

## Field Test of Rosemount<sup>™</sup> 5078 3D Solids Scanner, A Novel Coal Silo Measurement Device, at the National Carbon Capture Center

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During the G-5 gasification test-run from March to April of 2017, the National Carbon Capture Center (NCCC) tested a unique level measurement device, the Rosemount 5078 3D Solids Scanner. It was installed on a pulverized-coal silo equipped with existing guided wave radar and capacitance probe level measurements. This location provided a direct comparison of each technology's accuracy and benefits. NCCC staff worked closely with Rosemount's application engineers to best site a mounting location for optimal performance. The capacitance probe (LI4890) is located in the center of the vessel, and the guided wave radar (LI4872) is located near the edge of the vessel. The Rosemount 5078 3D Solids Scanner (LI4874) is located just off center on top of the vessel on an existing flange (See Figures 1 and 2).

Unlike traditional technologies, the Rosemount 5708 uses acoustic, phased-array technology that generates a dust-penetrating, low-frequency acoustic wave, and then receives echoes from the contents. The collection of the echoes allows the Rosemount 5708 to calculate level and volume of the vessel. The 3D visualization constructed in the Rosemount 3DVision/Rosemount 3DMultiVision<sup>™</sup> software is based on multiple points collected by the Rosemount 5708 and represents the material surface identified by the devices. It also provides information on material formations within the vessels (see Figures 3, 4, and 5).

Figure 6 graphs the results from the run. The measurements showed similar trends but deviated in value. The level derived from the capacitance probe was typically 20 tons higher than that of the Solids Scanner. The radar measurement, while often giving bad data points, tracked more closely with the Solids Scanner. It should be noted that the capacitance probe and the radar instruments use calculations based on the measured height/level in the silo to determine a quantity of coal (in tons), while the Rosemount 5708 is a constant calculation; this difference could contribute to the offset changing as the level in the silo changed.

As an additional comparison, the Rosemount 5708 pulverized-coal silo fill-rate data was compared to the corresponding drop-rate of the Foster Wheeler crushed silo and the pulverized coal feed rate to the gasifier, and this gave some credibility to the measurement. It is also worth noting that the Rosemount 5708 did not see a level above 75 tons which is considerably less than the 120-ton vessel capacity. The capacitance probe instrument was prematurely stopping feed to the silos earlier than necessary, and more coal could have been added to the silos.

Therefore, although more testing is needed to verify the accuracy of the Solids Scanner, it appeared to be the most reliable level indicator of the three types, and the most suitable for use in automatic control of the silo. Based on the run data, controlling the silo level based on

the Solids Scanner instead of the capacitance probe would allow fuller utilization of the silo's capacity.

The Rosemount 5708's 3D visuals were also valuable for analysis and troubleshooting. Being able to visually see the level and possible issues of uneven distribution and "rat-holes" allowed the NCCC team to make corrections sooner to prevent disruptions in operation. Other advantages of the Solids Scanner are that it requires little maintenance and has no moving parts to malfunction. The instrument does not require re-calibration, and its self-cleaning design prevents material from accumulating on the antennas, ensuring reliable performance in dusty conditions.



Figure 1 – Location of Level Measurement Devices in the Coal Silos



Figure2 – Rosemount 5078 Solids Scanner Actual Installation



Figure 3 - 3DMultiVision<sup>™</sup> View of Pulverized-Coal Silo Showing Uneven Level



Figure 4 - 3DMultiVision<sup>™</sup> View of Pulverized-Coal Silo Showing Possible "Rat-holing"



Figure 5 - 3DMultiVision<sup>™</sup> View of Pulverized-Coal Silo Showing a Level Coal Distribution



Figure 6 - Comparison of Coal Silo Level Measurements from the Three Devices