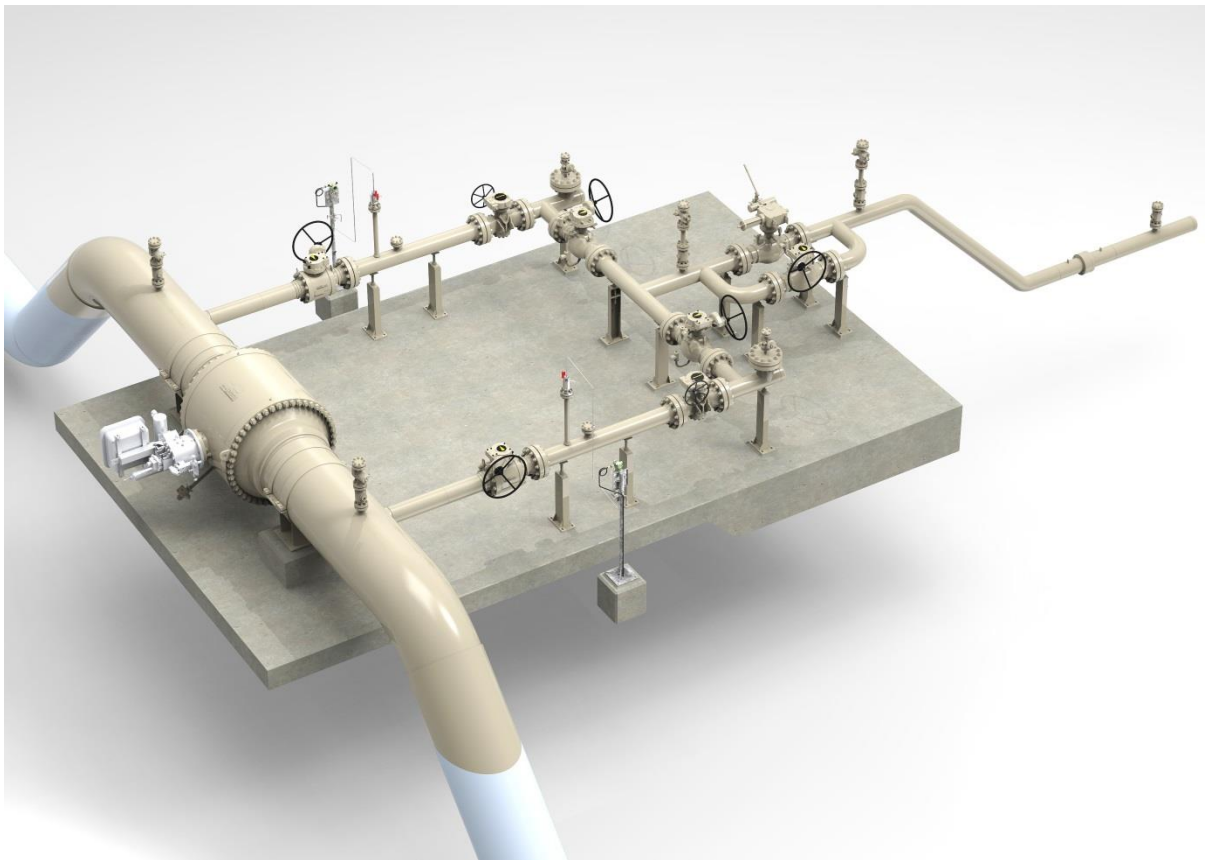
Network Innovation Competition

National Grid

Gas Transmission



Project CLoCC

Customer Low Cost Connections

1. Project Summary

1.1. Project Title	Project CLoCC - Customer Low Cost Connections
1.2. Project Explanation	Project CLoCC aims to minimise the cost and time of connections to the National Transmission System (NTS), with particular focus on unconventional gas connections. This will be achieved through fundamentally challenging every aspect of the connection process, building on worldwide 'best in class' technology and practice.
1.3. Funding licensee:	National Grid Gas Transmission (NGGT)
1.4. Project description:	1.4.1. The Problem(s) it is exploring Currently, the cost to connect to the high pressure NTS is approximately £2m and can take up to three years. For unconventional gas connections, which can have much lower gas flow rates than traditional NTS connections and be much faster to market, these connection costs and durations are typically prohibitive. To date all of the unconventional gas connections have connected to the low pressure distribution networks (DN's), but as numbers grow and due to potential restrictions in terms of location and flow rates there is increasing customer demand to connect to the NTS. Therefore this project aims to provide a connection service and range of connection options which will facilitate this emerging market. 1.4.2. The Method(s) that it will use to solve the Problem(s) To develop the connection service that is required for unconventional gas connections the project will focus on three key areas: a. **Optimised Commercial Processes** designed to meet the requirements of non-traditional customers. b. **Innovative Connection Solutions** tailored to the needs of unconventional gas connections. This will encompass a global technology watch, concept designs and the field trial of the proposed engineering connection solution(s). c. **A Visual Online Platform** to facilitate the customer experience. The innovative tool will use geographical data and customer information to enable customers to compare and assess suitable options for an NTS connection. *1.4.3. The Solution(s) it is looking to reach by applying the Method(s)*

	The project looks to develop a connection service that facilitates the unconventional gas connections market; specifically connection costs of below £1m and with duration of less than one year. *1.4.4. The Benefit(s) of the project* The cost of each connection will be reduced by approximately 50% and unconventional gas projects that may not have been economically viable will be able to proceed. Assuming that there are over 100 connections in the next 20 years, this will potentially create £100m of savings and there will be significant environmental benefits through the displacement of gas imports with indigenous gas.

1.5. Funding

1.5.1 NIC Funding Request (£k)	£4,820.07	1.5.2 Network Licensee Compulsory Contribution (£k)	£543.38
1.5.3 Network Licensee Extra Contribution (£k)	N/A	1.5.4 External Funding – excluding from NICs (£k):	N/A
1.5.5. Total Project Costs (£k)	£5,433.82		
1.6. List of Project Partners, External Funders and Project Supporters	**Premtech Ltd** Unit 5 Charter Point Way Ashby Park Ashby de la Zouch Leicestershire LE65 1NF **Protech** Land & Marine Engineering Ltd River House Riverside Way Uxbridge Middlesex UB8 2YF **Aqua Consultants** Bradford Chamber Business Park New Lane Bradford BD4 8BX		

1.7 Timescale

1.7.1. Project Start Date	01/02/2016	1.7.2. Project End Date	29/10/2018

1.8. Project Manager Contact Details			
1.8.1. Contact Name & Job Title	James Abrahams Gas Customer Account Manager	1.8.2. Email & Telephone Number	James.abrahams@nationalgrid.com 01926 653000
1.8.3. Contact Address	Gas Transmission National Grid House Warwick Technology Park Gallows Hill CV34 6DA		

1.9: Cross Sector Projects (only include this section if your project is a Cross Sector Project).	
1.9.1. Funding requested the from the [Gas/Electricity] NIC (£k, please state which other competition)	N/A
1.9.2. Please confirm whether or not this [Gas/Electricity] NIC Project could proceed in the absence of funding being awarded for the other Project.	N/A

Section 2: Project Description

2.1. Aims and objectives

Changes in the energy sector mean that customers can see value in connecting to the gas transmission system in a way that was not viable or foreseen in the past. In particular, those developing indigenous gas supplies see value in connecting to the NTS because of location and/or the benefits of a higher pressure network. However, these customers are quite different to traditional NTS connections and therefore find that the existing connection regime does not meet their project's requirements.

The aim of the project is to develop a low cost and timely NTS connection service for unconventional gas connections.

a) The Problem(s) which needs to be resolved;

In the past, connections to the NTS were generally required to support entry projects such as liquefied natural gas (LNG) terminals, gas fired power stations, storage sites and other similar large sized projects which would be either entering or off-taking gas over a long period of time. More recently, however, customers are now approaching NGGT with a view to connecting much smaller projects to the NTS. In terms of the current connections process, customers looking to connect to the NTS need to follow the 'Application to Offer' (A2O) process. This process was developed following extensive industry debate over a lengthy period which culminated in Uniform Network Code (UNC) modification proposal 0373 being approved by the Authority on 4 July 2012[1].

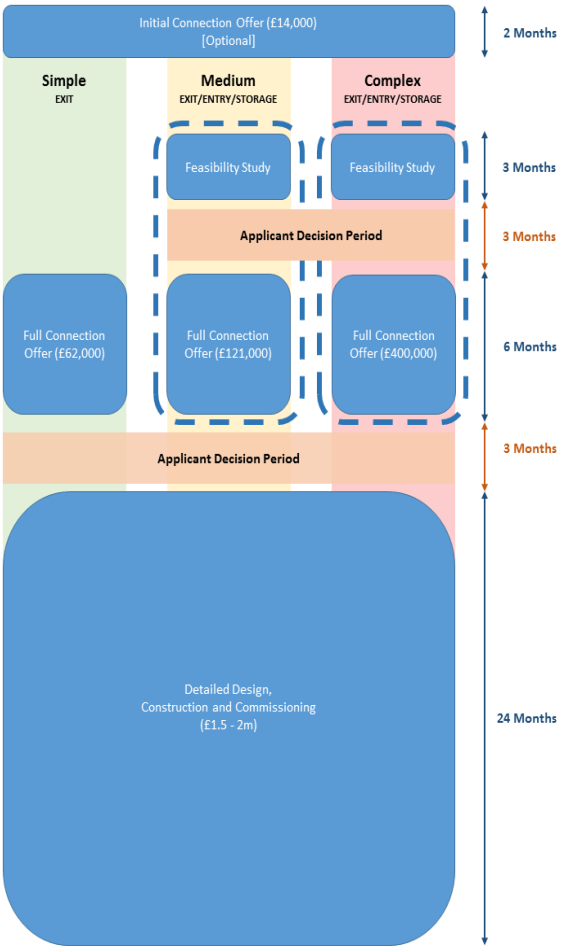


Figure 1 – Current A20 Process

The A20 process was jointly developed with our customers and is tailored to their needs. As aforementioned, the majority of our customers at the time were developing power stations, storage sites or new entry points e.g. Liquefied Natural Gas terminals. These types of projects typically have long lead times and the cost of the NTS connection represents a small proportion of their overall project. It should be noted that the actual engineering of these types of connections has not developed significantly over the last 20 years. However, overall satisfaction with our existing connection service is very good, with an average satisfaction score of 7.27/10 in 2014/15 compared to 6.33/10 in 2013/14, demonstrating an improvement over the last two years through incremental process changes.

If a customer wishes to connect to the NTS,

[1] For full details of the UNC modification proposal 0373 see http://www.gasgovernance.co.uk/0373

the actual costs payable for that connection are calculated based on the time and materials used to undertake the activity. For a Minimum Offtake Connection (MOC) at a greenfield site, the cost of the connection is generally ~£2m and can take up to 3 years to deliver. The costs and timescales for more complex connections can be significantly higher than those for a MOC.

Additionally connection assets are currently designed to cater for the full production flow rates (as this is ultimately what they need to support) and the cost and complexity of the connection are driven by these full production figures. However, the cost and timescale to support this can be prohibitive if it is not entirely certain whether the project will progress or that it will indeed produce gas at the initially conceived rate. Therefore the current application and connection process can be prohibitive for smaller projects. Additionally it does not particularly cater for projects whose needs (in terms of flow rates) are subject to change over time as the projects develop.

We have now begun to see new types of connection customer, those developing unconventional gas sources, for example shale and biogas, for entry into the gas system and exit connections for applications such as for natural gas powered vehicle refuelling stations. The requirements of these customers are fundamentally different. Their projects are typically fast to market and the NTS connection cost represents a significant proportion of the total development costs.

If the present NTS connection service continues, the majority of these unconventional gas projects will seek connections to distribution networks, where possible, or try to find other ways of using the gas they produce, for example power generation. Depending on the situation, connections to the distribution network and alternative uses for the gas will have a number of disadvantages compared to a low cost NTS connection and may in some cases result in projects not being financially viable. The main disadvantages of a connection to a distribution network are the potential long pipeline distances between the MOC and the customer's facility, flow rate limitations in low demand periods, i.e. summer months and additional gas processing requirements.

b) The Method(s) being trialled to solve the Problem:

The method(s) being trialled has three key elements:

a. **Optimised Commercial Processes** designed to meet the requirements of non-traditional customers

b. **Innovative Connection Solutions** tailored to the needs of unconventional gas connections at high pressure. This will encompass a global technology watch, concept designs and the field trial of the proposed engineering connection solution(s).

c. **A Visual Online Platform** to facilitate the customer experience. The innovative tool will use geographical data and customer information to enable customers to compare and assess suitable options for an NTS connection.

c) The Development or Demonstration being undertaken:

NGGT is looking to make the best use of the existing assets that make up the transmission system. The NTS consists of 7655km of pipeline, over 250 block valves and connects into all 12 local distribution zones. Facilitating new types of connections will allow NGGT to maximise the usage of the high pressure network and provide additional benefit to all customers.

The project will trial and demonstrate a novel connection based on innovative connection solutions targeting less than £1m and less than one year from initial enquiry to 'gas on' date. The project will also demonstrate a novel visual online platform.

d) The Solution(s) which will be enabled by solving the Problem:

There are three clear solutions which will be enabled by solving the current challenge NGGT has with its current NTS connection process:

1) The time it takes from Initial Enquiry to 'Gas On' date will be significantly reduced from up to three years to less than one year.

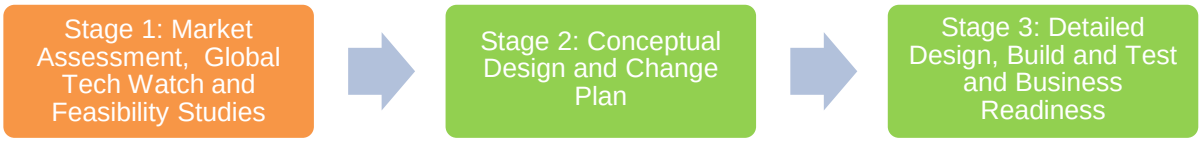
2) The cost of a connection will be reduced significantly from up to £2m to less than £1m.

3) Enabling customers to instantly see viable connection options.

2.2. Technical description of Project

Project CLoCC has three clear stages, which are explained below. A detailed project programme can be found in Appendix C.

Stage 1: Market Assessment, Tech Watch and Feasibility Studies



Optimised commercial processes: As part of the NIC Bid preparation the project has already undertaken a preliminary market research study to identify customer requirements (a sample customer questionnaire can be found in Appendix E). This has identified the key requirements of unconventional gas customers. Further exploration of these requirements at a more detailed level will be undertaken during the UK market assessment. As part of the market assessment, we have also spoken to all of the gas distribution companies to understand their offerings and processes. The information we have from customers will guide the commercial processes, visual online portal and innovative connection solutions we develop and we will build on the knowledge from the distribution companies to fast track the project's progress. During stage 1 the deficiencies and limitations associated with both transmission and distribution legislation/standards/codes and specifications will be identified and documented for action within the change plan.

Innovative connection solutions: As well as the upfront UK market assessment, the project has undertaken a global technology watch (GTW) during the NIC bid preparation phase, which has scanned the world for the latest developments in connecting unconventional gas sources. The GTW will be revisited and built upon throughout stage 1 of this project. This will ensure that at the point at which conceptual design is underway, the full picture of the equipment available, gas types expected and customers is understood. This will also enable the project to position itself at the forefront of technologies in the area. The GTW will also provide an international understanding of key gas supplies and gas parameters (flow profiles, pressures, gas composition etc.) of different unconventional gas types such as biogas, shale and coal bed methane. Key areas for innovation are:

- The live connection to existing assets.

- Low cost telemetry.
- Valve technology.
- New metering developments.
- Skid mounted, transportable units.
- Modular construction, to enable additional customer/loads to be added into the connection infrastructure.
- Hub solution systems.
- New gas quality monitoring equipment.

Through discussions with vendors and suppliers it was felt that these are key areas that can be targeted for innovation. Taking gas quality for example; there are products on the market that utilise laser technologies to detect up to 20 gases. Whilst these do not currently provide a full analysis of the gas composition delivered by the Ofgem approved gas chromatographs, it would be worthwhile reviewing the critical parameters which need to be analysed for unconventional gases and how NGGT can work with Ofgem and manufacturers to develop accurate equipment that focusses on measuring a smaller set of specific gas parameters appropriate to that type of gas.

Based on the outputs from the UK market assessment and GTW, the project will develop a number of feasibility designs for innovative connection options. As a minimum we see three standard offerings:

a) **Minimum offtake connection** based on existing NTS infrastructure (i.e. NTS block valve).

b) **Minimum offtake direct connection** to a live high pressure pipeline (i.e. 'hot-tap' connection).

c) **Enhanced connection/hub solution** that provides additional functionality based on the customer requirements, such as metering and gas quality measurement and permits the capability for multiple customers/connections.

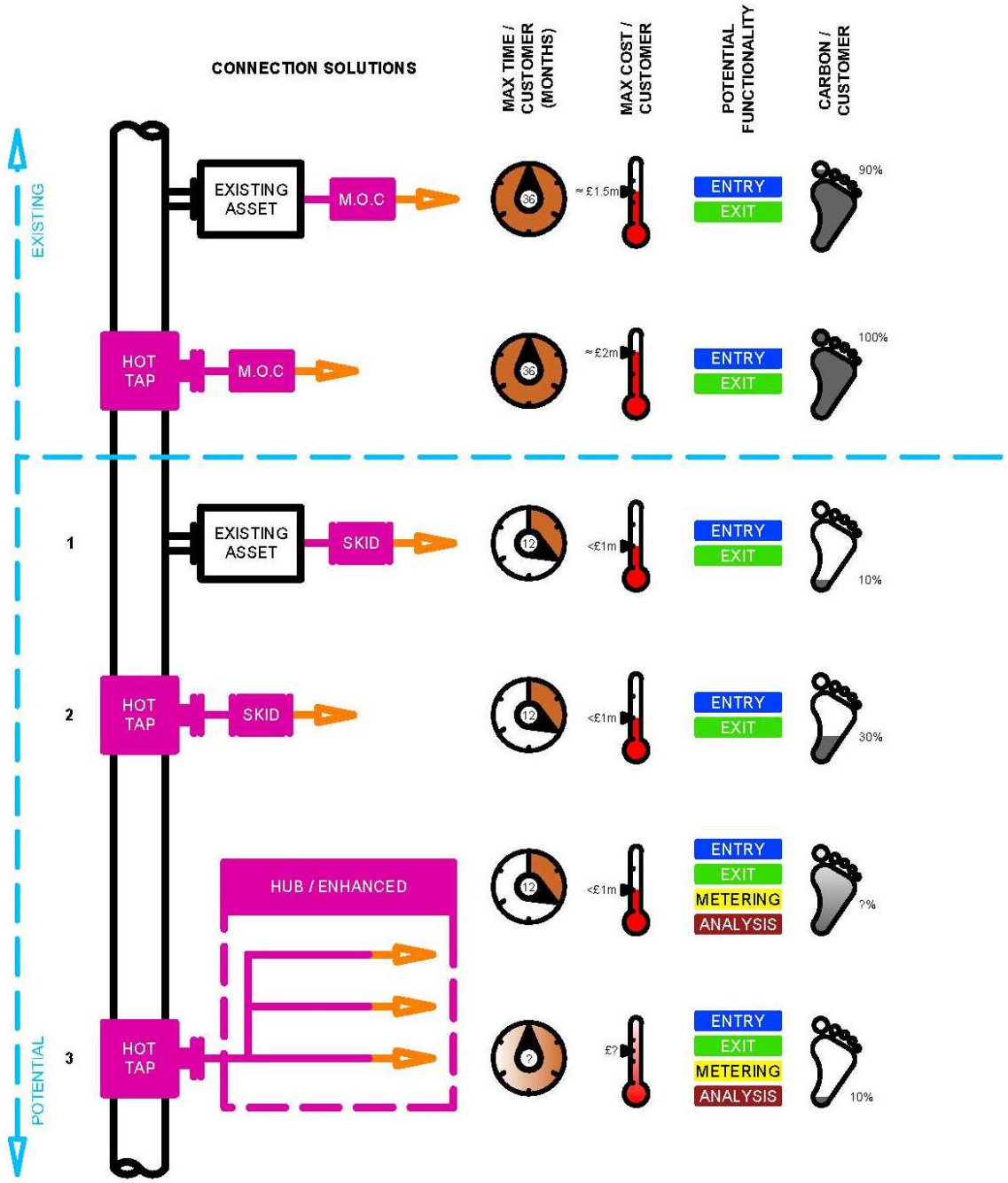
These feasibility designs will allow Protech to commence preliminary vendor discussions during stage 1 of this project to ensure timely and efficient delivery of all equipment and materials.

Diagram 2 illustrates the existing connection options currently available to customers and the three connection offerings available to NTS customers following the successful development of this project as detailed below:

Existing NTS connection options:

1. Minimum offtake connection to an existing NTS asset: A MOC to an existing asset can currently take up to 3 years and cost the customer ~£1.5m. However, most if not all recent connection requests (Exit, Entry or Storage) have been large supplies and the customer has normally requested a greenfield site. This is because the existing pipework in a block valve is too small for the large gas capacity requirements.

2. Minimum offtake connection with NTS hot-tap connection**:** A MOC connected directly to the NTS through a 'hot-tap' connection can also take up to 3 years and costs of ~£2m can be incurred.



Proposed innovative connection solutions:

1. Minimum offtake connection based on existing NTS infrastructure (i.e. NTS block valve): Our ambition is to allow for a connection to an existing block valve in less than 1 year and for less than £1m through the development of a skid based innovative solution. The current market for smaller gas customers lends itself better to connect into a block valve or any existing site. Hence we are looking at the option under the Network Innovation Allowance (NIA) to attempt to meet customer requirements and expectations. This will allow us to have a distinct strategy on detailed design for small gas customers to better position ourselves to inform customers what we can or cannot do. At the moment we do not have a generic gas connection design for anything below a 6"/150mm design and it is

normal for all the connection to be buried where as our thinking is to provide an above ground installation.

2. Direct minimum offtake connection to a live high pressure pipeline: Our ambition is to reduce the time for a hot tap connection to less than 1 year and reduce the cost of connection to less than £1m against the current 3 years and ~£2m through the development of a skid based innovative solution.

3. Enhanced connection/hub solution that provides additional functionality based on the customer requirements, such as metering and gas quality measurement: It is proposed to provide an enhanced connection/hub solution where a number of gas customers utilise a new facility with a single connection to the NTS. This enhanced solution will allow an initial connection to the NTS with applications based on an initial customers requirements i.e. metering, gas quality measurements etc. If an additional customer(s) wishes to connect into the NTS at the same location, this connection point can be utilised and a customer would only be required to purchase the additional functional requirements such as metering and gas quality.

The options detailed above will use a standardised design and realise time and cost efficiencies based on this scalable approach.

Visual online platform: Stage 1 of the project will also involve a feasibility study for the visual online portal and a review of similar existing systems currently deployed or in the process of development across the international gas industry and comparable sectors to ensure any best practice can be incorporated into the development of the portal.

The feasibility study will define the steps required for the development of the customer web interface, hardware, hosting environment, system administration, security and functionality requirements.

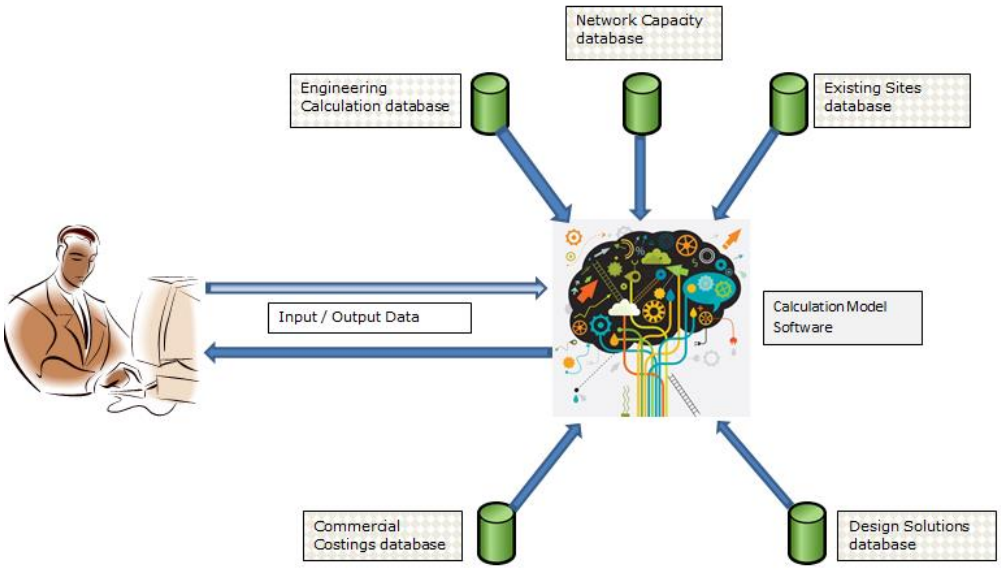


Figure 3 – Functionality of visual online platform

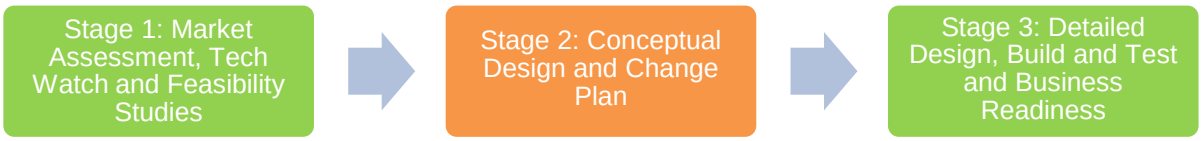
As a minimum the visual online portal will need to develop the capability to accept a grid reference and determine the nearest high pressure gas pipeline or other physical

infrastructure, for example a block valve, and provide an indicative price. Parametric modelling, utilising a finite number of technical parameters will allow for standardised designs to suit customers' requirements. The project will also look to embed a high level network analysis view of each of the connection options to identify whether there is a need for further reinforcement and/or any specific requirements in terms of flows. The intention is to link building information modelling (BIM) functionality which will allow a customer to visualise the connection solution based on initial parameters.

The key outputs from Stage 1 are summarised below:

- UK market assessment
- Understanding of International gas parameters.
- Global technology watch providing an understanding of innovative technologies.
- Feasibility designs for skid and hub based connection solutions.
- Development of BIM strategy report.
- Functional requirement for the visual online portal.
- Preliminary vendor discussions.
- Stage 1 completion report.

Stage 2: Conceptual Design and Change Plan



Optimised commercial processes: Based on the UK market assessment, we will design the changes we need to make to our internal processes to simplify and accelerate the application to offer an optimised process for unconventional gas connections. It is likely that we will also need to modify the Uniform Network Code (UNC), the contract that governs our relationship with the users of our system; therefore we would initiate a working group to consider the changes that we would like to make. Throughout this process we will engage with all stakeholders to ensure the changes we intend to make to our internal processes and the UNC changes remain valid and aligned to our customer's requirements. In addition, as the portal and engineering solutions develop, we will have greater understanding of the advantages these new innovative solutions can offer and how they may be able to further streamline our processes.

Innovative connection solutions: As part of the optioneering, initial drawings and imagery will be generated to engage the relevant stakeholders and assist in the optioneering process. For example, to reduce the duration of the overall process our designs are likely to be skid mounted and as far as possible 'off the shelf'. Utilising a skid based connection solution which will incorporate equipment from multiple original equipment manufacturers (OEM's) in one small footprint with minimal complexity which provides the following customer benefits in relation to both operation and maintenance:

- **Portable** (non-permanent) - allowing for transportation and potential re-use for multiple applications.
- **Scalable** – allowing for multifunctional add-on systems to meet whole life customer requirements.
- **Maintainable –** above ground installation allows for ease of maintenance and also reduction in construction activities providing alternative options to exposing a pipeline. The cost and time to remove such a system will also be reduced due the nature of an above ground installation.

To ensure we gain the benefits of this approach we will need to overcome the challenge of long lead time items, and probably more importantly ensure the designs in terms of aesthetics, including height, will meet the requirements of planning authorities. In addition the standardised designs are likely to have some options, which provide the potential to reduce costs but may place operational restrictions on the customers. An example of which, is that currently we install bypasses on the connection to allow us to annually maintain the valve on the connection without interrupting customer flow, however this adds cost. For options such as this, we will work across the three work streams to engage stakeholders and develop commercial options and relevant operational procedures. Critical success factors will be defined and criterion (which satisfies both customers and industry) will be fully challenged and reviewed so as to develop a process to ensure the developed solutions meet the stated goals.

