

## CASE STUDY

# Advanced Flow Meter Technology To The Rescue: V-Cone Reduces Installation Costs For Aging Power Plant

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Metso Power Oy, located in Finland, began a new project in 2002 to design and build a new flue gas treatment operation within the new power plant for client, Kotkan Energia Oy, located in Kotka, Finland. Metso Power had to design the flue gas treatment plant to fit into the section of the new plant, which was pre-determined by Kotkan Energia. The fact that the location of the flue gas treatment plant was selected in advance, added to the complexity of the project. It was necessary to fit the equipment into a limited space.

Metso Power, a part of Metso Group, is a forerunner in fluidized bed combustion of biomass, coal and other fuels alone or in combination with power plants, and a global leader in chemical recovery systems for pulp and paper mills. The products are fluidized bed boilers and recovery boilers, evaporators, environmental systems and service. The company has designed and manufactured the world's largest biomass-fired fluidized bed boilers and recovery units.

Kouvo Automation provides process flow meter technology expertise and services to its customers. The company specializes in helping clients identify and install the optimal technology solution for each application, including flow meters, radiometric density instrumentation and level meters, weighing systems, process viscosity meters, refractometers and metal detectors.

### The Problem

In flue gas treatment operations such as the one at the Kotkan Energia's power plant, liquid flow meters are used to measure the amount of circulation water. This water washes combustion (exhaust) gas and flows through the heat exchangers taking the heat from the exhaust gas. This heat is then used for district heating. Combustion gas comes from the plant's biomass-fuelled boiler which converts steam into district heating and also drives its electric power generators. The washing of the exhaust gas eliminates many of the pollutants that would otherwise contaminate the air. The heat recovery from the gas will increase the efficiency of the biomass-fired power plant.

In power plants, accurately measuring the flow of liquids is always a top priority for operational efficiency. Precise flow measurement is essential to control costs and maintain profitable plant operations. Engineers generally specify one of two solutions in this type of energy plant liquid flow application: magnetic or orifice flow measurement.

The problem with both of these flow meter technologies—magnetic and orifice plate—is that they require significant upstream and downstream straight diameter pipe runs in order to achieve a regular, consistent flow of media that is suitable for accurate flow measurement. They also do not pre-condition the flowing media prior to measurement in order to compensate for any lack of sufficient upstream and downstream straight pipe due to installation space limitations.

Magnetic flow measurement technology—most often used by Metso Power in this type of application—requires long, disturbance-free straight pipe runs both before and after the flow meter placement. In this project there was limited space available for the flow measurement equipment.

## The Solution

Metso Power was already familiar with McCrometer's advanced differential pressure (DP) V-Cone® flow technology and had in fact installed smaller V-Cones in other applications. Unlike DP instruments such as orifice plates and venturi tubes, the V-Cone flow meter design is inherently more accurate because the flow conditioning function is built into the basic flow meter design.

The V-Cone conditions fluid flow to provide a stable flow profile that increases accuracy. The flow meter design features a centrally-located cone inside a tube. The cone interacts with the fluid flow and reshapes the velocity profile to create a lower pressure region immediately downstream.

The pressure difference, which is exhibited between the static line pressure and the low pressure created downstream of the cone, can be measured via two pressure sensing taps. One tap is placed slightly upstream of the cone and the other is located in the downstream face of the cone itself. The pressure difference can then be incorporated into a derivation of the Bernoulli equation to determine the fluid flow rate.

The cone's central position in the line optimizes the velocity of the liquid flow at the point of measurement. It forms very short vortices as the flow passes the cone. These short vortices create a low amplitude, high frequency signal for excellent signal stability. The result is a highly stable flow profile that is repeatable for continuously accurate flow measurement. All of this is possible with a minimal straight pipe run of 0 to 3 diameters upstream and 0 to 1 diameters downstream from the flow meter.

Even though the V-Cone is designed specifically for use in difficult to measure applications such as oil and gas production and delivery, as well as tight spaces such as those in older power plants, the Metso Power engineers initially thought that the larger V-Cone

required for this particular application would be too expensive. The plant engineers and purchasing department decision makers were very cost conscious on this project and, at first, considered only the purchase price.



In Finland's power industry, the Instrumentation/Automation department typically purchases the lowest cost flow meter (most often either orifice plate or magnetic flow meters). The goal is to reduce costs on the technology purchase. In the beginning, the engineers did not take into account the added installation labor and material costs that would be required for the extra piping needed in a magnetic flow measurement solution.

The V-Cone flow meter design, however, offers inherent flow conditioning that allows it to accurately measure irregular flowing media. The flow conditioning that is built into the V-Cone's design eliminates the long extra upstream and downstream straight pipe runs required with magnetic and many other flow measurement technologies.

Extra piping is an expensive incremental cost in any budget. In addition to the labor and the materials cost

for re-piping, specifying a magnetic flow meter for this project also required the construction of an extra service platform to accommodate the magnetic flow meter. At this point, the extra construction/installation costs became the problem of the Pipe and Plant Layout Design Department.

The Project Layout Designer and the Project Manager evaluated the overall design and installation costs. They began to focus on the total re-piping costs, which included construction of the new service platform. All of the decision-makers for the project reviewed the incremental installation costs for the re-piping and determined that the initial cost of acquisition for the V-Cone flow meter solution was a better investment than the magnetic flow meter.

Metso Power estimates the savings realized from the V-Cone application to be approximately \$13,750 (US dollars). The savings estimate includes extra piping and the new service platform. Approximately 45 percent of the savings is from materials and 55 percent from labor costs. Additional benefits from using the V-Cone include improved layout compared to using a magnetic flow meter and increased safety for workers by eliminating the need for an operation platform due to difficult positioning. Another important benefit was the improved appearance of the flue gas treatment plant, since Metso Power supplies these very same scrubbers.

The DN350 ss316 V-Cone from McCrometer was sized and quoted for the project's liquid circulation flow metering application by Kouvo Automation. The V-Cone was installed during the spring of 2003 and has provided accurate measurement without any problems for 18 months as of this writing. The final installation included about two diameters of straight pipe before the V-Cone and a 45-degree bend just after the meter.

## About Metso

Metso is a global engineering and technology corporation with 2007 net sales of over EUR 6 billion. It's over 27,000 employees in approximately 50 countries serve customers in the pulp and paper industry, rock and minerals processing, the energy industry and selected other industries.

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