



Gas Network Innovation Competition

NGGD BioSNG Demonstration Plant

First Project Progress Report (PPR) for period April – May 2014

1. Executive Summary

The project commenced on 1st April 2014 as planned and is proceeding on schedule. The collaboration agreement between the three UK partners, National Grid, Advanced Plasma Power and Progressive Energy was signed on 30th April, and work at APP's Swindon site has focused on finalising the process plant layout and preparing for planning and permitting for the facility. Consultants have been appointed in relation to permitting and safety studies in line with the project plan, and the development of specifications for the equipment are well advanced.

The UK side of the BESTF ERANET funding for the project has been formally signed off by the Technology Strategy Board and discussions are continuing with the German partner Carbotech in relation to technical integration of their PSA gas upgrading equipment into the overall design. Carbotech are in the final stages of discussions with the German funder FNR in relation to their support for the Carbotech contribution to the project.

The project bank account has been established, and National Grid's Compulsory Contribution and the first two instalments of the Approved Amount have been paid into the account.

The project website went live on 30th May 2014, fulfilling the first of the project Successful Delivery Reward Criteria.

Activity on the project will ramp up significantly over the next few months as the development of package specifications and datasheets are progressively completed and the emphasis switches to analysing tenders and placing orders for the main items of equipment.

2. Project Manager's Report

The project is proceeding on schedule, as described in more detail under section 4.

The process plant layout for the site has been fixed, enabling us to proceed with planning and permitting for the facility. APP has been advised that the planning consent required for the proposed changes to the site can be obtained through a Local Development Order (LDO) and for which a Certificate of Lawfulness is due to be issued. In respect of the plant permitting, it is anticipated that the BioSNG facility will be considered as an exempt activity due to the scale of operation. The consultant, Enzygo, has been appointed to fully advise on this matter and provide guidance in any engagement needed with the Environment Agency.



Detailed process engineering is well advanced with the completion of all Process Flow Diagrams (PFDs), Piping and Instrumentation Diagrams (P&IDs), equipment sizing and the preparation of an Equipment List specifying instruments, process lines and valves.

An independent safety evaluation is to be conducted by the Consultants Rowan House, which will incorporate Hazid, DSEAR and Hazop studies. A 4 day Hazops assessment of the BioSNG facility is scheduled for the W/C 16th June.

The development of the package specifications is well advanced for the gas compressor (WP1) gas storage (WP2) and main process reactor vessels (WP3) as highlighted in section 4 below. The datasheets will be progressively completed over the coming months with the emphasis then switching to tendering analysis and order placement.

Expenditure for the NIC BioSNG project over April and May is summarised in Section 5. Overall, the costs are £9.8k below budget. There was some increase to the labour costs and reduction in Contractors costs noted over the months, mainly due to the decision to undertake detailed design work in house rather than use Otto Simon Limited There has also been deferment of third party costs on planning and permitting resulting in a £7.1k delay in costs.

The technical, financial and administrative risks associated with the project are being managed through a formal risk register as set-out in section 10.

3. Business case update

There have been no significant developments in the business case for the project in the first two months. However, it is notable that as political parties begin to finalise their policy positions for parliament in the run-up to the 2015 election, the issue of green gas (biomethane and bioSNG) has already been raised. In a recent speech the Shadow Energy and Climate Change Secretary, Caroline Flint, stressed the importance of green gas and the contribution it could make in relation to energy security, greenhouse gas reductions and waste management; all points that have previously been made in support of the development of bioSNG. A summary of the speech can be found at: <http://www.energynetworks.org/blog/2014/05/14/caroline-flint-gives-green-gas-the-green-light/>



4. Progress against Plan – May 2014

The project is proceeding to timelines of the Project Plan.

The process plant layout has been fixed at APPs site in Swindon, Wiltshire which will permit engagement with planning and permitting agencies.

Planning consent has been initiated by engagement with the Local Authority Planning body, who have advised pursuing the Local Development Order (LDO) approach, which greatly de-risks this particular requirement. Certification of Lawfulness in this regard is due to be by early June 2014. Issues concerning access/egress changes and equipment storage raised by other site stakeholders have been addressed.

Consultants have been appointed to oversee the environmental permit application. It is believed that this plant will be excluded from permitting regulations due to the scale of operation, but the formal declaration and permit application is due for completion on 18th July 2014.

Process Flow Diagrams (PFDs), Piping and Instrumentation Diagrams (P&IDs) and equipment sizing have all been finalised. However, P&IDs are being kept updated to reflect the need to revise ancillary equipment choices and process control logic, due to issues with availability of such equipment, e.g. heat exchangers and gas blowers able to operate at a combination of small scale, high pressure, high temperature and in the presence of hydrogen gas. These changes are peripheral and do not alter the functionality of the core BioSNG plant. From the equipment list that has been established: instrument, process lines, and valves have been compiled.