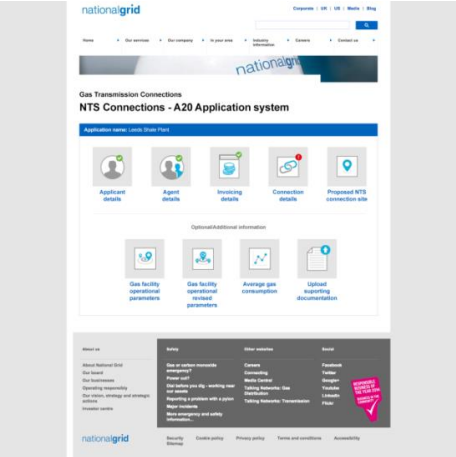


Figure 4 – Example of proposed visual online portal

Visual online platform: In terms of the visual online portal, a working prototype, with limited functionality will be developed during this phase of the project. This will allow the portal to be tested, challenged and reviewed to ensure the tool provides the required customer interface and functionality defined by the project. Based on this, the prototype will identify the nearest high pressure pipelines and other infrastructure. It will also show the high level network analysis for that pipeline, identifying if there is sufficient capacity and any likely restrictions or whether there is a need for more in depth analysis. At this stage a very high level budget price will be provided based on the current process and engineering solution development. This prototype will be tested with a sample of stakeholders and feedback will be gathered to be incorporated in the final model.

The web branding, customer interface, web portal, customer reporting structure and visuals will be designed. A review of the existing asset database will also be undertaken during this stage of the project.

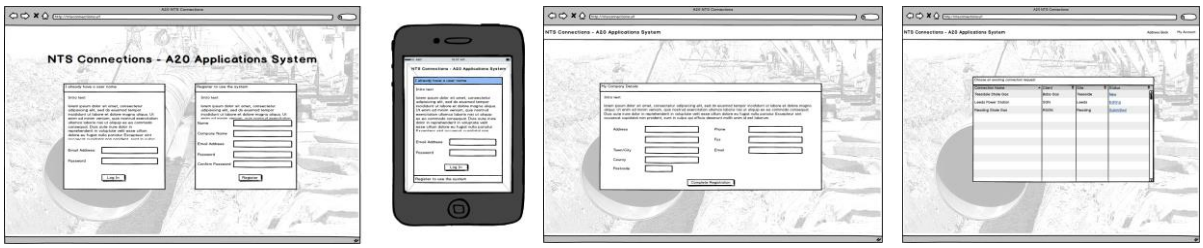
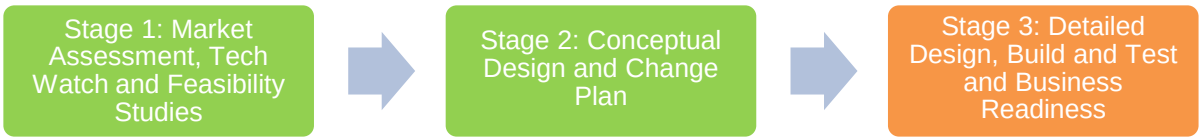


Figure 5 – Example of proposed visual online portal

Key Outputs from Stage 2 are summarised below:

- Change document to address internal and external processes.
- Three standardised designs, with supporting information.
- Initial vendor specification.
- Visual online portal conceptual design/prototype.
- Operational procedures produced.
- Stage 2 completion report.

Stage 3: Detailed Design, Build and Test and Business Readiness



Optimised commercial processes: The final stage of the project will be to finalise and implement the new processes and procedures which will have been determined following the UK market assessment and the development of a change document. As discussed, it is envisaged that this could involve changes to the commercial processes (contained within the UNC), together with amendment of the suite of commercial documents which are produced to help customers interact with NGGT in its role as developer and operator of the NTS. On the presumption that we will need to introduce new commercial processes (i.e. that UNC mods will need to be raised) there will need to be ongoing discussions and stakeholder engagement to ensure that the changes to the processes are widely supported and that the changes are fully understood by all affected parties

Innovative connection solutions: The project will build, test and commission one of the standard offerings – the enhanced connection; this will in effect also prove the costings and viability of the other two standardised options. In addition full detailed design will be carried out for each standardised option. This will involve work across a number of disciplines including: mechanical, civil, electrical and control and instrumentation. At this point the components for construction during the project will be selected and fully detailed ready for the testing phase. Premtech have already begun utilising modelling technologies on other projects and the latest software would be used to engage stakeholders and customers alike. The project is aiming to make the process easier and giving customer's an alternative way of looking at what they are building and engaging with models earlier in the process.

As with all projects on the gas network the designs and calculations will need to be appraised and approved by industry experts from each discipline before they can be finalised. Part of this process involves reviewing and cross-examining the designs with multiple stakeholders to ensure that whatever is developed is safe and fit for purpose. Safety is of paramount importance to National Grid. Consequences of a high pressure incident on a natural gas network would be far reaching. As such we operate under a stringent process safety regime. Throughout the project we will undertake formal process safety assessments against existing legislation and standards and in addition the project will engage with a number of stakeholders – IGEM, HSE & local planning authorities.

With full standardised drawing packs for the each design and full design calculations undertaken a testing strategy will be produced. This will allow for the equipment to not only be pressure tested but assessed on other criteria as detailed in the testing strategy.

In addition to the physical engineering, of equal importance are the working practices and also the commercial agreements with suppliers to ensure that the equipment can be pre-assembled and delivered to site for installation in less than one year. Working instructions will be developed and fully documented that will be followed upon the customer acceptance of one of the standardised offerings.

Visual online platform: Upon completion of the offline testing the system will be ready for installation within the hosting environment. The hosting environment will either be within the existing NGGT IS environment, or externally hosted at an approved location, with all necessary security and redundancy capabilities. Once installed within the hosting environment the system will undergo final testing prior to being in a state of readiness for implementation. A full working version of the online platform will be

provided to NGGT supplemented with full user instructions and will go live for customers to use. During this phase the build of the final site will be refined and there will be extensive user testing with key defined stakeholders. In addition the feedback from customers during Phase 2 will be incorporated and all costings will be updated based on the latest information from the innovative connection solutions workstream.
Key outputs from stage 3 are summarised below:

- Internal and industry processes changes
- Customer/Stakeholder reality design modelling.
- Commercial agreements with Vendors and internal procurement discussions and approvals.
- Full detailed design pack for three standardised connections.
- Construction and commissioning of enhanced connection complete.
- Full work instructions.
- Live customer online portal.
- User instructions/operation and maintenance (O&M) manuals handed over to core business.

2.3. Description of design of trials

Based on the global technology watch (stage 1) and vendor discussions (stage 2) orders will be placed for long lead time items during stage 2. The enhanced connection will demonstrate the costs and viability of the other two standardised options, as in effect they are subsets of the enhanced connection.

Design trials of the physical engineering solutions will take place during Phase 3. The plan is to build an enhanced connection system, most likely at a NGGT site which could use a standby stream such as a multi-junction to get gas flow through the skids, due to the novel nature of the equipment to be installed. An offline facility such as Eakring (NG training centre) may also be used. It is important that the connection system is tested to ensure that the full system operates as expected including all the telemetry, instrumentation and control equipment. Protech will attend Factory Acceptance Tests (FAT's) for specific, individual systems components as well as factory acceptance testing the complete connection solution which will be attended by NGGT Operations prior to delivery to the designated site.

All materials will be delivered to the Protech fabrication facility in either Ireland or Leeds. The materials will be inspected and approved for use by NGGT and Protech. Any issues with new vendors will be addressed and if changes are required to the designs these will be made. The skid mounted unit will be fully assembled at the Protech site. The costings and works instructions will be fully validated and documented. The fully assembled unit will then be transported by lorry to the chosen NGGT site and the connection will be made. The unit will then be fully tested and commissioned. Throughout the processes timings and amendments to work instructions will be recorded. The performance of the enhanced connection will be validated over the following 3 months, after which the unit will be disconnected and located into store.

After completion of the 3 month period, a full review of the whole process and design will be undertaken from material order placement to the commissioning of the enhanced connection. Engagement with the wider business is critical, along with challenge and review sessions with the distribution networks, and supplier process evaluation allowing for improvements to be identified and changes made to designs and works instructions where necessary.

2.4. Changes since Initial Screening Process (ISP)

There have been no changes since the Initial Screening Proposal.

Section 3: Project business case

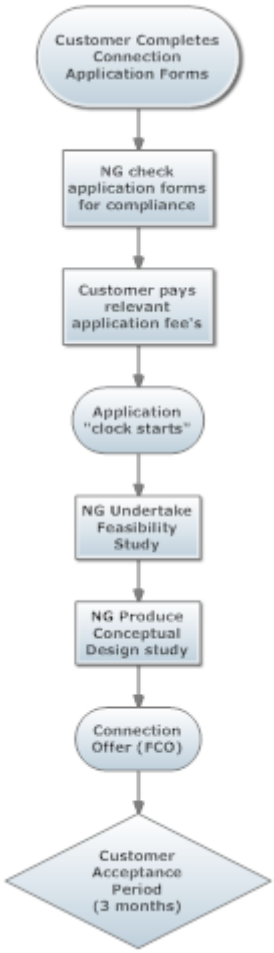
a) Background

The business case for this project is based upon reducing the cost and timing of NTS connections for unconventional gas projects. The aim is to reduce the cost from ~£2m to less than £1m and reduce the duration from three years to less than one year.

Considering the current cost of an NTS connection since 2006, approximately 14 connections have been undertaken, with costs ranging from £1.05m to £3.75m which equates to an average cost of £2.2m per connection. These costs are generally only associated with costs incurred from offer acceptance and exclude feasibility studies.

b) Existing A2O process

Current Customer connection process flow

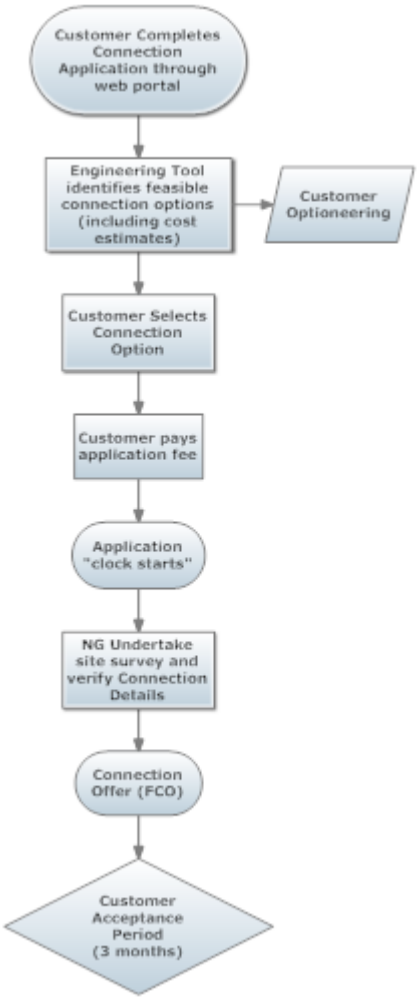


The existing connection application process is set in the Unified Network Code (UNC) and follows the A20 connection application process. The A20 process starts with a customer downloading the connection application forms from the website and submitting them back to NGGT. This starts a process, ultimately leading to the customer receiving a Full Connection Offer (FCO). There are timelines, set in the UNC which NGGT are required to adhere to.

The period from initial enquiry to full connection offer is dependent on the type of offer to be made.

- Initial Connection Offer (ICO): Within 2 months
- Full Connection Offer (FCO): Conceptual Design Study within 6 months (greenfield sites only)
- Full Connection Offer: Feasibility Study within 3 months & Conceptual Design Study within 6 months
- Total – 12 months from ICO (including 3 months customer acceptance window)

Proposed A2O process flow chart



The length of time it currently takes for a full connection offer may be prohibitive for smaller projects. As we have seen from our initial market research it is apparent that the interviewees felt that the time it takes was one of the most important aspects of a connection for their type of projects.

Using the flow chart it is clear to see that project CLoCC could significantly improve the NTS connection process. Over the short to long term this innovative approach to customer connections will significantly reduce the timescales from initial enquiry to customer connection.

c) Existing engineering solutions

Currently NGGT is required to undertake a full engineering design for each customer connection request on to the NTS and due to the high operating pressures and criticality of the NTS infrastructure, the design and engineering works that must be carried out for each connection incur significant costs associated with high pressure fittings and construction, which are passed on to the customer.

As a result of the engineering effort required to make a connection on to the NTS, the connections are designed for the maximum flow parameters required by the customer for the full design life of the connection (typically 40 years). Therefore, these connections are likely to be large to avoid additional connections or modifications to the connection once installed. This means customers who expect changes to their flow profile are more complex and costly to connect. Currently the scale of the task may put a lot of customers off applying in the first place, due to the timescales of the connection but also the cost of the connection.

Although each connection is optimised to the specific flow and pressure parameters specified by the customer, connections are likely to share many attributes with the designs from other customers; hence this innovation project offers the scope to develop standardised off the shelf designs not currently available for high pressure installation.

The current process is perceived as complex and time consuming. This may discourage enquiries/applications and also may put customers off before they've even enquired. In some cases potential customers may not be aware of the potential to connect in existing NGGT assets; hence reducing costs and timescales for a connection. The introduction of a visual online portal will eliminate these problems, providing customers with a simple guide to the connection process.

d) Customer benefits

Based on government projections for the potential of shale gas in the UK which could amount to 32 bcm per year in 2035, this is likely to require approximately 100 connections to the gas networks. The majority of these are likely to be medium or high pressure connections. Assuming there are 50 connections to the NTS leading up to 2035 and we can achieve the aim of this project we should be able to save approximately £1m on average per connection. Therefore based on shale gas connections alone customers should be able to save £50m over the next 20 years which may in turn result to the reduction in end consumer costs.

As previously stated, NGGT have undertaken preliminary market research (sample customer questionnaire can be found in Appendix E) to fully establish what aspects of the connections process are of value to unconventional gas customers. Eight gas customers, who were generally developers of either biomethane or shale gas have been contacted either via a teleconference or face to face interview. During the interview we explored the future requirements of our customers, to understand what they see as key enablers from National Grid for an effective unconventional gas industry going forward. This is to ensure our project deliverables are aligned to the future needs of our customers and their views are considered when shaping the scope of our project.

Generally customers were very supportive of this innovation project and letters of support can be found in Appendix G.

We also held face to face discussion and telephone interviews with each of the gas distribution network companies to understand the challenges faced on the lower pressure networks and any consequential changes to connection solutions and processes.

From this limited market research on unconventional gas connections, customers stated that over the next 5-10 years they considered that there would be over 150 projects. Of these, 18 were attributed to shale gas, with the majority Compressed Natural Gas (CNG) vehicle, gas engine and biogas related.

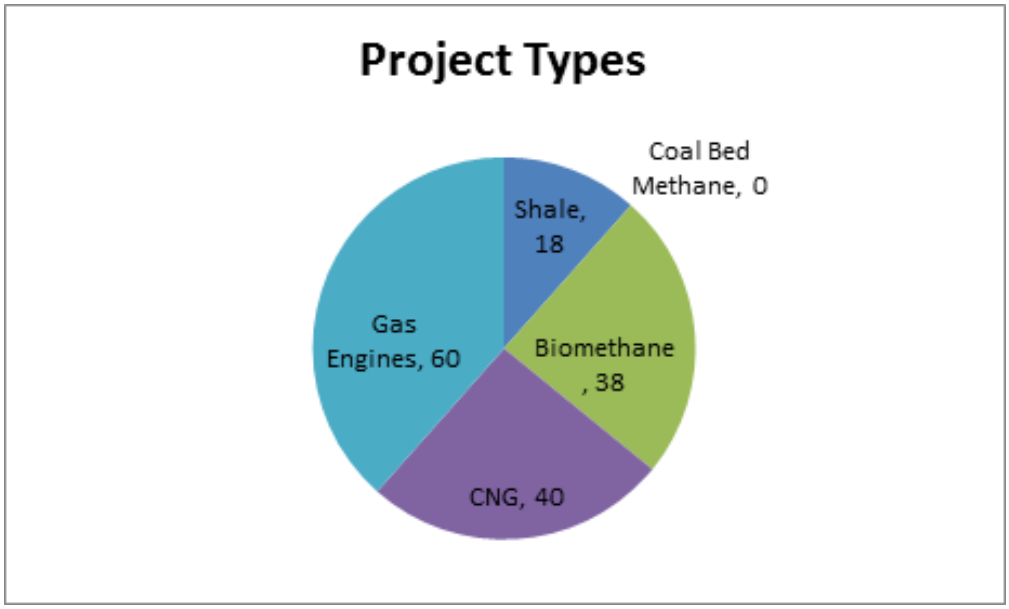


Figure 6 – Customer project type (5-10 year forecast)

Assuming CLoCC achieves its objectives we would anticipate some of the larger vehicle and/or biogas projects will connect to the NTS. We have therefore included an additional 50 NTS projects and assumed a similar level of saving of £1m.

Therefore over a 20 year period we anticipate savings in the region of £100m against a project cost of £5.43m**.** Given the level of potential supplies of unconventional gas being forecast, it is important that the project is started as soon as possible. As the connection of indigenous sources such as shale gas over the transportation of LNG would save in the order of 5g CO_2 equivalent per mega joule of natural gas[2] and as shale gas supplies could reach up to 32 bcm per year by 2035, the energy equivalent of natural gas equates to 1264 billion mega joules. So if the indigenous gas replaced 100% of the imported LNG, this would represent a saving of 6 million tonnes CO_2 equivalent per year

It should be noted that the cost of an NTS connection is currently fully paid by the connectee and NGGT does not place a margin on the connection. Therefore there is no direct financial benefit to NGGT of reducing connection costs. From a consumer perspective, the benefit will be seen through more indigenous gas being commercially available and thus exerting downward pressure on gas prices and improving security of supply. In addition the reduction in the upfront connection cost should also be reflected within the associated gas cost.

The mandated NIC costings spreadsheet can be found in Appendix A with the benefits spreadsheet at Appendix B. A summary of key figures per year is below:

Year	Cost(£k)
2015/16	220.67
2016/17	1393.56
2017/18	2380.48
2018/19	1439.11
Total Project Cost	**5433.82**

The NIC bid preparation costs are likely to be in the region of £175,000 which will be funded through NIA bid preparation costs, and include bid preparation and procurement costs. The project will be subject to robust project management practises, including a stage gates process throughout. NGGT will establish a Project Management team with the other project partners and appoint a Project Manager to ensure the project is delivered to time and to budget.

The following table illustrates the project spending at each stage against each of the three project work streams.

[2] http://www.theccc.org.uk/wp-content/uploads/2013/04/Reducing-carbon-footprint-report.pdf

	Timeline	Optimised Commercial Processes	Innovative Connection Solutions	Visual Online Platform	Total
Stage 1 - Market Assessment, Global Tech Watch and Feasibility Studies	**7 Months**	£140k	£300k	£200k	**£640k**
Stage 2 - Conceptual Design and Change Plan	**9 Months**	£220k	£630k	£300k	**£1,150k**
Stage 3 - Detailed Design, Build and Test and Business Readiness	**18 Months**	£350k	£2,650k	£680k	**£3,680k**
Total		**£710k**	**£3,580k**	**£1,180k**	**£5.5m**

Three separate stage gate reviews will be held following the completion of each of these project stages. These review sessions are required to ensure the project has reached the expected output, not just in terms of cost and programme, but also to ensure we maintain our stakeholder focus throughout the entire duration of the project.

4: Benefits, timeliness, and partners

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing Customers.

This project will maximise the potential to fully support the development of future indigenous gas sources. Additionally, the project, if successful will allow new types of exit connection (such as to facilitate Compressed Natural Gas projects) to be supported.

Although shale gas, like other forms of gas, cannot be regarded as a low-carbon fuel source, the use of shale gas, however, will have lower lifecycle emissions than imported liquefied natural gas (LNG). The connection of indigenous sources such as shale gas over the transportation of LNG would save in the order of 5g CO_2 equivalent per mega joule of natural gas[3] and as shale gas supplies could reach up to 32 bcm per year by 2035, the energy equivalent of natural gas equates to 1264 billion mega joules. So if the indigenous gas replaced 100% of the imported LNG, in this scenario, this would represent a saving of 6 million tonnes CO_2 equivalent per year, contributing towards the Government target of reducing greenhouse gas emissions (from the 1990 baseline) by at least 80% by 2050.

In terms of biomethane, there are currently around 27 projects injecting biomethane to the distribution networks, with more due this year (forecast to be around 50 by the end of 2015). Additionally there are biogas projects which have not connected to the Distribution Networks as it has not been feasible for them to make such a connection. This has been either due to the proximity of the distribution network to the project (they are too far away or there are river or road crossings proving a difficulty for such a connection) or that the distribution network could not support the level of flow that the project was seeking, usually due to insufficient demand in summer months on the distribution network to accommodate their desired flow rate. For some of these cases, the NTS is located very close to these projects and therefore if an option to connect to the NTS could be developed which was cost effective and timely for these projects then customers would prefer to choose this option rather than their only alternative option at the moment which is to generate electricity through CHP. Therefore it is important that the option to facilitate such connections is implemented as soon as possible.

Biomethane is expected to become an increasingly important element of the nation's future energy strategy, helping to meet environmental targets while reducing reliance on gas imports. The production process for biomethane is considered to be a 'green' technology that has a small carbon footprint, as it makes efficient use of existing materials that would otherwise go to waste. Injecting biomethane into the grid is more energy efficient than using the gas to generate electricity. Around 90% energy is retained through grid injection, but just 30-35% when combusted to generate electricity. Combustion also leads to the escape of methane into the air, which contributes to the build-up of harmful greenhouse gasses.

Because of the environmentally friendly production process, the UK government has identified biomethane as an important part of the national energy mix, and has allocated generous tariffs for the supply of this gas into the network. It is anticipated that the adoption of biomethane will help the UK meet its 2020 commitments to supply 15% of energy demand from renewable sources.

[3] http://www.theccc.org.uk/wp-content/uploads/2013/04/Reducing-carbon-footprint-report.pdf

The Government also released a report in 2014, issued by the Low Emission HGV Task Force[4] stating that HGVs account for 21% of surface transport CO_2 emissions, 28% of NOx emissions and 16% of particulate matter emissions. Alternative fuels such as CNG or biomethane are far less polluting than conventional fossil fuels (such as diesel) and therefore substantial environmental savings could be realised from greater use of these technologies.

Part of their report included a case study of Howard Tenens, one of the largest privately owned logistics companies in the UK, which showed that a dual fuel vehicle operating on CNG saves up to 15% CO_2 compared to an equivalent diesel vehicle, and up to 60% if operating on biomethane. Introducing dual fuel vehicles into their fleet was instrumental in driving down the company's carbon footprint. In 2011-12 the company saved just under 1,000 tonnes of CO_2 due to its dual fuel fleet, equivalent to an 8% reduction in overall fleet emissions. Therefore if CNG or biomethane powered vehicles were to be more widely adopted in the UK, the environmental savings could be considerable.

(b) Provides value for money to gas/electricity distribution/transmission Customers

As described above we anticipate that there could be approximately 50-100 NTS connections over the 20 years. Reducing the costs of these connections by approximately £1m per connection will directly benefit the customer connecting to our network. This saving should be passed through to consumers through lower gas prices. In addition, we anticipate due to the lower cost of connection more projects will be viable and inject gas into the gas grid, this should mean that more indigenous gas is available putting downward pressure on gas prices and improving security of supply. To highlight the potential benefit, 32 bcm of shale gas per year would equate to 41% of predicted annual demand in 2035, therefore the impact of this would be very significant.

From our initial market research we have seen that some projects have recently connected to the local transmission system (LTS >7bar) on the distribution networks. By connecting to the LTS the customer has not been required to add propane to meet the statutory calorific value limits. Although a connection to the LTS is more expensive than that to a lower pressure tier, one customer confirmed a saving of approximately £350k through eliminating the requirement to inject propane. This saving would mean the connection would effectively pay for itself within 2-3 years. We would expect that the same would be true for connecting to the NTS – i.e. it is most likely that there wouldn't be a requirement to inject propane to biomethane.

Another example project from the LTS network uses a blending service, so no propane needed to be added by the customer as the connection was into an existing above ground installation (AGI) on their 42 bar network so commingling was possible – again we would expect the same to be true for the NTS. Therefore a major benefit of connecting to the NTS over the lower pressure tiers is the potential removal of the requirement to add propane. Whilst not yet definitive, given the flows through the pipelines and the volume the customers want to inject it should be possible to remove the necessity of propane injection. An additional benefit of the NTS over the lower pressure tiers is that there is no need to add odorant (as this is absent on the NTS), so there is an additional saving on operating costs.

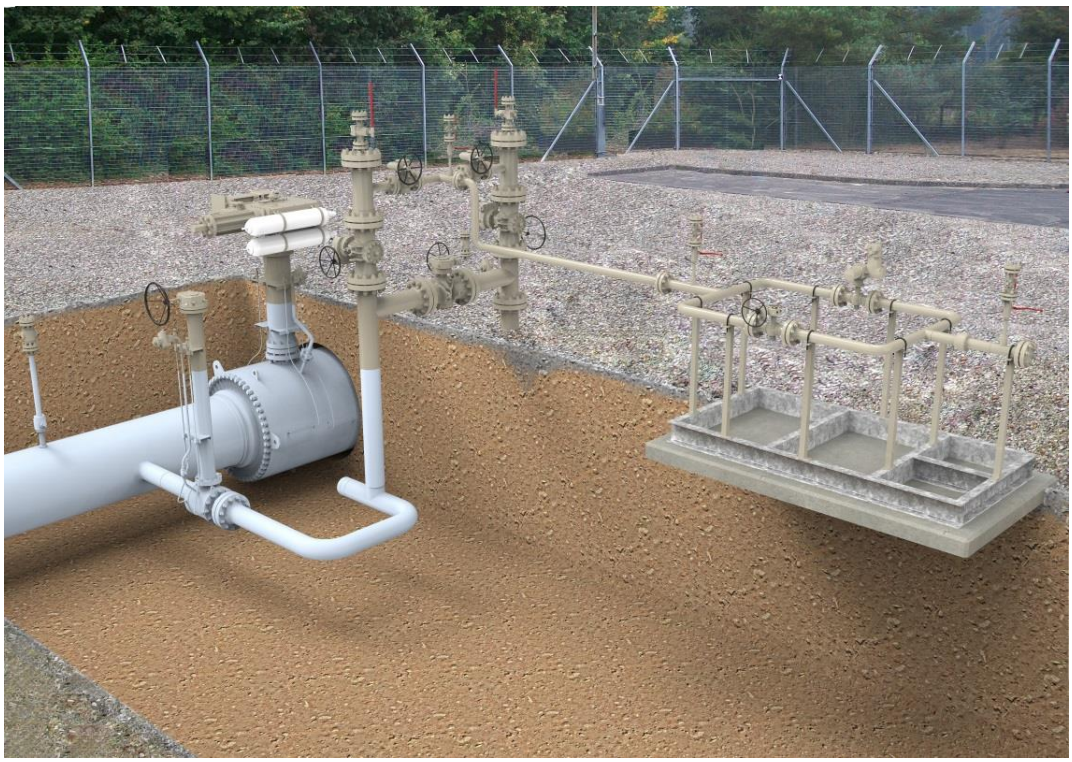
[4] For details see https://www.gov.uk/government/publications/low-emission-hgv-task-force-recommendations-on-use-of-methane-and-biomethane-in-hgvs

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness

To enable NGGT to deliver a connection service for under £1m and in less than one year requires us to innovate at every step of the process. Key areas of innovation are:

- **Off Site Construction – Above Ground Installations**: The duration of a connection project from inception to delivery is an extremely significant contributor to overall project costs. Therefore the project CLoCC concept is to minimise below ground on site construction and move to above ground, skid mounted units acceptable to Planning Authorities, which can be preassembled, delivered to site, built, commissioned and tested in a very short timeframe. So far in our global technology watch we have not found any products off the shelf that operate at high pressure suitable for this task. The upfront assembly of an above ground skid unit will allow the vast majority of work to be done offsite and we would anticipate being able to undertake the physical site work within days rather than months i.e. a plug and play system. The key benefits of this approach are[1]:
  - Shorter build times; minimal requirement for civils work onsite
  - Improved quality; Controlled build environment with all snagging and testing completed offsite.
  - Reduced environmental impacts; minimising excavations, land take and risk of pollution. Waste will also be controlled offsite including hydrostatic (pressure) test water.
  - Less noise and local disruption
  - Fewer operatives, machines and construction equipment onsite
  - Reduced project costs
  - Reduced health and safety risks by minimising work on site

  Overall though this innovative technique, we would target at least a 50% reduction in the mains works contractor costs, in addition to the other associated benefits described above.



- **Customer Visualisation:** Reducing the processing time and directing customers appropriately, we are aiming to develop a visual online portal that identifies the best option based on grid co-ordinates and where possible removes the need to undertake network analysis – typically the network analysis part of the connection process can take up to 3 months and cost up to £25k. Implementing the use of building information modelling (BIM) software within the visual online portal - pegging datasets such as cost to 3D images will allow the customer to visualise a suitable connection option.

