (39% more 44mm pipe installed by length than 40mm pipe).

Further detail of pipe sizing analysis can be found in Appendix I.

Within the field trial, no feedback has been obtained to advise whether installations were not possible due to excess pressure loss. One consideration would be to review theoretical installations and network nodes to assess whether the existing pipe is adequate or whether an upsized variant would be preferred. Before proceeding with a commercial review it would be sensible for this exercise to be undertaken.

In the production of the GIS/PL5-1 standard, the development of the topics was largely routine and based on the known failure modes anticipated in the existing twin-wall pipe offerings to the gas industry, and achieving relevance to the linked GIS/PL2-1 standard for the base materials used in production. The harder elements to identify have been aspects linked to Engineering Policy in respect of pipe hydraulic performance expectations and also, the probable dimensions of steel pipes to be encountered in normal service. The following are points to which attention is drawn:

- For hydraulic performance we have examined gas meter capacity associated with the proposed pipe dimensions and used the peak measured flow value as indicative of likely performance expected from the

connected pipe. This sets a flow range for the purpose of pressure loss testing to be conducted by manufacturers.

- There is no pass/fail criteria for pressure loss by pipe diameter, instead we have proposed that manufacturers should present a data folder detailing the pressure loss of their product offering and the practical insertion lengths will then be agreed with Engineering Policy.
- The sizing of steel pipe in the networks is not a matter of public record. Anecdotally we consider the overwhelming majority of pipes will be standard gauge/schedule 40 size pipes. We have though stated manufacturers should consider designing pipes to include heavy gauge/schedule 80 sizes which have a more restrictive bore. This means pipes for insertion will err on the smaller side in capacity terms and network operators may wish to reflect on this and challenge the assumption if greater benefit is achieved tackling the larger population of thinner walled steel pipes.

The GIS/PL5-1 standard has been developed from an original draft undertaken by National Grid Gas and they have been privy to the details of the proposed amendments, as have MACAW Engineering, a consultancy group engaged in a number of NIA development projects in the United Kingdom. Both of these groups have been able to offer commentary and peer review of the proposed standard as interested stakeholders to assist in eliminating claims of bias.

12.2 40mm Serviflex suitability

While the completed installations provided some detail of the installations attempted, there were no recorded incidences within the project where a 2" Service was required to be rehabilitated but the 40mm Serviflex system, in its current format, was unsuitable for consideration. It is not known therefore if installations were considered and then abandoned, with possible reasons being:

- Length of the service requiring rehabilitation
- Pressure loss across the Serviflex pipe being unsuitable
- Installation procedure not being suitable due to pipe route or access
- Serviflex pipe kits not being available
- Trained Installation personnel not being available

Radius Systems would welcome any feedback from the construction engineers where 40mm Serviflex was considered but was not suitable for installation.

12.3 Lessons learnt – Communication

For Radius Systems there was significant difficulty experienced during the field trial installation phase in obtaining visibility of trial opportunities. This was exacerbated by the long time period over which the installations were made. The concern is that there were not many opportunities in reality and this would question the value of the project and the technique to SGN. Possible improvements could be to limit the timescale of such trials to a shorter window and provide daily call options to track progress in that period so that communication might be improved.

13 Conclusions

A draft industry standard has been delivered within scope:

- A draft Gas Industry Standard, GIS/PL5-1, has been produced to cover the application of twin-wall flexible pipes to the rehabilitation of metallic service pipes upto and including 2" nominal bore.
- Independent authors and third party stakeholders have peer reviewed the draft GIS/PL5-1 standard to eliminate unnecessary tests/claims of bias in the required tests
- Network operators are requested to review in particular the requirements for steel pipe sizing and hydraulic flow requirements for inserted pipes currently stated in GIS/PL5-1

A 40mm Serviflex pipe and fitting system has been produced and provided to the network within the scope of the project:

- A consumable kit comprising pipe, a factory welded polyethylene below ground connection to supply mains and fire proof building fittings was produced
- The products used were type tested and results of type testing reviewed and agreed with Engineering Policy prior to field trial implementation

It has not been possible to confirm within the project that a 40mm outside diameter controlled pipe is the preferred option for 2" service replacement

- No analysis has been conducted of theoretical models, nor any feedback on unsuitable installations that prevented use of the 40mm system provided
- Theoretical modelling shows that a 44mm system customised for this application would permit a 39% increase in installed length for a given pressure drop
- Theoretical modelling shows that a 44mm system customised for this application would permit a reduction in annular sealant usage (and cost) of 0.26 litre/meter

Radius Systems have received field observation reports on nine completed installations. Radius Systems.


