Low Carbon Gas Preheating

Project Progress Report 08

19 June 2018

Issued by email to:

lcnfund@ofgem.gov.uk

networks.innovation@ofgem.gov.uk

Ian.Bagworth@ofgem.gov.uk

Table of Contents

Table of Figures

1.0 Executive Summary

1.1 Project Snapshot

The transition to a low carbon energy sector in the UK presents Gas Distribution Networks (GDNs) with a number of challenges, including reducing the Business Carbon Footprint (BCF) of operating gas networks. The requirement for GDNs to preheat gas at pressure reduction stations (PRS) to avoid freezing the outlet pipework and ensure continuity of supply is a significant contributor to our BCF. GDN's preheating requirement is currently delivered using aging Water Bath Heaters (WBH) or more modern Boiler Package technologies (BH). However, there are several key issues that GDNs currently face when appraising investment options for preheating technology. Firstly, the whole life costs and in particular the carbon impact of currently available technologies is not understood. Secondly, there has been limited research or development in this area resulting in no financially viable alternative to existing technologies. And finally, the current shrinkage arrangements provide no incentive to target reductions in BCF associated with preheating.

The Low Carbon Gas Preheating (LCGP) seeks to address these issues directly. The project will install two 'alternative' preheating technologies across six NGN sites of differing scale - three Thermo Catalytic Systems (HotCat) and three Low Pressure Steam Systems (LP Steam). Smart metering technology will be installed on each of the six sites to provide data required to calculate and publish the system efficiency of each site and each technology. Additionally, smart metering technology will be installed separately on six sites that employ existing technologies. System efficiencies will be calculated and published for direct comparison.

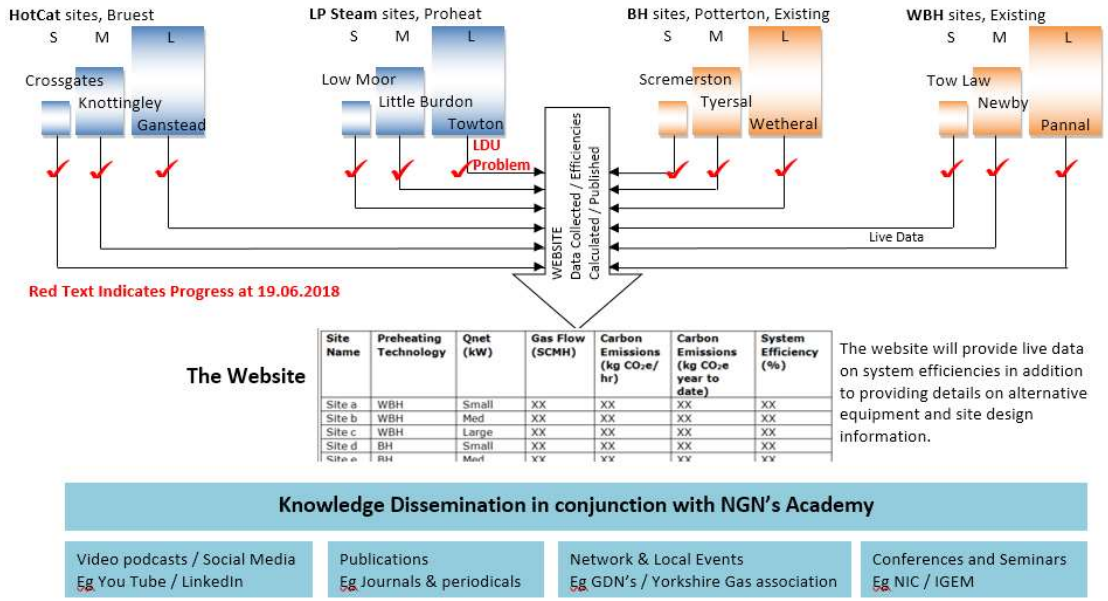

Figure 1. The LCGP Project as at June 2018

All 12 LCGP sites are now fully commissioned and the project website has received live data from all sites.

At the time of writing, at Towton, the alternative technology preheating equipment is not operational due to a problem with the pressure let down unit serving the preheater. Design modifications to this unit are in progress and will be resolved this summer.