- **Wireless Field Instrumentation/Telemetry:** This technology enables the quick and easy installation of instrumentation, reducing civil infrastructure costs by eliminating the need to install instrumentation and electrical ducting across sites. Examples include the Emerson Smart Wireless and WirelessHART technology range which provide a suite of field instrumentation equipment which can be installed wirelessly, without the need for cabling and associated civil infrastructure and ducting. As a result of its wireless characteristic, this technology also provides the flexibility and scalablility to expand or reduce the system to meet customer needs.

- **Solar powered valve actuation:** Paladon's range of solar powered valve actuator systems provide a self-contained actuation (power) solutions which include solar panels and battery backup to meet individual valve actuation requirements even with a period of up to 7 days without sunlight. Renewable power sources for valve actuation eliminates costs in the region of £40k for electrical grid connections and also reduces civil infrastructure costs by around £10k by eliminating the need to install electrical ducting and draw pits across sites.

- **Gas Quality:** The initial global tech watch identified a number of innovative solutions. The Emerson Cascade CT5800 utilises laser technology to detect up to 20 gases and is a compact gas chromatograph which requires no reference or utility gas. This technology provides gas analysis within seconds as opposed to the industry standard 4 minutes. The Gas PT from Orbital is a small compact device which can be mounted directly to a sample probe and can be installed and operated quickly and easily, with no additional infrastructure or civil works. The Siemens SITRANS CV gas chromatograph has been specifically designed for natural gas and bio-gas and has been developed to cope with extreme locations such as off-shore platforms where it can be mounted directly on to pipework. A conventional gas analyser (with all ancillary equipment) cost up to £250k, whereas for novel solutions identified in the GTW, such as the Gas PT and Cascade 5200, we would anticipate costs in the region of £50k.

As part of the Project CLoCC full GTW/best practice review we will be further exploring the following areas identified in the initial GTW and focussing on innovative solutions for the following:

- Under pressure Connections (Hot Tap)
- Flow monitoring / measurement
- Gas Composition Analysis
- Other treatments e.g. gas conditioning / clean up and compression.
- Hub technologies e.g. solutions supplementary to those listed above that are suitable for centralised processing and connection facilities where a number of gas suppliers utilise a single facility to share the cost of expensive equipment or a connection.

The business case for NGGT is unproven as there is no direct financial benefit of NGGT pursuing this project; connection are cost pass through - NGGT do not make any margin and the connection is paid in full by the customer, therefore there is no direct benefit to National Grid. From an overall customer perspective the business case is sound – with potentially £100m of savings. However, it would be unattractive for an individual customer to fund this project as there are a number of innovative risks which would mean the timescales could not be guaranteed and not all aspects of the project would be relevant to the specific customer. This is in addition to the increased costs of this project compared to a conventional connection. Therefore this project enables NGGT to develop standardised offerings and build an enhanced connection to prove that these challenging goals are attainable. Without this project NGGT would continue to improve its processes and engineering solutions, but on an incremental and customer specific basis, this project provides NGGT with the opportunity to make a large leap forward that will benefit customers and the wider gas industry. Additionally, NGGT do not have any regulatory allowances to investigate and trial new approaches other than through the Network Innovation Allowance (NIA) and Network Innovation Competition (NIC).

Upon successfully completion of Project CLoCC NGGT will continuously drive improvements through 'Performance Excellence'. Performance Excellence is about changing the way we work, understanding and improving our end-to-end processes and removing waste and blockers to deliver the best possible solutions for our customers. Performance Excellence is a standard approach to finding better ways of working, to improve the safety and service we give our customers and create value for stakeholders. This approach enables employees to understand where they fit into, and their impact on, our End to End Processes and provides a structure to identify opportunities to improve the way we work.

Project CLoCC will be providing new connection options both commercially and technically that will need to be managed closely by our connection team. As the project is handed over into business as usual, the Performance Excellence approach will be applied and if any blockers or process improvements are identified, options will be considered and solutions deployed as appropriate. This drives a culture of learning from best practice and a drive for continuous improvement for both our employees and customers to ultimately drive efficiency and cost reduction to our processes.

(e) Involvement of other partners and external funding

The initial partner selection process started with the identification of priority themes relating to gas transmission which would be suitable for the 2015 NIC submission.

A workshop was held where all of the different aspects of the gas transmission business were represented (Asset Management, Market Operations, Safety, Sustainability and Resilience, Capital Delivery, Transmission Network Services and RIIO Delivery) from which ten themes were identified:

- Unconventional gas
- Outage minimisation
- Zero emissions compressor station working towards a zero emissions NTS
- Alternative pipelines materials and construction methods
- Facilitation of highly flexible power plant
- Full lifecycle management of materials
- Information to end customer "best way to heat your house"
- Third party interference
- Asset health and intelligent asset management
- Sensors/non-destructive testing

These themes were published on the NGGT website and circulated via email to all the NGGT innovation contacts and via LinkedIn. Ten proposals were received from various innovation partners and these were compared and scored against the NIC criteria and NGGT's innovation strategy. This proposal was the successful candidate.

At this stage, the following three partners have been identified:

Premtech Limited: Premtech's primary focus is to provide engineering, consultancy and design management services for onshore pipeline and associated installation projects of all sizes. As a UK-based SME Premtech are able to work closely with clients which include almost all of the major UK Gas Distribution Network owners/operators as well as NGGT. In addition to the professional services listed above Premtech have been instrumental in delivering a number of innovation projects for NGGT, the most significant of which being the Building Information Modelling (BIM) Demonstration project and the Gas Robotic Agile Inspection Device (GRAID) Project. Other projects include renewable Power for Installations, Pigtrap Door Seal Study and Direct Replacement Pre-heat Package (DRPP).

Protech Limited: Is an engineering consultancy with experience of engineering projects from the feasibility/conceptual stage through to the detailed design, with the majority involving natural gas processing and transportation. Protech will bring process design experience in unconventional gas field development, gas storage, gas treatment and bio-gas processing to the project.

Aqua Consultants: Aqua will provide commercial modelling, programming and develop the web based engineering platform. Aqua Consultants, in conjunction with the water utility companies, has been the sole consultant developing the software platforms for the water industry. The development of these software platforms has been ongoing for the last four years, culminating in the platforms being implemented as "business as usual. Aqua has gained invaluable experience and knowledge from this development programme; Furthermore, the Aqua team has wide experience in High Pressure gas industry, with key team members having extensive knowledge of the National Transmission System.

The diagram below illustrates the number of companies and organisations who are involved in some way with this project. You will also note that there are stakeholder letters of support in Appendix G.

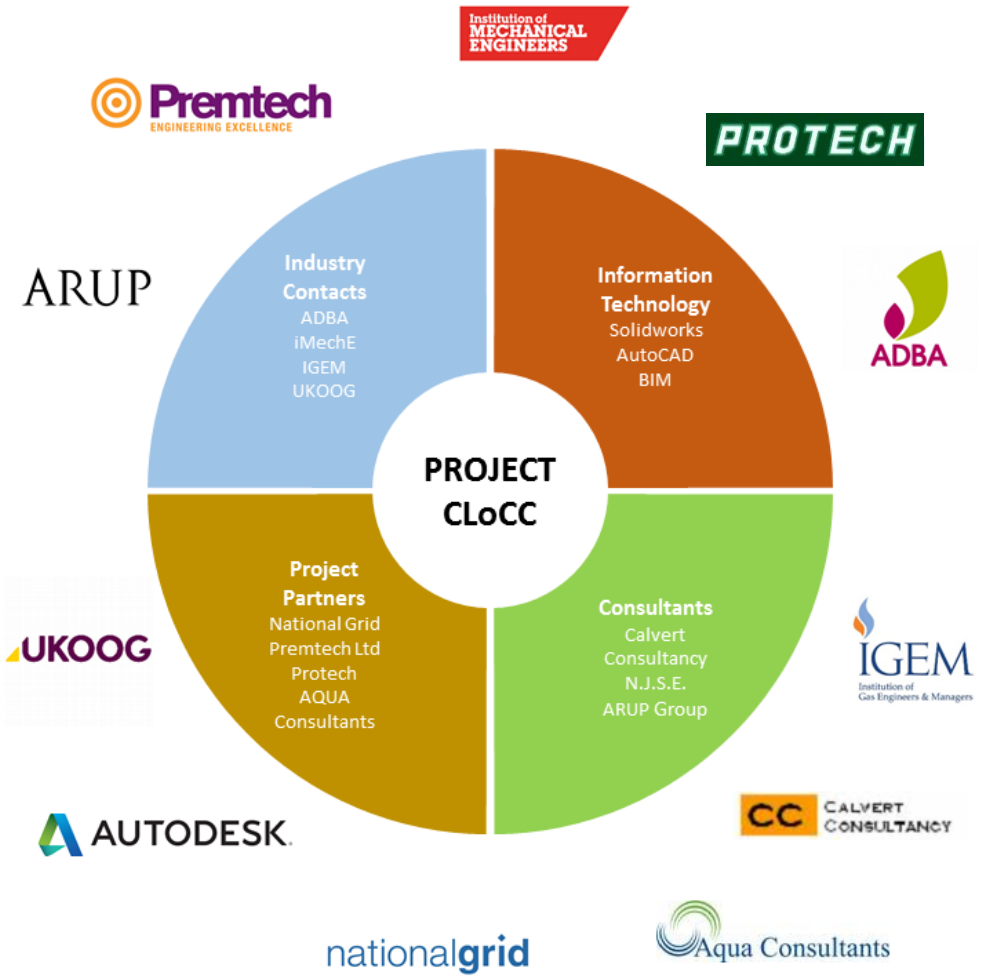


Figure 8 – High level stakeholder view

(f) Relevance and timing

Given the level of potential supplies of unconventional gas being forecast, it is important that the project is started as soon as possible. The biomethane entry type of project is very dependent on the level of the Renewable Heat Incentive (RHI) tariff it will receive. The current form of this scheme provides a guaranteed income over a 20 year period and unlike the Feed-in Tariff does not include any pre-accreditation process. Such projects will therefore only secure the RHI tariff when gas flows commence. Additionally, as annual budgets for the RHI are fixed, the actual level of the tariff offered is subject to a quarterly degression mechanism which depends on the take up under the scheme. It is therefore important for any biomethane project to secure its connection as soon as possible and therefore the timing of this project is very important for these type of project.

Similarly for the shale gas type of entry projects, it is imperative that a connections regime is developed which will ensure that these type of project can be accommodated in a timely manner so that a full assessment of the potential of any well can be made.

Given current Government policy regarding emissions reductions and the commitment to increase the energy security in the UK, it is clear that there will need to be a dependence on these newer sources of gas. A number of the industry agreed Future Energy Scenarios[5] (FES) have a significant portion of indigenous gas (such as biomethane or shale gas) being forecast to be needed to ensure that demand for gas can be met in the UK into the future.

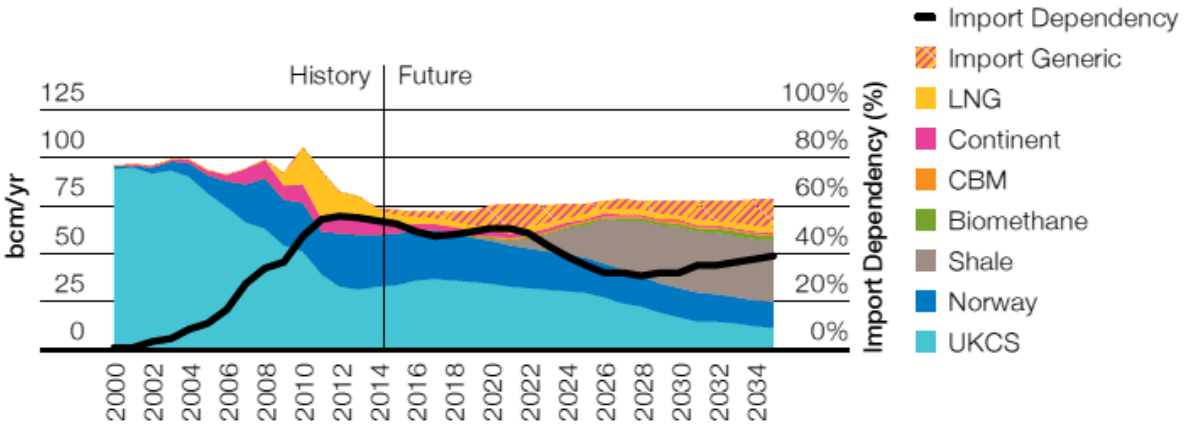


Figure 9 – Annual supply pattern in 'Low Carbon Life' scenario

The scenario above illustrates a definite increase in the percentage of demand satisfied by onshore unconventional gas (mainly shale and bio-methane), demonstrating the need for investment into the networks which will be responsible for transporting this gas around the UK. Working closely with suppliers and those involved with writing the FES will ensure that the project is at the forefront regarding prospective new and unconventional gas supplies.

Future energy scenarios, combined with our customer research has identified there are customers currently resorting to using gas in power generation projects due to the cost and time of an NTS connection. Based on the above, there could be over 100 shale gas connections over the next 20 years, on top of biomethane connections and vehicle refuelling connections. Waiting any longer or trying to do this in an incremental way through business as usual will result in lost opportunities and sub optimal projects.

[5] http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Future-Energy-Scenarios/

Section 5: Knowledge dissemination

5.1. Learning generated

This project will deliver significant opportunity for knowledge dissemination across NGGT and the gas distribution networks as summarised below:

Global technology watch: The CLoCC project team have undertaken a global review of the technologies associated with connecting on to the National Transmission System, this includes conducting research on potential unconventional gas types and customers. The review contains a detailed and systematic analysis, not only of standard equipment found on connections but also novel equipment which, although not yet approved by Ofgem, has the potential to radically reduce the cost associated with a simple connection which in turn can be disseminated amongst the distribution networks and developers.

New standards and processes: These will be designed specifically for the connection of unconventional gas into (or new types of offtake from) the NTS. It is envisaged that there will be aspects of the project which will be directly applicable to the more conventional customers of the NTS and therefore the project should also have benefits for these types of customer. The new ways of working which the project will establish may also provide input into other activities on the gas transportation system such as for diversions or for maintenance activities.

Standardised connection regime: An outcome from our initial bid preparation market research has emphasised that it would be much easier for potential customers if there was consistency applied across all the Gas Networks (particularly regarding the standards needed for gas injection, the timelines and costs for connections) as this is not currently the case. This project seeks to challenge current industry standards and innovatively lead the way for all network licensees.

Standardised designs: The project will produce 'off-the-shelf' standardised designs for connections that can be used regardless of the customer, size of connection or type of gas. These will be developed through a full design process that incorporates a number of challenge and reviews and appraisals, ensuring that the solution is appropriate for a range of situations. A standardised approach to designing connections should also make managing them easier. Operations and maintenance staff would benefit from working with the same arrangements on each site that are designed with consideration paid to the maintenance required and functionality expected. Working on the code compliance alongside the technical elements allows the project to test the boundaries of the current process, assessing where technical innovations can be made that possibly weren't considered prior to this. Meaning that flexible and scalable solutions can be developed that would fundamentally change the approach to a connection. Current connections on the NTS are not designed to grow or shrink dependent on demand but this project will trial a solution that can do this to fully understand the benefits along with any limitations that may be associated with it.

Customer confidence: Along with increasing the knowledge of those who work closely with the NTS this project will look to assist customers, particularly those with little gas knowledge, connect onto the network. Being able to select a preferred method of connecting would allow them to assess the most appropriate connection for both their requirements and their budget. Small customers have many barriers when connecting onto a gas network, a number of these can be alleviated by removing some of the design challenges and providing a wider number of options we can assist them in identifying the optimum solution. This may give customers more time and resources that can be dedicated to other tasks such as tailoring the design for their chosen site or connection method. Not only does this increase the customer's confidence but it would also give the gas transporters further assurance that the designs will be suitable for the connection

requested. Outside of the typical connection the project is also due to explore a technical solution that would solve or at least mitigate the issue of smaller customers being unable to get gas to the NTS due to the high costs and timescales in comparison to their gas flow rates and expected benefits. A 'hub or 'collector system' will be fully detailed which would potentially allow the cost to be shared amongst multiple parties, the learning from this could lead to the development of real 'hub' sites in the future.

It is anticipated that the knowledge gained from the project will be directly of benefit to all the gas transporters, particularly with respect to their higher pressure networks, therefore the project will ensure that all the learning is shared openly and proactively with the gas distribution networks particularly where they are facing similar commercial and technical challenges.

Alongside these benefits there are a number of ways in which the project can aid the wider gas industry going forward. Through training and documentation the project can provide further industry knowledge, both from customers and international partners, as to what future gas types can be expected on the network. These connections can be used for potentially any homogenous connection regardless of the gas origins or the size of the pipe and carrying out this design work for high pressure pipelines will undoubtedly offer a better understanding of how connections could be provided faster and at a lower cost for lower pressure pipelines around the UK. This could have an impact not only on new customer connections but also on maintenance, diversions and other operations that require either a permanent or temporary connection onto a feeder.

A number of stakeholders, both internal and external to NGGT will have an interest in the project data, knowledge and learning which falls out of this NTS connections project, these will include:

- Premtech
- Protech
- Aqua Consultants
- IGEM (Institute of Gas Engineers and Managers)
- All Gas Distribution Networks – [the learning from this innovation project can potentially benefit not only the UK lower pressure distribution networks but also gas networks globally]
- Gas shippers
- Existing NTS customers
- Ofgem
- GIGG (Gas Innovation Governance Group)
- The Energy Networks Association
- NGGT staff, contractors and Direct Service Developers and Manufacturers
- Office of Unconventional Gas and Oil (OUGO)
- All Party Parliamentary Group on Unconventional Oil and Gas (APPG)
- Anaerobic Digestion & Biogas Association (ABDA)
- UKOOG (UK Onshore Oil and Gas)

5.2. Learning dissemination

Ultimate responsibility for knowledge dissemination and learning will lie with the Project Manager and the project team. As such the project manager will produce a sound communications plan which will include knowledge and learning dissemination procedures both internally and externally. In addition to this, the three prominent partner companies (Premtech, Protech and Aqua Consultants) will also have a role and will contribute to the dissemination of knowledge as well as learning from the project.

Learning dissemination will be extensively laid out in the Project Communications Plan which will be written by the Project Manager as part of the comprehensive Project Plan. This will include:

- **Challenge and review sessions with the distribution networks:** From our initial engagement with the distribution networks we are seeing an increased interest in connections at higher pressures. We aim to hold a challenge and review session following the completion of each project stage as follows:
  - Stage 1 completion challenge and review – 19/07/2016
  - Stage 2 completion challenge and review – 24/04/2017
  - Stage 3 completion challenge and review – 04/04/2018

- **Networking events/industry conferences/seminars:** Specific events which the project team will attend and potentially present to are:
  - IGEM Section Events (Presentations) – Various dates during 2016/17
  - PIG Section Events (Presentations) – Various dates during 2016/17
  - Low Carbon Networks & Innovations Conference – 24-26 November 2016
  - Shale World UK Event – 18th May 2016
  - Project CLoCC hosted events - Various dates during 2016/17

- **Specific publications which the project manager will target are:**
  - Gi Magazine – IGEM
  - PE (Professional Engineering) Magazine – IMECHE
  - Pipeline and Gas journal
  - Pipeline Industries Guild (PIG)

- **Web based sharing techniques:** A project Website will be developed and launched. This will allow the facility for all interested parties (both internal and external) to register their interest in the project. An update newsletter will be released and published on the website every 6 months. This update will report project progress, risk/issues, key findings to date and news of any event where the project will potentially be presented.

5.3. IPR

The project will conform to the default IPR arrangements set out in section 9 of the NIC Governance Document (publication date 2nd April 2015).

Section 6: Project Readiness

6.1 - Evidence as to why the project can start in a timely manner

Both NGGT and its partner companies Premtech, Protech and Aqua Consultants have carried out a number of activities to ensure that Project CLoCC is ready in terms of project management procedures. The following management systems and preparatory work has already been implemented:

Customer Engagement: As previously noted, connections to the NTS were generally required to support large sized projects which would be either entering or off-taking gas over a long period of time. More recently however, customers are now approaching NGGT with a view to connecting much smaller or shorter term projects to the NTS.

NGGT has undertaken a small survey to enable us to find out what aspects of the connections process is of value to these projects whilst capturing feedback regarding issues with the existing NTS connection process This has therefore enabled us to gauge interest in changes being developed to the NTS connections regime and particular customer's requirement which could then feed into project development in order to make it more appealing to these projects and consequently has provided additional justification for this Innovation project being proposed.

A questionnaire was designed (Appendix E) to enable us to compare the number and the needs of the different projects which may wish to connect to a Gas Transporter over the next 5 to 10 years. Telephone interviews were held with potential customers who were generally developers of either biomethane or shale gas projects. In addition, the views of a leading consultancy (involved in helping bring such projects to market) and of a trade association were also sought. As part of the questionnaire, we considered what aspects of a connection to a Gas network would be important to potential customers. Here is a summary of the findings showing the importance they attached to each of the various criteria as an overall average score where 5 is most important and 1 is least important:

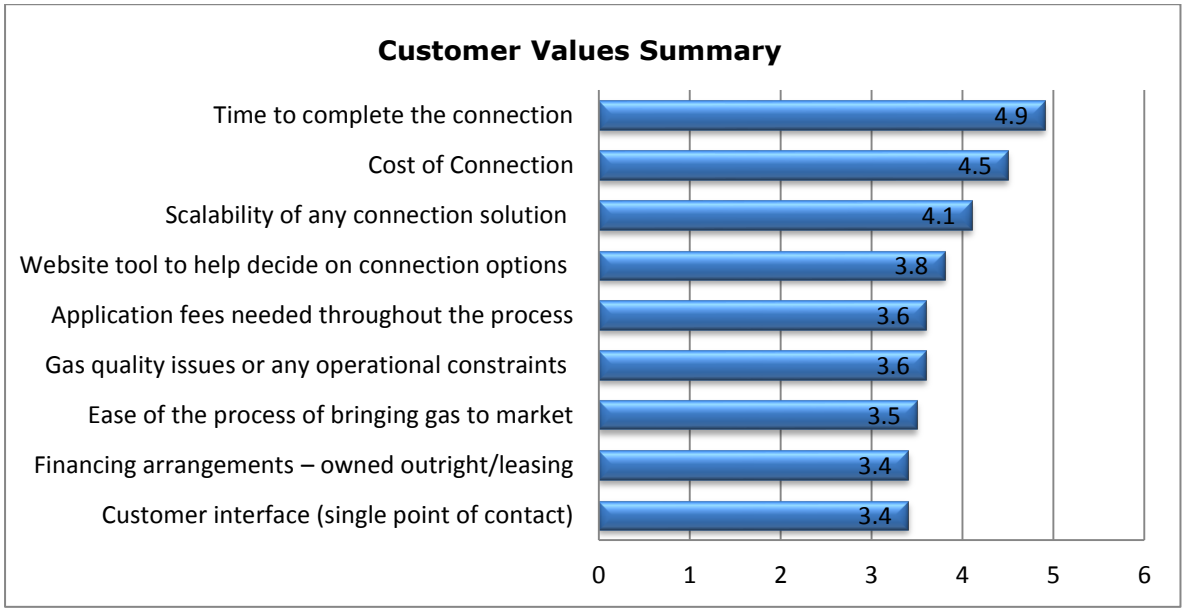


Figure 11 – Customer values graph

From this summary it is apparent that the interviewees felt that the time and the cost were the two most important aspects of a connection for their type of projects. For the biomethane type of projects (which are reliant on funding mechanisms under the Renewable Heat Incentive (RHI)), the timeliness or more precisely the predictability of the time for any connection was paramount as the tariff under the RHI is only secured once gas flows commence. Additionally, as annual budgets for the RHI are fixed, the Government needs to ensure that the scheme stays within budget and therefore the actual level of the tariff offered is subject to a quarterly digression mechanism which depends on the take up under the scheme. It is understood that the current form of the RHI is only agreed until April 2016 and therefore the development of any biomethane projects in future will be dependent on the exact form of the scheme in future and the potential level of the tariffs.

Interviewees also felt that the scalability of any connection solution was an important feature. Currently the connection assets are designed to cater for the full production flow rates of any project and the cost and complexity of the connection are driven by these full production figures. However, the cost and timescale to support this can be prohibitive if it is not entirely certain whether the project will progress or that it will indeed produce gas at the initially conceived rate. Therefore a connection process which could be scalable as the project progresses and grows would allow the exploratory phases of projects to be supported at a reasonable cost level before the commitment to support full production levels was needed to be made.

For projects which have already established where they wish to connect, the potential to offer a website tool to aid the process was not seen to be that important. However, for projects which are still at the exploratory phase (or indeed to support any future project developments), interviewees were very interested in this option as they saw that it would be a very useful facility to help them through the process.

Interviewees generally felt that the customer values which had been identified as part of the questionnaire covered most of the aspects of a connection which was of importance to them. However, one interviewee noted that it would be much easier for potential customers if there was consistency applied across all the gas networks (particularly regarding the standards needed for gas injection, the timelines and costs for connections) as this was not currently the case. As one of the benefits of any project undertaken under the Network Innovation Competition is to facilitate the generation of knowledge which can be exchanged between Network Licensees, we see the development of such standardisation relating to the approach to connections as being a direct benefit of undertaking this project.

All parties interviewed were interested in the outcome of the potential project and several parties were willing to work with NGGT as part of the Innovation project.

Distribution Network Engagement: Distributed Gas[6] is a term used by the DNs to cover coal bed methane, shale gas and biomethane. Each DN has its own documentation relating to how it will connect such gas (some DNs only consider bio-methane) and these broadly align. They follow an approach which was jointly developed by the DNs in 2012 as part of Ofgem's Energy Market Issue for Bio-methane Projects[7].

[6] The definition of Distributed Gas in St Sp C D20 is given as "means gas that is injected into the network by means of a connection to the distribution network of the licensee that is not an NTS exit point (within the meaning of the UNC)"
[7] For details of the functional specification for injection of bio-methane into a GDN of see http://www.gasgovernance.co.uk/sites/default/files/EMIB%20Appendix%203%20%20Functional%20Specification.pdf

As part of the NIC bid development NGGT has held initial meetings with National Grid Gas Distribution, SGN, Wales & West Utilities and Northern Gas Networks between the 18th May and the 18th June. In these meetings we went through a structured questionnaire to understand their processes, costs, technologies and demand for biomethane/shale/biogas type projects onto the distribution network. This activity has also enabled NGGT to understand whether or how the learning from this innovation project would be of help to the distribution network and sharing our intentions as part of Project CLoCC. In these discussions there was significant interest from all the networks in the solutions we intend to develop that they could potentially utilise.

We have letters of support from each of the GDNs, and all would like to be kept up date of project developments and to be engaged over the life cycle of the project. The Project CLoCC bid team will be presenting and participating in a workshop with the GDNs on connecting renewables to the gas grids as part of the Low Carbon Networks and Innovation (LCNI) conference in Liverpool in November 2015. Over the project lifecycle, the programme of works will involve specific engagement with the GDNs at stage gates and will also be considered as part of the wider communications plan and knowledge dissemination strategy.

The Distribution Networks will be consulted throughout the entire lifecycle of the project. There will be an initial opportunity for the Distribution Networks during the first challenge and review session planned for 19/07/2016.

These challenge and reviews sessions will be structured as a 1/2 day workshop where all the Distribution Networks will be invited. We will present our information of each stage and offer up the chance for the Networks to challenge/comment. The product of these sessions will subsequently feed into the following stages of the project and contribute to the overall dissemination of learning amongst the Network Licensees.

Global Tech Watch (GTW): The CLoCC project team have undertaken a global technology watch of the technologies associated with connecting on to NTS, this includes conducting research on potential unconventional gas types and customers.

The purpose of a GTW is to ensure that there are no existing solutions and therefore prevent unnecessary duplication of solutions. Premtech have undertaken the GTW by carrying out a detailed analysis of technology that may already exist that could be used for all aspects of the initial scope.

Initial scope:

- Gas Types.
- Modular Skids for Gas Processing.
- Customer Engagement.
- Methods of Connecting to Gas Networks in the UK.
- Hot Tapping
- Flow Monitoring Equipment.
- Analysers and Gas Quality Equipment.
- Processing Skid Arrangements.
- Hot Taps.
- Gas Conditioning Processes.
- Gas Compressors.
- Gas Filtration Equipment.

