Anglian Water's AMP5 Biosolids Special Projects

combined heat and power generation - early installation

by Michael Power

Since AMP4, Anglian Water has been implementing a strategy of installing high efficiency Combined Heat and Power (CHP) engines at new advanced digestion plants, as part of its Biosolids Programme. At the beginning of AMP4, Anglian Water had a total installed power generation capacity across its region of just 14 gigawatt hours/year (GWh/year). By the end of AMP4, this was increased to over 40GWh/year and is projected to increase to almost 90GWh/year, by the end of AMP5. This will fully achieve Anglian Water's regulatory outputs for power generation and enhanced treated biosolids quality for AMP5. Anglian Water also has a commitment to reshape its business around a low-carbon model. Installing these engines is an integral part of new advanced (hydrolysis) digestion plants and provides an important component to reducing operational carbon.

Colchester WwTW Existing digester and gas holding tanks – new gas holder base and valve chambers
Courtesy of GallifordTry Meica JV Ltd

AMP5 obligations

Following on from the successful AMP4 Biosolids Programme, Anglian Water planned to further increase its enhanced sludge treatment capacity in AMP5, thereby maximising renewable energy generation and helping to safeguard biosolids recycling to agriculture for the foreseeable future. Ofwat accepted Anglian Water's proposed biosolids investment plans and in its final determination defined the following outputs by March 2015:

- Biosolids advanced digestion capacity to increase from the current 46% of total raw sludge production, to a minimum of 80%.
- Biosolids treatment by lime stabilisation to reduce to less than 1% of total raw sludge production.
- Total renewable electricity output from biogas to increase to 86.8GWh/year.

To meet these outputs, Anglian Water plan to upgrade five regional sludge treatment centres, comprising four new biological hydrolysis plants and the modification of an existing hydrolysis plant. Each site will have an increased biosolids throughput and include the installation of new or additional CHP capacity, thereby maximising renewable energy generation capacity at each site. The AMP5 Programme also includes the decommissioning of eight lime stabilisation facilities as well as modifications to other sites to facilitate raw sludge export.

ROC's target

The installation of CHP engines at four of the five sites by 31st March 2011 was an early target of the AMP5 Programme. Meeting this date enabled Anglian Water to achieve full Ofgem accreditation under the Renewables Obligation scheme and hence ensure the granting of one Renewables Obligation Certificate (ROC) for each MWh of power produced in future, rather than 0.5 ROCs/MWh for engines accredited after this date. Achieving this ROC target will provide considerable savings over the lifetime of these assets.

The newly installed CHP engines currently make use of the existing biogas production at the sites until the new advanced digestion plants, with their increased biogas production, are installed later in the AMP period.

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Collaboration, innovation and savings

Anglian Water chose to continue with its Special Projects framework partners from AMP4. This comprised: consultants Mott MacDonald and contracting partners GTM, (a GallifordTry and Imtech Process joint venture) and Black & Veatch. Anglian Water saw this continuation as an opportunity to build on the proven ability of their partners to collaborate, challenge and innovate and deliver lessons learnt from AMP4. All these components will be critical to successful delivery of the AMP5 Programme.

In addition to the ambitious delivery programme, Anglian Water also set tough targets for carbon reduction for all AMP5 schemes.

- 50% saving on embodied carbon of new assets compared to the 2010 baseline.
- 20% saving on operational carbon for new assets commissioned compared to the 2010 baseline.

A major benefit of the AMP5 Biosolids Programme is the expected significant reductions in Anglian Water's operating carbon emissions, delivered through increased renewable energy generation, reduced treatment process emissions and reductions in the volumes of treated biosolids transported for agricultural use. As a result of these projects and the early installation of the CHP engines, operational carbon emissions are expected to reduce by over 20,000 tonnes CO_2e per year, compared to the 2010 baseline.

