European Metrology Research Programme

Delivering Impact

# Improving power plant efficiency

Despite increases in renewable energy generation, large-scale power plants based on nuclear or conventional fuel provide about 80% of the electricity generated in the EU and are expected to continue to form the backbone of Europe's energy supply over the coming decades. Alongside continued efforts to increase renewables, improving the efficiency of these plants will lower the cost of energy for consumers and reduce greenhouse gas emissions.

**Europe's National Measurement Institutes working together**

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

# Challenge

One way to significantly increase plant efficiency is through better measurement of water temperature and flow rate. In nuclear power plants, water is taken in from natural sources (such as lakes and rivers) and pressurised and heated, before being converted into steam in the reactor vessel and used to generate electricity in the turbine hall. Temperature and flow rate of this water must be carefully monitored to ensure efficient plant operation.

Typically, these measurements rely on temperature sensors mounted at fixed points throughout the plant's pipework, giving information at the sensor's location rather than the overall system performance. Operational conditions are also very different to those in which flow meters are calibrated and must be accounted for with extrapolation models, which can lead to inaccuracies in plant measurements. Improved measurements of both temperature and flow rate in a plant's pipework system will give plant operators a better understanding of the system, allowing them to optimise processes and improve efficiency.

# Solution

The EMRP project *Metrology for improved power plant efficiency* developed new methods at PTB in Germany and SP in Sweden which allow flow meters to be accurately calibrated in a water pipe simulating typical nuclear power plant operating conditions. KROHNE, a leading manufacturer and supplier of industrial process instrumentation, has used the new methods to demonstrate the accuracy of an improved flow meter, developed by KROHNE following participation in the project.

Besides measuring flow rates, KROHNE's improved flow meter now has the capability to measure fluid temperature using ultrasound. This novel feature can measure average temperatures over a pipe cross-section, rather than just the single point at which the sensor is located. This allows plant operators to monitor temperatures more accurately, and optimise processes based on precise measurements. The validation of the ultrasonic technology in the new facility provided KROHNE with the impetus and confidence to start production of its improved flow meter.

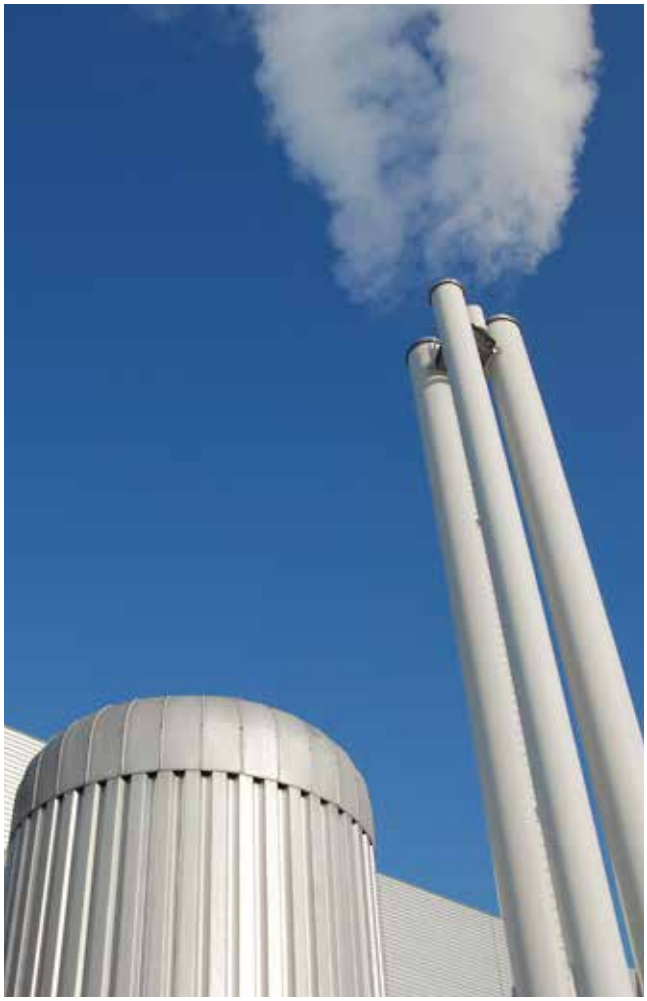
# Impact

KROHNE's flow meter has been sold to major electricity provider, E.ON. E.ON is currently trialling the flow meter in one of its plants, to compare its temperature measurement performance against the plant's existing sensors. On-site temperature testing is a requirement before regulatory approval can be granted and the ultrasonic flow meter can be introduced to the wider market as a recognised temperature sensor.

Preliminary indications are that operational efficiencies resulting from the flow meter's use would be around 60 MW, equivalent to the electricity required to power 10,000 extra homes. This is a significant improvement in plant efficiency, and given Europe's dependence on large-scale power plants for the foreseeable future, an important contribution to the efforts to reduce Europe's carbon footprint.

## Metrology for improved power plant efficiency

The EMRP project *Metrology for improved power plant efficiency* focused on reducing the uncertainty in measurements of important control parameters used in the operation of power plants, such as temperature, flow rate, thermal energy and electrical output, and researching advanced materials for use in future turbines. The results of the project are expected to contribute to a 2-3% improvement in energy efficiency for all types of large power plant, and a comparable reduction in $CO_2$ emissions.





EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

**www.euramet.org/project-ENG06**

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