The review contains a detailed and systematic analysis, not only of standard equipment found on connections but also novel equipment which, although not yet approved by Ofgem, has the potential to radically reduce the cost associated with a simple connection. The below summarises the Technology and Market Review process:

- **Scope** the extent of the review; define the requirements for the equipment.
- **Meet** with vendors, manufacturers, suppliers and customers.
- **Collect** data via multiple sources: using online searches, appropriate journals, standards and equipment catalogues.
- **Review** and compare the equipment, establishing where there are possible knowledge gaps and where the technological trends are heading.
- **Collate** the data into a logical format, introducing comparison tables and matrices where appropriate.

Network Innovation Allowance Projects: Premtech have also worked with NGGT on a number of Network Innovation Allowance (NIA) projects which support the installation of new connections on the NTS. The four projects outlined below detail innovative ways to reduce both the cost and time associated with new connections onto the NTS. These NIA projects have funding and will have produced quantifiable results that will be available for use during the first stage of this NIC project.

i. Building Information Modelling (BIM): BIM is a method of attaching critical data and parameters to design assets to provide significant savings in terms of cost, programme and carbon. Currently NGGT are looking to utilise BIM on major construction projects following the success of the 'BIM Phase 1' and 'BIM Phase 2' projects undertaken with Premtech and other partners. Utilising BIM correctly for these standardised models should improve the process for both the customer and NGGT, allowing savings to be passed on to the end user. Models can be quickly generated from supplier 3D models allowing customers to quickly see the arrangements in photorealistic 3D where required. With the information stored within the BIM mode the data can be used to optimise the design and reduce the sizes of overall arrangements thus potentially reducing the overall space requirements of the design.

ii. NTS Block Valve Connections: NGGT, Premtech and Aqua Consultants are currently working on an NIA project addressing the feasibility of smaller customers connecting to block valves on the NTS through a standardised connection arrangement. This has allowed for key stakeholders within the company to be engaged and brought together to challenge the feasibility of using these connections in the future. A risk report has been developed along with a comparison matrix detailing the key criteria associated with a connection. This project has allowed the team to identify certain pieces of equipment within a typical connection that may not be required in a standardised design. Whilst this project is ongoing it has justified the base concept for the NIC as standardised designs for connecting onto the NTS have been proven to be feasible. A number of strategy reports regarding mitigating issues associated with introducing extra equipment onto current Above Ground Installations (AGI's) are being generated and these will be completed prior to the NIC start date.

iii. Gas Quality Study for NTS Unconventional Gas Supplies: It has become apparent that the process successfully used for conventional connections will not necessarily

be the most efficient or effective for unconventional gas customers (e.g. biomethane or shale). The four key challenges to the current process are:

1. Long timeline.
2. Minimum flow rate.
3. Oxygen content.
4. Gas quality Blending

New learning and innovation will from undertaking this NIA lie in:

- Providing clarity on the requirement for a commingling sample point to be 20 pipe diameters downstream from the injection point
- Investigating whether gas really needs to be sampled from the centre third of the pipe
- Determining if it is possible to extend the oxygen exemption limit for unconventional gases to 1 mol% for NTS entry
- Establish if the minimum flow rate is currently appropriate in the light of potential small unconventional gas connections

iv. Renewable Power Trial Demonstration: NGGT are working with Premtech and a number of other Partners on the NIA Project 'Renewable Power Trial Demonstration' which has been looking to demonstrate how renewable technologies can be harnessed to create operational sites which allow for operation of both valves and telemetry, solely utilising the power produced on site. The focus of the project was looking at attaining power to remote block valves that will allow valves to be controlled remotely utilising renewable power. The kiosk designed utilises a number of solar panels (dependent on the geographical location) and a wind turbine to generate power, the first one has been constructed, installed and is due to be tested over the next year. The most important results for the trial will be available in the winter months of 2015 and these can be used to assess the feasibility of supplying these kiosks as an alternative to the traditional electrical connection. Another benefit of the kiosks for these short-term connection solutions is that, dependent on the geographical location and power demands on site, they can be moved from one connection to another should it be required

Further NIA Developments - As part of our NIA and NIC knowledge dissemination activities, we exhibited at Utility Week Live and met representatives from EBRI, (European Bioenergy Research Institute) from Aston University. We discussed potential collaborations in support of Project CLoCC and have since had two meetings to scope out an NIA project which would run alongside Project CLoCC, if successful. In essence this project would look to provide a decision support tool for unconventional gas customers to assess whether a NTS connections is the most suitable option for their proposed development. The tool would be flexible to take information and data in a variety of different forms and units such that a wide range of customers can make use of it with terminology they are familiar with. The tool would also allow the customer access to a geospatial mapping tool within the CLoCC Visual Online Portal, which would indicate areas of the UK best suited to connections of various types. As Project CLoCC progresses we will continue to identify opportunities for further add-ons to complement the aims of this project.

Risk Register: A Risk & Opportunities workshop has been held with all the project partners. The meeting follows a set format, which addresses all of the internal and external influences that could affect the cost and delivery of the project. The output of the risk workshop is a P50 risk value which has been added to the project costings. The objective of the Risk workshop is to create a risk register which lists the significant cost and schedule risks that may have an impact on the successful delivery of the project.

Specifically to this project, the key risks identified as having a potential time and cost impact include:

- Potential for scope creep/changes to scope definition - minor changes within design and skid unit manufacture.
- Incorporation of new technology and introduction of non-Ofgem approved equipment.
- Potential for a lack of specialist knowledge for working within unconventional gas types.
- Potential for software interface issues between the software solution and existing NGGT software or due to changes to the NGGT IS policy.
- Problems during testing and validation of the skid units.
- Integration of different technology, vendors and control systems.
- Potential for site specific issues (power supply etc.) leading to additional requirements on skid units.
- Potential for commercial modification proposals does not receive industry and/or Ofgem support.
- Failure/delay to delivery of key materials and equipment.

Individual costs have been discussed relating to the minimum, most likely and maximum cost outcomes for each particular risk. Risk mitigation measures have been identified in order to reduce both the commercial and schedule impacts on the project.

Forecasted costs: Detailed project costs can be found in Appendix A. Project partner costs have been reviewed and challenged by NGGT in line with the defined scope of work. NGGT costs have been forecast based on estimated man hours required to support the project.

Project Programme: Detailed project programme can be found in Appendix C. The project will be assured and assisted by the NGGT Project Management Office (PMO) and the Project Manager will report directly to the Project Sponsor. The project team's organisation structure, showing lines of reporting can be found in Appendix H. One of the key criteria for building a robust Project Plan was in the selection of the relevant project participants and the forming of a competent project team.

The Project has been presented internally to the NGGT investment committee and approval to proceed has been received. As part of the proposal, NGGT has ensured that all members of the Project Team can commence project work in February 2016, are aligned to the specific project deliverables and are able to commit to and meet their scope of work and defined outputs. The work schedules have been developed together with Premtech, Protech and Aqua Consultants to ensure the project will start in a timely manner as detailed in the project programme at Appendix C.

6.2 Evidence of how the costs and benefits have been estimated

There is a comprehensive study of projected costs is in Appendix A. Premtech are on the design framework for NGGT due to their competitive pricing. Having been involved with NIA and NIC projects before, Premtech can lean on experience to ensure the delivery of the project occurs as expected. Preliminary work carried out in the GTW has identified industry best practice and allows for an estimation of manufacturing and materials costs to be developed.

6.3 Evidence of the measures a Network Licensee will employ to minimise the possibility of cost overruns or shortfalls in Direct Benefits

Project assurance methods such as earned value management techniques, and benefits analysis methods will be utilised throughout the project lifecycle in order to forecast project health in terms of cost and time overruns. A stage gate review approach will be adopted. Three stage gate reviews will be held following the completion of each project stage, these stage gate reviews will follow on from the three programmed stakeholder challenge and review sessions:

- Stage 1 – July 2016
- Stage 2 – April 2017
- Stage 3 – April 2018

At each gate review these project assurance methods will produce results and those results will shape decisions regarding the future of the project. Through the stage-gated process, programme and costings will be challenged and reviewed, should the project not reach expected output at any given point then the process will be stopped.

It is expected that the key equipment utilised within the innovation connection solution will be sourced through a competitive process. The project management, equipment, procurement, assembly, fabrication and testing of the skids will be performed by Protech with assistance from other group companies.

When seeking potential supply chain partners, Protech will typically approach 3 suppliers in order to ensure that the best value price currently available within the marketplace is received. A full technical package will be compiled by the engineering team for issue to the supplier. A technical bid evaluation (TBE) against the equipment specification will be carried out by the engineering team and any discrepancies will be queried with the vendor. A commercial bid evaluation is also performed by the commercial team to ensure alignment with project objectives and terms and conditions (T&Cs). Once compliant bids are established, the most technically and commercially compliant bid will be selected and an order placed if commercial terms are suitable.

6.4 A verification of all information included in the proposal

The project team has worked closely with NGGT finance to verify all financial data for past NTS connection projects in order to substantiate the project benefits. All distribution network information contained within the proposal is a direct output from our initial distribution network engagement interviews and can be verified as correct.

An Irregular Submission Assurance Report has been produced under Licence Condition A55/B23 – Data Assurance Requirements (DAG) which includes a DAG risk and impact assessment for this submission.

6.5 How the project plan would still deliver learning in the event that the take up of low carbon technologies and renewable energy in the Trial area is lower than anticipated in the submission

The business case for this project stands in the event that the output from the trial area is lower than expected as the modular, off the shelf solutions may well be suitable for many other industrial concepts. The proposed process changes will still deliver learning across the whole of gas transmission and distribution with the aim of providing a unified and standardised approach to system connections.

6.6 The processes in place to identify circumstances where the most appropriate course of action will be to suspend the project, pending permission from Ofgem that it can be halted

Throughout this project NGGT will employ Association of Project Management sanctioned methods and procedures for analysing the health of the project in terms of time, budget and quality. If, at any point during each of the three stages, the project management assurance techniques of Earned Value Management for example highlights that the project is in a poor state of health, the Project Sponsor will lay out the best course of action.

Section 7: Regulatory issues

It is not considered that the project will require any derogation, license consent or license exemption. Consequently, there are no regulatory hurdles to the project commencing or completing on the desired timescales.

There is currently no perceived long term regulatory impact as a result of this project.

Section 8: Customer Impact

The project will not have a direct impact on customer's premises nor is it planned to cause any interruptions to supplies. The project does not require any customer disconnections or interruptions during the installation and/or testing of the connection solution.

There are no identifiable indirect customer impacts as a result of this project.

Section 9: Successful Delivery Reward Criteria (SDRCs)

Genuine actions linked to outputs of the project with a realistic and challenging deadline, e.g. milestones and criteria must be SMART (Specific, Measurable, Achievable, Relevant and Timely).

Project CLoCC is set over 3 clear stages. In the following section we set out criteria (9.1 – 9.8) which take place throughout these 3 stages and state the evidence we propose Ofgem should use to assess performance against the criterion.

Successful Delivery Reward Criteria	SMART Measures	Completion Date
9.1 - Knowledge, Learning & Dissemination Strategy.	▪ Deliver project website. ▪ Facility to register interest in website implemented. ▪ Deliver Project Communications Plan	01/04/2016
9.2 - Production and release of internal and external process change document.	▪ Deficiencies and Limitations with Transmission Legislation/Standards/Codes and specifications identified and documented. ▪ Deficiencies and Limitations with distribution Legislation/Standards/Codes and specifications identified and documented. ▪ Production of a full report identifying commercial and regulatory impacts to the project and proposed changes to processes. [NTS and DN identification aiming to streamline and standardise processes]	30/09/2016
9.3 - Visual online portal prototype available for test.	▪ Existing site as-built data classified and pegged with supplementary data. ▪ Visual Online portal prototype tested.	12/12/2016
9.4 - Completion of detailed connection solution designs.	▪ Buildability and maintainability study complete for three standard designs. ▪ Detailed drawing pack issued.	12/02/2018
9.5 – Live customer online	▪ End-to-end functionality testing complete.	17/07/2018

portal available.	▪ User functionality testing complete. ▪ Live customer online portal available.	
9.6 – Online tests of connection solution complete.	▪ Factory acceptance testing of connection skid equipment complete. ▪ Connection skid transported to designated test site. ▪ Construction and installation of connection skid complete. ▪ Commissioning/Online tests of connection skid complete.	01/08/2018
9.7 - Full connections handover pack issued to NG.	▪ As-built drawings and H&S file complete and returned to NG. ▪ Stage 3 completion report issued. ▪ Final Stakeholder challenge and review session held. ▪ Full final Project CLoCC application pack issued to NG for implementation into business as usual.	29/10/2018
9.8 – Project evaluation and final report	▪ Production of a detailed final report to close down the project – this will include project findings, knowledge and learning generated for distribution as per the dissemination strategy [SDRC 9.1]	29/10/2018

Section 10: List of Appendices

Appendix A – Full Submission Spreadsheet

Appendix B – NIC Benefits table

Appendix C – Project Programme

Appendix D – Project Risk Management Plan

Appendix E – Sample Customer Engagement Questionnaire

Appendix F – Sample Distribution Network Engagement Questionnaire

Appendix G – Letters of Support

Appendix H - Project Team Organogram

Appendix A – Full Submission Spreadsheet

Appendix B – NIC Benefits table

KEY

Method	Method name
Method 1	Project CLoCC – Customer Low Cost Connections
Method 2	[Insert method names here]
Method 3	[Insert method names here]

Gas NIC – financial benefits

Financial benefit (£m)								
Scale	**Method**	**Method Cost**	**Base Case Cost**	**Benefit**			**Notes**	**Cross-references**
				2020	**2030**	**2050**		
Post-trial solution *(individual deployment)*	Method 1	£100	£200	£6	£74	£100	Over 32 years the estimated financial savings are £100m. These are realistic figures based on an approximate saving of £1m per NTS connection. The estimated benefits however could be significantly higher if there were more connections to the NTS than the number used as a basis for this estimate. The number of connections over the period has been calculated as a profile based on Low Carbon Life from the National Grid Future Energy Scenarios (FES).	Financial benefits are stated within section 4(b) of the NIC proposal document. In short they are based on: - 100 connections over the next 20 years. - Approximately £1m saving per connection.
	Method 2							
	Method 3							
Licensee scale *If applicable, indicate the number of relevant sites on the Licensees' network.*	Method 1						The above figures represent the net financial savings if Project CLoCC delivers connections anywhere on the NTS.	
	Method 2							
	Method 3							

GB rollout scale *If applicable, indicate the number of relevant sites on the GB network.*	Method 1						The net financial benefits could be higher if the learning from Project CLoCC was utilised on the LTS network and similar financial savings were realised. However, it is not possible to calculate exact savings at this time as it is not known whether this approach to unconventional gas connections will be adopted by the UK distribution networks.	
	Method 2							
	Method 3							

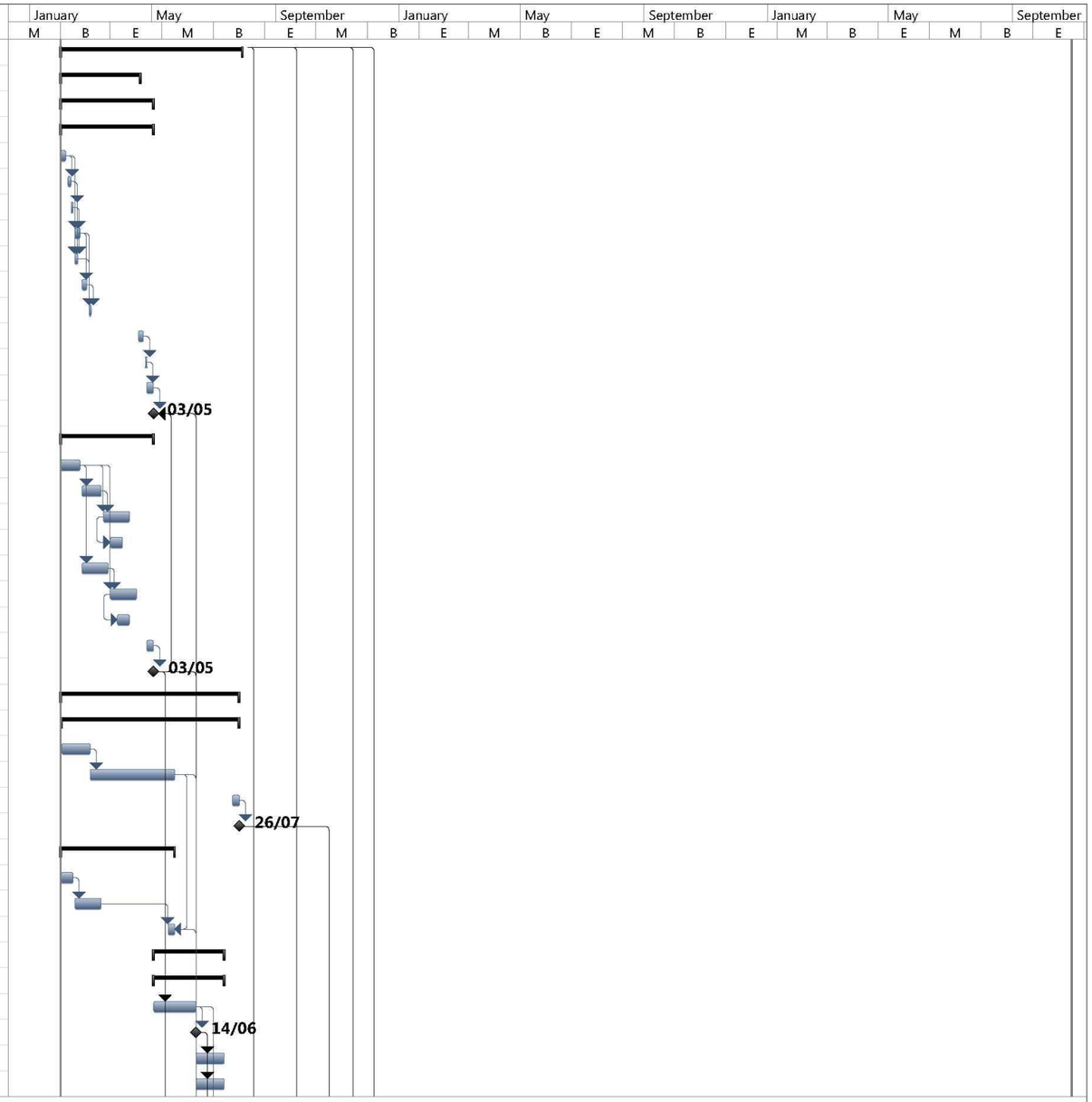
Gas NIC – carbon and/ or environmental benefits

Carbon and/ or environmental benefit (MtCO2e)								
Scale	**Method**	**Method Cost**	**Base Case Cost**	**2020**	**2030**	**2050**	**Notes**	**Cross-references**
Post-trial solution *(individual deployment)*	Method 1	82.42	0	0.21	34.58	82.42	The Base case cost is calculated using a base cost of (0) assuming the continued importation of LNG, none of which is substituted by indigenous supplies. The Method cost estimates total savings equal to 88.74 Mts CO_{2e} over a 20 year period. Assuming the Low Carbon Life Scenario, indigenous shale replaces LNG imports and a profile with the associated carbon savings has been applied across the period.	Environmental benefits are analysed in detail in section 4 (a) of the NIC proposal document. In short they are: - Assumed that shale supplies could reach up to 32 bcm by 2030 and displace LNG imports. - Carbon estimation based on 5g CO_{2e} saving per mega joule of natural gas.
	Method 2							
	Method 3							
Licensee scale *If applicable,*	Method 1						The above figures represent the total environmental savings if	

indicate the number of relevant sites on the Licensees' network.	Method 2						Project CLoCC delivers connections anywhere on the NTS.	
	Method 3							
GB rollout scale *If applicable, indicate the number of relevant sites on the GB network.*	Method 1						The environmental benefits could be higher if the learning from Project CLoCC was utilised on the LTS network and similar CO_2 savings were realised. However, it is not possible to calculate exact savings at this time as it is not known whether this approach to unconventional gas connections will be adopted by the UK distribution networks.	
	Method 2							
	Method 3							
If applicable, indicate any environmental benefits which cannot be expressed as MtCO2e.	**Post-trial solution:** [Explain any environmental benefits which cannot be expressed as MtCO2e]							
	Licensee scale: [Explain any environmental benefits which cannot be expressed as MtCO2e]							
	GB rollout scale: [Explain any environmental benefits which cannot be expressed as MtCO2e]							

Appendix C – Project Programme

ID	Task Name	Duration	Start
1	**Stage 1**	**130 days**	**Mon 01/02/16**
2	**Regulatory Review**	**57 days**	**Mon 01/02/16**
9	**Feasibility Studys**	**66 days**	**Mon 01/02/16**
10	**Aqua Consultants Activities**	**66 days**	**Mon 01/02/16**
11	Define web platform hosting requirements	5 days	Mon 01/02/16
12	Define hardware architecture and requirements	3 days	Mon 08/02/16
13	Define security and adminstration functionality requirements	2 days	Thu 11/02/16
14	Define scope for engineering calculations	5 days	Mon 15/02/16
15	Define scope for commercial model database	3 days	Mon 15/02/16
16	Define scope for existing site surveys and parameters	5 days	Mon 22/02/16
17	Define default settings strategy	2 days	Mon 29/02/16
18	Incorporate outputs from regulatory review	5 days	Mon 18/04/16
19	Challenge & review feasibility report	1 day	Mon 25/04/16
20	Incorporate comments from challenge & review	5 days	Tue 26/04/16
21	Issue feasibility report	0 days	Tue 03/05/16
22	**Premtech / Protech Activities**	**66 days**	**Mon 01/02/16**
23	Review Records (Info Required from National Grid)	15 days	Mon 01/02/16
24	Survey Selected Sites	15 days	Mon 22/02/16
25	Develop Block Valve Feasibility Study	20 days	Mon 14/03/16
26	Preliminary ELDs and Gas for Block Valve	10 days	Mon 21/03/16
27	Connection Point Analysis	20 days	Mon 22/02/16
28	Develop Hub Concept Feasibility Study	20 days	Mon 21/03/16
29	Preliminary ELDs and Gas for Hub	10 days	Mon 28/03/16
30	Review Feasibility Studys	5 days	Tue 26/04/16
31	Issue Feasibility Study	0 days	Tue 03/05/16
32	**Techwatch**	**127 days**	**Mon 01/02/16**
33	**Premtech / Protech Activities**	**126 days**	**Tue 02/02/16**
34	Assessment of Future Gas Types	20 days	Tue 02/02/16
35	Develop Techwatch	60 days	Tue 01/03/16
36	Review Techwatch Report	5 days	Wed 20/07/16
37	Issue Techwatch Report	0 days	Tue 26/07/16
38	**Aqua Consultants Activities**	**81 days**	**Mon 01/02/16**
39	Technology assessment	10 days	Mon 01/02/16
40	Software platform tech watch	20 days	Mon 15/02/16
41	Produce software platform tech watch report	5 days	Tue 17/05/16
42	**Strategy Documentation**	**50 days**	**Tue 03/05/16**
43	**Premtech / Protech Activities**	**50 days**	**Tue 03/05/16**
44	Develop Strategy Report	30 days	Tue 03/05/16
45	Issue Strategy Report	0 days	Tue 14/06/16
46	Develop AIM Strategy Report	20 days	Tue 14/06/16
47	Develop BIM Strategy Report	20 days	Tue 14/06/16

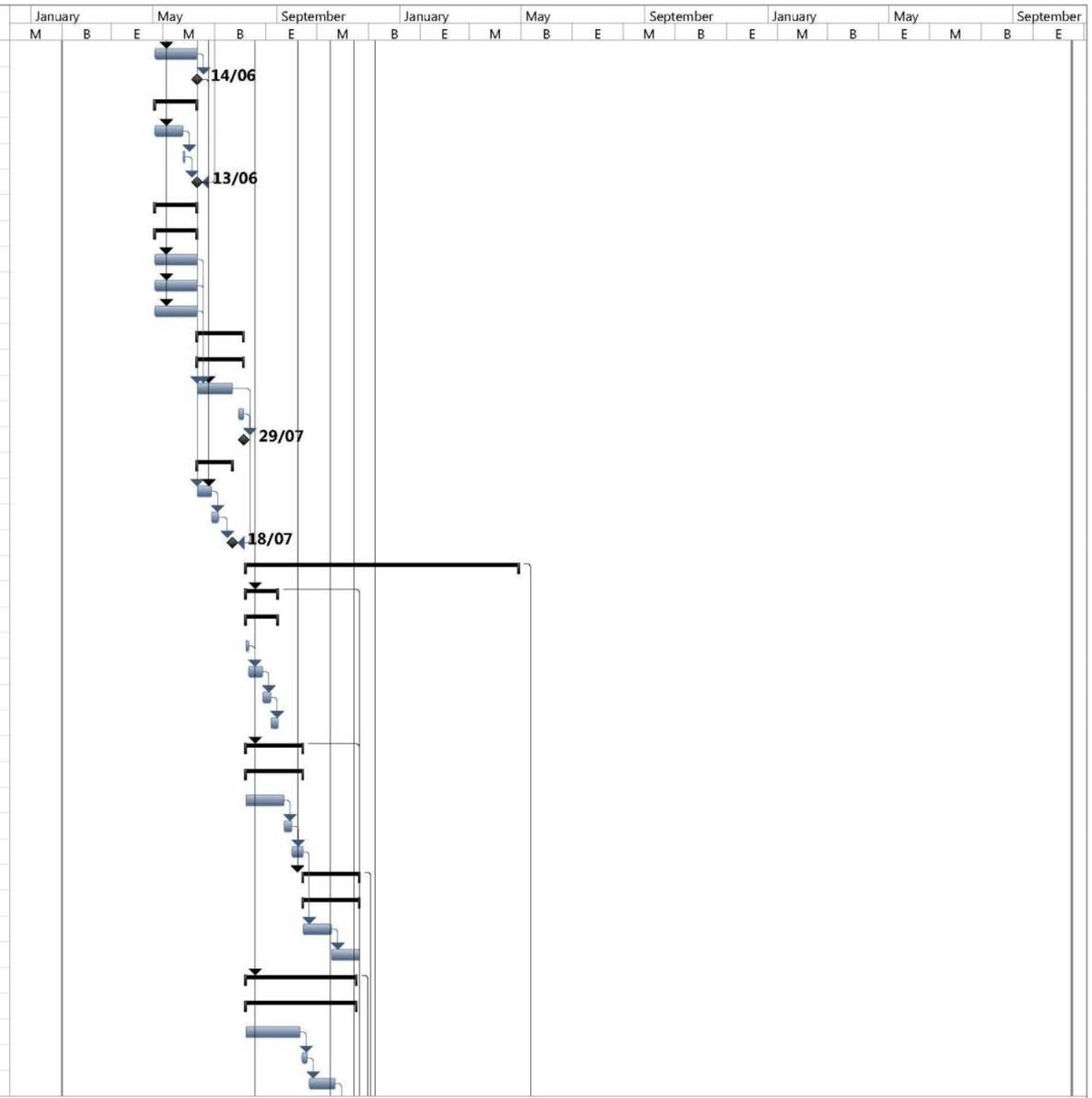


0019-902.SC - Protech NIC Pro
Date: Mon 27/07/15

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone

Page 1

ID	Task Name	Duration	Start
48	Develop Basis of Design Document	30 days	Tue 03/05/16
49	Issue Basis of Design Document	0 days	Tue 14/06/16
50	**Aqua Consultants Activities**	**30 days**	**Tue 03/05/16**
51	Develop strategy doucument for web based selection tool	20 days	Tue 03/05/16
52	Challenge & review strategy document	2 days	Tue 31/05/16
53	Issue web based selection tool strategy for incorporation in strategy re	0 days	Mon 13/06/16
54	**Preliminary Drawings**	**30 days**	**Tue 03/05/16**
55	**Premtech / Protech Activities**	**30 days**	**Tue 03/05/16**
56	Develop Preliminary ELDs	30 days	Tue 03/05/16
57	Develop Preliminary GAs	30 days	Tue 03/05/16
58	Review Preliminary PFDs from Protech (On Receipt of Drawings from Pr	30 days	Tue 03/05/16
59	**Stage 1 Completion**	**34 days**	**Tue 14/06/16**
60	**Premtech / Protech Activities**	**34 days**	**Tue 14/06/16**
61	Develop Stage 1 Completion Report	25 days	Tue 14/06/16
62	Review Stage 1 Completion Report	5 days	Mon 25/07/16
63	Issue Stage 1 Completion Report	0 days	Fri 29/07/16
64	**Aqua Consultants Activities**	**25 days**	**Tue 14/06/16**
65	Develop Stage 1 Completion Report	10 days	Tue 14/06/16
66	Review Stage 1 Completion Report	5 days	Tue 28/06/16
67	Issue Stage 1 Completion Report	0 days	Mon 18/07/16
68	**Stage 2**	**195 days**	**Mon 01/08/16**
69	**Web based customer portal conceptual design**	**24 days**	**Mon 01/08/16**
70	**Aqua Consultants Activities**	**24 days**	**Mon 01/08/16**
71	Web branding Definement	3 days	Mon 01/08/16
72	Customer interface Definition	10 days	Thu 04/08/16
73	Web portal design	6 days	Thu 18/08/16
74	Customer reporting definition and design	5 days	Fri 26/08/16
75	**Engineering calculation model conceptual/prototype design**	**41 days**	**Mon 01/08/16**
76	**Aqua Consultants Activities**	**41 days**	**Mon 01/08/16**
77	Develop engineering calculation model requirements	28 days	Mon 01/08/16
78	Develop engineering calculation interface matrix requirements	6 days	Thu 08/09/16
79	Review engineering calculation model validity	7 days	Fri 16/09/16
80	**Commercial model conceptual design**	**40 days**	**Tue 27/09/16**
81	**Aqua Consultants Activities**	**40 days**	**Tue 27/09/16**
82	Develop cost engine requirements	20 days	Tue 27/09/16
83	Review cost engine validity	20 days	Tue 25/10/16
84	**Existing site database development**	**80 days**	**Mon 01/08/16**
85	**Aqua Consultants Activities**	**80 days**	**Mon 01/08/16**
86	Review existing site as built data	40 days	Mon 01/08/16
87	Develop existing site database	5 days	Mon 26/09/16
88	Populate site database	20 days	Mon 03/10/16



