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Key Contributors

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<th>Company</th>
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Reviewers

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<th>Job Title</th>
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<td>Sam Wilson</td>
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<tr>
<td>Angus McIntosh</td>
<td>NIC Robotics Project Director</td>
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Distribution List

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2 Executive Summary

The purpose of this document is to report on the progress the project has made since the last submission on the 19th June 2016 and the key deliverables over the next six months of the project. The report contains a summary of the progress made by SGN with subsequent reports from ULC Robotics (ULC) as the principal project partner and DNV GL as the technical consultant.

The aim of the Robotics project is to develop a robotics system to be used in a live gas main to perform the following functions:

- Element 1 – Development of a robotic ‘platform’ and launch system to enable deployment of modular repair and inspection devices for 12” to 48” diameter metallic gas mains
- Element 2 – Development of an internal mechanical joint installation module and Weco seal repair method
- Element 3 – Robotic visual and non-visual inspection
- Element 4 – Automated live asset replacement for distribution services and mains for Tier 1 pipes

Since the last PPR (Project Progress Report) the project has progressed as planned in line with the project plan and budget, successfully delivering each milestone and the targets listed in PPR5. A list of the key deliverables is shown below with a breakdown of each one later in this report.

Element 4

- Selection and Procurement of Motors, Gears and Bearings
- User Interface and Control System Design and Programming
- Creation of Detailed Fabrication and Manufacturing Documentation

In the last six months, the project has progressed through the initial research and conceptual design phases, identifying key suppliers and the requirements of the system, through to the exciting stage of defining the detailed design of the operating system. Detailed analysis of the challenging environment of a live mains replacement site was carried out, supported by site visits and controlled testing exercises. Key design features have been determined, in particular the operational deployment strategy and the key components required to deliver the end to end process of mains and service replacement successfully.

One of the most critical aspects of the project to date has been the selection of appropriate vendors who are capable of supplying the specialised tooling and fittings required in line with agreed specifications and target price. This has been achieved successfully and within the projected timescales laid out in the project plan.

Designs shared in previous Project Progress Reports (PPR’s) have undergone extensive engineering design, 3D modelling, testing and analysis. Figure 1 shows the first prototype service insertion robotic tool head demonstrated to the project team during a face to face meeting in June 2016. Figure 2 shows the final CAD model of the robotic inspection transport platform following extensive testing of the measurement technology to be used. The system will be manufactured and assembled over the coming months in preparation for controlled testing.
Following the successful completion of Elements 1-3 of the project and the learning taken from the live field trials the design improvements for the CIRRIS XI™ platform have been fully integrated. The first live site works of the 16km robotics pilot programme started in October 2016 on Paisley Road West, the first of three projects in Glasgow. The pilot programme will provide valuable empirical data on large diameter assets, prove the system can be used on a commercial basis and provide valuable learning for the other GDN’s who visit site. DNV GL have been appointed to provide independent analysis of the outputs and build on the valuable work carried out as part of element 3 of this NIC project.

![CIRRIS XR and CIRRIS XI](image)

*Figure 3 Images of the CIRRIS XR™ Repair and the updated CIRRIS XI™ Inspection systems*

This progress report has been written in accordance with the Network Innovation Competition (NIC) guidance document.

### 2.1 Risks to Project Delivery

A summary of the associated risks highlighted in the guidance document are listed below with a short description of the mitigation methods used. All risks and their associated mitigation methods are listed in detail in the project risk register in Appendix C.

Due to £1, 2 & 3 of the project ending in January 2016 and the final report submitted, 18 of the risks identified on the project risk register were successfully mitigated and have now been removed from the live risk register. The remaining risks relate to the development of E4. At this point in the development process, no additional risks have been identified. Any historic items from the risk register remain on record on a separate tab of the file for future reference if required.

**Recruitment Risk**

There is no requirement to recruit customers to take part in the project until the field trial stage of Element 4 scheduled for the second half of 2017. This stage presents no risk to project delivery. A customer engagement plan will be drafted and submitted to Ofgem for review in advance of the field trial. The anticipated submission date is March 2017. Preparation for this will start in early 2017.