- A total of 15 installation kits were delivered into the network of which 6 kits remain unaccounted for.
- Of the installations made, no problems were encountered with completion of the installation
- Feedback for improvement is centred on the tooling with some suggestions for tweaking to improve effectiveness. Key tooling such as the proving head and pipe towing head could be developed further based on feedback provided. This will be reviewed in accordance with the commercial offering, where required.

14 Recommendations

- GIS/PL5-1 should be reviewed by SGN Engineering Policy prior to submission of the draft to the Technical Standards Forum with particular attention to recommendations around the types of steel pipes to be found in service and the expected hydraulic flow rates to be used for product assessment
- Further work should be undertaken to perform a theoretical model of the suitability of 40mm Serviflex based on the pressure loss/design flow rate to be used in designing installations to enable a firm decision to be made on the suitability of this size, or, whether the design needs to be upsized to circa 44mm in order to be used
- The TRL6 objective to evaluate functional prototypes in an operational environment is completed and the next step is a stage-gate review on proceeding with operational implementation of the product in the network. A business case is required that should reflect on usage in the field trial phase to assess likely usage and facilitate engagement with commercial supply partners on that basis.

Appendix A - Training presentation


The Training Presentation will be provided electronically as a separate document.




RADIUS
Systems

Radius Systems

40mm ServiFlex – SGN Field Trials



Trainer – Chris Kowalski

 POLYPLASTIC GROUP

1

Pioneers in PE Pipe Technologies

Appendix B - Trainers manual

The Trainers manual will be provided electronically as a separate document.



40mm Serviflex Trainers Manual

40mm Serviflex NIA Project
Radius Systems
Southern Gas Networks
Scotland Gas Networks

Version 1.3 SGN March 2015

Appendix C - Training course test paper

40mm Serviflex - Question Paper

1. What existing metallic pipe size has 40mm Serviflex been designed to reline?
 - a. 1" services
 - b. 2" services
 - c. ¾" services

2. What length in metres of Service rehabilitation is 40mm Serviflex limited to?
 - a. 10m
 - b. 15m
 - c. 12m

3. What pressure application is 40mm Serviflex suitable for?
 - a. Low Pressure services up to 75mbar
 - b. Medium Pressure services up to 350mbar
 - c. Medium pressure services up to 1 bar

4. What if the 2" Service is not in serviceable condition?
 - a. The relining with 40mm Serviflex must not be attempted.
 - b. The 40mm Service should be attempted to see if the pipe will still pass through without any damage.
 - c. The 40mm Serviflex can be installed but extra annulus sealant will be required.

5. Why should the metallic pipe ends be deburred?
 - a. So the pipe can be installed quicker
 - b. So the SHA and anchor fitting will fit on the pipe ends
 - c. So the pipe is not damaged when installed

6. What type of bends will 40mm Serviflex go around?
 - a. The pipe will only pass around slow radius bends
 - b. The pipe will only pass around 1 knuckle bend and 2 slow radius beds
 - c. The pipe will pass around 2-3 knuckle type bends

7. To what is the Proving probe attached to before pushing it through the pipe work?
 - a. The Proving probe is attached to the wire towing cable
 - b. The Proving probe is attached to the Sprung cable
 - c. The Proving probe is attached to the anchor fitting outside the property

8. Why must the proving probe be first passed through the pipework?
 - a. To clear any blockages in the pipe route
 - b. To ensure the route is clear and assess the pipe route and number of bends
 - c. To calculate the time required to install the pipe

9. What is attached to the proving probe in the outside position before the Sprung cable/proving probe is pulled back inside the property?
 - a. The 40mm Serviflex pipe
 - b. The flexible towing head
 - c. The wire towing cable

10. How do we calculate the length of the service?
 - a. The pipe route is estimated by measuring the exposed pipe work and estimating the route through the foundations
 - b. No measurement is required if the length of service is below 12m
 - c. The Sprung cable is marked at the meter position after it is fully inserted, when removed the length is measured from the end to the marked point

11. What length of Serviflex is cut after the inserted the sprung cable has been measured?
 - a. Length of Sprung cable measured + 1metre
 - b. Length of Sprung cable measured
 - c. Length of sprung cable measured + 4 metres

12. When cutting the Serviflex to the Installation length what is the correct procedure?
 - a. Measure the length required from the end of the pipe, mark and then cut the pipe
 - b. Measure the length required from the anchor fitting, mark and cut the pipe
 - c. Measure the length required from the end of the 63mm PE pipe section, mark and then cut the pipe

13. When fitting the Flexible towing head, what is used to secure it in the Serviflex pipe?
 - a. A tie wrap
 - b. 1 wire tie applied with the tensioner
 - c. A spring clip

14. What is the correct 40mm Serviflex installation procedure?
 - a. The pipe is pulled from inside the property and guided in the outside position.
 - b. The pipe is winched through from inside the property.
 - c. The pipe is pushed from the outside position, and guided from inside the property through the winch mechanism.