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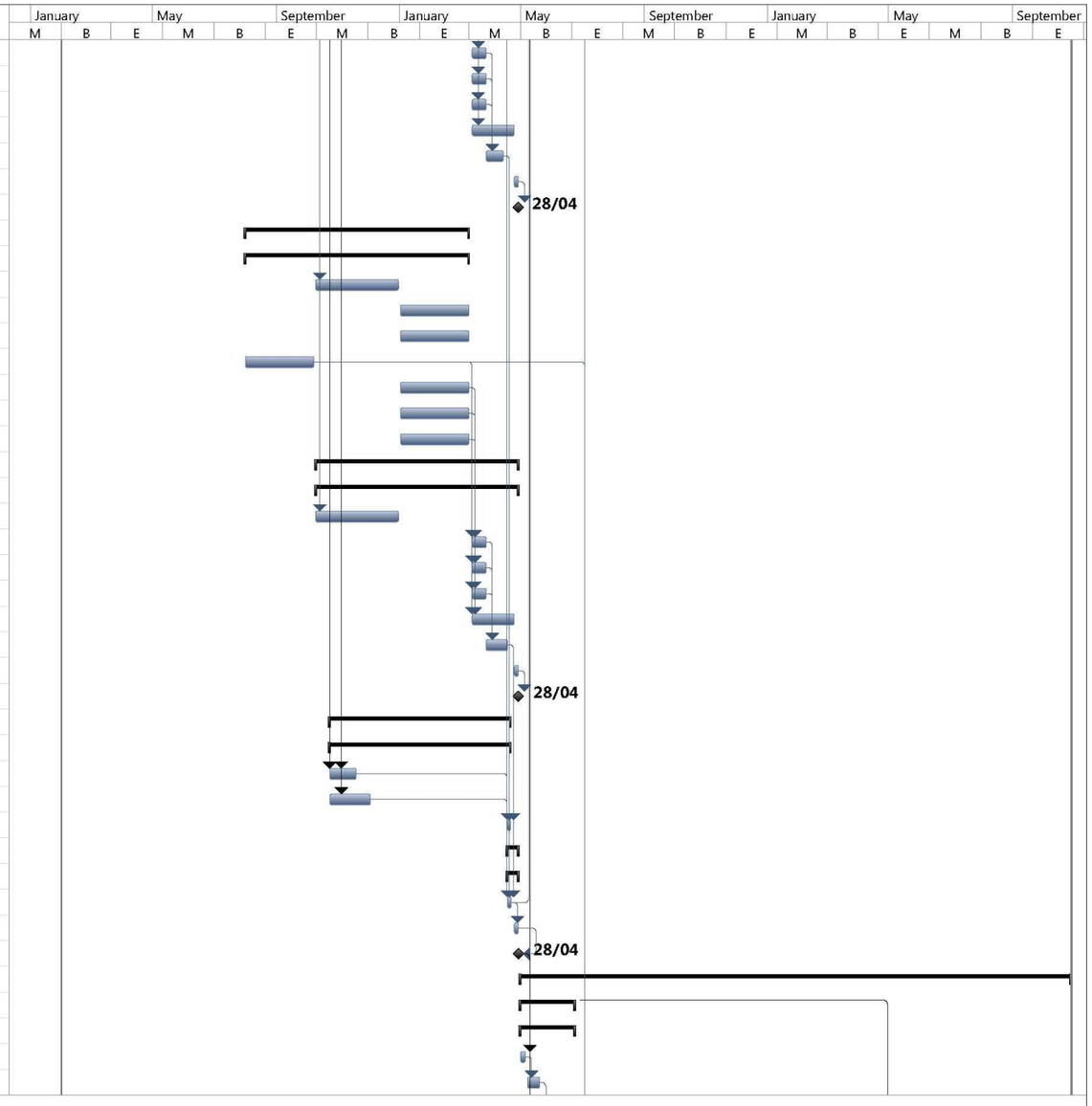
Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

ID	Task Name	Duration	Start
130	Develop Conceptual Mobile Facility ELDs	10 days	Tue 14/03/17
131	Develop Conceptual Mobile Facility GAs	10 days	Tue 14/03/17
132	Develop Conceptual Mobile Facility PFDs	10 days	Tue 14/03/17
133	Develop Mobile Facility 3D Isometric Drawings and Models	30 days	Tue 14/03/17
134	Develop Mobile Facility Conceptual Design Report	13 days	Tue 28/03/17
135	Review Mobile Facility Conceptual Design Report	4 days	Tue 25/04/17
136	Issue Mobile Facility Conceptual Design Report	0 days	Fri 28/04/17
137	**Hub / Connector Network Conceputal Design**	**160 days**	**Mon 01/08/16**
138	**Premtech / Protech Activities**	**160 days**	**Mon 01/08/16**
139	Initial Conceptual Design Details	60 days	Mon 10/10/16
140	Process Conceptual Design - Hub / Connector Network	50 days	Mon 02/01/17
141	Preliminary specifications and vendor discussions - Hub / Connector Ne	50 days	Mon 02/01/17
142	Mechanical Conceptual Design - Hub / Connector Network	50 days	Mon 01/08/16
143	Civil Conceptual Design - Hub / Connector Network	50 days	Mon 02/01/17
144	Control & Instrumentation Conceptual Design - Hub / Connector Netwo	50 days	Mon 02/01/17
145	Electrical Conceptual Design - Hub / Connector Network	50 days	Mon 02/01/17
146	**Hub / Connector Network Conceputal Design Drawings**	**145 days**	**Mon 10/10/16**
147	**Premtech / Protech Activities**	**145 days**	**Mon 10/10/16**
148	Develop Initial Drawings	60 days	Mon 10/10/16
149	Develop Conceptual Hub / Connector Network ELDs	10 days	Tue 14/03/17
150	Develop Conceptual Hub / Connector Network GAs	10 days	Tue 14/03/17
151	Develop Conceptual Hub / Connector Network PFDs	10 days	Tue 14/03/17
152	Develop Hub / Connector Network 3D Isometric Drawings and Models	30 days	Tue 14/03/17
153	Develop Mobile Facility Conceptual Design Report	15 days	Tue 28/03/17
154	Review Mobile Facility Conceptual Design Report	4 days	Tue 25/04/17
155	Issue Mobile Facility Conceptual Design Report	0 days	Fri 28/04/17
156	**Strategy Documentation**	**129 days**	**Mon 24/10/16**
157	**Premtech / Protech Activities**	**129 days**	**Mon 24/10/16**
158	Best Practice Report and Review	20 days	Mon 24/10/16
159	Establish Process Conditions and Requirements / Parameters	30 days	Mon 24/10/16
160	Conceptual Constraints and Opportunities Matrix	3 days	Tue 18/04/17
161	**Stage 2 Completion**	**9 days**	**Tue 18/04/17**
162	**Premtech / Protech Activities**	**9 days**	**Tue 18/04/17**
163	Develop Stage 2 Completion Report	4 days	Tue 18/04/17
164	Review Stage 2 Completion Report	4 days	Tue 25/04/17
165	Issue Stage 2 Completion Report	0 days	Fri 28/04/17
166	**Stage 3**	**390 days?**	**Mon 01/05/17**
167	**Web based customer portal build**	**40 days**	**Mon 01/05/17**
168	**Aqua Consultants Activities**	**40 days**	**Mon 01/05/17**
169	Develop customer / user database	5 days	Mon 01/05/17
170	Produce web template design	10 days	Mon 08/05/17



0019-902.SC - Protech NIC Pro
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Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

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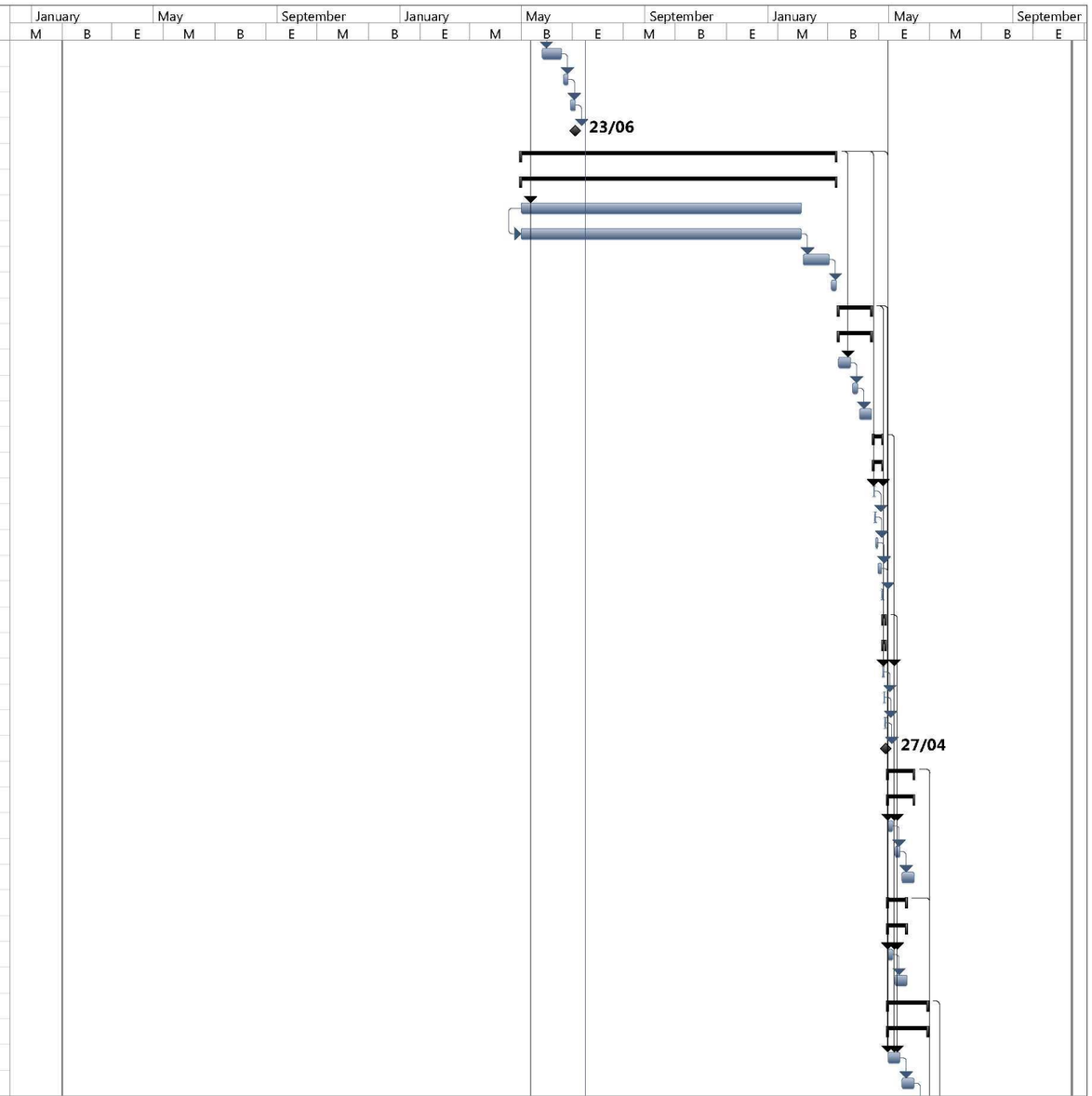
ID	Task Name	Duration	Start
171	Develop web pages and customise for mobile, tablet and web	15 days	Mon 22/05/17
172	Integrate web pages with customer database	5 days	Mon 12/06/17
173	Test website functionality	5 days	Mon 19/06/17
174	Hand over site to Aqua	0 days	Fri 23/06/17
175	**Calculation model build**	**225 days**	**Mon 01/05/17**
176	**Aqua Consultants Activities**	**225 days**	**Mon 01/05/17**
177	Write calculation models	200 days	Mon 01/05/17
178	Define and write calculation model interface code	200 days	Mon 01/05/17
179	Test calculation model functionality	20 days	Mon 05/02/18
180	Test calculation model interfaces	5 days	Mon 05/03/18
181	**Integrate customer portal and Aqua System**	**25 days**	**Mon 12/03/18**
182	**Aqua Consultants Activities**	**25 days**	**Mon 12/03/18**
183	Integrate UI elements of model interfaces into customer portal	10 days	Mon 12/03/18
184	Integrate interface dependencies into user interface	5 days	Mon 26/03/18
185	Integrate Platform jquery interfaces into webapplication	10 days	Mon 02/04/18
186	**Build UAT / Test hosting environment**	**7 days**	**Mon 16/04/18**
187	**Aqua Consultants Activities**	**7 days**	**Mon 16/04/18**
188	Create virtual networks	1 day	Mon 16/04/18
189	Create firewall and loadbalancer rules	1 day	Tue 17/04/18
190	Create and install web virtual servers	2 days	Wed 18/04/18
191	Create and install application virtual servers	2 days	Fri 20/04/18
192	Create and install database cluster servers	1 day	Tue 24/04/18
193	**Deploy UAT/QA version of application**	**3 days**	**Wed 25/04/18**
194	**Aqua Consultants Activities**	**3 days**	**Wed 25/04/18**
195	Deploy platform databases	1 day	Wed 25/04/18
196	Deploy platform application services	1 day	Thu 26/04/18
197	Deploy web application	1 day	Fri 27/04/18
198	Enable firewall rules to private audience	0 days	Fri 27/04/18
199	**Web portal testing**	**20 days**	**Mon 30/04/18**
200	**Aqua Consultants Activities**	**20 days**	**Mon 30/04/18**
201	Test customer interface	5 days	Mon 30/04/18
202	Test customer input data fields and calculation model interface	5 days	Mon 07/05/18
203	Test default settings and web portal functionality	10 days	Mon 14/05/18
204	**Calculation model testing**	**15 days**	**Mon 30/04/18**
205	**Aqua Consultants Activities**	**15 days**	**Mon 30/04/18**
206	Define calculation model testing matrix	5 days	Mon 30/04/18
207	Run calculation model tests	10 days	Mon 07/05/18
208	**Web based selection tool testing**	**30 days**	**Mon 30/04/18**
209	**Aqua Consultants Activities**	**30 days**	**Mon 30/04/18**
210	End to end functionality testing	10 days	Mon 30/04/18
211	Upset condition reporting and testing	10 days	Mon 14/05/18



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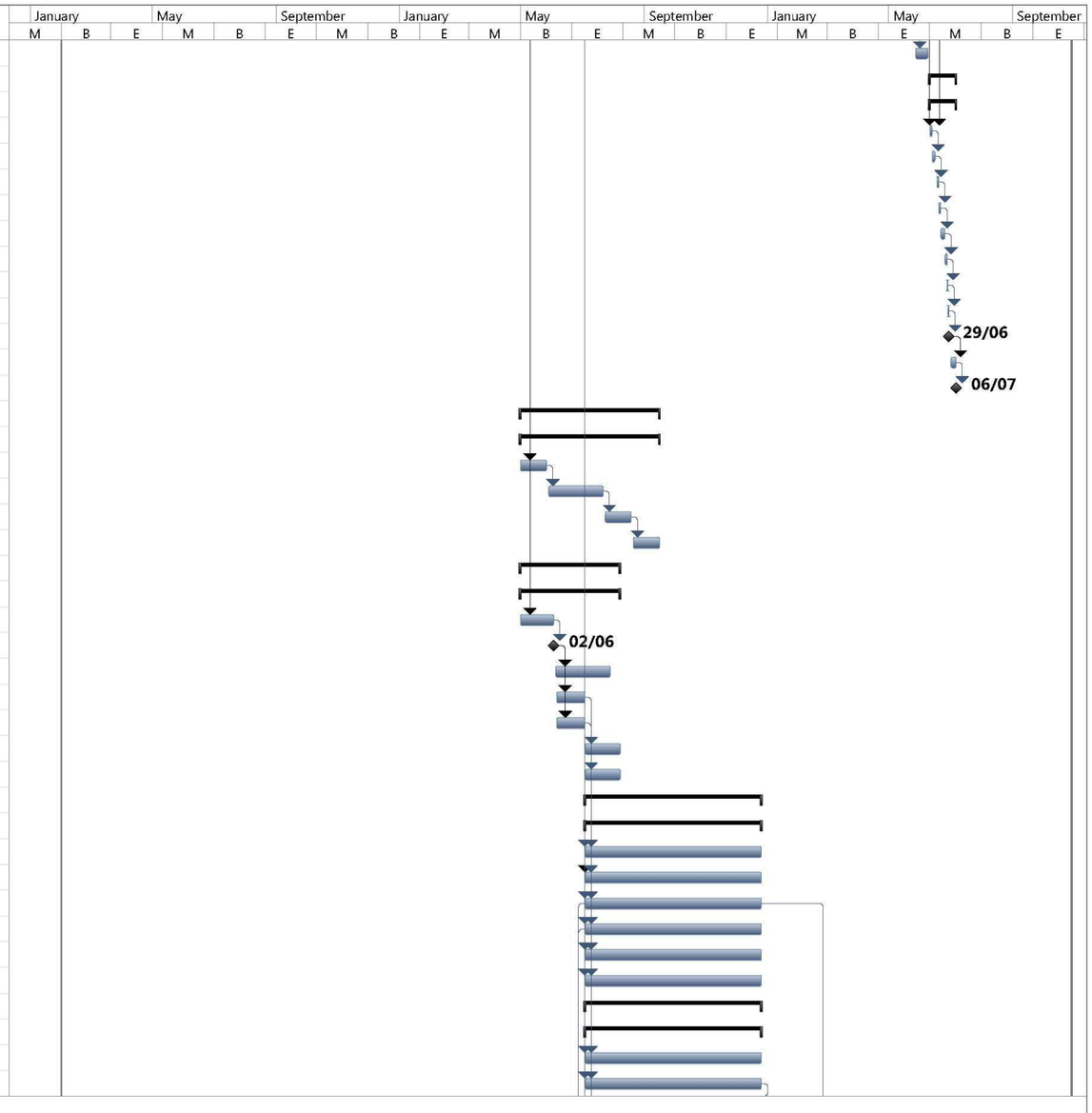
Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone

ID	Task Name	Duration	Start
212	User functionality testing	10 days	Mon 28/05/18
213	**Build hosting environment**	**20 days**	**Mon 11/06/18**
214	**Aqua Consultants Activities**	**20 days**	**Mon 11/06/18**
215	Create virtual networks	2 days	Mon 11/06/18
216	Create firewall and loadbalancer rules	3 days	Wed 13/06/18
217	Create and install web virtual servers	2 days	Mon 18/06/18
218	Create and install application virtual servers	2 days	Wed 20/06/18
219	Create and install database cluster servers	2 days	Fri 22/06/18
220	Deploy platform databases	2 days	Tue 26/06/18
221	Deploy platform application services	1 day	Thu 28/06/18
222	Deploy web application	1 day	Fri 29/06/18
223	Enable firewall rules to private audience	0 days	Fri 29/06/18
224	Test platform	5 days	Mon 02/07/18
225	Enable firewall rules for internet access	0 days	Fri 06/07/18
226	**Regulatory review**	**100 days**	**Mon 01/05/17**
227	**Calvert Consultancy Activity**	**100 days**	**Mon 01/05/17**
228	Development of new processes for NG	20 days	Mon 01/05/17
229	Development of any necessary changes to the Commercial codes	40 days	Mon 29/05/17
230	Changes to the relevant commercial documents	20 days	Mon 24/07/17
231	Ongoing Industry consultation and development of processes	20 days	Mon 21/08/17
232	**Technical Documentation**	**71 days**	**Mon 01/05/17**
233	**Premtech / Protech Activities**	**71 days**	**Mon 01/05/17**
234	Develop Preliminary Material Take Offs (MTOs)	25 days	Mon 01/05/17
235	Issue Preliminary MTOs	0 days	Fri 02/06/17
236	Request Additional Material Specs from Vendor	40 days	Mon 05/06/17
237	SIL Determination Study	20 days	Tue 06/06/17
238	AIL Determination Study	20 days	Tue 06/06/17
239	Pressure Testing Strategy	25 days	Tue 04/07/17
240	Buildability and Maintainability Study	25 days	Tue 04/07/17
241	**Mobile Facility Detailed Design**	**125 days**	**Tue 04/07/17**
242	**Premtech / Protech Activities**	**125 days**	**Tue 04/07/17**
243	Process Detailed Design - Mobile Facility	125 days	Tue 04/07/17
244	Specifications and vendor discussions - Mobile Facility	125 days	Tue 04/07/17
245	Mechanical Detailed Design - Mobile Facility	125 days	Tue 04/07/17
246	Civil Detailed Design - Mobile Facility	125 days	Tue 04/07/17
247	Control & Instrumentation Detailed Design - Mobile Facility	125 days	Tue 04/07/17
248	Electrical Detailed Design - Mobile Facility	125 days	Tue 04/07/17
249	**Hub / Connector Network Detailed Design**	**125 days**	**Tue 04/07/17**
250	**Premtech / Protech Activities**	**125 days**	**Tue 04/07/17**
251	Process Detailed Design - Hub / Connector Network	125 days	Tue 04/07/17
252	Specifications and vendor discussions - Hub / Connector Network	125 days	Tue 04/07/17



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Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

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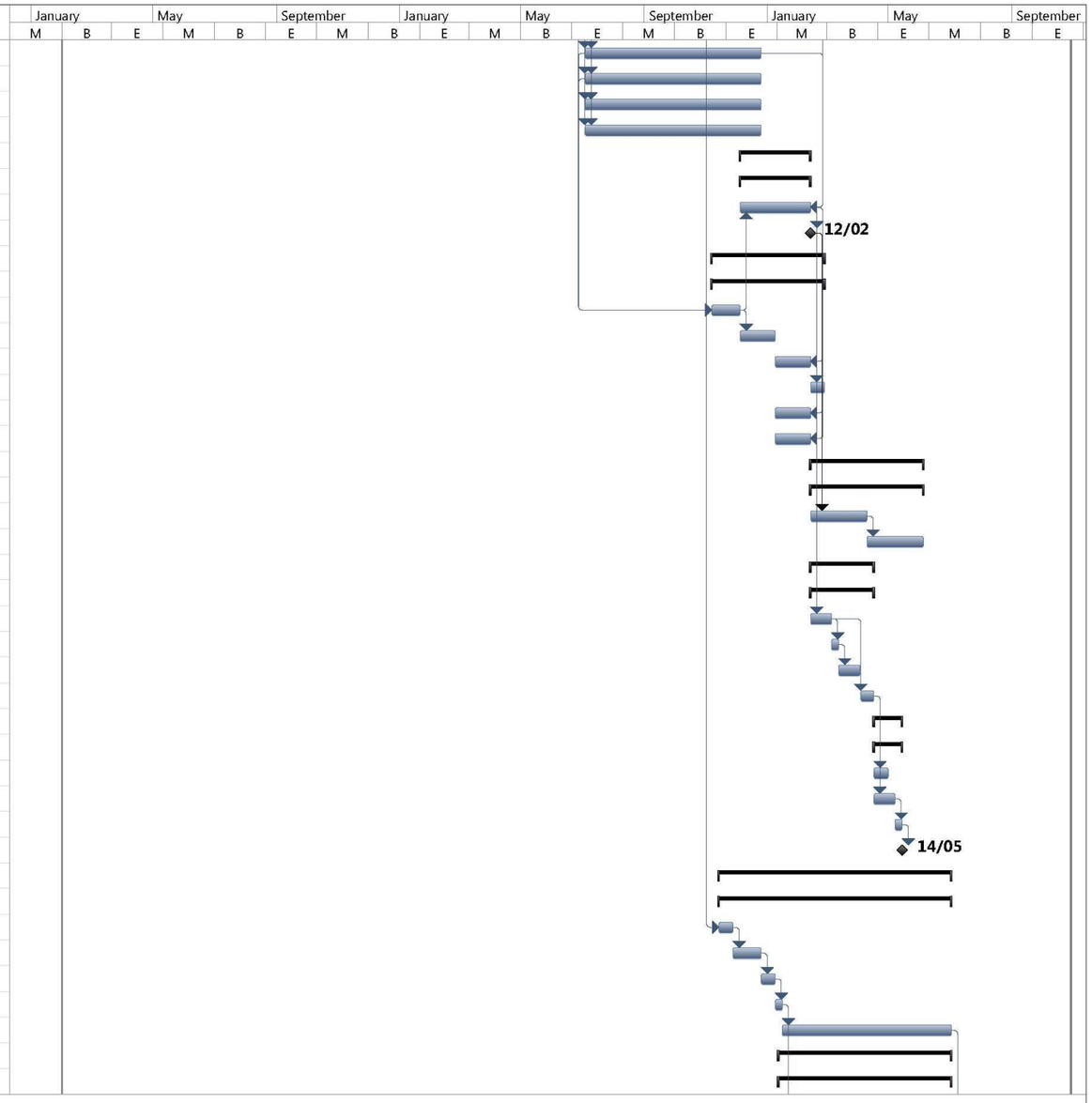
ID	Task Name	Duration	Start
253	Mechanical Detailed Design - Hub / Connector Network	125 days	Tue 04/07/17
254	Civil Detailed Design - Hub / Connector Network	125 days	Tue 04/07/17
255	Control & Instrumentation Detailed Design - Hub / Connector Network	125 days	Tue 04/07/17
256	Electrical Detailed Design - Hub / Connector Network	125 days	Tue 04/07/17
257	**Drawings**	**50 days**	**Tue 05/12/17**
258	**Premtech / Protech Activities**	**50 days**	**Tue 05/12/17**
259	Develop Detailed Drawing Packs	50 days	Tue 05/12/17
260	Issue Detailed Drawings	0 days	Mon 12/02/18
261	**Calculations**	**80 days**	**Tue 07/11/17**
262	**Premtech / Protech Activities**	**80 days**	**Tue 07/11/17**
263	Detailed Hazardous Area Calculations	20 days	Tue 07/11/17
264	Develop Detailed 2D and 3D Hazardous Area Drawings	25 days	Tue 05/12/17
265	Design Factor Calculations	25 days	Tue 09/01/18
266	Pressure Testing Strategy	10 days	Tue 13/02/18
267	Velocity Calculations	25 days	Tue 09/01/18
268	Flow Calculations	25 days	Tue 09/01/18
269	**Customer Engagement**	**80 days**	**Tue 13/02/18**
270	**Premtech / Protech Activities**	**80 days**	**Tue 13/02/18**
271	Modelling Strategy	40 days	Tue 13/02/18
272	VR & AR Reality Modelling	40 days	Tue 10/04/18
273	**Appraisals**	**45 days**	**Tue 13/02/18**
274	**Premtech / Protech Activities**	**45 days**	**Tue 13/02/18**
275	G35 and G19 Approvals	15 days	Tue 13/02/18
276	Incoporate Approver Comments	5 days	Tue 06/03/18
277	G35 and G19 Appraisals	15 days	Tue 13/03/18
278	Incorporate Appraisal Comments and Stakeholder Feedback	9 days	Wed 04/04/18
279	**Construction Issue**	**20 days**	**Tue 17/04/18**
280	**Premtech / Protech Activities**	**20 days**	**Tue 17/04/18**
281	Review Documentation	10 days	Tue 17/04/18
282	Update Detailed Drawings	15 days	Tue 17/04/18
283	Construction Issue Drawings	5 days	Tue 08/05/18
284	Issue Construction Issue Package	0 days	Mon 14/05/18
285	**Procurement**	**165 days**	**Tue 14/11/17**
286	**Premtech / Protech Activities**	**165 days**	**Tue 14/11/17**
287	Issue AFC Spec and drawing package to vendors	10 days	Tue 14/11/17
288	Final AFC Quote	20 days	Tue 28/11/17
289	Techincal and cemmercial bid analysis	10 days	Tue 26/12/17
290	Place order	5 days	Tue 09/01/18
291	Procurement / Fabrication Period	120 days	Tue 16/01/18
292	**Fabrication / Procurement Support**	**122 days?**	**Fri 12/01/18**
293	**Premtech / Protech Activities**	**122 days?**	**Fri 12/01/18**