**Procurement Risk**

The risks associated with the selection of vendors to supply the supporting technologies have been identified for the development of Element 4. Contractual agreements have been set in place with 3rd party vendors with initial design development and testing in progress. As part of the learning taken from the development of Elements 1-3 communication will be maintained throughout the early stages of the project to ensure all contractual requirements and design specifications are met. The ULC project team has held a number of face to face meetings with the selected vendors and received details of early conceptual design information and testing results.
Installation Risks
This risk does not affect the project at its current stage. Details of the field trial and the associated risk and mitigation methods are listed in the updated risk register. As part of the learning taken from the development of Elements 1-3 a detailed plan will be prepared to ensure the schedule does not slip prior to the field trial.

Other Risks
At this stage there are no significant risks to the successful delivery of the project.

2.2 Learning Summary
In line with previous PPR’s, the project learning outcomes will be divided into two categories of dissemination; internal and external. The aim of the project dissemination plan is to ensure accessibility to, and dissemination of the project results and methods. The plan details the format and timescales of the internal and external dissemination modes, ensuring transparency and effective communication with all stakeholders. Further detail can be seen in ‘Learning Dissemination’ in Section 3 of this report.

Since the last progress report SGN have used a number of different methods to disseminate information on the project:

1. 2016 LCNI Conference included two presentations on Robotics. The first focused on the development of the NIC project supported by a second presentation on the implementation and benefits realisation of the 16km robotics pilot trial.
2. Multiple on-site face to face meeting with National Grid representatives to discuss pilot operations of CIRRIS™.
3. The ‘Robotics’ Homepage on sgn.co.uk has had 593 visits between 1st May and 30th November 2016 January 2016
4. Update presentations to internal SGN project steering group
5. Presentations to local councils and highways authorities in Glasgow, London and Brighton to support the CIRRIS pilot programme and provide an update on E4.
6. Both internal and external press releases were issued to provide dissemination to the wider stakeholder group and general public
3 Project Managers Report

Since the submission of PPR5, the project has progressed as planned with no variation to the schedule or the budget despite potential delays that could have arisen following the consultation period earlier this year. The project has entered an extremely exciting and important stage where the theory and research conducted during the first stages of the project are being put into practice. The operating platform and associated supporting equipment designs are being finalised and are moving through the manufacturing process continuing with the development prototypes. This is an extremely important time for any project, amplified by the intricacies of the robotic systems under development and the potential for the operating costs to escalate when in operation.

Taking the learning gained from the development of Element 1-3, Element 4 has effectively been broken down into a number of sub elements. Each of the elements were originally identified from the operational flowchart which was created to support the detailed design specification and focus on the individual operations. Each of the sub elements can be seen in the list below:
A key change to the development process arose over the last six months with regard to the detailed design specification becoming a live document. This was supported with an operational flowchart which has helped the project team meticulously map out the full operation of the Element 4 system. The flowchart development method has allowed the project team to integrate the SGN testing procedures that are normally required for the current manual operations. As such the complexity of the overall operation and combination of what is currently carried out on site was easily integrated into the design of the system. An example section of this flow chart can be seen in Figure 4.

Figure 5 shows the financial spend on the project to date in comparison to the budget forecasted from the bid document and the contractual projection.
Project dissemination through LCNI 2016
The project team attended the 2016 LCNI conference in Manchester to present and promote the project to key stakeholders present. The project team had held two presentations, the first as an update to the project’s progress and the second on business implementation and benefits realisation of robotics on a commercial basis. Further detail on the conference and the dissemination activities undertaken can be found in the Learning Dissemination section of this report.

CIRRIS XI™ design improvements
Based on learning taken from the November 2015 field trials, improvements to the design of the inspection robot have been carried out to enhance functionality and robustness. During the field trial it was discovered
Pipeline Travel Testing
The deliverable for this stage of the project covers a number of sub-elements. It is anticipated that the most significant challenge will be for the main-insertion equipment, ensuring that the pipe fitting lines up with service entry points. At the time of writing, ULC have been carrying out controlled testing to determine the effects of insertion. The learning that will be taken from this has been used as part of the development.

For the other robotic transport platforms, the risk to delivery is less for the travel testing than that of the mains insertion equipment. Throughout the development of the service insertion robot multiple prototypes have been manufactured improving the robot functionality with each iteration.