The alternative technology preheaters at Ganstead and Knottingley received approval for commissioning in October & November 2017 respectively. Following some initial operational problems, rectified by the manufacturer in February 2018, the units have been providing preheating and associated data.

On 17 May 2018 NGN submitted an application to Ofgem to extend the end date of the project until May 2019. This was due to the problems experienced at Ganstead / Knottingley / Towton as above. The extended period of data collection will allow NGN to collect sufficient data to achieve the goals as set out in the Project Direction.

All project costs and analysis of costs are contained within the Confidential Annex.

The website remains live and publicly accessible via the NGN Website. All data is available for download to allow individuals to undertake their own data analysis should they wish to do so. Further to work carried out by the LCGP team we are now confident that the data being obtained from site contains no glitches. This report contains initial findings in terms of efficiency being calculated from each site. This information will ultimately be used to assist with calculating whole life costs and associated carbon emissions for each type of technology and for each size of site.

The website can be viewed at:

https://www.northerngasnetworks.co.uk/ngn-you/the-future/preheating/

1.2 Project Summary

During the last 12 month reporting period of the LCGP project the team have successfully commissioned the large and medium hotcat units at Ganstead and Knottingley. They have also resolved all 'glitches' within the data collection and calculations supporting the website.

Site specific data has been collected to use to demonstrate some initial findings of preheater efficiency across all sizes and technologies where possible. This initial data is based on a 1 week data period where minimal anomalous results were noted and a relatively high flow rate was recorded. A summary of the initial system efficiencies calculated are contained within this report.

Subject to approval of the extension of time requested from Ofgem, the project shall now continue to collect data until early 2019. This data will then be analysed to draw some final project conclusions from and to deliver the original project benefits.

1.3 Risk Section

An updated risk register is contained within the Confidential Annex.

Details of live risks are given along with all costs to date and forecast costs to complete the LCGP project.

1.4 The Learning Section

The LCGP website is live and contains data from all 12 LCGP sites. We have also uploaded a mini case study for each of the sites with an alternative technology preheater (6off altogether).

https://www.northerngasnetworks.co.uk/ngn-you/the-future/preheating/

2.0 Project Manager's Report

2.1 Project Overview

Over the last 12 month period all preheating equipment across all 12 LCGP sites has been commissioned. Commissioning of the Proheat unit at Towton was completed in March 2017 whilst commissioning of the Hotcat units at Ganstead and Knottingley was completed in November 2017 with further modifications to the Hotcat units carried out in February 2018.

All glitches have been resolved in the data collection, calculations and displaying of information on the project website. Further work will be done to identify site specific items affecting data from each of the 12 sites, due to different site configurations and different instrumentation etc.

Information provided within the Close Down report shall contain forecasted whole life costs and associated carbon emissions of both the existing and alternative preheater technologies in line with the original Project Objectives.

Fault data per site, efficiency calculations and carbon emission data is being collected now in readiness for the project Close Down report. Faults per site to date and an initial value of system efficiency are contained within this report. Details of these initial findings, in addition to predicted whole life costs of the preheating assets will be shared at Knowledge Dissemination events between now and 1 May 2019.

Remaining work on the LCGP project involves ensuring the preheaters serving the 12 LCGP sites remain operational and continue to produce useful data, and sharing the knowledge gained to date with other GDN's and any other interested parties at Knowledge Dissemination events.

2.2 Work Packages

The project has been broken down into 10 work packages. Each is detailed in this section but can be summarised as follows:

- WP01 to 06. Each of the 6 sites where alternative technology is installed
- WP07. Work carried out on the 6 sites with existing technology; 3 boiler houses / 3 water bath heater sites
- WP08. The website and information management
- WP09. Training / System Control
- WP10. Project Management

2.2.1 WP01. Hotcat Small (Crossgates)

Figure 2. Small Hotcat at Crossgates.

This site installation and commissioning was completed prior to PPR 03. Details can be found in previous PPR's and in the mini case study published on the project website.

The Hotcat has provided preheating to the Crossgates site since winter 2015 / 16.

"NGN/PM/MAINT/10003 Management Procedure for maintaining the mechanical safety, integrity and reliability of bruest (model HC-1300) catalytic infrared heater" and "NGN/PM/MAINT/10004 Management Procedure for maintaining the E&I safety, integrity and reliability of bruest (model HC-1300) catalytic infrared heater" were approved by NGN's Standards Steering Group on 18 May 2018. The document is now available through the NGN standards website for colleagues to access.

