

Energy from waste:

Dundee Energy Recycling paves the way for a cleaner future POWER

BY SARI LEHTONEN-LAMMI

The amount of waste continues to rise all around the world. Processing this waste calls for new efficient technologies to replace both land filling and old, sometimes troublesome incineration plants.

Dundee Energy Recycling Ltd. in Scotland took a pioneering initiative and decided to convert their

waste mountains into energy. The state-of-the-art energy from waste plant was contracted by a consortium between Balfour Beatty Projects and Engineering and Kvaerner Pulping. Metso Automation supplied the plant's automation and information solutions.

Dundee Energy Recycling is located on a two ha. site on the Baldovie

Industrial Estate, in Dundee, Scotland. The modern EfW (energy from waste) plant was built between 1997-1999 to replace an old waste disposal incinerator that was closed due to its inability to meet new EU regulations. The new plant combusts municipal, industrial and even clinical waste using bubbling fluidized bed boiler (FBB) technology.

The first of its kind in the UK

Kvaerner Pulping from Sweden was the turn-key contractor for the new plant, which is one of six new EfW type plants built in the UK in the past decade, and the first of its kind based on bubbling fluidized bed boiler technology.

Dundee Energy combusts approximately 120,000 tons of waste



A room with a view: Operators in the control room enjoy their real-time process views.

Ready to meet the future: All flue gases are cleaned to meet the latest environmental standards before being expelled through the 70 m chimneys.



For a cleaner future: Dundee Energy Recycling Ltd. in Scotland decided to turn their waste into electricity for the good of the environment. No more land filling is required!

a year with its two 17 MWth Kvaerner fluidized bed boilers and provides approximately 8.3 MW of electricity from one steam turbine generator. The design rate of the boilers is 7.6 ton/h per boiler. The plant is owned by Dundee City Council and a group of private sector partners. It was commissioned in early 2000.

Derek Kiddie, engineering manager of Dundee Energy, describes their pioneering choice of technology: “We wanted to meet the challenges of the future. Land filling was definitely no choice for the future, and the old incineration method caused some public concern. Energy recovery and recycling seemed to be the environmentally sound alternatives,” he says. “Though this has been a rather complex and challenging process, the environmental benefits gained from FBB combustion are quite clear,” he continues.

A pioneer always has the toughest role

“The goal of this plant is to treat waste by reducing its volume and hazards, while at the same time enabling full-scale recycling and energy recovery,” explains Kiddie. “Waste is a highly heterogeneous material, consisting of organic substances, minerals, metals and so on. A lot of sorting and separating

has to be done before the RDF (refuse derived fuel) combustion can take place,” Kiddie comments on the complexity of their process.

“The fuel air balance is another challenging task when burning RDF as the only fuel. This means ensuring that the RDF flow is as even and uninterrupted as possible.”

“I think the main driver for a plant like this is a strong vision for environmentally superior solutions. The environmental plusses, such as getting rid of toxic materials, improved dry ash handling, as well as better flue gas treatment, are the hard facts that make this plant worthwhile,” Kiddie underlines.

Reality bites

The storage hall at Dundee Energy presents a real-time panorama of modern life styles and consumption habits. Approximately 400 tonnes of waste a day is delivered from Dundee and the neighboring communities – an area that covers a population of 300,000 people. During the peak time of 10:00 am to 6:00 pm, this means that a truck loaded with waste arrives every five minutes – amounting to 70 trucks a day. The company has long-term waste disposal contracts with the nearby City Councils.

When delivered, hazardous or otherwise inappropriate pieces are first sorted out manually. The ▶

▶ waste is then shredded and ferrous metals are removed with magnets. Non-ferrous metals are removed later with other separators, after which the waste is fed into the twin combustion chambers.

The heat derived from combustion is further processed in a steam turbine. Flue gases are cleaned to meet the current environmental standards before being expelled through the two 70 m high chimneys.

“RDF combustion requires a very labor-intensive and complicated process before the waste can be fed into the boiler. Multiple separation and sorting procedures are needed to make sure that hazardous or even explosive components don’t go to the boiler bed. Therefore, 5 of our 36 full-time employees work on sorting and separation,” Kiddie points out.

Energy recovery

The waste processing at Dundee Energy ultimately results in energy generation, which not only meets

the plant’s own electricity needs but also supplies 8.3 MW for public use. This electricity is delivered through Scottish Power and Scottish Hydro Electric based on a 15 year contract. In addition to energy, the plant also recovers some 5,500 tonnes of metal, which can be reused.

Crystal clean ash

“One of the greatest benefits from using fluidized bed boiler technology is the clean ash content,” says Kiddie.

“The ash contains no carbon oxides or other impurities and its quality is better than ever before. This ash is crystal clean, ‘like fragments of glass,’” Kiddie smiles.

“A local quarry takes it from us, then sells it on as aggregate to the construction industry,” he explains.

Automation is essential

Metso supplied the new plant with an integrated automation and information system containing ap-

proximately 1,500 hardwired I/O and 600 serial data connections.

“This system is responsible for overall control and data collection throughout all plant processes, including the boiler auxiliaries and the boiler combustion, steam system, feed water system and flue gas treatment. Package plant equipment, for instance, the material handling system, is controlled by smaller package plant plc’s with data being transferred to the Metso system by serial links,” explains Kiddie.