Tapping & Fitting Tool Validation (SDRC 9.5)
Within the next six months there is one SDRC scheduled for submission on the 12th May 2017. As with SDRC 9.4 “Configuration Testing with Robotic Platform”, each criteria set out in the bid document will be rigorously reviewed by the project team to ensure that each deliverable is achieved.

Draft of Customer Engagement Plan
The customer facing engagement program for Element 4 of the CIRRIS™ project is due to start 1st July 2017. Taking into consideration the review period required by Ofgem, the leeway for updating the plan following Ofgem comments and internal process constraints the following timeline has been established.

<table>
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<th>Date</th>
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<tr>
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<td>January 2017</td>
<td>Internal</td>
</tr>
<tr>
<td>Submission</td>
<td>February 2017</td>
<td>Ofgem</td>
</tr>
<tr>
<td>Program start</td>
<td>July 2017</td>
<td>All Stakeholders</td>
</tr>
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</table>

4 Business Case Update
Due to the success of the field trial for Elements 1-3, SGN has started the 16km pilot package with ULC with operations being carried out in Glasgow and moving to the southern network in second quarter of 2017. The 18 month pilot package will allow for further testing to be conducted, refinements to be made to the system and for the associated supporting structure to be put in place. SGN’s commitment to the pilot trial further demonstrates our intention to using robotics to drive efficiencies across our business and to integrate innovative techniques into ‘business as usual’ practices.

Prior to the start of the pilot trial operations a number of modifications, upgrades and improvements to the system, determined during field testing, were performed by ULC. Following the learning taken from the field trial CIRRIS XI™ necessitated the greatest number of updates, specifically around the deployment method of the sensors.

Under the Pilot Program additional learning regarding the methodology, efficiency of the system will be gained which will better inform the commercial unit pricing for the system. It is anticipated that the costs associated with a fully commercial operation will decrease to a range well below that of conventional replacement as the volume of work increases and as operational process confidence is gained. Further details of the CIRRIS XI™ pilot trial operations can be found earlier in the report.

At present there are no changes to the business case with respect to Element 4 that was submitted in the full submission pro-forma report, or the target prices set. Once the controlled testing and a live field trial have taken place a commercial appraisal of the process and the potential impacts the system can have against the original bid submission will be carried out. This will encompass the total cost of the operations including the replacement of both the mains and services as well as a comparison of the excavation costs.
The full SDRC breakdown can be viewed using the link below:


9 Consistency with Full Submission

At this stage of the project there are no variances to the Full Submission document published on the Ofgem website.

This has also been independently verified by DNV GL, the project’s technical consultants.

10 Learning Outcomes

Element 4 detailed specification development
Throughout the development of the Element 4, it was identified early on that the detailed project specification would become a live document. Keeping the detailed specification a live document has enabled the project team to develop multiple concepts for some of the sub elements. As such two conceptual methods have been developed as part of the main insertion equipment. As discussed earlier in this report, the first utilises equipment in the excavation to push the PE, the second concept pushes the PE from outside the excavation. This has allowed in depth gap analysis to be carried out, ensuring that the most suitable solution is carried forward through the manufacturing stage.

In support of the detailed project specification, an operational flow chart for on-site activities was created. This flow chart maps out the step-by-step operations, identifying what equipment is used, what activity it will carry out and which party will be in control of the development of the equipment and its operation. This document has also gone through a number of iterations as part of the development process. This was carried out through internal distribution as well as discussed during face to face meetings and regular project team teleconferences. The flow chart has allowed the project team to provide additional information with respect to key SGN operational and testing procedures. With these two live documents, careful management of the development process ensured that where necessary the additional resources can be allocated to maintain the project schedule.

Stakeholder communications on CIRRIS XI™ & XR™ operations

Prior to the start of onsite activities, the SGN project team held a meeting between DNV GL and senior SGN management with respect to data management and operational strategies. The outcome of the meeting was shared with the NGGD project management team.

Similar to the dissemination plan used for the CIRRIS™ field trial in November 2015, the other GB GDN’s were invited to attend site to see the CIRRIS XI™ operations. At the time of writing, only National Grid Gas Distribution has taken up the offer and has attended site a number of times.

