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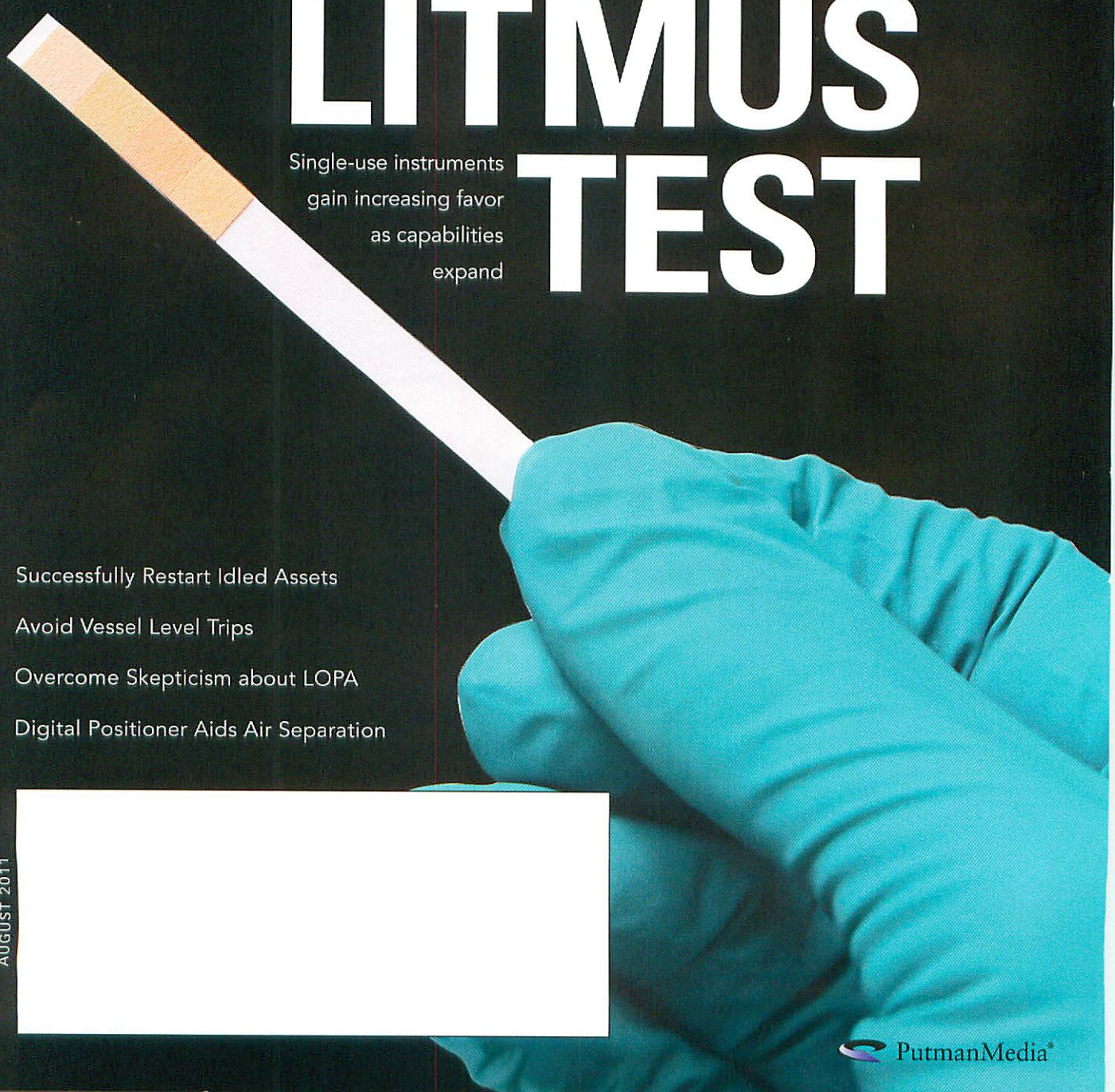

