

# Uskmouth conversion project – a world first

A project underway at Uskmouth in the UK, with the aim of converting the plant to run fully on waste-derived pellets, could have important lessons for other redundant coal fired plants looking for a new role as low carbon generators, and also offers a timely potential solution to the problem of dealing with non recyclable waste plastic

**Christopher Biggs, RJM International**

On 19 July RJM International and WSP reported successful completion of the first phase of the FEED (front-end engineering and design) project at Uskmouth B power station, Newport, South Wales, an important step towards converting it from coal to waste-derived energy pellets.

Working in partnership with WSP and SSF\*, RJM was tasked to deliver a new engineering-based firing concept that will enable the operator, SIMEC Atlantis Energy – developer of renewable energy projects, including Meygen tidal stream installations – to run the plant on waste-derived energy pellets, comprising a mixture of biogenic material and waste materials containing a high proportion of non-recyclable plastics.

This is a first-of-a-kind re-tasking of a front-wall-fired boiler, originally designed to fire pulverised coal and opens up the possibility of redundant coal plants being given a new lease of life, delivering low carbon power.

For the past eight months, RJM has been working on a number of tests and studies to arrive at an appropriately-modified firing system that will deliver a stable flame and the desired combustion characteristics.

A stable flame has now been achieved in medium-scale testing, proving that stable combustion of the 100%-waste-derived fuel

\* Simec Subcoal Fuels, a 50:50 joint venture between N+P Group and SIMEC Energy. In June 2019, N+P Group started commissioning of a new pellet facility in Teesport, UK, which could supply the converted Uskmouth plant, while a further three UK facilities are planned to supply fuel for the project

pellets is possible. These results correlate to the CFD (computational fluid dynamics) modelling carried out by RJM and confirmed a stable, self-sustaining flame could be achieved with combustion performance within expected parameters.

Commenting on the successful completion of the FEED study, John Goldring, managing director of RJM International, said, "This has been a genuinely ground-breaking project for RJM as we have been heavily involved in developing and assessing the impacts of the constituent parts of different pellet formulations and how that impacts on the ability to mill the pellets and ultimately how they combust. Specific tests have been designed by RJM and we have developed a new combustion system to handle this type of fuel.

"Going forward, our work now informs the specification for the EPC tender that includes the design, supply, installation and commissioning of the full combustion unit.

"And looking further ahead, the Uskmouth conversion project will provide the blueprint for other coal to 100%-waste-derived fuel conversions around the world.

"The regeneration and repurposing of coal fired power stations to consume waste-derived fuel and deliver low cost, low carbon electricity is already attracting strong interest from generators and governments worldwide."

## Return to service

Uskmouth B, originally a three unit power station, entered service in 1959. One block

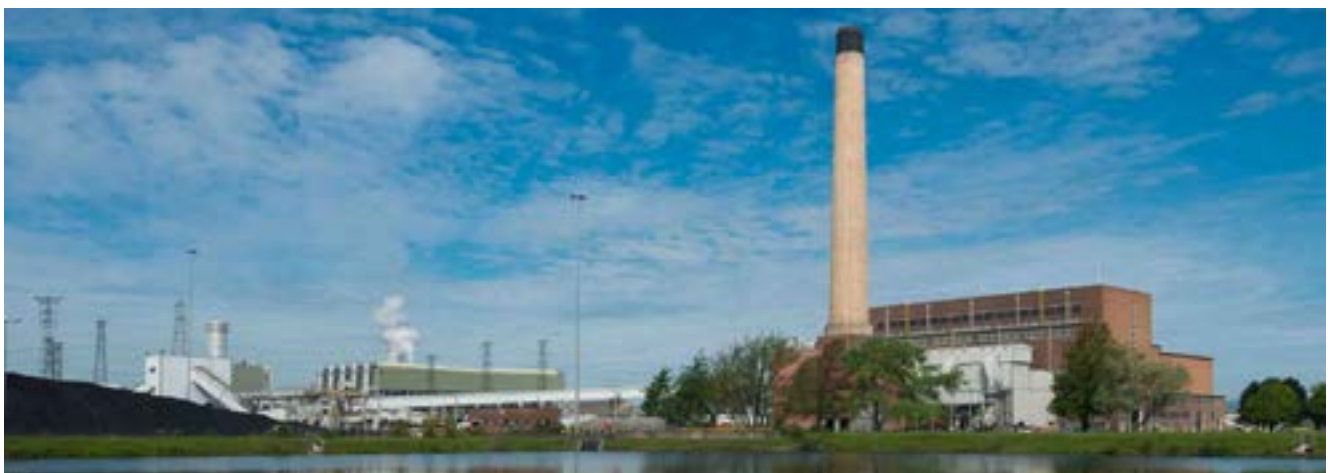
was closed down in 2013, with the remaining units having an installed capacity of around 260 MWe. Following conversion to the new fuel the plant will have an installed capacity of about 220 MWe, with commercial operation targeted for 2021.