Representatives from IGEM attended site in Glasgow on Paisley Road West with positive feedback being received. Particular note was made of the robustness of the setup and attention to detail not only of the kit but also the SGN safety procedures when working closely with the public and alongside a highway.

LCNI Conference

As one of the main stakeholder events attended by all GB GDN’s, their key stakeholders, industry professionals and students alike the LCNI conference provides a great opportunity for dissemination of information. The conference was held in Manchester from the 11th to 13th October 2016 with almost 1500 delegates attending. Members from the project team presented on the development of the project to date as well as on the “Implementation and Benefits Realisation” of using robotics as an inspection and remediation method for large diameter cast iron mains. SGN also had a dedicated robotics end to their stand shown below and the CIRRIS XR™ system was at the conference on ULC’s stand which attracted a large amount of attention. Both Pictures from ULC’s and SGN’s stands this year are shown in Figure 42 and Figure 43.
SGN Dissemination Plan

SGN and ULC have developed an extensive internal and external communication plan to ensure the project and the CIRRIS™ field trial is recognised across the gas industry to provide a platform for CIRRIS to become a commercial success in the future.

The most significant stakeholder event was LCNI where an interactive robotics stand was showcased. Feedback was collected through a survey on iPads that were displayed on the stand to collate stakeholder information.

Figure 44 highlights the primary stakeholders and their relationship with the project. SGN will continue to engage with the parties listed to provide updates on how the CIRRIS™ system develops throughout the pilot works, and to provide updates on Element 4 as the design matures leading up to live field trials.

A customer engagement plan will be drafted in early 2017 for submission to Ofgem prior to any engagement with members of the public. Learning will be taken from SGN’s other NIC projects, Opening up the Gas Market and Real Time Networks where similar plans have been submitted to Ofgem, approved and used with great success. The change in focus that Element 4 brings will also lead to the stakeholder table being reviewed together with what information is to be distributed to whom, the frequency and in what manner.
## Primary Stakeholder Groups

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<thead>
<tr>
<th>Stakeholders</th>
<th>Knowledge base and interests</th>
<th>Importance</th>
<th>Type of Engagement Activity</th>
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<tbody>
<tr>
<td>Transport for London (TfL)</td>
<td>External – focused on the benefits to road users</td>
<td>High</td>
<td>Invited to LCNI. Separate presentation direct to TfL. Contacted for Element 4 consultation.</td>
</tr>
<tr>
<td>GDN’s – includes WWU, NGN, NG Distribution and Transmission</td>
<td>Internal – knowledge of the industry and technical challenges faced.</td>
<td>High</td>
<td>Invited to field trial of E1-3. Full system presentation given, operations shown and outputs identified with one to one Q&amp;A. Engagement at LCNI. Contacted for Element 4 consultation.</td>
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<tr>
<td>MPs/MSPs</td>
<td>External – focused on the benefits the general public</td>
<td>Low</td>
<td>Engagement through existing channels within SGN. Contacted for Element 4 consultation.</td>
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<tr>
<td>Water companies</td>
<td>Internal – knowledge of the industry and technical challenges faced.</td>
<td>Low</td>
<td>Water companies face similar challenges whilst maintaining their networks. Invite to LCNI conference. Contacted for Element 4 consultation.</td>
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<tr>
<td>Replacement contractors – Southern and Scottish</td>
<td>Internal – knowledge of the industry and technical challenges faced.</td>
<td>High</td>
<td>Considered interested Third Parties. Contractors carry out a large proportion of Tier 1 mains replacements works across the country. Communication through existing channels. Contacted for Element 4 consultation.</td>
</tr>
<tr>
<td>Universities/independent consultants</td>
<td>External – focused on the benefits the general public</td>
<td>High</td>
<td>Engagement at LCNI conference. Potential for an independent view on the impacts of the new technology on the general public.</td>
</tr>
<tr>
<td>Health and Safety Executive (HSE)</td>
<td>Internal – knowledge of the industry and technical challenges faced.</td>
<td>High</td>
<td>Regular interface meetings, unlikely to issue written support. Contacted for Element 4 consultation.</td>
</tr>
<tr>
<td>Environment Agency (EA)</td>
<td>External – focused on the benefits to the environment</td>
<td>Low</td>
<td>Contact will be made to discuss the outputs of the project and the reduction in the carbon footprint of the works if the proposed solution is developed further. Contacted for Element 4 consultation.</td>
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<tr>
<td>Local press</td>
<td>External – focused on the benefits the general public</td>
<td>Low</td>
<td>Multiple press releases given around the field trial. A full list of articles can be found in Appendix E.</td>
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*Figure 44: Primary Stakeholder Groups and general engagement approach*
13 Other

