Coordination with 3-D Scanning

By Dave Wellman and Steve Woods

Plant site located near Springfield, Ore.

The 66 foot pipe ran from a giant fan upward and away from us in a number of angles until it paralleled the roof line approximately 60 feet in the air. You could get a glimpse of it through the supporting structures from different angles as it wound its way along its snake like route to the far end of the plant. The best view of its entire length was from the plant parking lot nearly 300 feet away, but alas we were unable to see the beginning reducer assembly at the giant blower. The brightly colored OSHA placards indicated temperatures in excess of those commonly found in this surveyor's acceptable temperature range. So begins another day in the life of a surveyor.

The engineers not only wanted to verify the location of this pipe work, but also the location of various motor drive shaft ends, augur style conveyors, and a mysterious tank of unknown diameter. The tank was hidden away in a second story room whose access was either by a metal staircase or through an equipment access opening also on the second floor. To top it off, the engineers would like to know the coordinates, size, and detail of a series of down vents located on the roof originating from various locations along the "big pipe". The plant coordinate system base line was shown on the as-built plans as being along the not so handy web centers of the southern most line of upright steel. Required survey tolerance – "All to 1/4 inch please."

The initial survey control was laid out at various critical points around the plant to take advantage of not only conventional but digital 3D survey techniques. Control points within the plant and outside in the parking lot were reconned prior to the survey with full knowledge of providing all required deliverables by one technique or the other. A temporary control datum was established, to be recomputed once the baseline of the plant was determined by our survey. Many of the survey deliverables such as machine shaft end

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points, elevations of machine decks, and key machine components were easily gathered by conventional techniques. The details and locations of the "big pipe" and roof vents was a different matter. The CYRAX 2500 3D laser scanner was positioned so as to scan these areas of interest that could not be easily data collected in any other way. Each scan was registered to the temporary coordinate system by surveying in special reflecting targets used by the scanner to register multiple scans together. In this way a fully coordinated scan cloud was produced being on the same system as other data collected by conventional means.

By producing a comprehensive 3D "point cloud" of scanned data, specific areas of the cloud could be modeled into 3D solids. From the solid models the hot "big pipe" could be interrogated for details producing diameter measurements, centerline locations, elevations, and bend radii at each point of interest from the blower to the roof vents. The vents were also modeled, and with supplemental tape measure data, a generated location, elevation, shape, and height was determined. Ah, yes, the tank on the second floor? Enough of the tank was captured in a point cloud to calculate a solid model. From the model we were able to determine the location within the plant relative to other items of interest and the unknown diameter determined for the engineers to use in plant upgrades. A few of the plant base line I beams were modeled and coordinates of the center of the webs yielded the coordinate basis used to rotate and translate our temporary coordinate system to that of the paper as-built plans.

Surveyors are ever skeptical of high tech gadgets which produce answers you can't measure. I haven't seen a surveyor yet (including myself) that trusted anything until proven. Our confidence in the 3D scan survey was gained by struggling to manually survey in a couple of the roof vents locations. By all indications the calculated dimensional difference between the digital 3D models and the conventionally surveyed positions was less than 0.03 feet from a distance of over 300 feet. These differences were quickly analyzed as being the difference of where each survey team took or modeled it's measurements of a non plumb, and geometrically irregular vent structure. No offense intended to the daring sheet metal workers who put the thing together in the first place.

In a complex industrial setting this project presented some difficult situations of accessibility, and data collection challenges. As it turned out the project was a superb example of how well traditional measurement techniques can be combined with the latest 3D scanning technology. When the situation merits consideration of 3D scanning don't be hesitant to let it solve some of the more difficult survey problems for you.

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Did You Know That North Is Moving In Russia?

Scientists predict that the Magnetic North Pole, which has been in Canada for at least four centuries, is heading for Russia. The Geological Survey of Canada (GSC) has located the current position of the Magnetic North Pole to be: 81degrees, 3 minutes North, and 110 degrees, 8 minutes West, or about 200km off the northern tip of Ellef Ringes Island in the Arctic Ocean. Larry Newitt, a senior geophysicist at the GSC, has indicated through his analysis of survey data that the Magnetic Pole is moving in a northwesterly direction at an average speed of 40km per year. In the past it moved at 10km per year. At its current direction and speed, Magnetic North will move out of Canadian waters by 2005 and reach the coast of Siberia in about 50 years.

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