15. What preparation does the Serviflex pipe undergo before the flexible towing head is fitted?
 - a. The pipe end is 'worked' to increase the flexibility before the flexible towing head is fitted.
 - b. The pipe end is cleaned and lubricated.
 - c. The pipe end is squeezed to increase the chance of passing round the bends.

16. What Torque setting is applied to the wrench to prevent over stretching of the 40mm Serviflex pipe when operating the winch unit?
 - a. 20Nm
 - b. 12Nm
 - c. 15Nm

17. When the pipe is fully pulled through at the meter position and the winch mechanism is removed what is the next step?
 - a. Thoroughly inspect the leading end of the pipe for damage.
 - b. Cut the Serviflex pipe flush with the end of the 2" Service pipe and fit the SHA.
 - c. Remove the towing head from the end of the pipe and fit the pipe insert.

18. If when the Serviflex pipe reaches the meter position the pipe end is badly damaged with splits along exposed pipe length, what is the correct course of action?
 - a. The Serviflex pipe should be pressure tested to check if it can still be used
 - b. The installation should be stopped and the Team leader informed
 - c. The pipe should be pulled back to the outside position and replaced

19. What is the purpose of the anchor fitting?
 - a. To convert the Serviflex pipe to solid wall PE pipe
 - b. To provide a connection to the new gas meter
 - c. To anchor the Serviflex pipe in position on the 2" Service pipe

20. When connecting the anchor fitting at the outside location what is the correct tightening sequence?
 - a. Hand tight, then a further 1½ turns while ensuring the main body is fixed
 - b. Hand tight, then a further 2½ turns while ensuring the main body is fixed
 - c. Hand tight then rotate the main body 1½ turns

21. How is the SHA adapter prepared before being installed on the end of the 2" pipe work?
 - a. The threads of the SHA should be cleaned prior to placing on the 2" Service pipe.
 - b. The top section and main body of the SHA should be tightened
 - c. The top section and main body of the SHA should be separated and the black grip ring and anti-rotational washer removed, prior to connecting to the 2" service pipe.

22. What distance above, should the Serviflex be cut to after the main body of the SHA is fitted?
 - a. 10mm
 - b. 1 convolution (5mm)
 - c. 2 convolutions (10mm)

23. What is the correct tightening sequence for the top section of the SHA?
 - a. Use the 75mm Spanner and stilsons to fully tighten and compress the fire washer
 - b. Use the 75mm Spanners to tighten the SHA ensuring the fire washer can be rotated
 - c. Using a torque spanner tighten the SHA to 75Nm







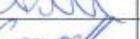


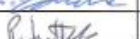
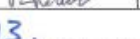
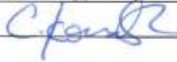
24. What is the sequence of testing and commissioning the installed Serviflex Service installation?
 - a. Pressure Test – Commission pipe line – Apply annulus sealant
 - b. Apply annulus sealant – Pressure Test - Commission pipeline
 - c. Pressure Test – Apply annulus sealant – Commission pipe line

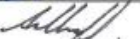
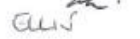

25. What is the correct procedure for apply annulus sealant?
 - a. Inject the Annulus sealant through the SHA until it is visible in the anchor fitting outside the property.
 - b. Inject the annulus sealant through a port in the outside anchor fitting, until it is visible from a port in the SHA.
 - c. Dose the Annulus sealant through the top of the SHA fitting until it appears in the anchor fitting outside the property.

Question Number	Correct Answer		
1	A	B	C
2	A	B	C
3	A	B	C
4	A	B	C
5	A	B	C
6	A	B	C
7	A	B	C
8	A	B	C
9	A	B	C
10	A	B	C
11	A	B	C
12	A	B	C
13	A	B	C
14	A	B	C
15	A	B	C
16	A	B	C
17	A	B	C
18	A	B	C
19	A	B	C
20	A	B	C
21	A	B	C
22	A	B	C
23	A	B	C
24	A	B	C
25	A	B	C