Future Projects
Element 1 of the robotic platform has been designed to be versatile and have the ability to carry a number of payloads. The platform is currently able to transport both the joint sealing module and the inspection module developed under the scope of the NIC project. SGN has been in discussions with ULC to identify other applications where the transport platform can be used to provide a solution for a number of different industry challenges with the management of large diameter gas mains.

The following areas have been identified for feasibility studies to be carried out to investigate if and how the NIC platform can be utilised:
14 **Accuracy Assurance Statement**

The same steps that were taken in the previous PPR’s have been followed for this report. The aim of these measures is to ensure accuracy and to comply with governance provided.

![Accuracy assurance procedure diagram](image-url)

*Figure 48: Accuracy assurance procedure*
Appendix A - ULC Project Progress Report

Project Progress Report
Prepared for SGN PPR #6

SUBMITTED ON: December 19, 2016
PREPARED BY: Mike Passaretti
Program Manager
ULC Robotics
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Revision History

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<td>--</td>
<td>19 DEC 2016</td>
<td>JS</td>
<td>Initial release</td>
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Referenced Documents

1. NIC Project Plan (schedule)
2. NIC Project Agreement
3. Gas Network Innovation Competition Governance Document
1.0 Executive Summary

The objective of the NIC Robotics project is to develop new, cutting edge robotic repair and inspection technologies which can operate inside live gas distribution mains. The project is split into four elements. Elements 1 through 3, which have been successfully completed under the NIC Robotics project, provide unprecedented inspection and repair technology to tier 2 and 3 mains. The goal of Element 4 is to develop a system capable of remotely reconnecting service lines to inserted pipe in tier 1 mains without the need to perform excavations over each of the connection points. The success and achievements of the project to date are a direct result of an excellent level of collaboration and attention to detail from all project stakeholders, namely SGN, the project sponsor.

ULC Robotics has been under contract since February 2014. Since the submission of the last project progress report (June 2016) all milestones were achieved on schedule. Since the start of the project, and as of the date of this report, forty-nine (49) deliverables have been completed on schedule which includes six (6) SDRC’s and thirteen (13) Go/No-Go’s. There are no project milestones remaining for Elements 1, 2 & 3. The milestones that were successfully completed since the submission of the previous progress report reflect several significant project accomplishments. With the completion of Elements 1 through 3 in January of this year, the CIRRIS XI™ (Elements 1 & 3) has entered the market as a commercial product. The robot was deployed for commercial work on SGN mains in October 2016. Element 4 of the NIC Robotics Project is well underway, with ULC on schedule to deliver the next milestone “Initial Parts Fabrication” on December 23rd.

A detailed summary of the project’s progress and upcoming objectives are given in this report. What we’ve learned, our development approach and the intricate details of the designs have been detailed in all project milestone reports. To date, all project deliverables have been submitted on or ahead of schedule.
2.0 Project Managers Report

The reporting on and development of Elements 1 through 3; the CIRRIS XI™ and CIRRIS XR™ robotic systems were completed in the last progress reporting period. Modifications, upgrades, and improvements to the system, determined during field testing last year, have been performed by ULC. Following the completion of these modifications, the system was deployed at SGN in Glasgow in October 2016. The system is operating under an 18-month pilot program, inspecting 16 km of Tier 3 pipeline. Initial results have been positive, and modifications implemented after the field trials have proven to be successful. Minor modifications and improvements to the commercial operation are expected and will be incorporated during the pilot.