A formal safety assessment of the BioSNG facility is to be conducted by the independent Safety Consultants, Rowan House. The scope of work includes; i) **Hazid**: specific risk identification (handling, transport, storage of the process materials), an assessment of process material compatibility with process equipment and other plant materials, a statement on COMAH, and advise on other regulations that may impact the build and operation of the Bio-SNG plant. ii) **DSEAR** study to evaluate and protect against potential fire and explosion risks due to the presence of dangerous substances and iii) **HAZOP**: A 4 day exercise to systematically evaluate and mitigate the potential process plant hazards and operability issues associated with the plant .

Package specifications and datasheets covering the sourcing of the gas compressor (WP1), gas storage (WP2), and main process reaction vessels (WP3) is underway, with the tender issuance for the compressor work package and the gas storage expected shortly, and the main process reaction vessels by 4th July 2014. The design of this latter package, which incorporates the bulk of the gas process vessels, conversion equipment and instrumentation and control, has now been frozen. In addition, work is currently underway to define more closely the expectations for the plant control system (WP6).

The development of package specifications and datasheets will be progressively completed over the coming months with the emphasis then switching to tendering analysis and order placement.



5. Progress against Budget

The table below summarises the expenditure on the NIC BioSNG project for the two months to 31 May 2014. Overall, project costs are £9.8K below budget.

Labour is £25.6K above budget. This is because:

- A contractor is not being used for detailed design work resulting in a £18.8K saving in contractor costs. This work is being carried out in house resulting in £2.5K of additional APP labour costs.
- National Grid involvement in the project is higher than expected in the budget. Costs are £8.9K higher than budget, partly due to additional project set-up tasks.
- PEL involvement has been higher than expected resulting in a £3.4K variance, again due to additional project set-up activity.
- Work has started on the procurement of equipment, carbon analysis and experimental design ahead of schedule. This work was not expected to be carried out until July 2014 and results in £10.0K of costs ahead of budget.

Contractors' costs are £25.9K below budget because:

- A contractor is not being used for design work resulting in a £18.8K saving.
- Work on planning and permitting and Hazops has been deferred resulting in a re-phasing of £7.1K of costs.

Other costs are within expectations.

	Project to Date			Total		
	Actual £	Budget £	Variance £	Actual £	Budget £	Variance £
Labour	96,652	71,018	(25,634)	96,652	1,353,724	1,257,072
Equipment/Consumables	0	0	0	0	2,273,480	2,273,480
Contractors	0	25,911	25,911	0	240,677	240,677
IT	0	0	0	0	59,900	59,900
IPR Costs	0	1,778	1,778	0	32,000	32,000
Travel and Expenses	2,179	4,633	2,455	2,179	88,400	86,221
Contingency		5,300	5,300		202,409	202,409
	<u>98,830</u>	<u>108,641</u>	<u>9,810</u>	<u>98,830</u>	<u>4,250,590</u>	<u>4,151,760</u>
NIC Contribution (45%)	44,474	48,888	4,415	44,474	1,912,766	1,868,292
NG Contribution (5%)	4,942	5,432	491	4,942	212,530	207,588
Total	<u>49,415</u>	<u>54,320</u>	<u>4,905</u>	<u>49,415</u>	<u>2,125,295</u>	<u>2,075,880</u>



6. Bank account

The balance in the project bank account stood at just over £525k at the end of May, following the payment by National Grid of its Compulsory Contribution of £212.55k and also the first two monthly instalments of the Approved Amount totalling £312.5k. There have been no payments from the account to date, as APP has not yet submitted any invoices to National Grid. The first invoice is expected to be submitted shortly. A pdf copy of the bank statement covering April and May 2014 is attached.

Please note that the project bank account pays an interest rate of only 0.05%. National Grid has modelled the expected total interest receipts over the three year life of the project, based on the payments into the account from National Grid and the expected timing of the budgeted costs. The total interest receipts are expected to be only around £500 compared with the total interest of almost £38k which National Grid was required by Ofgem's Governance Document to use (Base Rate plus 1.5%) in calculating the required Approved Amount. This means that the project is expected to be underfunded by over £37k unless project costs are lower than expected.

7. Successful Delivery Reward Criteria (SDRC)

The first SDRC milestone of developing and making live the project website was achieved on schedule on 30th May 2014. The project website may be accessed at:

<http://www.nationalgrid.com/biosng>

The second SDRC is associated with the completion of the final design and safety review, and it is anticipated that this will be achieved on target by the end of July 2014.

8. Learning outcomes

Knowledge transfer is an important element for the project. During this early stage, the opportunities for this are relatively limited, however the team is conscious of its importance.