Number of preheater logged items : 7 (November 2015 to April 2018)

Initial 1 week average efficiency : 76%*

* Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

2.2.2 WP02. Hotcat Medium (Knottingley)

Figure 3. Medium Hotcat at Knottingley

As previously reported, Bruest have designed and built the Hotcat Mark II as a direct result of funding from the LCGP project. Approval to commission this unit was obtained on 6 November 2017. The hotcats at both Knottingley and Ganstead were commissioned by Bruest between 31 October and 10 November 2017.

Details of sizes / layouts / lessons learned are contained within the mini case study published on the project website.

During initial operation it was found that more condensate was being collected than had been expected at the design stage. This lead to regular tripping out of the Hotcat unit and resulted in subsequent call outs for NGN maintenance teams. As a result of this problem the units were temporarily shut down shortly before Christmas. Bruest attended site again to carry out some remedial works in February 2018. The unit has been the primary heat source for this site since the work was carried out.

Work to remove the exisitng preheating technology (WBH's) will only be carried out once the Bruest hotcats have proven to be reliable.

"NGN/PM/MAINT/10005 Management Procedure for maintaining the mechanical safety, integrity and reliability of the Bruest catalytic infrared heater (containerised) model -2750" was approved by NGN's Standards Steering Group on 18 May 2018. The document is now available through the NGN standards website for colleagues to access.

Number of preheater logged items	:	10 (March 2018 to April 2018)*
Initial 1 week average efficiency	:	14%#

*Existing WBH's still remain on this site, further investigation into each fault logged is required

Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

2.2.3 WP03. Hotcat Large (Ganstead)

Figure 4. Large Hotcat at Ganstead

As previously reported, Bruest have designed and built the Hotcat Mark II as a direct result of funding from the LCGP project. Approval to commission this unit was obtained on 30 October 2017. The hotcats at both Knottingley and Ganstead were commissioned by Bruest between 31 October and 10 November 2017.

Details of sizes / layouts / lessons learned are contained within the mini case study published on the project website.

During initial operation it was found that more condensate was being collected than had been expected at the design stage. This lead to regular trips of the hotcat and call outs for NGN maintenance teams. As a result of this problem the units were shut down shortly before Christmas. Bruest attended site again to carry out some remedial works in February 2018. The units have been the primary heat source for this site since the work was carried out.

Work to remove the existing preheating technology (Boilerhouse and Heat exchanger) will only be carried out once the Bruest hotcats have proven to be reliable.

"NGN/PM/MAINT/10005 Management Procedure for maintaining the mechanical safety, integrity and reliability of the bruest catalytic infrared heater (containerised) model -2750" was approved by NGN's Standards Steering Group on 18 May 2018. The document is now available through the NGN standards website for colleagues to access.

Number of preheater logged items	:	9 (March 2018 to April 2018)
Initial 1 week average efficiency	:	17%*

* Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

2.2.4 WP04. LP Steam Small (Low Moor)

Figure 5. Small LP Steam at Low Moor

This site installation and commissioning was completed prior to PPR 03. Details can be found in previous PPR's and in the mini case study published on the project website.

The LP Steam unit has provided preheating to the Low Moor site since winter 2015 / 16.

"NGN/PM/MAINT/10001 Management Procedure for maintaining the E&I safety, integrity and reliability of proheat preheat units" and, "NGN/PM/MAINT/10002 Management Procedure for maintaining the mechanical safety, integrity and reliability of immersion tube preheat system" were approved by NGN's Standards Steering Group on 18 May 2018. The document is now available through the NGN standards website for colleagues to access.

Number of preheater logged items	:	18 (November 2015 to April 2018)
Initial 1 week average efficiency	:	64%*

* Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

2.2.5 WP05. LP Steam Medium (Little Burdon)

Figure 6. LP Steam Unit at Little Burdon

The Proheat units at Little Burdon were left in automatic service following successful commissioning completion on 9 December 2016 (prior to PPR07). This successful commissioning followed remedial works resulting from the incident on 10 October 2015.

Work done to obtain approval to commission these units was detailed in PPR06.