The facility was acquired by SIMEC in 2015, with a view to biomass conversion. The plant, once one of the UK's cleanest coal stations (having been equipped (in the late 90s) with FGD and low NO<sub>x</sub> burners), ceased operation as a coal fired plant in 2017.

A review of the plant life extension and return to service for all areas of the existing plant has been completed by WSP and RJM, enabling the commencement of intrusive return to service surveys, SIMEC says.

WSP was appointed by SIMEC in November 2018 to focus on return to service of the Uskmouth power plant, especially steam turbine and associated equipment, and to manage the fuel conversion FEED effort. WSP in turn appointed RJM (also in November 2018) to carry out the FEED study.

RJM had been working for SIMEC at Uskmouth since 2016. A combustion audit carried out by RJM in 2016 confirmed that certain operational issues could be resolved successfully and provided technical and operational knowledge of the plant. A biomass feasibility study carried out by RJM in 2017 confirmed that the two Uskmouth units could be converted successfully to fire 100% white pellet biomass, but it was found not to be an economic option, even with the UK



**Uskmouth B power station. To the left of the picture is the the Severn Power combined cycle plant, built on the site of Uskmouth A**

government's green energy subsidies available at the time. An alternative option, the "new generation" waste derived pellets made up of 50% biogenic material (mainly waste wood, paper and cloth) plus 50% non-recyclable plastics, was assessed in a further study. The plant conversion costs for firing these pellets were similar to plant conversion costs for 100% biomass white pellets, but the cost per tonne of the new energy pellets was significantly less, so much so that the plant could become financially viable without reliance on government



Inside Uskmouth B

subsidy. As well as the massive fuel cost advantage, there was also the huge potential environmental benefit that the new pellet provides a real use for the millions of tons of plastic that is currently being dumped in landfill, dumped in the ocean or incinerated.

However, the new strategy was not without its challenges: developing the new fuel and making changes to the Uskmouth plant to make it useable; storage and preparation; combustion; plant integrity; emissions control to meet latest UK/EU requirements; dealing with post combustion ash.

The new pellet has around 50% less calorific value by volume than coal, so more fuel is needed to deliver the equivalent MWe output, creating logistics challenges.

More attention needs to be paid to how the fuel is stored on site, moisture levels being critical, for example.

The combustion behaviour of the new pellet is also very different from coal, requiring different furnace residence times. And it contains chlorine, derived from the plastic and paper components of the feedstock, resulting in an ash that is highly corrosive to furnace and convective section pressure parts.

It is therefore critical that the combustion system redesign includes corrosion mitigation measures and pressure system material changes to deliver world class reliability to the project.

Another focus is emissions limits, which will be met by using a combination of optimised

combustion and flue gas treatment – one of RJM's core areas of expertise.