Appendix D - Course registers

Radius Systems Training Course Register

Course Title : 40mm ServiFlex Installation Training.						Trainer completes
Course Date : 9-03-15 Duration 4 hrs						
Course Location : ALDERSHOT SGN. DEPOT.						
Course Content : 40mm ServiFlex - Theory and Installation Practical Session						
Trainers Name: CHRIS KOWALSKI						
Name (print)	Signature	Employer	Job Title	EUS or Registered No.	Contact details (if req)	Test Completed
TERRY PEARCE		SGN	MATE			/
MARTIN LEWIS		SGN	TEAM LEADER			/
MATI LAUNCEBURY		SGN	TECH TRAINER	295706		/
MARK BRADON		SGN	REPAIR TEAM MANAGER			/
Sam Teale		SGN	Repair Team Manager	21476		/
STEVE MINGEN		SGN	Team Manager			/
George Hare		SGN	Mate			/
Ryan Dixon		SGN	Team Manager			/
Lee Gardner		SGN	Team leader			/
P CHATTELL		"	TRAINING	88888	07970 239682	/
No. Candidates completed course 13.					Trainers Signature 	

A. Fuller		SGN	Team leader.	/
DAVE		SGN	TEAM MANAGER	/
RICHARD		SGN	TEAM MANAGER	/

Radius Systems Training Course Register

Course Title : 40mm ServiFlex Installation Training.						Trainer completes
Course Date : 19-03-15 Duration 1 Day						
Course Location : Rt Livingston (Bracefield Ind. Park).						
Course Content : 40mm ServiFlex - Theory and Installation Practical Session						
Trainers Name: CHRIS KOWALSKI.						
Name (print)	Signature	Employer	Job Title	EUS or Registered No.	Contact details (if req)	Test Completed
William Campbell		SGN	TECHNICAL TRAINER	37101		/
I STREET		"	TEAM MANAGER			/
P. ROBERTSON		SGN	TEAM LEADER			/
M. DANANJA		SGN	GNOZ			/
R. MANGOLD		SGN	APPLICATOR			/
Hugh Reid		SGN	TECH TRAINER	33180	hugh.reid@sgn.co.uk	/
Alex Crossin		SGN	TEAM MANAGER			/
RYAN MACCUNN		SGN	TEAM LEADER			/
AJAXO CROSSIN		SGN	TEAM MANAGER			/
JOHN ROBERTS		SGN	TEAM MANAGER			/
CHRIS KOWALSKI		RADIUS	TRAINING			NA
Markus RESCH		+GFT	Innovation h.		markus.resch@georghubert.com	NA
No. Candidates completed course 11.					Trainers Signature 	

Appendix E - Draft GIS/PL5-1:2015

The GIS/PL5 standard will be provided electronically as a separate document.

Gas Industry Standard

GIS/PL5:2015

Specification for

**Flexible pipes and fittings for natural gas and suitable
manufactured gas**

**Part 1: PE Flexible Twin-walled Corrugated Pipes for Use at
Pressures up to 75 mbar**

nationalgrid

Northern
Gas Networks

Scotia
Gas Networks plc

WALES & WEST
UTILITIES

Appendix F - SGN draft work instruction

The SGN Draft work instruction will be provided electronically as a separate document.



SGN/WI/XX/XX
(completed by registrar post approval)

Safety Management Framework
Work Instruction For 40mm Serviflex Installation
DDD Ref No: DESC-XXXX-XXXXXXXX
(Removed by Registrar post approval)

31/03/2015 d4

Revision XX/XX

Appendix G - Field trial report

The Field trial report will be provided electronically as a separate document.



40mm Serviflex NIA Project

Radius Systems

Southern Gas Networks

Scotland Gas Network

Field Trial Report

October 2015

Amended February 2016

Additional information provided by SGN

January 2016



Appendix I - Pipe sizing analysis

Serviflex – Flexible pipe sizing consideration

Operating parameters	
Density natural gas	0.735
Viscosity of natural gas	1.4E-0.5
Gravitational constant	9.80665
Surface roughness of PE pipes	3.00E-06
<i>40mm Serviflex dimensions</i>	
Inner peak, max diameter	35.7mm
Inner bore, min diameter	32.3mm
Pitch	7.0mm
<i>44mm Serviflex dimensions</i>	
Inner peak, max diameter	39.7mm
Inner bore, min diameter	36.3mm
Pitch	7.0mm

Example of increase of Serviflex pipe OD from 40mm

Design flowrate for 1.5" pipe (nominal 40mm bore)	12 SCMH
As measured, differential pressure	0.112 millibar/metre
Increasing pipe diameter	4mm to 44mm OD
Estimated differential pressure	0.080 millibar/metre
For a given drop of	5 millibar per service
The 40mm Serviflex max installation (circa)	44.6 metres
The 44mm Serviflex max installation (circa)	62,2 metres
An increase on installed length of	39%
Decrease in annular sealant usage	0.26 litres/metre

See Pressure loss graph below based on millibar per metre.