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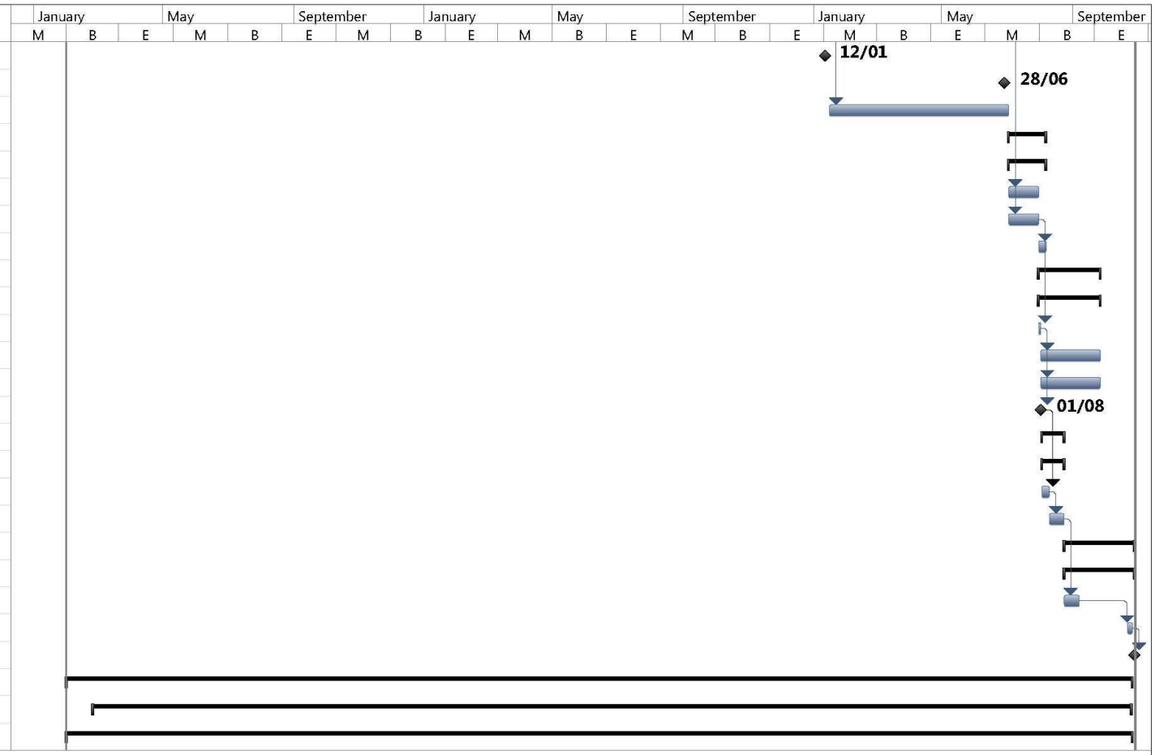
Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

ID	Task Name	Duration	Start
294	Fabrication / Procurement Support	0 days?	Fri 12/01/18
295	Fabrication / Procurement Support	0 days?	Thu 28/06/18
296	Engineering Support during Fabrication / Procurement Phase	120 days	Tue 16/01/18
297	**Factory Acceptance Testing**	**25 days**	**Tue 03/07/18**
298	**Premtech / Protech Activities**	**25 days**	**Tue 03/07/18**
299	Testing of skid equipment	20 days	Tue 03/07/18
300	Testing Support	20 days	Tue 03/07/18
301	Review Findings from Testing Phase	5 days	Tue 31/07/18
302	**Construction and Commissioning**	**42 days**	**Tue 31/07/18**
303	**Premtech / Protech Activities**	**42 days**	**Tue 31/07/18**
304	Ship to site	2 days	Tue 31/07/18
305	On Site Construction and Commissioning	40 days	Thu 02/08/18
306	Construction and Commissioning Support	40 days	Thu 02/08/18
307	Construction Complete	0 days	Wed 01/08/18
308	**Post-Construction Finalisation**	**15 days**	**Fri 03/08/18**
309	**Premtech / Protech Activities**	**15 days**	**Fri 03/08/18**
310	Redlines	5 days	Fri 03/08/18
311	As-Builts	10 days	Fri 10/08/18
312	**Stage 3 Completion**	**46 days**	**Fri 24/08/18**
313	**Premtech / Protech Activities**	**46 days**	**Fri 24/08/18**
314	Develop Stage 3 Completion Report	10 days	Fri 24/08/18
315	Review Stage 3 Completion Report	5 days	Mon 22/10/18
316	Issue Stage 3 Completion Report	0 days	Mon 29/10/18
317	**Design Management & Coordination**	**715 days**	**Mon 01/02/16**
318	**Key Meetings**	**695 days**	**Fri 26/02/16**
363	**Safety Management**	**715 days**	**Mon 01/02/16**



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Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone

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Appendix D – Project Risk Management Plan

EXECUTIVE SUMMARY

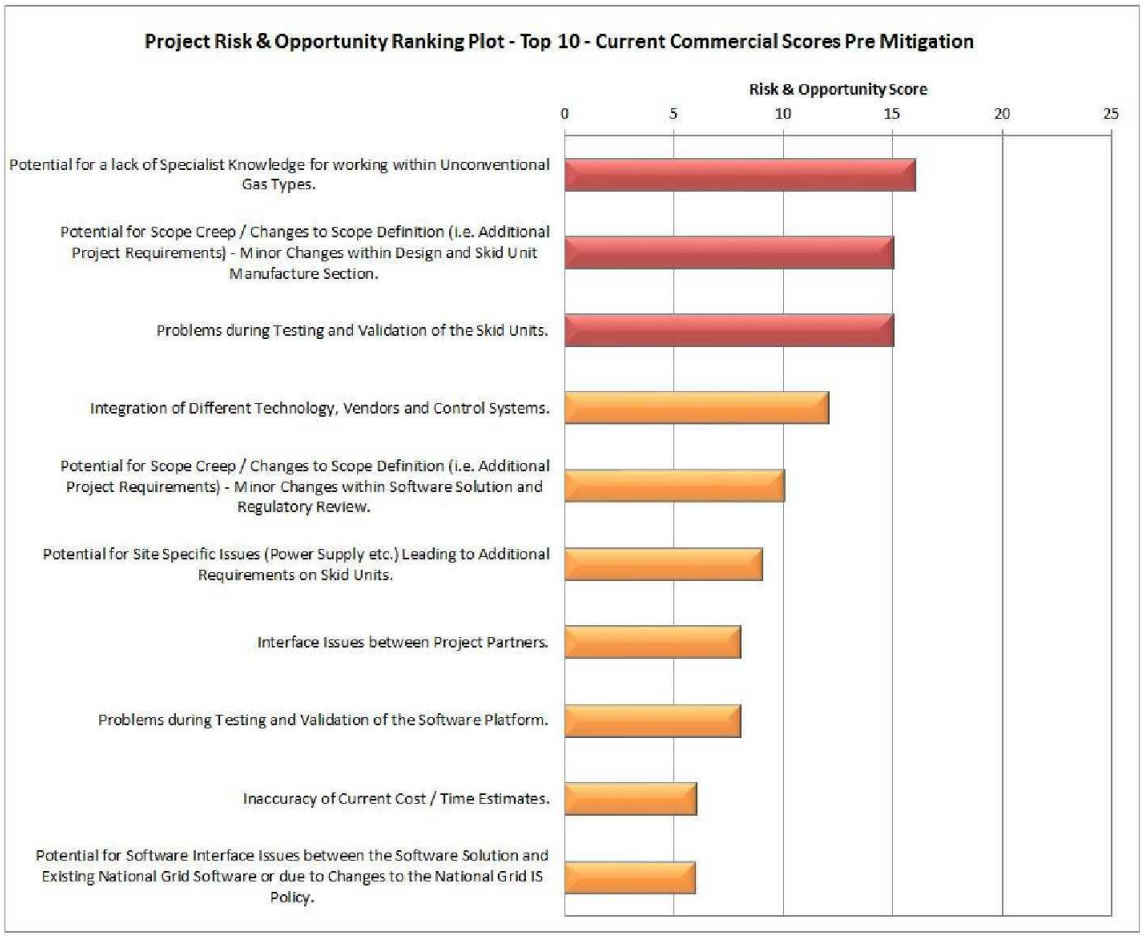
This report details the outcomes obtained from the National Grid 2015 Network Innovation Competition (NIC) - A New Approach to NTS Connections Project Risk & Opportunity Workshop No.1, held at the Premtech Ltd Offices in Ashby de la Zouch, on Wednesday 10th June 2015.

The objective of the meeting was to create and complete the Project Risk & Opportunity Register which lists the significant Risks that may have an impact on the successful delivery of the Project (in terms of both Cost and Schedule) as well as identifying any possible Cost and Schedule saving Opportunities. The meeting also aimed at identifying Threat Mitigation Control Measures / Actions and the resultant Mitigation Action Owners in order to effectively aid the management of the successful delivery of the Project.

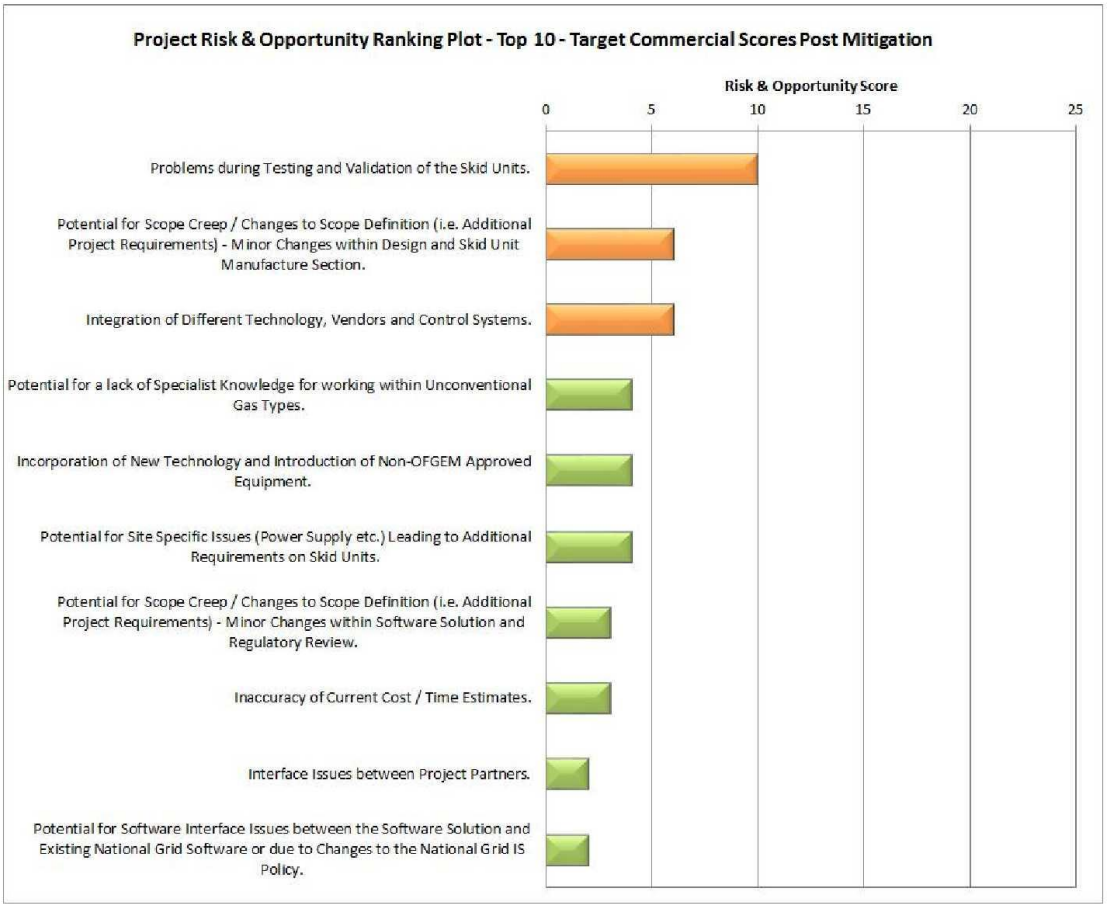
The report also includes four charts;

- Appendix D.1 - Risk & Opportunity Ranking Plot - Current Commercial Scores Pre Mitigation.
- Appendix D.2 - Risk & Opportunity Ranking Plot - Target Commercial Scores Post Mitigation.
- Appendix D.3 - Risk & Opportunity Ranking Plot - Current Schedule Scores Pre Mitigation.
- Appendix D.4 - Risk & Opportunity Ranking Plot - Target Schedule Scores Post Mitigation.

The Plot from Appendix D.1 can be seen below and uses the Current Commercial Impact Score to rank the Risks and Opportunities in the order of which will potentially cause the highest impact to the Project, and as a result, highlights the Risks and Opportunities which are the most important for the Mitigation Control Measures and Actions to be prioritised and implemented. Please see Appendix D.3 for the same Plot however this time using the Current Schedule Impact Score to highlight which will potentially cause the highest impact to the Programme.



The Plot from Appendix D.2 can be seen below and uses the Target Commercial Impact Score to rank the Risks and Opportunities in the order of which will potentially cause the highest impact to the Project after all Mitigation Control Measures and Actions have been put in place. As a result this helps to identify the Risks and Opportunities that will still be most prevalent following the implementation of the Mitigation Control Measures and Actions and which will therefore will require very close monitoring and management. Please see Appendix D.4 for the same Plot however this time using the Target Schedule Impact Score to highlight which will potentially cause the highest impact to the Programme after all Mitigation Control Measures and Actions have been put in place.



It is also important to note that due to the nature and characteristics of some of the Risks & Opportunities they will have to be managed in different ways. These ways are;

- **Treat:** a Plan which attempts to reduce either the Likelihood or the Impact on the Risk without fundamentally altering the work. Alternatively, a Plan which attempts to increase either the Likelihood or the Impact on the Opportunity without fundamentally altering the work.
- **Avoid:** a Plan which recommends not undertaking the Activity which may lead to the Risk impacting the works.
- **Transfer:** a Plan which recommends changing the Ownership of the Risk (or Opportunity) to a Third Party.
- **Tolerate/Accept:** with some of the Risk it may not be possible to fully mitigate the impact by using some/all of the methods above. As a result the Project may have to accept that some of the Risks may impact the works and as a result ensure that the Risks are fully managed and, where possible, contingency plans are put in place to manage the outcomes of any Risks that do occur during the works. It is important to note that the Project is aware of this possibility due to the nature of the works that will be undertaken, i.e. their new, inventive and exploratory nature.

PROCEDURE

This report details the outcomes obtained from the National Grid 2015 Network Innovation Competition (NIC) - A New Approach to NTS Connections Project Risk & Opportunity Workshop No.1, held at the Premtech Ltd Offices in Ashby de la Zouch, on Wednesday 10th June 2015.

Within the report there are four sections which are as follows;

1. Executive Summary.
2. Procedure.
3. Commercial Risk & Opportunity Results.
4. Schedule Risk & Opportunity Results.
5. Appendices.

The objective of the meeting was to create and complete the Project Risk & Opportunity Register which lists the significant Risks that may have an impact on the successful delivery of the Project (in terms of both Cost and Schedule) as well as identifying any possible Cost and Schedule saving Opportunities. The meeting also aimed at identifying Threat Mitigation Control Measures / Actions and the resultant Mitigation Action Owners in order to effectively aid the management of the successful delivery of the Project.

A list of Risks and Opportunities were created and reviewed in relation to the following:

- Likelihood Score - both Current (Pre Mitigation) and Target (Post Mitigation).
- Schedule Impact Score - both Current (Pre Mitigation) and Target (Post Mitigation).
- Commercial Impact Score - both Current (Pre Mitigation) and Target (Post Mitigation).
- Risk / Opportunity Mitigation Control Measures / Actions.
- Risk / Opportunity Mitigation Action Owner/s.

The Risks and Opportunities, once identified, were scored on a Rating Level of 1 to 5 for the Likelihood Level and the Impact Level to the Project (in terms of both Cost and Schedule) by those present at the Project Threat Workshop. This was carried out for both the Pre Mitigation and Post Mitigation positions. These Ratings Levels that were agreed upon during the Project Risk & Opportunity Workshop can be seen within the tables in Appendix B - Risk & Opportunity Scoring Criteria and Tolerance Scale and Probability and Impact Scoring Diagram (PID).

Once agreed, the Scores for the Likelihood Level and the Commercial Impact Level were then combined using Monte Carlo Simulation to determine the uncertainty and range within the Project costs. The Commercial Risk & Opportunity Model was created in the Primavera Risk Analysis software package and, using the Latin Hypercube sampling technique, the software simulated 1,000 possible iterations and calculated the "relative frequency" of the probable outcomes, presented as a Histogram. This was carried out for both the Pre Mitigation and Post Mitigation positions and the relative Results and Histograms can be seen within the Commercial Risk & Opportunity Results section and within Appendix C.1 and Appendix C.2.

Also included within this report are the following appendices;

- Appendix A - Risk & Opportunity Register.
- Appendix B - Risk & Opportunity Scoring Criteria and Tolerance Scale and Probability and Impact Scoring Diagram (PID).
- Appendix C.1 - Risk & Opportunity Results and Histogram - Commercial Pre Mitigation.
- Appendix C.2 - Risk & Opportunity Results and Histogram - Commercial Post Mitigation.
- Appendix D.1 - Risk & Opportunity Ranking Plot - Current Commercial Scores Pre Mitigation.
- Appendix D.2 - Risk & Opportunity Ranking Plot - Target Commercial Scores Post Mitigation.
- Appendix D.3 - Risk & Opportunity Ranking Plot - Current Schedule Scores Pre Mitigation.
- Appendix D.4 - Risk & Opportunity Ranking Plot - Target Schedule Scores Post Mitigation.

COMMERCIAL RISK & OPPORTUNITY RESULTS

Table 1 contains the full Project Commercial Risk & Opportunity Results - Current Pre Mitigation while Table 2 contains the full Project Commercial Risk & Opportunity Results - Target Post Mitigation.

	TOTAL PROJECT Risk & Opportunity Total	
P20	£667,809	(n/a)
P50	**£1,194,195**	(n/a)
P80	£1,706,884	(n/a)

Table 1 - Summary of Project Cost Risk & Opportunity Results - Current Pre Mitigation
Previous Results Shown in Blue (N/A)

	TOTAL PROJECT Risk & Opportunity Total	
P20	£17,548	(n/a)
P50	**£142,176**	(n/a)
P80	£389,929	(n/a)

Table 2 - Summary of Project Cost Risk & Opportunity Results - Target Post Mitigation
Previous Results Shown in Blue (N/A)

From Tables 1 & 2 it can be seen that via the use of effective Mitigation Management there is the potential to reduce the 'Most Likely' P50 forecast Risk Total from a value of **£1,194,195** to a total of **£142,176**.

At present the main Risks and Opportunities that drive the potential Project Cost Risk & Opportunity Results - Current Pre Mitigation can be seen within Appendix D.1. This Commercial Risk & Opportunity Ranking Tornado Plot shows that the main Risks and/or Opportunities that would need attention and the implementation of Mitigation Actions in order for the Project Cost Risk & Opportunity Results - Current Pre Mitigation to be returned to an amount closer to the Project Cost Risk & Opportunity Results - Target Post Mitigation are;

1. R-009 - Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.
2. R-002 - Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.
3. R-014 - Problems during Testing and Validation of the Skid Units.
4. R-016 - Integration of Different Technology, Vendors and Control Systems.
5. R-003 - Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.

In addition to the Risks above there are further Risks which do contribute to the forecast P50 Project Cost Total so it is important that Appendix D.1 and Appendix D.2 are reviewed in further detail in order to ensure that all Risks are managed effectively to ensure that the Project Cost Risk & Opportunity Results - Current Pre Mitigation are reduced as much as possible.

SCHEDULE RISK & OPPORTUNITY RESULTS

At present no formal Risk & Opportunity Analysis has been carried out against the Programme and as such there are no Quantitative Schedule Risk & Opportunity Results.

During the Risk and Opportunity identification process however there were Schedule Impact Scores identified against each Risk and Opportunity and as a result it is possible to produce Schedule Risk & Opportunity Ranking Tornado Plots - for both the Current Pre Mitigation position and the Target Post Mitigation position.

These can be seen within Appendix D.3 for the Risk & Opportunity Ranking Plot - Current Schedule Scores Pre Mitigation and Appendix D.4 for the Risk & Opportunity Ranking Plot - Target Schedule Scores Post Mitigation.

Appendix D.3 shows that the main Risks and/or Opportunities that would need attention and the implementation of Mitigation Actions in order to minimise any potential delay to the Current Project Programme are;

1. R-008 - Project Resource Issues (due to Availability etc.).
2. R-009 - Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.
3. R-002 - Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.
4. R-014 - Problems during Testing and Validation of the Skid Units.

Appendix D.4 shows that the main Risks and/or Opportunities that would still need attention, close monitoring and potentially further Mitigation Actions to be considered after the implementation of the current Mitigation Actions in order to minimise any potential delay to the Current Project Programme are;

1. R-014 - Problems during Testing and Validation of the Skid Units.
2. R-015 - Incorporation of New Technology and Introduction of Non-OFGEM Approved Equipment.
3. R-016 - Integration of Different Technology, Vendors and Control Systems.
4. R-017 - Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.

In addition to the Risks above there are further Risks could contribute to the potential delay to the Current Project Programme so it is important that Appendix D.3 and Appendix D.4 are reviewed in further detail in order to ensure that all Risks are managed effectively to ensure that any potential delays to the Current Project Programme are reduced as much as possible.

National Grid 2015 Network Innovation Competition (NIC) - A New Approach To NTS

Connections Project Risk & Opportunity Workshop Number **1** - 10/06/15

Appendix **A** - **Risk & Opportunity Register**

Risk / Opp **ID**	Risk / Opp Name	Risk **or** Opportunity	Risk / Opp Status	Area **of Project**	Risk / Opp Description **(Cause** and **Effect)**	**Pre** Mitigated Risk / Opp Qualitative Impact **Scores**					Risk / Opp Mitigation Actions	Risk / Opp Mitigation Action Owner/s	Risk / Opp Mitigation Action Status	**Post** Mitigated Risk / Opp Qualitative Impact **Scores**				
						Probability Impact	Schedule Impact	Commercial Impact	Schedule Impact **Score**	Commercial Impact **Score**				Probability Impact	Schedule Impact	Commercial Impact	Schedule Impact **Score**	Commercial Impact **Score**
R-001	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Major Changes.	Risk	Open	Project Delivery	There is a risk that there could be additions to the Functionality of what is required on each type of Connection, changes to Customer requirements, or, an increase to the number of Connection Types etc. that are all classed as Major changes. Note - this is influenced by future Energy requirements. There is a potential for NG to fund Major changes that would not be covered within the agreed NIC Scope (if deemed beneficial by NG). Major changes are deemed to be a Business Risk so opened for	1	0	0	0	0	1. Hold Challenge and Review Workshops. 2. Ensure the development of a fully defined scope with the NIA proposal. 3. Ensure the involvement of all Key Stakeholders at key times. 4. Ensure early engagement with potential Customers to explore Requirements / Demand Levels etc. 5. Ensure the use of a full Stage-Gated Project approach. 6. Continued Risk Workshop Reviews during the Project to manage issues.	Project Team	Ongoing through Project.	1	0	0	0	0
R-002	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.	Risk	Open	Project Delivery	There is a risk that there could be additions to the Functionality of what is required on each type of Connection, a change in estimated Equipment Size due to Process Conditions (due to Flows, Pressure etc.), the potential for additional Process Equipment that are not currently identified, changes to Customer requirements, issues with Lead Times, or, an increase to the number of Connection Types etc. that are all currently classed as Minor changes within the Design and Skid Unit Manufacture Section.	3	5	5	**15**	**15**	1. Hold Challenge and Review Workshops. 2. Ensure the development of a fully defined scope with the NIA proposal. 3. Ensure the involvement of all Key Stakeholders at key times. 4. Ensure early engagement with potential Customers to explore Requirements / Demand Levels etc. 5. Ensure the use of a full Stage-Gated Project approach. 6. Continued Risk Workshop Reviews during the Project to manage issues.	Project Team	Ongoing through Project.	2	2	3	4	6
R-003	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.	Risk	Open	Project Delivery	There is a risk that there could be additions to the Functionality of what is required on each type of Connection, a change in estimated Equipment Size due to Process Conditions (due to Flows, Pressure etc.), the potential for additional Process Equipment that are not currently identified, changes to Customer requirements, issues with Lead Times, or, an increase to the number of Connection Types etc. that are all currently classed as Minor changes within the Software Solution and Regulatory Review.	5	2	2	**10**	**10**	1. Hold Challenge and Review Workshops. 2. Ensure the development of a fully defined scope with the NIA proposal. 3. Ensure the involvement of all Key Stakeholders at key times. 4. Ensure early engagement with potential Customers to explore Requirements / Demand Levels etc. 5. Ensure the use of a full Stage-Gated Project approach. 6. Continued Risk Workshop Reviews during the Project to manage issues.	Project Team	Ongoing through Project.	3	1	1	3	3
R-004	Impact of National Grid Block Valve Policy and Functionality.	Risk	Open	Project Outcomes	There is a risk that the NG Policy regarding the future planned use of Block Valve may impact the Project. Note - the is no direct impact to the progress of the Project but this is deemed as key to the successful outcome of the Project - open for	0	0	0	0	0	1. Clarify the current NG Policy regarding the future for the use of Block Valves within the NTS.	Robert Earl	Ongoing through Project.	0	0	0	0	0
R-005	Impact of National Grid Gas Quality Requirements.	Risk	Open	Project Delivery	There is a risk that the NG Policy regarding Gas Quality may impact the Project and could lead to a change within the Project Scope (in terms of changes to the currently planned Generic Designs) as Gas Quality is not currently part of the Project Scope. This would only impact on Entry into the Grid. There is a potential for a change in the Level of Monitoring Equipment	3	1	1	3	3	1. Clarify the current NG Policy regarding Gas Quality. 2. Monitor the outcomes of current NIA concerning Gas Quality.	Robert Earl	Ongoing through Project.	1	1	1	1	1
R-006	Potential for Additional Existing Block Valve Arrangements that have not been Assessed by the Project to Date.	Risk	Open	Project Delivery	At present only a sample of all of the Block Valve Arrangements have been collated to form the basis of the Generic Designs. If all of the existing Block Valve Arrangements haven't been included within the Project there could be additional requirements if Works are required at one of the Sites not included.	2	1	1	2	2	1. Physical Site Surveys will establish the full level of requirements.	Project Team	Ongoing through Project.	0	0	0	0	0

R-007	Interface Issues between Project Partners.	Risk	Open	Project Delivery	There is the potential for delay / additional cost due to delays in Information Flows, interface issues etc.	4	3	2	**12**	8	1. Hold Challenge and Review Workshops. 2. Ensure the involvement of all Key Stakeholders at key times. 3. The Project is to be managed by National Grid to existing National Grid standards, including the development of a full Project Management Plan - Quality Control, Compliance, Comms Strategy etc. There will be a full Project Organigram developed, including Clear and Defined Roles, Critical Skills, Job Role Descriptions etc. 4. The use of the Regular Project Progress Meetings to identify any potential future issues are identified and managed. 5. Ensure involvement of all key Stakeholders at key times.	Project Team	Ongoing through Project.	1	3	2	3	2