The Metso system is composed of one engineering, one information and two operator work stations managed from two control rooms by three operators and one plant operator working in three shifts, 24 hours a day, seven days a week.

“A plant like this wouldn’t survive very long without automation. Highly automated and complex processes like these depend essentially on automation. Our protection and security systems are

linked with automation, which switches off vulnerable operations if something goes wrong,” Kiddie lists.

“Furthermore, it would be impossible to calculate emission figures in accordance with today’s requirements without proper automation tools. In emission calculations, it is often a matter of hundredth’s and thousandth’s, so no human brain could manage them in a reasonable time – if at all,” he continues.

Both Mr Kiddie and the operators appreciate the reliability of the Metso system.

“The automation system has never caused any production losses. With redundant stations and easily performed modifications, this system has turned out to be both extremely reliable and easy to work,” Kiddie praises.

Ready to meet the future

The main achievement at the new plant has been its environmental performance, which now complies



Happy with Metso: Derek Kiddie, engineering manager of Dundee Energy Recycling Ltd., is 100% satisfied with the reliability of their Metso automation system.

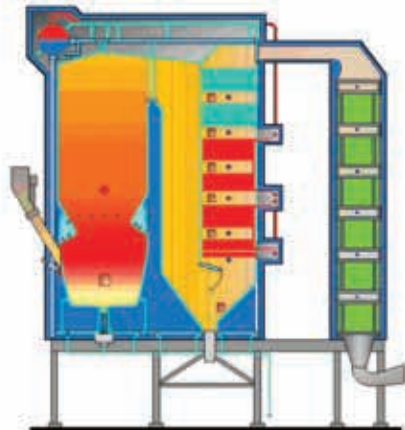
Reality bites: This waste mountain in the storage hall grows by 400 tons in a single day.



ACZTM Bubbling Fluidized Bed Boiler by Kvaerner Pulping

Dundee Energy Recycling Ltd.
Dundee, Scotland

Steam 2 x 17 MW_{th}
2 x 6.5 kg/s
40 bar
400 °C
Fuels MSW (municipal solid waste),
industrial waste, clinical waste
Start-up 1999



Picture: Kvaerner

with even the most stringent regulations agreed as part of in the latest Waste Incineration Directive in the UK.

“With average emission values currently as follows, we can sincerely claim to be ready for the future: dust 5 mg/Nm³, NO_x 300 mg/Nm³ (as NO₂), HCl 10 mg/Nm³, and CO 50 mg/Nm³, PCDD/F 0.05 ng/Nm³,” Kiddie states, satisfied. “Additionally, since we don’t use non-renewable fossil fuels or land filling, we can say this plant has succeeded with its environmental performance.”

“As for the future, we will need to concentrate on enhancing task-oriented, volume-based and commercial performance,” Kiddie continues. “This will probably include utilizing more support from advanced control tools and specialized EfW automation and information applications,” he concludes. ■

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Reap the best performance in energy from waste

“Metso Automation has wide and long experience in burning difficult fuels. Based on this knowledge, we provide a range of specialized automation and reporting applications for diverse energy from waste plants, utilizing industrial, municipal and wood waste or sludge,” explains **Jari Leppäkoski**, development director at Metso Automation.

Caloric Value Compensator for stabilized combustion

Metso has developed the Caloric Value Compensator to compensate for disturbances in the waste fuel feed to stabilize combustion and steam production. The application adapts the waste feed of the boiler to maximize incineration capacity and adjusts the air feed to the combustible material. The result is stabilized combustion during normal operation and fuel feed disturbance situations, as well as during caloric value variations.

Waste fuel management system integrates process and waste fuel data

The waste fuel management system is an advanced tool for storing and reporting waste fuel load and analysis data. The system integrates process data collected from the DCS system, and emission measurements, with the waste fuel data from weighing system and laboratory analysis – thus sharply reducing the work required for the plant’s reporting routines.

Emission monitoring – for effective emission control and reporting

Designed for efficient emission management, the Emission Monitoring application calculates and stores information on atmospheric emissions. This information can be utilized for various follow-up and reporting functions. The emissions are reported in standard units in accordance with the Incineration of Waste 2000/76/EU Directive, enabling easy

comparison and help in compiling authority reports.

FBB Combustion Optimizer for maximum capacity with minimum emissions

The FBB Combustion Optimizer is a supervisory level control application for optimum combustion control of both bubbling and circulating fluidized bed boilers. This application helps achieve more stable operation, minimizes the flue gas emissions, and improves the combustion efficiency while keeping certain process variables, such as the bed, combustion chamber and cyclone temperatures, within acceptable limits. This fuzzy logic based software product calculates the process variables for adjusting and fine-tuning the boiler operations.

In addition to FBB Combustion Optimizer, Metso offers several other fuzzy logic based optimization tools specially developed for energy from waste plants. For instance, the NO_x Optimizer reduces NO_x with the help of an optimized urea injection into the boiler. The SO₂ and HCl Capture control can be optimized with a multi-predictive control (MPC) application to achieve the minimum use of limestone.

“All of these applications help the plants utilize the energy generated from waste more efficiently, safely and environmentally soundly, as well as enhancing the plant’s performance over its entire lifecycle,” Leppäkoski concludes. ■

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