Work to replace the 2 stage burner head from a 70/30 to a 50/50 head were carried out by Proheat on 16 – 18 October 2017.

Details of sizes / layouts / lessons learned are contained within the mini case study published on the project website.

The LP Steam unit has provided preheating to the Little Burdon site since December 2016. Fault reporting has only been referenced below since October 2017 as the service visits carried out by NGN's maintenance teams on the 70 / 30 burner head do not reflect the reactive / planned maintenance visits recommended by Proheat.

"NGN/PM/MAINT/10001 Management Procedure for maintaining the E&I safety, integrity and reliability of proheat preheat units" and, "NGN/PM/MAINT/10002 Management Procedure for maintaining the mechanical safety, integrity and reliability of immersion tube preheat system" were approved by NGN's Standards Steering Group on 18 May 2018. The document is now available through the NGN standards website for colleagues to access.

Number of preheater logged items	:	6 (19 October 2017 to April 2018)
Initial 1 week average efficiency	:	76%*

* Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

2.2.6 WP06. LP Steam Large (Towton).

Figure 7. Large LP Steam Unit at Towton

The Proheat units at Towton were left in automatic service following successful commissioning completion in March 2017.

Details of sizes / layouts / lessons learned are contained within the mini case study published on the project website.

Regular trips of the Proheat units have been caused by the pressure let down unit serving the Proheat units. This was supplied separately to the Proheat equipment. Proheat were called to site on the following dates. During these site visits the problem was identified:

1. 11 December 2017
2. 13 – 15 December 2017
3. 18 – 21 December 2017

The existing Water Bath Heaters were brought back into service following these visits.

To resolve the situation NGN have engaged an external design partner. At the time of writing the G17 Approved / Appraised design is awaiting a G17 Part C from NGN's asset department to allow installation to commence.

Work to remove the exisitng preheating technology (WBH) will only be carried out once the Proheat Units have proven to be reliable.

Fault logs listed to date do not reflect what NGN would expect to be 'normal' operation of these units due to the trips caused by the pressure let down unit.

Number of preheater logged items	:	NA*
Initial 1 week average efficiency	:	NA

*Faults not recorded against the Towton preheater as these were caused by the pressure let down unit as detailed elsewhere in this report.

2.2.7 WP07. Existing Technology (Boilerhouses (BH) and Water Bath Heaters (WBH))

All instrumentation is now live and reporting back to SCADA.

Fault logs have been obtained from NGN System Control department and are shown in the below table along with Initial 1 week average efficiency.

Table 1. Existing Technology Faults and Initial Efficiencies

Site	Technology	Number of preheater logged items	Dates of logged items	Initial 1 week average efficiency*	Comments
Pannal	WBH Large	50	Jan 16 – April 18	54%	
Newby	WBH Medium	14	Jan 16 – April 18	86%	
Tow Law	WBH Small	64	Jan 16 – April 18	#	
Scremerston	BH Small	11	Jan 16 – April 18	76%	
Tyersal	BH Medium	9	Mar 17 – April 18	59%	
Wetheral	BH Large	45	Jan 16 – April 18	79%	

* Initial results based on 1 week of data. Efficiencies will be confirmed along with all analysis within the project Close Down Report.

#Unable to obtain accurate efficiency data at this time due to meter size and site flow rate.

2.2.8 WP08. Website

Further to previously reported website data 'glitches', the LCGP team has been supported by an NGN member of staff, Shane Muirhead. Shane has identified and resolved all data glitches.

It should be noted that although the calculations carried out by the NGN SCADA system are now fault free, the data produced often needs interpretation. For example, when efficiencies are shown greater than 100%, this is due to no fuel gas or electricity being used within the hour by the preheater. However, preheat is provided to the gas stream by residual heat within the preheater, measured and reported in the 'previous' hour. See Figure 8.

In addition to hourly system efficiency calculations, the website also calculates efficiency based on a 24 hour period. This resolves the 'excess of 100%' issue.