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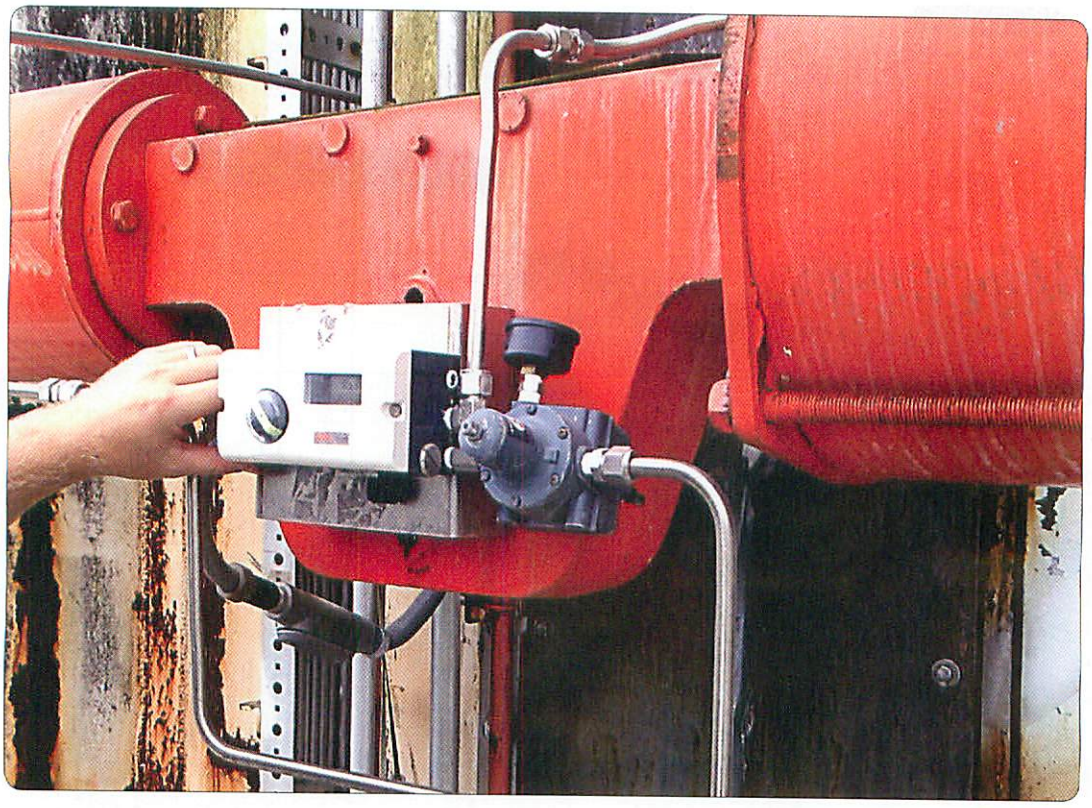

Digital Positioner Aids Air Separation

Tighter control enables significant boost in argon output

By Naas de Jager, ABB

A MODERN digital electro-pneumatic positioner is minimizing flow-rate swings of rich-liquid vapor at an air separation plant in Louisiana. The ABB positioner (pictured above), installed in March 2010 on the actuator of a 20-in. butterfly valve, has helped stabilize the sensitive cryogenic distillation process, resulting in increased argon production.

The plant, which handles 4.2 million std ft^3 of air per hour, first purifies and dries the air to remove contaminants, such as moisture, carbon dioxide and residual hydrocarbons, that would become solids at cryogenic temperatures. A compressor takes the air to about 75 psi. Most of the air then goes to the distillation process. A small side stream, about 0.5 million std ft^3/hr, is compressed to 110 psi; its subsequent expansion to 7 psi provides cryogenic refrigeration for the distillation columns.

COMMON CONFIGURATION

The plant uses a distillation arrangement that's relatively standard throughout the air separation industry. It consists of three columns — low pressure, high pressure and crude argon (Figure 1). The low-pressure column sits above the high-pressure column, with a condenser/reboiler between the two.