In tandem with the pilot program, the development of the robotic system for Element 4 has continued on schedule. Progress has been made across all sub-systems of the Element 4 designs in terms of design, manufacturing, and testing. The development of this system will lead to a significant improvement in the way mains and service line replacement is performed.

The NIC project is being performed by dedicated personnel and each team member’s experiences, and strengths have been focused on a specific aspect of the project. A number of resources are available to the team including an extensive array of engineering software tools, a full machine shop, and test facility. ULC has brought on Steve Vick International Ltd and Radius Systems Ltd, providers of innovative pipe renewal technology, as subcontractors to utilize their engineering services for Element 4.

Throughout the duration of the project, with the exception of the consultation period, ULC Robotics has been providing updates to SGN and DNV GL via teleconferencing. These meetings also serve as a forum to discuss technical developments and project planning to ensure milestones are met on schedule. In-person meetings are also held as needed. An in-person meeting between SGN, ULC and DNV GL, the technical consultant, was held on 16 of October in Edinburgh. This meeting served to thoroughly update the project team about various parts of the project. At this meeting, ULC brought the team up to speed and displayed the high accuracy laser rangefinder which will be used with the measurement robot. Since this meeting, ULC has gone on to manufacture parts for the measurement robot transport platform as seen in Figure 50.
2.1 Review of Milestones

ULC has completed a number of milestones during this reporting period, of which can be seen in Table 1. The milestones remaining can be seen in Table 2.

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<th>Go/No-Go No.</th>
<th>SDRC No.</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection and Procurement of Motors, Gears, and Bearings</td>
<td></td>
<td></td>
<td>22 JUL 2016</td>
</tr>
<tr>
<td>User Interface and Control System Design and Programming</td>
<td></td>
<td></td>
<td>29 JUL 2016</td>
</tr>
<tr>
<td>Creation of Detailed Fabrication and Manufacturing Documentation</td>
<td></td>
<td></td>
<td>19 AUG 2016</td>
</tr>
</tbody>
</table>

Table 1 – Element 4 Milestones Completed This Reporting Period

<table>
<thead>
<tr>
<th>Remaining Element 4 Milestones</th>
<th>Go/No-Go No.</th>
<th>SDRC No.</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Parts Fabrication</td>
<td></td>
<td></td>
<td>23 DEC 2016</td>
</tr>
<tr>
<td>Robot Assembly</td>
<td></td>
<td></td>
<td>20 JAN 2017</td>
</tr>
<tr>
<td>Robot Preliminary Functional Test</td>
<td>2</td>
<td></td>
<td>17 FEB 2017</td>
</tr>
<tr>
<td>Integration of Electrical System into Mechanical Prototype</td>
<td></td>
<td></td>
<td>31 MAR 2017</td>
</tr>
<tr>
<td>Service Installation Validation</td>
<td>5</td>
<td></td>
<td>14 APR 2017</td>
</tr>
<tr>
<td>Pipeline Travel Testing</td>
<td>3</td>
<td></td>
<td>12 MAY 2017</td>
</tr>
<tr>
<td>Tapping &amp; Fitting Tool Validation</td>
<td>4</td>
<td>9.5</td>
<td>12 MAY 2017</td>
</tr>
<tr>
<td>Develop Test Plan for the Field</td>
<td></td>
<td></td>
<td>23 JUN 2017</td>
</tr>
<tr>
<td>Incorporate Improvements Discovered During Testing</td>
<td></td>
<td></td>
<td>04 AUG 2017</td>
</tr>
<tr>
<td>Perform 20 Days Field Testing</td>
<td></td>
<td></td>
<td>15 SEP 2017</td>
</tr>
<tr>
<td>Launch Robot</td>
<td>6</td>
<td>9.8</td>
<td>13 OCT 2017</td>
</tr>
<tr>
<td>ULCR Generate Final Report</td>
<td></td>
<td></td>
<td>27 NOV 2017</td>
</tr>
</tbody>
</table>

Table 2 - Remaining Element 4 Project Milestones
3.0 **Consistency with Full Submission**

The contents of this report are consistent with the original NIC Robotics proposal document. Any variances to the proposal will be clearly captured as part of the report structure to ensure the learning outcomes can be assessed and disseminated. There are no variances to report at this time.