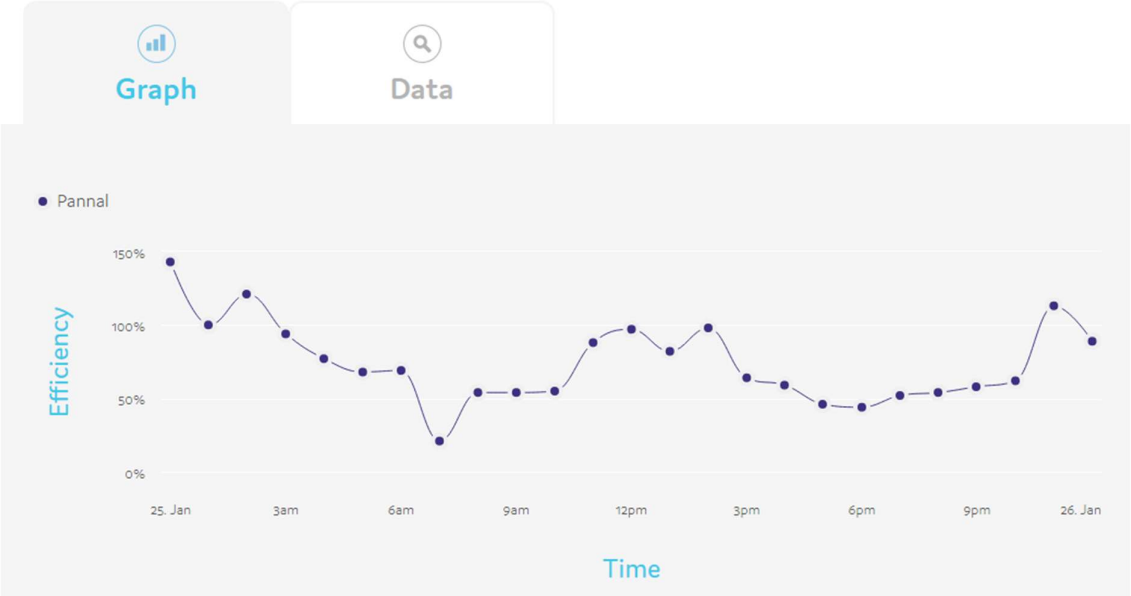

Figure 8. Daily Efficiency Plot

Interpretation, or disregarding of data is required when low gas flow rates cause spurious results. This can be due to issues including;

1. Inlet gas temperatures representing ambient air temperature.
2. Excessive energy lost to atmosphere between the preheater and the site outlet gas temperature sensor.

To manage this issue, in attempting to calculate a system efficiency for each site, the team have identified a time period of 1 week where flow rates were suitable. Average efficiencies for all sites where this data was collected are shown in Sections 2.2.1 to 2.2.7.

Site specific issues also need to be considered in future reporting when interpreting data. For example

- Some sites have a greater length of pipework between the preheater and the pressure regulators / downstream temperature instrumentation. This can affect the 'system efficiency' of the gas site due to heat being lost to atmosphere.

- Different types of instrumentation between sites can affect the results. Some sites have surface mounted inlet temperature sensors whereas others pick up temperature data from fiscal quality metering on site.

Data analysis will be carried out in depth and form part of the Close Down report for this project. Details of instrumentation will be provided and compared.

2.2.9 WP10. Project Management

Project management will focus on maintaining preheater operation across all 12 sites to ensure sufficient data is collected to produce a Close Down report which achieves all of the original project objectives.

All design, installation and commissioning work has now been completed with the exception of the remedial works to the pressure let down unit serving the LP Steam unit at Towton.

The personnel working on the project will carry out Knowledge Dissemination events for external stakeholders and produce all reporting, complete with data analysis, to complete the project.

2.3 The next 6 months

Over the next 6 month period there are 4 remaining priorities:

1. Rectification of the issues with the LDU at Towton
2. Data collection (ensuring the preheaters remain active)
3. Data analysis including the collection of commercial information relating to all call outs to preheaters. This will allow the Whole Life costs of each type of preheater to be calculated
4. Knowledge Dissemination

3.0 Business Case Update

The benefits to be gained from this project have not changed since the full submission. The four key objectives will be achieved, however, an extension of time has been applied for and as such these objectives will be achieved later than originally anticipated:

1. *Assess the potential for alternative technologies to meet preheating requirements across a range of heating system sizes and operating site parameters*.

The extension of time applied for will allow adequate data to captured over a suitably extended period to allow meaningful results and conclusions to be drawn within the Close Down report.