8.1 Project web site

The web portal has now been set up. This will provide an important vehicle for communication about the project and presenting learning outcomes. The team has developed an approach to its website which is amenable to simple updating, which it has learnt is likely to improve ability to post progress updates and disseminate information to achieve knowledge transfer.

8.2 Conferences

Team members attended the annual biomethane conference in April. National Grid gave a general presentation on its vision for renewable gas, including a brief overview of the project. Whilst it was too early in the project to present in more detail, it was an opportunity to engage with the community and highlight the project and its benefit.



8.3 Leveraging funding for NIC Projects

The BioSNG project has been configured to provide particularly high value for money for gas customers by securing financial support for the project, not only from the project partners but also from third party sources, in particular the BESTF EraNET Programme.

The Project team has always maintained close links with UK and European research and development funding networks, in particular through the Department of Energy and Climate Change (DECC), as well as the Technology Strategy Board. Given the close alignment of this project with the objectives of the BESTF EraNET Programme a successful bid was made to this funding call. Bidding to NIC and BESTF took place concurrently. Following award, certain specific requirements were placed on the project by both funding parties, in particular from the selection board of the BESTF EraNET programme, who required, for example, an increase in scale of the demonstration facility and enhanced commercial development. The team has worked together to accommodate these requirements within the programme, ensuring that the needs of both funding parties will be met.

Key learning points from this process were:

- Where projects meet the interests of multiple bodies supporting innovation it may be possible to leverage the support from individual programmes to enhance value for money of delivered outcomes.
- Project teams should maintain awareness of additional funding sources.
- Multiple stakeholders will have different detailed outcomes required from a project; ensuring their individual requirements can all be met whilst enhancing, and not compromising, the needs of other stakeholders requires a committed core team who are prepared to work together. Maintaining dialogue with all stakeholders is also important.
- However, project teams should not underestimate the challenges in finalising contractual arrangements with multiple and international stakeholders, as outlined more fully below.
- Careful project management is required to ensure that reporting requirements by multiple funding streams are met efficiently

8.4 European Collaboration Agreements

One of the significant activities during this reporting period has been to progress the arrangements for European support for this programme and the associated agreement with the German partner undertaking collaborative research and provision of equipment under the BESTF EraNET Programme. This had been formally awarded prior to commencement of the programme, however German budgetary constraints meant that final sign off for the German funding element could not be approved until the National Budget had been sanctioned, which also made it challenging for our German collaborator to finalise their agreement with us.



During this reporting period significant progress was made on these issues, whilst also making some technical progress with regard to this aspect of the programme, despite not having formal agreements in place.

Key learning points were:

- A well-established core partnership, bound together under a well-defined collaboration agreement with a track record of collaborative working with established governance and steering committee, enabled the core partners to address this issue effectively.
- Development of good professional relationships with key individuals in the German partner organisation enabled progress to be made on a trust basis, despite not having everything contractually in place.
- Being prepared to support proactively the German partner in its negotiations with its own member state, along with maintaining open dialogue, significantly facilitated progress.

8.5 Technical Learning Outcomes

As outlined in the original bid, the BioSNG process will operate in conditions of lower absolute pressure, and higher partial pressures and at temperatures that are markedly outside the applications within the existing state-of-the-art. It is also pertinent to understand that the production of pure methane is not the inevitable objective; rather it is the production of fit-for-purpose natural gas substitute, the specification of which tolerates a number of gaseous impurities. Crucially, for commercial operation at the moderate scale implicit in waste and biomass projects, the project viability rests with undertaking methanation at moderate pressures and with minimum product re-circulation in order to minimise compression loads and system equipment count. The partners therefore elected to develop their own methanation reactor concept, and this activity is a prime focus of the project.

Prior to award of this funding, and to address the perceived knowledge gaps in methanation technology (lower pressure, higher partial pressures and temperatures outside normal applications), the team undertook some methanation trials using an external specialist and the results of that work informed the process design for the NIC funded project, as well as the registering of patent applications. Following award of NIC funding the team has in Q1 of the project further developed plans for the characterisation of methanation catalysts as an essential element in determining operational envelopes. It has become clear that in addition to running operational ‘trials’ on the pilot facility, it will be important to understand aspects of the fundamental science associated with the methanation process. This testing will allow benchmarking against some of the computational analysis which has been done relating to the thermodynamics and kinetics associated with the chemical reactions within the methanator under the unusual process conditions proposed. This will allow the project team to understand better the viable combinations of temperature, space velocities, absolute and partial pressures etc. Through this understanding, the project team will be able better to identify the optimal techno-economic operating conditions for the process.

Initial testing will be undertaken with conventional “industry standard” methanation catalysts, but given the unfamiliar operating conditions the team will investigate the potential to deploy catalysts



specially formulated for these conditions. Objective learning outcomes will emerge in the main, however, when these plans are implemented in the testing phase following commissioning of the plant.