4.0 **Risk Management**

In accordance with the Gas Network Innovation Competition document risks are being tracked and monitored throughout the duration of the NIC Robotics project. ULC Robotics, along with DNV GL and SGN have been periodically reviewing the project risk register and collaboratively making appropriate updates to it.
6.0 Progress Against Plan and Budget

The project is progressing on schedule and on budget. A summary of the successful delivery reward criteria milestones are shown in Table 4. As discussed previously, Elements 1 through 3 of the project were completed as of January 18th.

<table>
<thead>
<tr>
<th>SDRC No.</th>
<th>SDRC Description</th>
<th>Status</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.2</td>
<td>Element 4: Development of Conceptual Designs</td>
<td>Completed</td>
<td>14 DEC 2015</td>
</tr>
<tr>
<td>9.5</td>
<td>Element 4: Tapping &amp; Fitting Tool Validation</td>
<td>On-schedule</td>
<td>12 MAY 2017</td>
</tr>
<tr>
<td>9.6</td>
<td>Element 1&amp;2: Launch Robot</td>
<td>Completed</td>
<td>04 DEC 2015</td>
</tr>
<tr>
<td>9.7</td>
<td>Element 3: Launch Robot</td>
<td>Completed</td>
<td>04 DEC 2015</td>
</tr>
<tr>
<td>9.8</td>
<td>Element 4: Launch Robot</td>
<td>On-schedule</td>
<td>15 SEP 2017</td>
</tr>
</tbody>
</table>

Table 4 - SDRC Milestone Schedule

7.0 Performance to Target Price

No variation.
Appendix B - DNV GL Project Progress Report

SGN ROBOTICS ELEMENT 4


SGN

Report No.: 160490-001, Rev. 0
Document No.:  
Date: 2016 12 12
Objective:
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<td>Stakeholder communications on CIRRIS XI™ &amp; XR™ operations</td>
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<td>LCNI Conference</td>
<td>29</td>
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1 SUMMARY
DNV GL were appointed as Technical Service Provider (TSP) to the project in May/June 2016. This report summarises DNV GL’s contribution to, and assessment of, project progress in the period July-December 2016.

Reference should be made to the current version of the SGN Project Plan.

2 DNV GL COMPANY PROFILE
DNV GL is a global provider of certification and technical qualification services to the oil and gas and other sectors. Within the UK gas marked, DNV GL’s heritage includes GL Industrial Services, Advantica, and BG Technology, which were the successors of British Gas Research and Development division. In addition, the Engineering Services division of British Gas (subsequently Transco) was merged with Advantica, transferring a significant level of current and historical gas transmission and distribution operational expertise into DNV GL.

DNV GL’s Technical Advisory team has extensive experience in all aspects of utility network engineering, spanning operational experience, training and assessment, quality assurance monitoring and improvement, fundamental and practical research, development and evaluation of new processes and equipment.

DNV GL has an established track record of development, evaluation and implementation support to utility operators, with extensive involvement in recent IFI and RIIO NIA/NIC project work. This expertise covers all stages of the project life cycle from concept to roll-out, including:

The key DNV GL personnel proposed to deliver this project are:

- Edward Faragher (Principal Engineer & Project Manager)
- Andrew Ellis (Principal Consultant)
- Ian Hepburn (Principal Consultant)
- Engineers – Matthew Galloway (Mechanical Engineering) – Lynsey Stevenson (Mechanical Engineering)
3 PROGRESS REPORT JUNE 2016 TO DECEMBER 2016

3.1 Update Against OFGEM PPR Reporting Criteria

3.1.1 Project Manager’s Report
The SGN Project Manager will provide the formal Project Manager’s report for the overall project.

From DNV GL’s perspective, this period has been successful in that the expected deliverables from ULC were produced, and DNV GL provided the independent review and challenge in its role as TSP. In addition to these formal feedback events, DNV GL has participated in the regular tripartite teleconferences which discuss the deliverable feedback, and allow the latest developments by ULC to be presented and discussed amongst the project partners. This mode of project management allows rapid dissemination of ideas between the three parties and reduces the risk of delays to progress.