Installed equipment

In 2004, Anglian Water only had an installed CHP generating capacity of around 3.5 megawatts (MW). The AMP4 Biosolids Programme added a further 10MW of generation capacity. The AMP5 Programme will install a further 6.6MW, thereby providing a total installed capacity of over 20MW, by the end of 2015. The early CHP installation work will provide over 80% of this capacity, some 5.4MW.

The four sites that received early CHP installations included Basildon with 2 (No.) 600kWe engines, Cliff Quay (Ipswich) with 2 (No.) 1,200kWe engines, Colchester1,200kWe engine and Cambridge, 600kWe engine. All sites currently produce biogas from either conventional anaerobic digestion, or with pre-digestion biological hydrolysis (Cambridge). Two of the sites, Cambridge and Colchester, already had small CHP engines; 340KWe MAN units installed in 2005.

Additional ancillary infrastructure was required at each site and this included transformers, ring main units, control panels and switchgear. The installed equipment to be integrated within the existing system, also needed to interface with the advanced digestion plants to be installed later. New gas holders and gas handling systems were also required at Colchester and Cliff Quay.

Anglian Water developed an innovative approach to procurement by using standard products, which has provided savings to its business. This was put to good use in the early CHP Installation Programme. Items of equipment which are procured on a regular basis, or lend themselves to standardisation, are procured using standard products through Framework Suppliers. This enables the streamlining of design, procurement, installation and commissioning through optimum standard designs and specification. This approach was applied when selecting a new framework partner for the supply of CHP plants. In June 2010, AW Edina UK was awarded a 5 year framework to supply high efficiency Motoren-Werke Mannheim GmbH (MWM) engines products ranging from 400 to 1,200KWe.

Design and construction

Design and construction challenges were prevalent at the four sites, and related to equipment location and integration with existing installations – as well as reducing the embodied carbon of the project. Basildon presented a particularly complex working

area, with limited space. The CHP engines, transformer, ring main unit and over-ground pipework were located on an existing road, positioned between two digesters and a heating building. Due to the extent of the existing services, pipework and cabling were supported on ladder racks. Where possible, control panels were located in existing structures with the use of back-to-back panels to reduce space and civils cost. Embodied carbon savings were achieved through optimising the structural design, and maximising use of existing structures.

The location of the gas holder at Cliff Quay proved challenging with several constraints, due to the presence of old underground structures. The best solution proved to be the demolition of an unused tank and reuse of the existing base. This solution also saved embodied carbon emissions associated with construction of a new foundation. The walls of the existing tank were post tensioned, which added to the complexity of the demolition.

Programme delivery

Although the engine procurement process started in early 2010, project delivery, including site surveys and design, commenced in September 2010 following Anglian Water's commitment to design and build. The project team then had effectively six months to design, procure and install the equipment, prior to testing and commissioning in March 2011.

The tight programme meant that close liaison with AW Operations, as well as third parties, was essential to ensure uninterrupted operation of the existing works and timely integration with the Distribution Network Operator's (DNO) infrastructure.

Various pre-operational procedures were required. One of which was accreditation, which included a G59 test, required to test the connection from the embedded generating plant to the DNO distribution systems. This entailed the on-site testing of the protection relays - a one hour test at full generating power, witnessed by a DNO Engineer.

Cliff Quay WwTW - Delivery and installation of CHP engine
Courtesy of GallifordTry Meica JV Ltd

The final key element was the granting of Environmental Permits for each site, required before commissioning could start. The Environment Agency had initially advised that it would take four months to determine the applications for all four sites, which were submitted by late October. However, aided by the high quality of the applications prepared by the team, the Environment Agency was able to grant the permits early prior to the scheduled commissioning dates.

In spite of the challenging programme and winter weather, the works at all sites were installed with the necessary tests completed by the March 2011 deadline.

The Editor & Publishers thank Michael Power, Senior Civil Engineer with Mott MacDonald and a design team leader in the Special Projects delivery team, for preparing the above article for publication.

Basildon WwTW – Engine, heat dump fans, pipework rack *Courtesy of GallifordTry Meica JV Ltd*