### Next steps

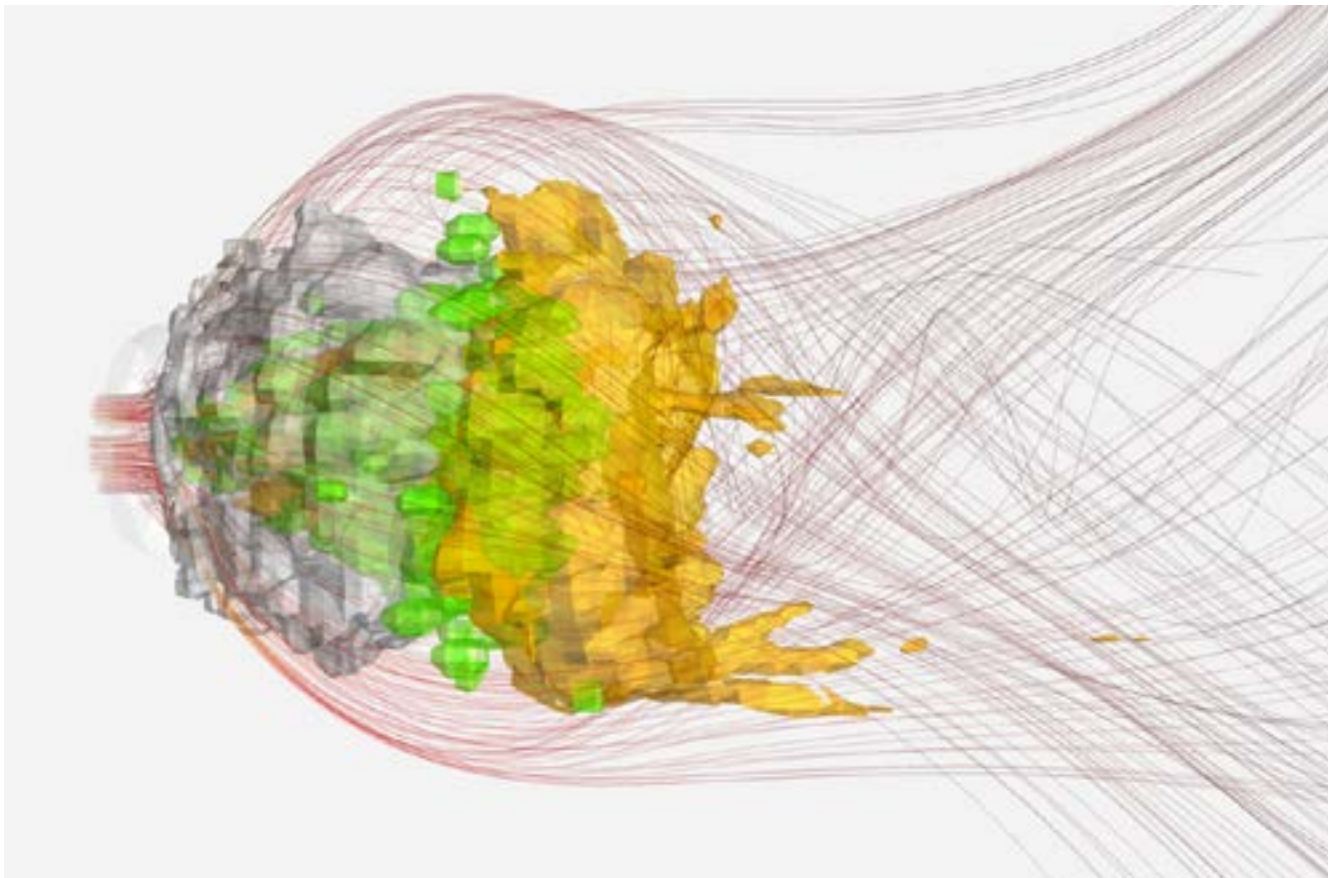
Environmental planning and permitting for the Uskmouth project is progressing well, and the project has now reached a design freeze for environmental impact assessments, a critical milestone in the planning application process.

SIMEC sees the next steps as follows:

- Industrial scale fuel production run and milling test, H2 2019.
- Contract for the combustion system awarded, H2 2019, after which the industrial scale combustion tests are expected.
- Comprehensive intrusive inspection and testing programme for the return to service works to be undertaken Q3 and Q4 2019.
- The appointment of financial advisers, expected Q3 2019, to advise on the financial close of the conversion project, which has an estimated capital cost of about £185 million.
- Development and submission of planning permission and permitting applications, by the end of 2019.
- A full contract tender for the remaining conversion works, to be issued in Q1 2020.

The project is thought to be the world's first conversion of a coal fired power station fully to waste derived fuel. The converted plant is expected to burn about 900 000t/y of waste derived pellets once in operation.

A private wire to the adjacent steel works is under consideration, providing the opportunity to manufacture "green steel." ■



CFD modelling of energy pellet combustion. The grey, green and yellow zones correspond to three of the main constituents within the pellet, all with varying particle shapes and sizes and all with different combustion and aerodynamic properties