The three parties (SGN, ULC and DNV GL) have successfully interacted on previous NIA project work, and this allowed a mutually respectful tripartite working relationship to be developed, which has been invaluable in facilitating the good progress of this project through effective and efficient liaison between the parties.

To the best of DNV GL’s understanding, the project outputs reported in this period remain compliant with the requirements of the SGN Bid Submission, as sanctioned by Ofgem, in terms of content and timescale.

3.1.2 Business Case Update
DNV GL is not aware of any changes required to the project Business Case during this period.

3.1.3 Progress against Plan
ULC have delivered the reports etc. due during this period, in a timely manner to allow rigorous review by SGN and DNV GL, and for the subsequent feedback and learning to be incorporated in the development process.

3.1.4 Progress against Budget
Within the overall project, DNV GL is contracted to SGN under a fixed price proposal basis. Variations to scope and cost implications would require the formal agreement of SGN before implementation, particularly if this were to have an impact on the overall NIC project budget.

3.1.5 SDRC
There were no SDRCs falling due in this period. The next SDRC (9.5: Tapping Fitting and Tool Validation) falls due in the next reporting period. From the speed of progress to date, this appears to be achievable.

3.1.6 Learning Outcomes
From DNV GL’s perspective, the following are the key learning outcomes achieved during this period:
3.1.8  Risk Management
A Risk Register for the project is held by SGN and regularly updated. This details potential risks to achieving the project goals, provides a rating of their severity of risk, details mitigation measures and assigns ownership of these amongst the three parties (SGN, ULC and DNV GL).

The Risk Register was updated on 17/10/16.

3.1.9  Other
No other significant issues have been identified in this period.

3.1.10 Accuracy Assurance Statement
To the best of DNV GL’s understanding, the information contained in this DNV GL report is both robust and accurate.

3.2  DNV GL Planned Activities
DNV GL was appointed as TSP in late May 2016, immediately prior to the PPR 5 due date (refer to DNV GL PPR5 Report 16806 dated 16/06/16).

The following activities were planned for this period up to PPR6, in accordance with the project programme.

• DNV GL Technical Team will review ULC technical reports produced to date, to get up to speed with current state of development

• Technical Review and Challenge/Critique to reports produced by ULC on the following elements scheduled in next 6 months:
  
  Selection and Procurement of Motors, Gears and Bearings

  User Interface and Control System Design and Programming

  Creation of Detailed Fabrication and Manufacturing Documentation

Progress against these activities, and other work undertaken by DNV GL, is reported in the following Section

3.3  DNV GL Completed Activities

3.3.1  ULC Report Review: Selection and Procurement of Motors, Gears and Bearings
The draft report was delivered by ULC on 26/07/16, and was reviewed by DNV GL, with comments forwarded to SGN on 04/08/16.
3.3.7 Project Teleconference Participation

DNV GL have participated in and contributed to the regular tripartite teleconferences organised by SGN throughout this period. The major issues arising are summarised in the following Table.

4 PLAN FOR NEXT SIX MONTHS (UP TO PPR 7 DUE DATE)

DNV GL will continue to perform its project role as an independent Technical Service Provider (TSP), providing specialist advice and guidance in all aspects of gas distribution operations, practice and technology as and when required by the project programme. This engagement is essential to ensure the design and operation of proposed Robotics technologies are ultimately fit for purpose for deployment and use in the gas distribution network.
DNV GL’s engagement will continue to be presented in the form of written feedback report (inserted into the standard SGN feedback template), or email/verbal at the regular project teleconferences. All teleconference outputs and decisions are rigorously documented by SGN and distributed to the project partners to ensure proper control of project developments.

DNV GL will provide Review and Challenge/Critique to concepts, designs and reports produced by ULC on the following elements scheduled in next 6 months, which will cover the following aspects:

- Initial Parts Fabrication – Robot Assembly – Robot Preliminary
- Functional Test – Integration of Electrical Systems into
- Mechanical Prototype – Service Installation Validation Pipeline
- Travel Testing – Tapping Fitting and Tool Validation (SDRC 9.5)

DNV GL will continue to provide *ad hoc* guidance to both SGN and ULC (where possible and within reason technically and financially) for any minor unforeseen technical issues or queries that arise, that require addressing to ensure project progress.
About DNV GL
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.