2. *Provide an independent and accurate model for assessing the efficiency of preheating systems across the UK based on reducing business carbon footprint (BCF) and whole life costs*.

The BCF and whole life cost data will be form part of the Close Down report.

3. *Increase the technological options available to gas transporters for the replacement of preheating assets and increase the supply side of this market*.

The Hotcat Mark II is available for other GDN's to purchase from Bruest, as is the Hotcat Mark I. The developments in the Proheat equipment are also available to other GDN's to purchase.

4. *Provide quantified data on system efficiency of both alternative and existing technologies that can provide the industry with information that will allow more informed investment decisions and a more efficient operation of the network*.

Data collection / analysis and Knowledge Dissemination events are the focus of the project team until the Close Down report is produced.

4.0 Progress Against Plan

The project programme of design / install / commission has been completed with the exception of remedial works to the pressure let down unit at Towton. As such this report does not contain an updated project plan.

Data collection, analysis, knowledge dissemination and report writing remain to be completed on the project.

5.0 Progress Against Budget

The project against budget summary is contained in the confidential annex.

6.0 Bank Account

The bank account details are contained in the confidential annex.

7.0 SDRC

7.1 Preheating Site Selection

Completed.

7.2 Preheating Site & Technology Design

7.2.1 Smart Metering (Existing Technology)

Completed.

7.2.2 HotCat and LP Steam Small Site Designs

Completed.

7.2.3 HotCat & LP Steam Medium and Large Site Design

Completed.

7.3 Technology Build & Installation

The medium and large Hotcat units were commissioned by November 2017. Due to 'teething' problems with the new Hotcat design, remedial works were carried out in February 2018. Data has been collected since this time and will be used to successfully complete the 'monitoring' aspect of this SDRC.

7.4 Successful trialling and demonstration of alternative preheating technologies

This SDRC was largely complete prior to PPR 03.

Mini-case studies have been uploaded the project website.

7.5 Successful estimation of system efficiencies of existing preheating technologies

Initial estimations of system efficiencies are contained within this PPR08. Further data will be collected and analysed over the coming months to provide clearer information around system efficiencies.

All issues with data accuracy and calculation co-efficients have been resolved over the last 12 month period.

7.6 Knowledge, Learning & Dissemination Strategy

The functionality of the website was proven prior to PPR 03.

Data can be captured by the project website for all sites. Whilst the date initially identified within this SDRC has passed, the data captured and shared will be in line with this SDRC once the project is complete.

7.7 Project Evaluation & Final Project Report

This report PPR 08 identifies that the Project Evaluation and the detailed Final Report will be produced later than originally anticipated in May 2019 (detailed within the original Project Direction on or before December 2017). An extension of time in light of this has been requested of Ofgem.

8.0 Data Access Details

Interested parties can download project information from the project website at:

https://www.northerngasnetworks.co.uk/ngn-you/the-future/preheating/

Should interested parties require any further information this can be requested by emailing the project team at lcgp@northerngas.co.uk

9.0 Learning Outcomes

Designs have been published on the project website for the Hotcat Mark II to allow other GDN's to better understand the preheater.

Mini case studies of all sizes of hotcats / LP Steam units have been published on the website for information.

10.0 IPR

No relevant IPR's have been generated or are forecast to be generated.

11.0 Risk Management

The project risk register has been updated and is contained in the Confidential Annex.

Due to the risks of this project being mainly focussed on the design, installation and commissioning of the project, over the last 12 months the risk items identified have either been realised or have not occurred. As such the risk register shows £0. All forecast costs to complete the project are shown in the project financial summary contained within the Confidential Annex.

12.0 Other

All information and progress relating to the LCGP project is contained in the sections above or in the confidential annex.

13.0 Accuracy Assurance Statement

The report has been prepared in accordance with the Network Innovation Competition Guidance document published by Ofgem. Additionally, this report has been subject to review and challenge via NGN's independent Internal Audit function to provide further assurance on the accuracy and integrity of the data and information being presented.

Senior Manager Sign Off:

I can confirm that the process followed to compile and check this return is compliant with the control requirements outlined above have been completed and the information presented is robust, accurate and complete.

Name: Stephen Parker

Position: Regulation Director

Signature: 

Date: 12 June 2018