Risk / Opp **ID**	Risk / Opp Name	Risk **or** Opportunity	Risk / Opp Status	Area **of Project**	Risk / Opp Description **(Cause** and **Effect)**	**Pre** Mitigated Risk / Opp Qualitative Impact **Scores**					Risk / Opp Mitigation Actions	Risk / Opp Mitigation Action Owner/s	Risk / Opp Mitigation Action Status	**Post** Mitigated Risk / Opp Qualitative Impact **Scores**				
						Probability Impact	Schedule Impact	Commercial Impact	Schedule Impact **Score**	Commercial Impact **Score**				Probability Impact	Schedule Impact	Commercial Impact	Schedule Impact **Score**	Commercial Impact **Score**
R-008	Project Resource Issues (due to Availability etc.).	Risk	Open	Project Delivery	There is a risk that a lack of Specialist Resources to deliver the current Project Scope to Programme.	4	5	1	**20**	4	1. Ensure management of Resources to minimise conflict between Projects. 2. Ensure that all Resource Training needs are to be identified early through Competence Assessments. 3. The use of the Regular Project Progress Meetings to identify any potential future issues are identified and managed. 4. Use of a Dedicated Project Team. 5. Engage Delivery Partners. 6. Identification of Key Project Personel.	Project Team	Ongoing through Project.	1	2	1	2	1
R-009	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.	Risk	Open	Project Delivery	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types which could lead to delays and/or additional cost, or could impact the Specification of Equipment used.	4	4	4	**16**	**16**	1. Gain Advice / Training from Specialist Contractor. 2. Ensure the use of Tech Watch.	Project Team	Ongoing through Project.	2	2	2	4	4
R-010	Inaccuracy of Current Cost / Time Estimates.	Risk	Open	Project Delivery	There is a risk that the initial cost and/or time estimates are found to be incorrect, which could lead to delay / additional cost.	2	3	3	6	6	1. Manage the Project to ensure Minimal Scope Creep. 2. Monitor Cost / Programme Progress. 3. The use of the Regular Project Progress Meetings to identify any potential future issues are identified and managed. 4. Utilise the experience from previous NIA, NIC and other Innovation Projects.	Project Team	Ongoing through Project.	1	3	3	3	3
R-011	Potential for Software Interface Issues between the Software Solution and Existing National Grid Software or due to Changes to the National Grid IS Policy.	Risk	Open	Project Delivery	There is a potential for non-compatibility between the proposed Software Platform Solution and the existing NG IS Systems, which could lead to delay / additional cost.	3	2	2	6	6	1. Arrange an IS Stakeholder meeting early during the Project to establish the full list of requirements. 2. Ensure continuous engagement with IS Stakeholder during Project.	Chris Barron	Ongoing through Project.	2	1	1	2	2
R-012	Increase Difficulty in Transferring the Current Water Industry Software Solution Development into the Gas Industry Software Solution Application.	Risk	Open	Project Delivery	There is a potential that the Software Platform developed for the Water Industry requires a greater number of modifications than currently anticipated in order to work within the Gas Industry Application.	2	1	1	2	2	1. Ensure the early assessment of required compatibility during the Feasibility Stage. 2. Ensure the use of the NIA to inform and identify any modifications required.	Chris Barron	Ongoing through Project.	0	0	0	0	0
R-013	Problems during Testing and Validation of the Software Platform.	Risk	Open	Project Delivery	There is a risk that issues could arise during the Testing and Validation of the Software Solution which could lead to reworks resulting in increased cost and delays.	4	3	2	**12**	8	1. Ensure that sufficient time is allowed within the Programme to fully Test and Validate the System. 2. Undertake Prototype Testing during the development of the Conceptual Design.	Project Team	Ongoing through Project.	2	1	1	2	2
R-014	Problems during Testing and Validation of the Skid Units.	Risk	Open	Project Delivery	There is a risk that issues could arise during the Testing and Validation of the Skid Units which could lead to reworks resulting in increased cost and delays. There is also an additional potential that a suitable Site is not available when needed.	3	5	5	**15**	**15**	1. Ensure that controlled Field Testing takes place. 2. Full FAT. 3. Ensure early Customer Engagement. 4. Ensure that sufficient time is allowed within the Programme to fully Test and Validate the System. 5. Ensure the Development of a full Testing and Commissioning Strategy.	Project Team	Ongoing through Project.	2	5	5	**10**	**10**
R-015	Incorporation of New Technology and Introduction of Non-OFGEM Approved Equipment.	Risk	Open	Project Delivery	There is the potential for delay and/or additional cost due to the incorporation of New Technology and the introduction of Non-OFGEM Approved Equipment.	3	3	2	9	6	1. Ensure early Vendor Engagement. 2. Produce comparisons with proven Technology where applicable. 3. Ensure Technical due diligence - i.e. G35 Approval and Appraisal.	Project Team	Ongoing through Project.	2	3	2	6	4
R-016	Integration of Different Technology, Vendors and Control Systems.	Risk	Open	Project Delivery	There is potential for delay / additional cost due to issues with the integration of New / Different Technology and the ability for Plug and Play Technology whilst still maintaining the Existing Functionality.	4	3	3	**12**	**12**	Ensure early Vendor Engagement. Produce comparisons with proven Technology where applicable. Ensure Technical due diligence - i.e. G35 Approval and Appraisal. Utilise the experience of Design Teams. Utilise the experience with New Technologies / Innovative Solutions.	Project Team	Ongoing through Project.	2	3	3	6	6
R-017	Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.	Risk	Open	Project Delivery	There is the potential for changes to Design and Manufacture (or the inability not to be able to use some of the Sites) which could lead to delay and/or increased costs.	3	4	3	**12**	9	1. Ensure the early review of existing Site Drawings takes place. 2. Early the completion, and review of, the basis for Design.	Project Team	Ongoing through Project.	2	3	2	6	4
R-018	Impact of the NIA on the NIC Project.	Risk	Open	Project Delivery	There is the potential for limited information to be made available out coming from the NIA Project which could lead to delay, false assumptions etc.	2	1	1	2	2	1. Ensure close monitoring of the progress of the NIA Project.	Project Team	Ongoing through Project.	1	1	1	1	1
R-019	Potential for Negative Public Relations.	Risk	Open	Project Delivery	There is the potential for Programme delay and/or increased costs due to the Project links to Shale Gas. There is also a potential for impact due to external Project Vendors	2	5	1	**10**	2	1. Ensure early Consultation with the NG Board to fully outline the Project.	Project Team	Ongoing through Project.	1	4	1	4	1
R-020	Potential for Commercial Modification Proposals does not receive Industry and/or OFGEM Support.	Risk	Open	Project Delivery	There is the potential for a delay to the completion of the Project if the Commercial Modification Proposals do not receive Industry and/or OFGEM Support.	2	5	2	**10**	4	1. Ensure early Stakeholder Engagement.	Project Team	Ongoing through Project.	1	5	2	5	2

R-021	Failure / Delay to Delivery of Key Materials and Equipment.	Risk	Open	Project Delivery	There is a risk that there could be a delay (or failure) to the delivery of Key Materials and Equipment which could lead to delay / additional cost.	2	4	2	8	4	1. Ensure early Engagement with Vendors. 2. Ensure an Expediting Team is put in place on the Project.	Project Team	Ongoing through Project.	1	2	1	2	1

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Project Risk & Opportunity Workshop Number 1 - 10/06/15

Appendix B - Risk & Opportunity Scoring Criteria and Tolerance Scale and Probability and Impact Scoring Diagram (PID)

Score	Level		Probability Level
5	Very High	VH	Over 75%
4	High	H	50% to 75%
3	Medium	M	25% to 50%
2	Low	L	10% to 25%
1	Very Low	VL	Up to 10%
0	Negligible	N	0%

	Colour	Score
High		>=15
Medium		>5
Low		<=5

Score	Level		Schedule Impact Level
5	Very High	VH	Over 3 Months
4	High	H	1 Month to 3 Months
3	Medium	M	2 Weeks to 1 Month
2	Low	L	1 Week to 2 Weeks
1	Very Low	VL	Up to 1 Week
0	Negligible	N	0 Days

	Schedule Impact Level				
Score	Very Low	Low	Medium	High	Very High
Very High %	5	10	15	20	25
High %	4	8	12	16	20
Medium %	3	6	9	12	15
Low %	2	4	6	8	10
Very Low %	1	2	3	4	5

Score	Level		Commercial Impact Level
5	Very High	VH	Over £500k
4	High	H	£250k to £500k
3	Medium	M	£100k to £250k
2	Low	L	£25k to £100k
1	Very Low	VL	Up to £25k
0	Negligible	N	£0k

	Commercial Impact Level				
Score	Very Low	Low	Medium	High	Very High
Very High %	5	10	15	20	25
High %	4	8	12	16	20
Medium %	3	6	9	12	15
Low %	2	4	6	8	10
Very Low %	1	2	3	4	5

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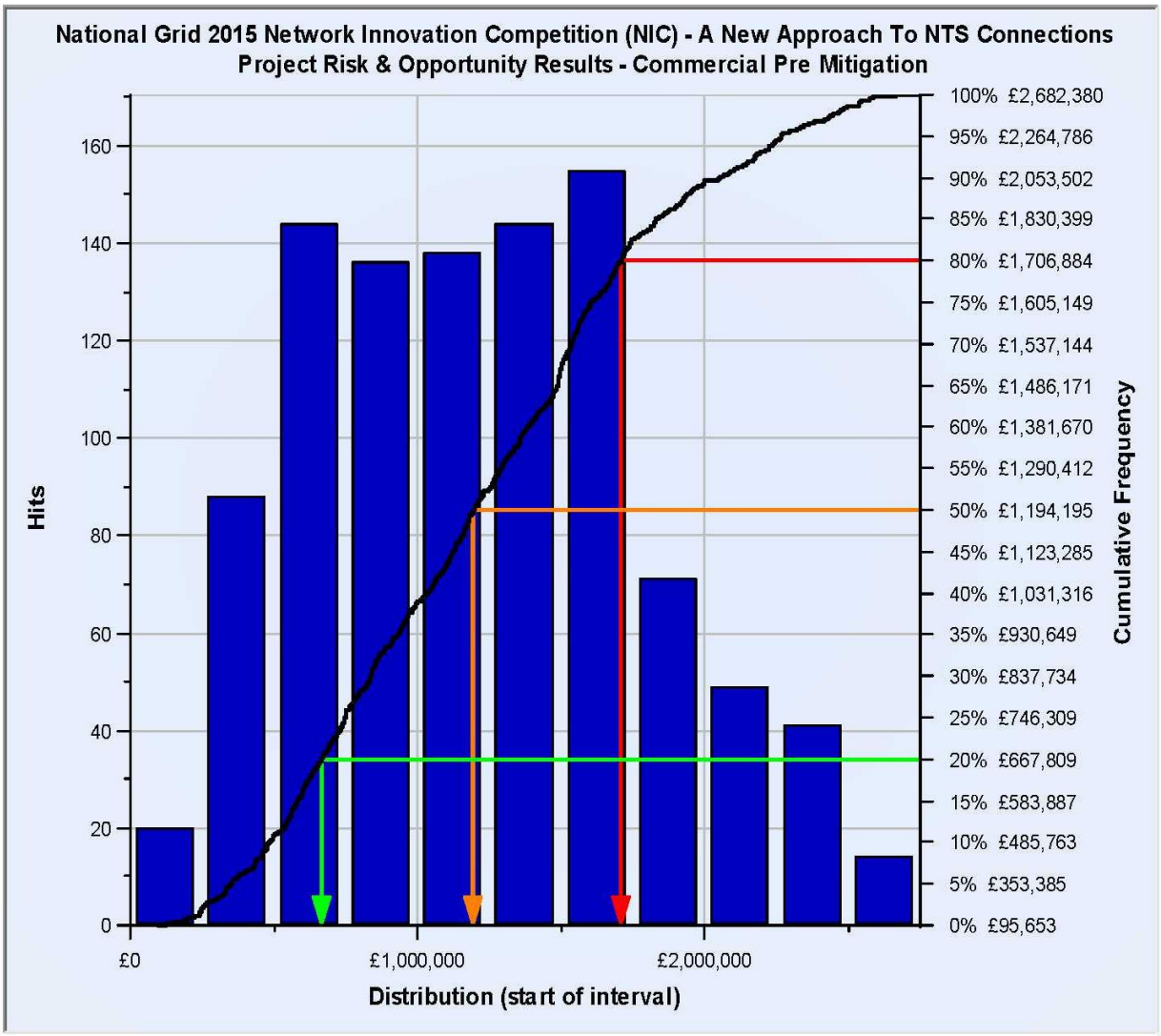
Appendix C.1 - Risk & Opportunity Results and Histogram - Commercial Pre Mitigation

	Project Risk & Opp Total	
P20	£667,809	(n/a)
P50	**£1,194,195**	(n/a)
P80	£1,706,884	(n/a)

(Previous Results in Blue - N/A)



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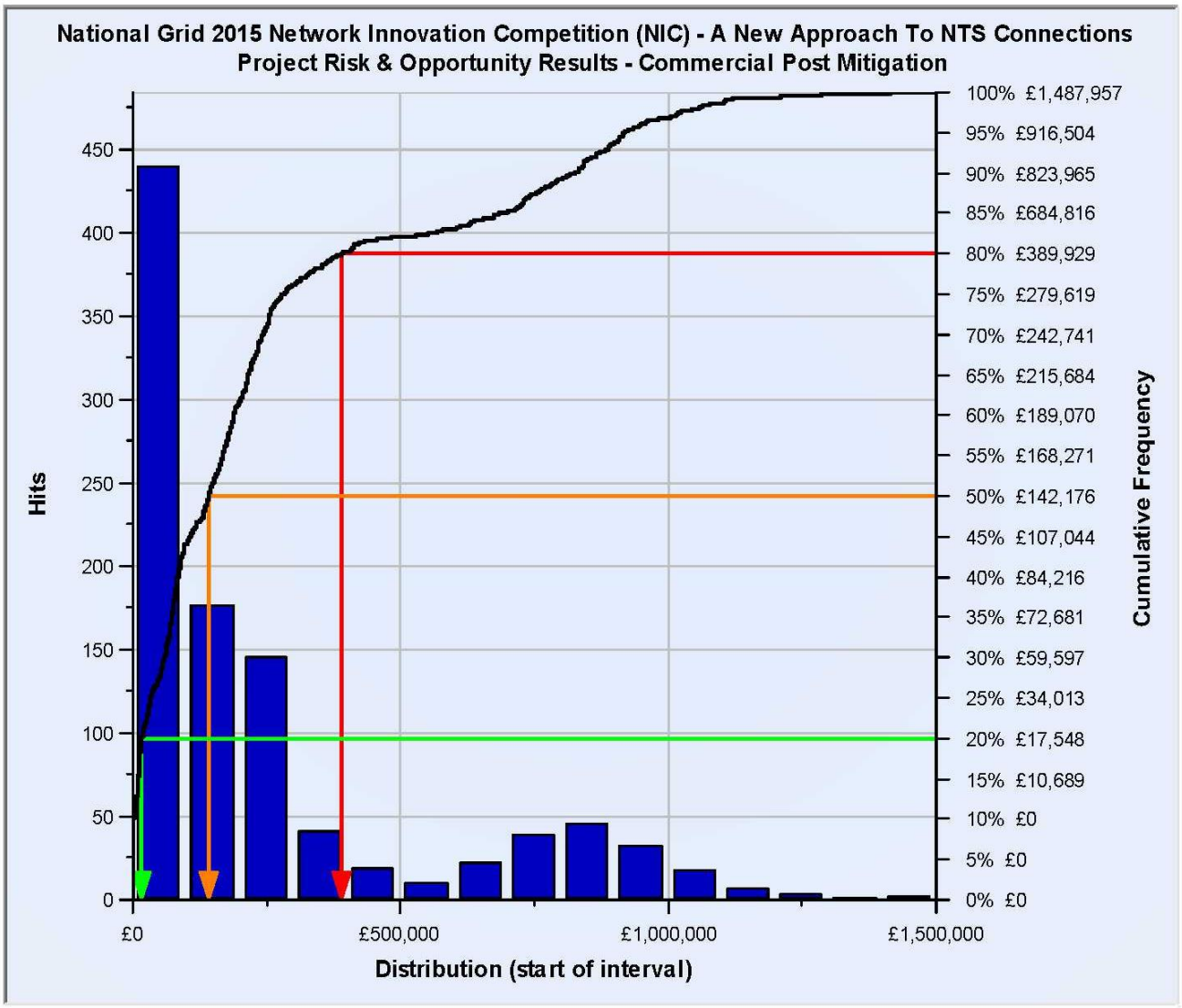
Project Risk & Opportunity Workshop Number 1 - 10/06/15

Appendix C.2 - Risk & Opportunity Results and Histogram - Commercial Post Mitigation

	Project Risk & Opp Total	
P20	£17,548	(n/a)
P50	**£142,176**	(n/a)
P80	£389,929	(n/a)

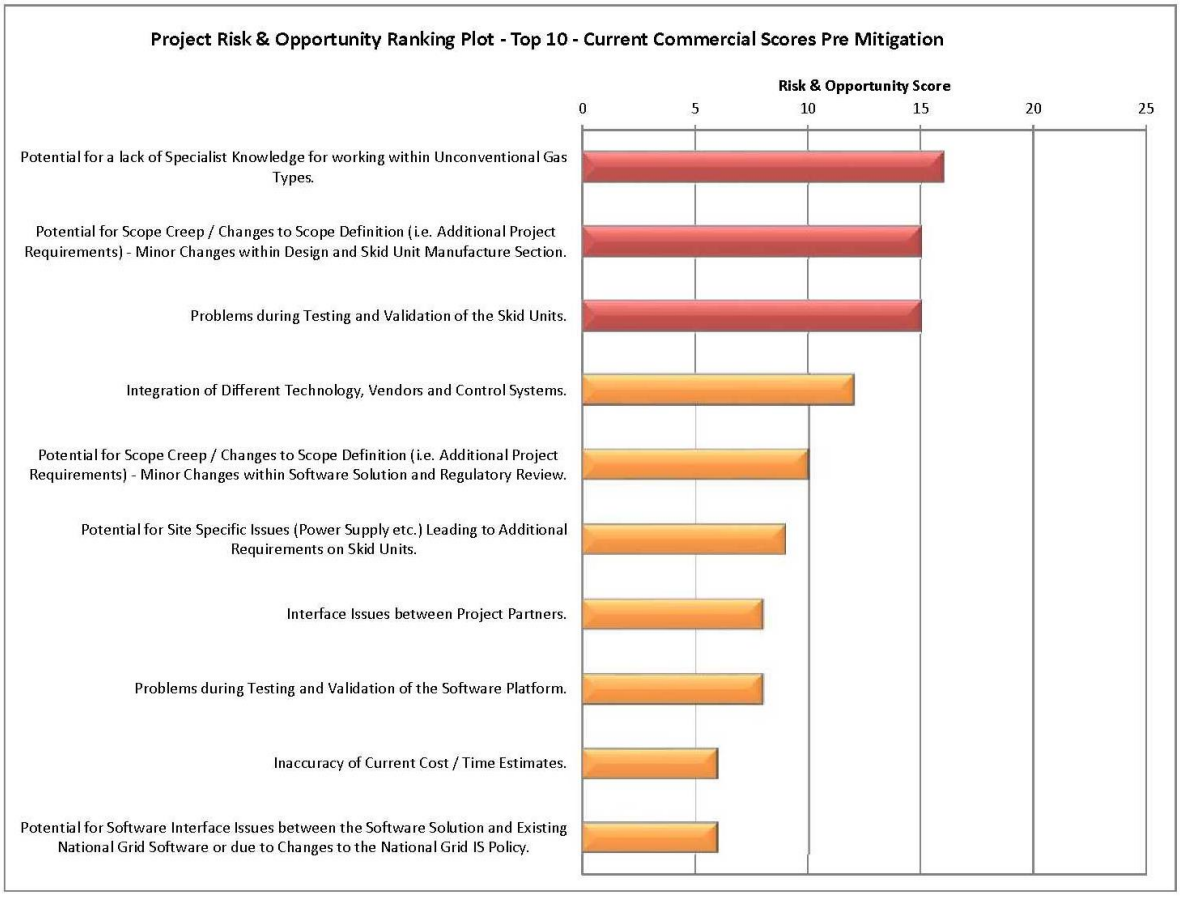
(Previous Results in Blue - N/A)



National Grid 2015 Network Innovation Competition (NIC) - A New Approach To NTS Connections

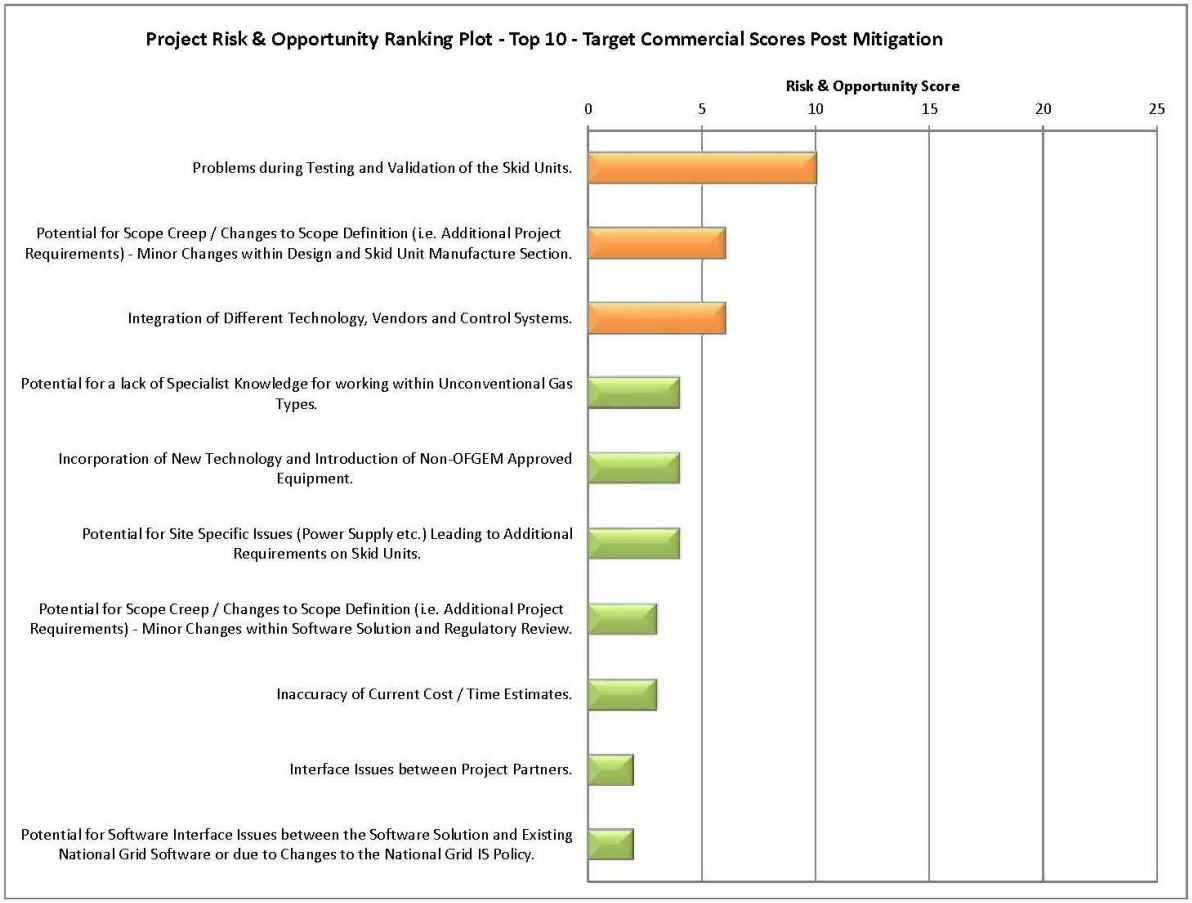
Project Risk & Opportunity Workshop Number 1 - 10/06/15

Appendix D.1 - Risk & Opportunity Ranking Plot - Current Commercial Scores Pre Mitigation



Risk / Opp ID	Risk / Opp Name	Pre Mitigated Risk / Opp Qualitative Impact Scores		
		Probability Impact	Commercial Impact	Commercial Impact Score
R-009	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.	4	4	16
R-002	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.	3	5	15
R-014	Problems during Testing and Validation of the Skid Units.	3	5	15
R-016	Integration of Different Technology, Vendors and Control Systems.	4	3	12
R-003	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.	5	2	10
R-017	Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.	3	3	9
R-007	Interface Issues between Project Partners.	4	2	8
R-013	Problems during Testing and Validation of the Software Platform.	4	2	8
R-010	Inaccuracy of Current Cost / Time Estimates.	2	3	6
R-011	Potential for Software Interface Issues between the Software Solution and Existing National Grid Software or due to Changes to the National Grid IS Policy.	3	2	6

Appendix D.2 - Risk & Opportunity Ranking Plot - Target Commercial Scores Post Mitigation



Risk / Opp ID	Risk / Opp Name	Post Mitigated Risk / Opp Qualitative Impact Scores		
		Probability Impact	Commercial Impact	Commercial Impact Score
R-014	Problems during Testing and Validation of the Skid Units.	2	5	10
R-002	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.	2	3	6
R-016	Integration of Different Technology, Vendors and Control Systems.	2	3	6
R-009	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.	2	2	4
R-015	Incorporation of New Technology and Introduction of Non-OFGEM Approved Equipment.	2	2	4
R-017	Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.	2	2	4
R-003	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.	3	1	3
R-010	Inaccuracy of Current Cost / Time Estimates.	1	3	3
R-007	Interface Issues between Project Partners.	1	2	2
R-011	Potential for Software Interface Issues between the Software Solution and Existing National Grid Software or due to Changes to the National Grid IS Policy.	2	1	2

National Grid 2015 Network Innovation Competition (NIC) - A New Approach To NTS Connections

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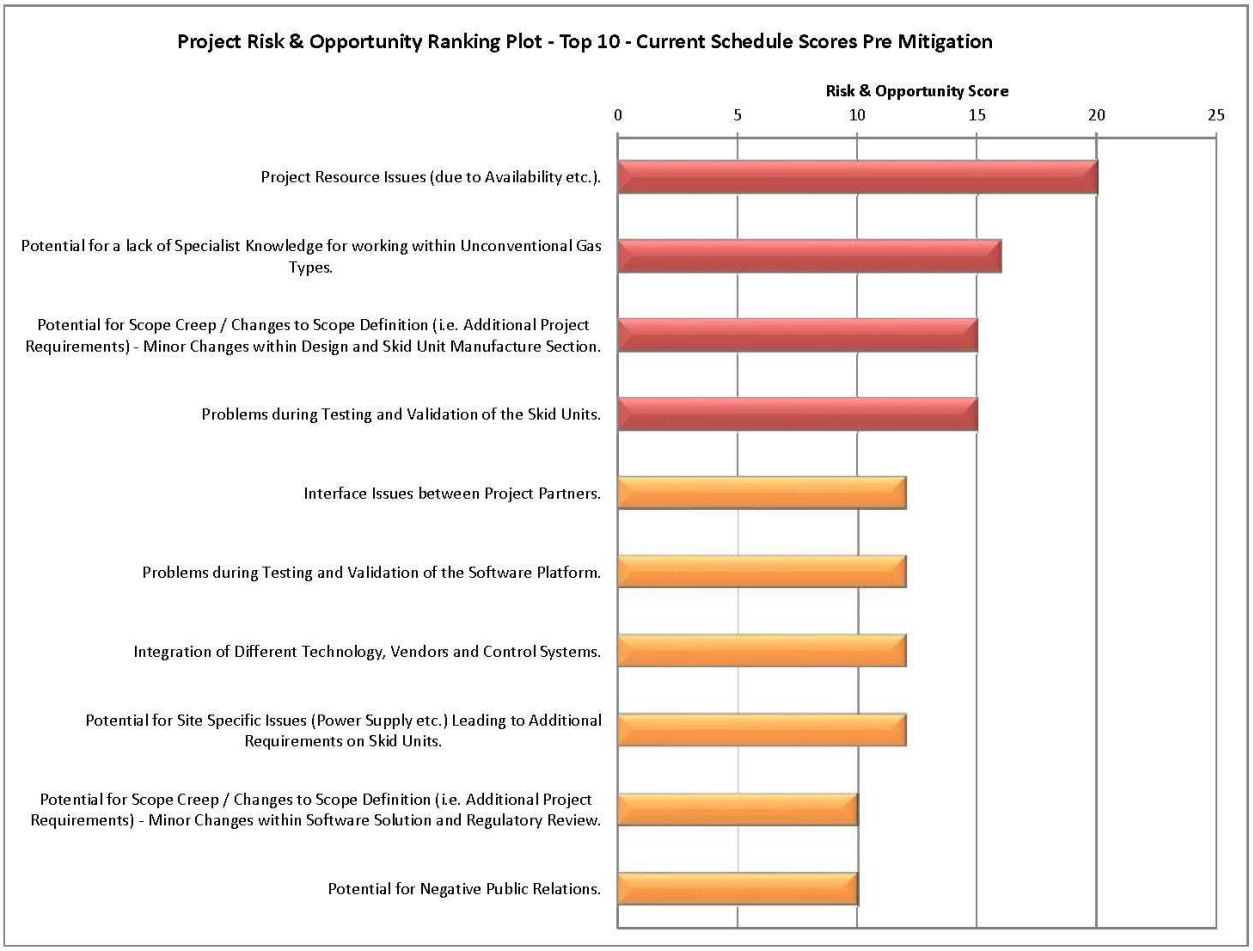
Appendix D.3 - Risk & Opportunity Ranking Plot - Current Schedule Scores Pre Mitigation