In the original programme much of the technical design work was expected to be provided entirely by third party consultants. Over this period it was recognised that a more subtle approach would be advantageous. Therefore much of the early work has been undertaken in-house (albeit supported the independent safety consultants, Rowan House) along with a greater use of design expertise from suppliers of the individual equipment packages, thus ensuring continuity between design and fabrication. As noted below the number of interfaces will be reduced through a smaller number of larger work packages.

In summary, the technical learning outcomes over this period were:

- Where projects are expected to push the boundaries of knowledge, there may be a requirement to develop programmes which include detailed scientific testing as well as operational trials. Such fundamental knowledge can be combined with analytical techniques to expedite practical outcomes
- Appropriate design expertise should be deployed, exploiting in-house skills as well as carefully chosen third party advisory services.

9. IPR

Nothing to report in relation to the first two months of the project.

10. Risk Management

There is a high degree of complexity in the project and a comprehensive live risk register has been developed to allow for the systematic evaluation and management of a number of technical, commercial and project management risks that have been identified by the partners. The rigorous approach that has been adopted is designed to allow the team to regularly monitor and effectively mitigate risks over the lifetime of project and is especially focused on ensuring that the key project delivery criteria are met. Accordingly, the risk register has been subdivided according to the main project tasks and a number of additional (internal) deliverables have been incorporated to permit a tighter, more responsive means of managing the project risks. A description of how the risk register has been drawn up and a copy of it (as updated in the latest risk management meeting of 4.9.14) is given in the confidential Appendix.

The potential risks associated with obtaining planning and permitting for the BioSNG facility have been eliminated. The consultants, Enzygo has confirmed that the proposed R and D operation is deemed to be an “excluded activity” under Environmental Permitting Regulations, 2010. Planning permission, for works required on the Swindon site has been granted by Swindon Borough Council, in the form of a “Certificate of Lawfulness” under the Local Development Order (LDO) scheme.



A formal safety assessment of the BioSNG facility has been conducted by the independent Safety Consultants, Rowan House, to mitigate the process plant operation risks associated with handling explosive gases. This work has incorporated i) **Hazid**: which identifies specific hazards, ii) **DSEAR** study to evaluate and protect against potential fire and explosion risks due to the presence of dangerous substances and iii) **HAZOP**: a 4 day exercise to systematically evaluate and mitigate the potential process plant hazards and operability issues associated with the plant .

Part of the project funding is being provided through the BESTF EraNET programme. Under this scheme a German partner, Schmack Carbotech (SCT), is providing equipment and expertise for the SNG refining stage of the process. SCT experienced delays in getting confirmation for their part of the funding from FNR, who is their grant funding body. This created the possibility of delay in delivery of their SNG refining equipment to site. Following a technical project meeting held with SCT, this risk has been downgraded as SCT have confirmed a scope and schedule for their equipment that falls within the project critical path.

An important risk faced in the design, procurement and installation stages is that associated with the high number of interfaces between the various unit operations. Any compatibility errors across boundaries, which typical arise at the design specification stage, can lead to considerable delays and cost overruns. This risk has been reduced by the decision to combine a number of the major work packages, greatly reducing the number of interfaces whilst also simplifying the procurement process. An interface register has been produced which further reduces the possibility of interface problems across battery limits.

Management of control of capital equipment spend requires close control for any R and D programme. Quotes from main process suppliers for the core methanation plant have placed some pressure on the budget in the current phase of procurement. A value engineering exercise is being undertaken with the preferred supplier of this equipment, with the objective of reducing the Capex to an acceptable level without compromising the required functionality and expected performance of the plant.

11. Other

It is noteworthy that funding for the project has now definitely been secured by the UK project partners from the Technology Strategy Board. Formal grant offer letters were received from the TSB in late May in relation to the UK portion of the BESTF EURANET funding that had previously been approved. The German project partner Carbotech is in the final phase of discussions with FNR, the German equivalent of the TSB, in relation to the German element of the BESTF funding. Once final agreement has been reached between FNR and Carbotech, a further collaboration agreement will be signed between all the partners, including Carbotech.



12. Accuracy assurance statement

Sections 2, 4 and 10 of this report were provided by Richard Taylor, BioSNG Project Manager at APP, and checked by Chris Chapman CTO of APP. Section 5 was provided by Andy Cornell, Finance Director at APP and checked by David Pickering. Section 6 is based on information provided by Jo Cook, Banking Lead, Finance and Shared Services, NG. Sections 3, 7, 8, 9 and 11 were provided by David Pickering, BioSNG Project Manager for National Grid.

Steven Vallender, Network Innovation and Investment Manager for National Grid Gas Distribution during the period under review has confirmed in the accompanying email that the processes in place and steps taken to prepare this PPR are sufficiently robust and that the information provided is accurate and complete.