Risk / Opp ID	Risk / Opp Name	Pre Mitigated Risk / Opp Qualitative Impact Scores		
		Probability Impact	Schedule Impact	Schedule Impact Score
R-008	Project Resource Issues (due to Availability etc.).	4	5	20
R-009	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.	4	4	16
R-002	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.	3	5	15
R-014	Problems during Testing and Validation of the Skid Units.	3	5	15
R-007	Interface Issues between Project Partners.	4	3	12
R-013	Problems during Testing and Validation of the Software Platform.	4	3	12
R-016	Integration of Different Technology, Vendors and Control Systems.	4	3	12
R-017	Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.	3	4	12
R-003	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.	5	2	10
R-019	Potential for Negative Public Relations.	2	5	10

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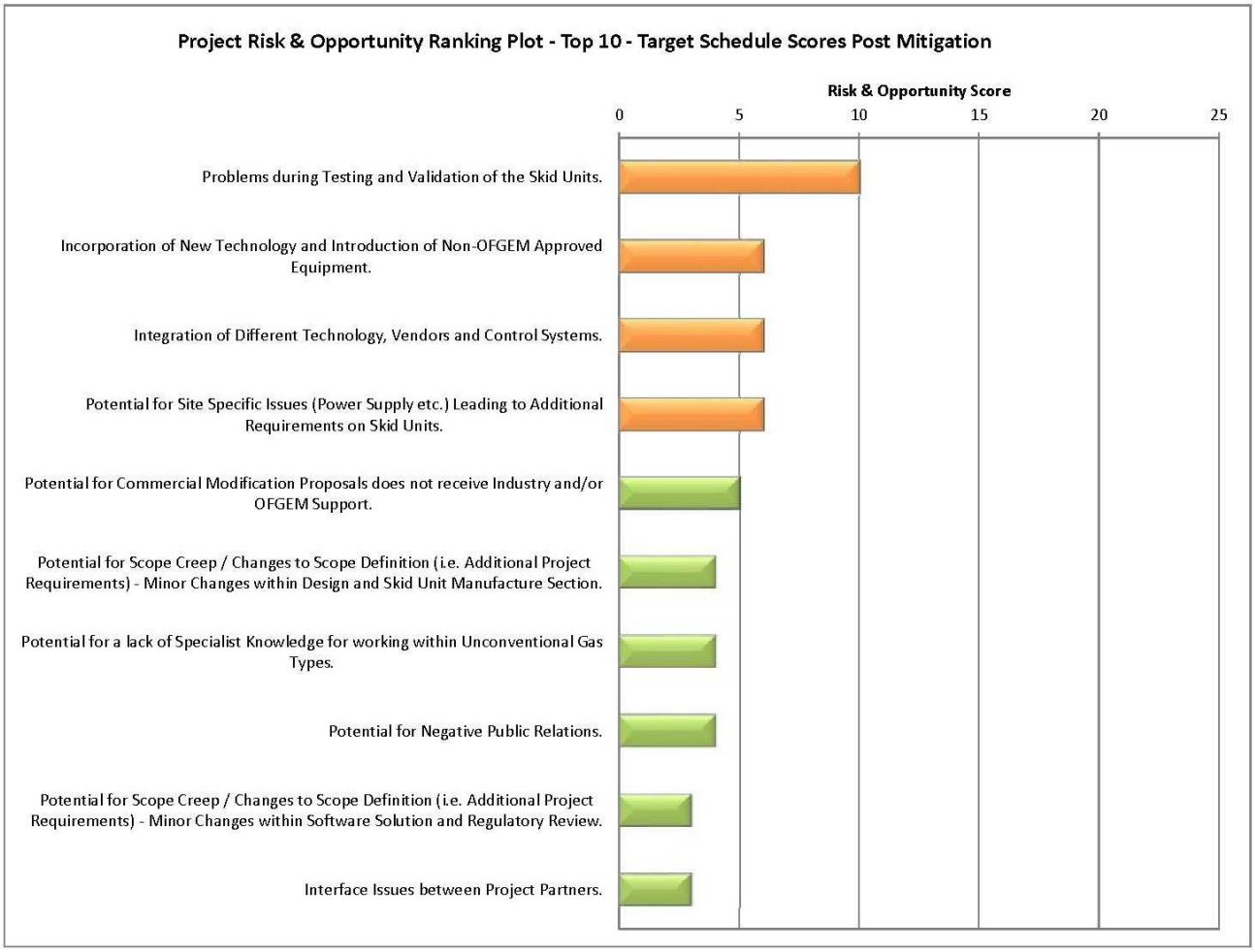
Appendix D.4 - Risk & Opportunity Ranking Plot - Target Schedule Scores Post Mitigation



Risk / Opp ID	Risk / Opp Name	Post Mitigated Risk / Opp Qualitative Impact Scores		
		Probability Impact	Schedule Impact	Schedule Impact Score
R-014	Problems during Testing and Validation of the Skid Units.	2	5	10
R-015	Incorporation of New Technology and Introduction of Non-OFGEM Approved Equipment.	2	3	6
R-016	Integration of Different Technology, Vendors and Control Systems.	2	3	6
R-017	Potential for Site Specific Issues (Power Supply etc.) Leading to Additional Requirements on Skid Units.	2	3	6
R-020	Potential for Commercial Modification Proposals does not receive Industry and/or OFGEM Support.	1	5	5
R-002	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Design and Skid Unit Manufacture Section.	2	2	4
R-009	Potential for a lack of Specialist Knowledge for working within Unconventional Gas Types.	2	2	4
R-019	Potential for Negative Public Relations.	1	4	4
R-003	Potential for Scope Creep / Changes to Scope Definition (i.e. Additional Project Requirements) - Minor Changes within Software Solution and Regulatory Review.	3	1	3
R-007	Interface Issues between Project Partners.	1	3	3

Appendix E – Sample Customer Engagement Questionnaire

[This questionnaire was designed to enable NGGT to compare the number and the needs of the different projects which may wish to connect to a Gas Transporter over the next 5 to 10 years. Telephone interviews were held with potential customers who were generally developers of either biomethane or shale gas projects.]

A New Approach to NTS Connections – Gas Customer Questionnaire

Introduction:
Introduce the Innovation project and give an overview of what we're trying to achieve. Customer should have had contact from NGG (James Abrahams) and agreed to take part in the survey. Should hopefully take no longer than 20 minutes to complete. Are you happy to continue?

Firstly, I just need to confirm that the details I've got for you are correct?

About the customer:			
Name:		Tel No:	
Organisation:		Email:	
Position:			

Now can I ask you about your potential project or any potential projects that you are aware of over the next 5 to 10 years?

How many such potential projects over the next 5 to 10 years?	

We'll now go through the following details for each one.

About the project:			
Entry:		Exit:	
- Shale		- CNG	
- Coal Bed Methane		- Other (type)	
- Bio-methane			
- Other (type)			
Scale of the project:			
- Approx. mcm/yr max?		- Will the project's needs change over time?	
- What yr is the project due to start?		- If so, could you provide a profile over time?	
- How long is the project due to produce/need gas for?			

Now can I ask you if you've any experience of undertaking a connection to a gas network?

Experience:			
Have you had any experience of trying to make a connection to a Gas network? No			
- If so, was it to one owned by National Grid?		- Transmission or Distribution?	
- If not, whose network was it?			
How far through the process did you progress?			
Could you identify the previous project or is it confidential?			

This Innovation project is focussing on exploring a new approach to connections to the Gas Tx network, but the information will be shared with Distribution networks, so can I now ask you about what aspects of a connection to a Gas network are important to you?

Provide a brief overview of the Tx process and overview of the commercials if the customer is not already familiar with this (Connection process incl Network Entry/Exit Agreement or SCA, Capacity processes, role of Shippers, licensing, xoserve, network code etc).

For each of the following could you provide a rating of 1 to 5 where 5 is very important and 1 not important at all. Could you please explain why you've rated each one as you have?

Customer values:						
	5	4	3	2	1	Comments/Why?
1. Cost of the connection						
2. Time to complete the connection						
3. The customer interface – single point of contact through the process						
4. Application fees and securities needed throughout the process						
5. Scalability of any connection solution (i.e. changeable over time)						
6. Gas quality issues or any operational constraints (i.e. gas needing to meet a specific standard)						
7. Financing arrangements – owned outright/leasing						
8. Website tool to make the process easier to decide on connection options (location to Tx network, availability of capacity, etc)						
9. Ease of the process of bringing gas to market (xoserve, Shipper, commercials in general)						

These were the factors which we thought would be important to you, but are there any further factors we should be thinking about?

Further Customer values:						
	5	4	3	2	1	Comments/Why?
10.						
11.						
12.						

Use of information:	
We will be summarising the information provided today (together with other responses) to include within our full submission to Ofgem,. We will not reveal any details of your project, but I need to check you're OK to include in our full submission?	

We'd like to keep you informed regarding the progress of our Innovation project, but what level of engagement would you welcome?

Future involvement:	
Do you want updates by phone, email or other (specify)? How often?	
Would you be willing to work with us during this project?	
Would you be willing to provide a letter of support to progress this Innovation project?	

Appendix F – Sample Distribution Network Engagement Questionnaire

[This questionnaire was designed to enable NGGT to fully understand the connections regime for biomethane/shale/biogas type projects connecting onto the distribution networks, focussing specifically on the connection application process and asset ownership models.]

A New Approach to NTS Connections – DN Questionnaire

Introduction:
Introduce the Innovation project and give an overview of what we're trying to achieve. Idea behind the DN meetings is to verify that we understand the connections regime for bio-methane/shale/biogas type projects onto the DN and also to understand whether or how the learning from the Innovation project would be of help to them

Ensure we've got the contact details correct for who we're interviewing

About the DN –			
Name:		Tel No:	
Position:		Email:	
Name:		Tel No:	
Position:		Email:	
Name:		Tel No:	
Position:		Email:	

Could you explain the connections process for such projects on the DN please?

About the connections process:	
How can the applications be made (online / electronically / paper)?	
What type information do you provide on your website to help the process?	
Do you have a separate department/person managing all of these?	
What type of option regarding connections do you offer such projects?	
What are the main stages in the process and the associated timescales?	
When do you do the network analysis to cater for the project?	
When do customers need to provide security?	
When do they pay for the connection itself?	
What limitation is there on the quality of the gas they can enter?	
What limitations are there on such connections (e.g. low flow	

conditions)?	

Is there anything else relevant relating to the connections process for such projects on the DN please?

Any further information:	
Capacity process	
If DN cannot accommodate the project's capacity requirements without reinforcement on the network what happens?	

We'd like to understand the scale of the demand for such projects on the DN network, firstly those already connected?

How many such projects have connected to the DN to date?	

What type of projects were they?

About the project:			
Entry:		Exit:	
- Shale		- CNG	
- Coal Bed Methane		- Other (type)	
-			
- Other (type)			
Scale of the project:			
- Approx. mcm/yr max?		- How long is the project due to produce/need gas for?	
- What yr did the project start?		- How long did the connection take?	
- Will the project's needs change over time?		- What was the cost to the customer of the connection?	
- If so, could you provide a profile over time?			

Now do you know of any potential projects that may want to connect over the next 5 to 10 years?

How many such potential projects over the next 5 to 10 years?	
Where are the projects located?	

What type of projects are they?

About the project:			
Entry:		Exit:	
- Shale		- CNG	
- Coal Bed Methane		- Other (type)	
- Bio-methane			
- Other (type)			
Scale of the project:			
- Approx. mcm/yr max?		- How long is the project	

		due to produce/need gas for?	
- What yr is the project due to start?		- How long is the connection forecast to take?	
- Will the project's needs change over time?		- What is the forecast cost to the customer of the connection?	
- If so, could you provide a profile over time?			

We're also interviewing some customers directly and asking them to rate certain aspects of a connection, but wondered if you had any feedback from your customers which you could share with us or any other relevant information which may be of use?

What have customers said is important about connections?	
Is there any other relevant information?	

Do you think that the innovation project we're proposing could have applicability to your DN?

Innovation project applicability to DN:	
Do you think any aspects of our project would be of interest to your customers? If so, which ones?	

We'd like to keep you informed regarding the progress of our Innovation project, but what level of engagement would you welcome?

Future involvement:	
Do you want updates by phone, email or other (specify)? How often?	
Would you be willing to provide a letter of support to progress this Innovation project?	

Appendix G – Letters of Support

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RIIO NIC NETWORK INNOVATION COMPETITION

nationalgrid

National Grid
Brick Kiln Street
Hinckley
Leicestershire
LE10 0NA

Customer Connections Team
National Grid Gas Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Stuart Easterbrook
Stakeholder Delivery Manager

stuart.easterbrook@nationalgrid.com
Direct Tel: 07880 783427

www.nationalgrid.com

22 July 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

National Grid Distribution is happy to support a review of the connections regime for unconventional gas projects to National Grid Gas Transmission's system.

Over the last few years we have seen a growing demand for connections from customers wishing to bring unconventional gas projects to market, such as those injecting either biomethane or shale gas. We believe that this level of demand is likely to continue into the future and therefore it is important that these projects can be accommodated onto the Gas Networks.

We are aware that for some projects a connection to a Gas Network with a higher pressure rating (such as to the LTS or the NTS) may be a more suitable option, but understand that the existing NTS connections process can be prohibitive for these types of project. Additionally, there are some projects which are located near to the NTS and therefore a connection to the NTS would be more convenient.

We fully support further development of the NTS connections regime to identify and address any barriers and facilitate gas to grid operations being brought to market. This review would also support improvements to higher pressure exit connections.

We believe that this NTS project could provide useful information which would also be applicable to the LTS. We are therefore keen to share our experiences to date and look forward to sharing in the outputs and conclusions of the project.

Yours sincerely

S. Easterbrook

Stuart Easterbrook
Replace and Extend Stakeholder Delivery Manager

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

WALES&WEST UTILITIES

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Wales & West House
Spooner Close
Celtic Springs
Coedkernew
Newport NP10 8FZ

Tŷ Wales & West
Spooner Close
Celtic Springs
Coedcernyw
Casnewydd NP10 8FZ

Telephone/Ffôn: 0800 912 29 99
Fax/Ffacs: 0870 1450076
Email/Ebost: enquiries@wwutilities.co.uk
www.wwutilities.co.uk

28/07/2015

Our reference: Network Innovation Competition 2015

Dear Sir / Madam

Wales & West Utilities Ltd is happy to offer support to National Grid Gas Transmission in respect of their 'A new approach to NTS Connections' NIC project.

We understand that the innovation project will be investigating the use of modular skid connection units to reduce both the time and the cost taken to connect to the NTS. Additionally, the use of such connection techniques could allow for a connection that could be easily scaled or altered throughout the lifecycle of a customer connection or which could be used to connect multiple customers at one connection site. As part of the project, we understand that National Grid Gas Transmission will develop a Customer Portal which will allow a customer to investigate connections points on the NTS to determine the most appropriate point to connect.

We feel that the proof of concept of such skid units could be transferable to connections on our higher pressure LTS.

For these reasons we support the innovation project and would be keen to share in the knowledge and learning from the project.

Yours faithfully

Bethan Winter
System Ops Manager

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

SGN Your gas. Our network.

SGN
Axis House
5 Lonehead drive
Edinburgh
EH28 8TG

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

21 August 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

SGN is happy to have discussed the aims of the National Grid Gas Transmission project in respect of their 'A new approach to NTS Connections' NIC project.

Over the last few years the industry has seen a growing demand for connections from customers wishing to bring unconventional gas projects to market, such as those injecting either biomethane, CBM or potentially shale gas. A key role for gas and electricity transmission and distribution networks is to be flexible to the changing needs of GB. Capital costs for connection and processing are often perceived as a barrier to network entry, therefore we encourage any initiative to reduce these.

Each project has its own unique features in terms of location and flow characteristics. For some potential network entry proposals a connection to the NTS may be the closest. We understand that the existing NTS connections process, and allowed connection methods, can be prohibitive for these types of project. We would be interested to hear of new innovative low cost methods of connection to the higher pressure network and would consider whether it could be applicable to the LTS.

We recognise that knowledge dissemination is the most powerful form of network collaboration, therefore we look forward to engaging with National Grid Transmission further on this matter.

Yours sincerely,

Angus McIntosh
Innovation & New Technology Manager
SGN
Tel: 07966 105 362
E: angus.mcintosh@sgn.co.uk

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RIIO NIC NETWORK INNOVATION COMPETITION

Northern Gas Networks

Northern Gas Networks Limited
Registered in England & Wales No 5167070
Registered Office
1100 Century Way
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Colton
Leeds LS15 8TU
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Fax: 0113 397 5301
www.northerngasnetworks.co.uk

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

08th October 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

Northern Gas Networks is happy to offer support to National Grid Gas Transmission in respect of their 'A new approach to NTS Connections' NIC project.

We believe that the current increase in demand for customer wishing to bring unconventional gas projects to market is likely to continue into the future and therefore it is important that these projects can be accommodated onto the Gas Networks. In general these types of project have made connections to the lower pressure tiers of the Gas Distribution Network, but due to the characteristics of the flow patterns on these networks, this has sometimes resulted in the network not being able to accept the levels of gas flow which the projects were initially seeking to deliver.

We are therefore aware that for some projects a connection to a Gas Network with a higher pressure rating (such as to the LTS or the NTS) may be a more suitable option, but understand that the existing NTS connections process can be prohibitive for these types of project. Additionally, there are some projects which are located near to the NTS and therefore a connection to the NTS would be more convenient. We therefore support further development of the NTS connections regime to enable such projects to be brought to market and believe that this innovation project could provide useful information which would also be applicable to the LTS.

We are therefore keen to share knowledge and learning with National Grid Gas Transmission. We believe that they have a robust knowledge dissemination plan and are committed to sharing best practise and look forward to sharing in this innovative thinking and engineering excellence.

Yours faithfully

Dan Sadler
HEAD OF ENERGY FUTURES

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

UKOOG United Kingdom Onshore Oil and Gas

United Kingdom Onshore Oil and Gas
40 Dukes Place
London EC3A 7NH

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick CV34 6DA

17 July 2015

Network Innovation Competition 2015 – National Grid submission

Dear Sir/Madam

I write to confirm the support of United Kingdom Onshore Oil and Gas (UKOOG) – the representative body for the onshore oil and gas industry and supply chain – for your submission to the Network Innovation Competition 2015, relating to a new approach to NTS connections.

Natural gas heats 84% of homes in the UK, and is a vital source of electricity generation and feedstock for the petrochemical industry. As you recently concluded in your Future Energy Scenarios publication, natural gas from shale has the potential to meet up to 40% of the UK's gas requirements, replacing declining offshore production. A new industry could also generate tens of thousands of jobs across the country.

But these benefits will not be felt if the gas cannot be delivered efficiently to the homes and businesses that need it.

We believe there are a lot of advantages in being able to export gas directly into the NTS to maximise production from future shale gas developments. However, there are currently a number of potential barriers, including the time taken for a connection to be completed; the high cost of such a connection; and the lack of flexibility in terms of flowrates.

We feel the objectives of your project submission in terms of reducing the time and cost involved, and optimising the sizing of connections are completely in line with our members' needs and we fully support them. Such an initiative could well have a significant positive impact on the successful development of a shale gas industry in the UK.

We would be pleased to support your project through open consultation with our members in a gas transportation working group. As a growing industry, we would like to see transportation solutions that are cost-effective and efficient, and we are encouraged by the scope of your project, which will help us to find the best ways to get the gas that we produce to market.

Yours faithfully

Corin Taylor
Director

1

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Dear Sir/Madam 15th June 2015

Re: Network Innovation Competition 2015

CNG Services supports the aim of the National Grid Transmission NIC Project *A new approach to NTS connections*. The present NTS connection process is geared towards very large loads. We believe there is a pressing need to establish proportionate approaches for smaller loads, reducing the time and costs associated with new NTS connections.

CNG Services is a gas engineering company with 50 staff, focused in four main areas of gas projects associated with GHG reduction:

- Biomethane injection into the gas grid (there will be 50 such plants by end 2015 and we have worked on 45 of them);
- CNG filling stations (using CNG as a replacement fuel gives very significant GHG benefits and we are developing three CNG filling stations at present, two from LTS and one from NTS);
- Gas connection to 20 MW gas engine power plants (typically 10 x 2 MW gas engines designed to back up wind, load factor of around 15%); and
- Shale gas/onshore gas injection into the gas grid (eg we work for Cuadrilla).

In all these areas cost effective connection to the NTS can help to ensure that major opportunities for GHG reduction are accessed.

We believe that all these areas will see significant growth in the next 5 – 15 years and can envisage a total of 15 new NTS connections per annum. For our proposed CNG filling station at Fordoun, we identified the possibility of connecting to the existing NTS block valve. In contrast to the approach adopted for NTS connections to date, this innovative use of a block valve enables a low cost NTS connection to be made with a very short lead-time. We believe that a number of the new connections we envisage in the coming years could follow this precedent (we have identified 20 NTS Block valves as prime candidates for connections for the above asset types). However, we also anticipate demand for 'greenfield' connections that are only likely to be economic if connection costs are reduced.

At present the process, capex and lead-time make it very difficult to utilise an NTS connection for low volume flows (up to 10,000 scmh). Despite the low flows involved and our proposal to connect to the NTS block valve, we have faced no option but to follow the standard UNC process that applies equally to all connections. We have therefore funded National Grid to progress a Full Connection Offer for the Fordoun development at a cost of £121k + VAT. This is a substantial, and we consider disproportionate, commitment for a small business and poses a significant risk when the project is not certain to proceed.

CNG Services therefore very much supports the aim of the NIC Project to reduce the time and costs associated with new NTS connections, and trusts this will also reduce the upfront costs to obtain a connection offer as well as the eventual cost of connection. We would be happy for our Fordoun

project to be included in any NIC work and estimate savings of around £500k can be achieved relative to the National Grid central case capex estimate.

We would also request that National Grid includes a Self-lay Option as part of the project. Attached is a briefing note that explains the benefits of the self-lay option for NTS connections - this has been successfully introduced by National Grid Distribution with six self-lay transmission connections due to be completed by end 2015.

Yours faithfully

John Baldwin

Managing Director
CNG Services Ltd

BioCow

Somerset Farm, Cants Drove, Murrow,
Wisbech, Cambridgeshire, PE13 4HN

Email: info@biocow.co.uk
Web: www.biocow.co.uk

23rd June, 2015

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
WARWICK
CV34 6DA

Dear Sir/Madam,

Network Innovation Competition 2015

I am writing to you on behalf of Biocow to offer support for your submission to the 2015 Network Innovation Competition relating to "A New Approach to NTS Connections".

We own and operate the Somerset Farm AD Plant in Wisbech, Cambs which currently produces 300 scm of biogas per hour. Our farm currently generates 500MWH electricity which is exported to the grid. Due to the close proximity of our farm to the NTS, it would be beneficial for us to secure a connection to the MTS. However the terms of the current connections regime do not particularly support projects such as our own, so we have not been able to do this as yet.

With our planned future expansion we are forecasting to be producing a further 1800 scm per hour. The stated objectives of your project submission are to develop a lower cost and more timely connection regime to the NTS. We fully support these objectives and therefore wish to offer our support for this project.

Yours Faithfully

pp

Derek Burgoyne

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

INEOS

INEOS Upstream
PO Box 21
Bo'ness Road
Grangemouth
Stirlingshire
FK3 9XH
UK

Tel: 01324 493099

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

19 June 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

Further to our conversation in respect of the customer questionnaire, I am writing to express our support for the National Grid NTS submission to the 2015 Networking Innovation Competition addressing a "New Approach to NTS Connections".

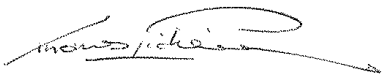
Shale gas represents an enormous opportunity for the UK and presents significant strategic value to our business by way of secure indigenous and competitive fuel and feedstock to underpin existing manufacturing.

We would strongly welcome a project that explores how the NTS might be able to provide timely, economic and technically efficient connections as backbone infrastructure underpinning, exporting and commercialising successfully produced shale gas.

INEOS has invested in a portfolio of prospective onshore shale gas licenses in Scotland, NE and Midlands of England. Whilst the LTZ presents some early commercialisation options for operators, if economic access can be achieved to the NTS, then it will underpin the accelerated development through optimum capacity and more strategic distribution of a national resource.

If you have any questions regarding this letter, please feel free to contact me for further information.

Yours sincerely



Tom Pickering
COO INEOS Upstream

Mob: 07909876122
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Registered Number: 09121775

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

Greener for Life energy

Cricket Barn
Tiverton
Devon
EX16 8NP

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

19th June 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

Greener For Life Energy Ltd are designing, building and operating several Anaerobic Digester (AD) plants in the UK. We constantly work with government bodies, renewable organisations and gas utility network's in order to promote the benefits of green gas and power.

We have recently highlighted some of the areas that can be improved upon in a letter and meeting with HM Treasury.

An area we would like to explore is the possible connection to the National Transmission Network (NTS). This is of particular interest as we have two existing AD plants in close proximity to an NTS pipeline.

The benefits of connecting to the NTS can be achieved by larger volumes of capacity being available and no requirement for injecting Propane.

Provided the connection costs and timeline to complete are in line with our project plans and finances, Greener For Life would welcome this development in order to maximise the future potential of Biomethane in the UK.

Yours Sincerely,

William Bedborough
Connections Manager
Greener For Life Energy Ltd
Mobile: 07946543237

ofgem

RIIO NIC NETWORK INNOVATION COMPETITION

IGas Energy

Incorporating

DART ENERGY

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

22nd June, 2015

Dear Sir/Madam

Network Innovation Competition 2015

I am writing to you on behalf of IGas Energy PLC in support of your submission to the 2015 Network Innovation Competition relating to a New Approach to NTS Connections.

As a company we are already looking at the various options available to monetise our gas production from future shale gas developments. There are a lot of advantages in being able to export treated gas directly into the NTS. However, there are currently a number of barriers in terms of the time taken for a connection to be completed; the high cost of such a connection; and the lack of flexibility in terms of flowrates.

The objectives of your project submission in terms of reducing the time taken, reducing the cost involved, and optimising the sizing of connections are completely in line with our future needs and we fully support them. Such an initiative could well have a significant impact on the successful development of a shale gas industry in the UK.

Yours faithfully,

Andrew Marple

Project Development Engineer
IGas Energy PLC

futurebiogas

10-12 Frederick Sanger Road, Guildford, Surrey, GU2 7YD
T: 01483 375920 E: info@futurebiogas.com

National Grid Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

17th June 2015

Dear Sir/Madam

Re: Network Innovation Competition 2015

Future Biogas Ltd is one of the leading developers and operators of anaerobic digestion biomethane plants. Future Biogas currently operates seven sites in the UK, with three further sites in construction this year and several more in the pipeline. We have gained valuable first hand experience through the completion of these projects, four of which are biomethane injection sites connected to National Grid's Distribution network.

Having successfully worked with National Grid Distribution for over three years we are collectively providing over 10,000 homes and businesses across Norfolk, Lincolnshire and South Yorkshire with renewable gas. In addition to this, these sites reduce CO_2 emissions by approximately 28,000 tonnes per year. All of these projects have required close collaboration with National Grid Distribution; from our first site in Doncaster, this was National Grid's first commercial biogas project injecting into the gas network to one of our latest projects in Holkham, Norfolk, which connected to a high-pressure pipe local transmission system (LTS).

The LTS project was another first for National Grid, allowing us as customers, to carry out a third-party connection to the LTS network, subsequently adopted by NGD. The trial project with National Grid enabled us to appoint an accredited contractor to construct the pipeline and connect onto the LTS. By developing this solution National Grid gave us the flexibility in the construction of design elements and secure project delivery.

As the biomethane industry is developing, the challenge of securing capacity for injection on lower pressure systems is becoming more apparent. With this in mind, the need to look for ways to develop more innovative gas connections is critical for the continued growth of this industry.

We believe there are many sites that would benefit from exploring the option of NTS connections. Several of our operational sites are located adjacent to NTS mains, with one in particular located just 40m away. These sites have the potential to be converted to biomethane projects.

As an industry, we have already faced capacity problems within the electricity market, whereby developers simply cannot connect; avoiding this in the gas network will be key for continued

market development. NTS connections would provide further opportunities for biomethane growth and thus continue to decarbonise the gas grid.

We are keen to support National Grid Transmission to realise the potential of reducing connection costs which would then allow biomethane plants to be financially viable in the NGT network. The adoption of innovative connection options is particularly attractive to stakeholders such as Future Biogas – securing these connections will help to provide sustainable energy to National Grid's customers, meet DECC's renewable heat targets and ensure wider renewable energy targets are met.

Yours Sincerely,

Philipp Lukas
Managing Director

Appendix H - Project Team Organogram

Project Team Organogram