A compressor discharges air directly into the high-pressure column. As the incoming air works its way up the column, it loses additional heat. The oxygen

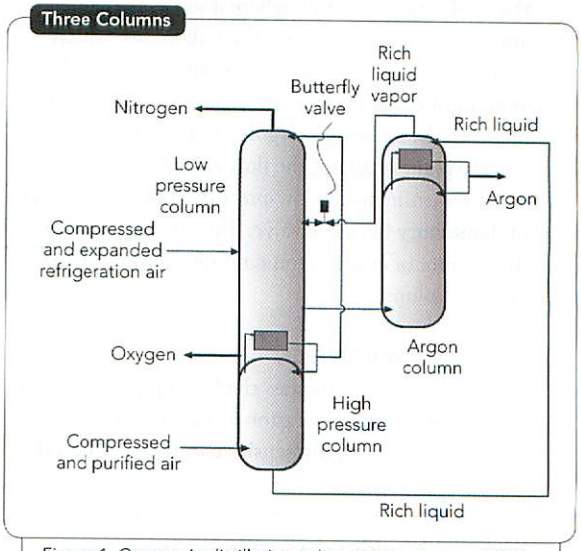

Figure 1. Cryogenic distillation splits air into nitrogen (78%), oxygen (21%) and argon (0.96%).

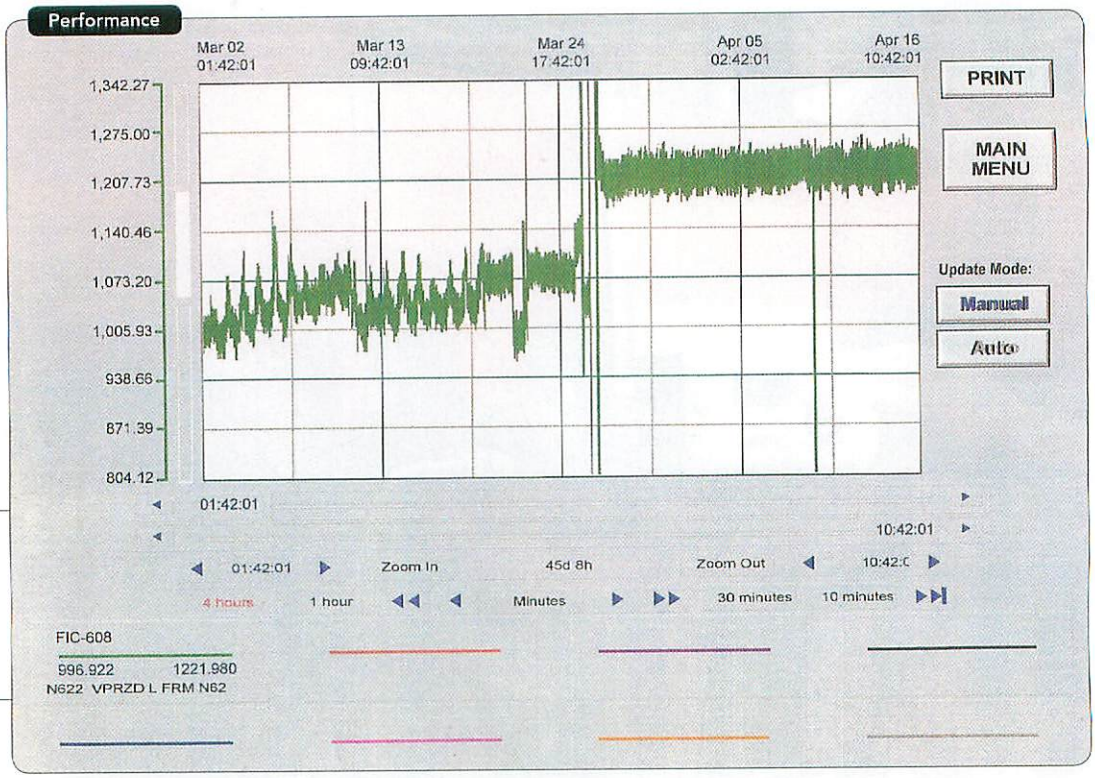

Figure 2. Rich-liquid-vapor flow rate stays flat with new digital positioner (right) — in contrast to swings experienced with previous positioner (left).

continues to liquefy, forming an ultra-cold oxygen-rich liquid (containing about 40% oxygen, with the balance being nitrogen) at the bottom of the high-pressure column.

Nitrogen and argon flow upwards through the low-pressure column. Oxygen is drawn off the bottom and nitrogen comes off the top of that column. A middle side stream runs to the bottom of the crude argon column. This side stream is a saturated gas consisting of about 90% oxygen and 10% argon.

Meanwhile, the rich liquid goes to the top of the crude argon column, where it serves to condense argon reflux. This vaporizes the rich liquid, which returns as a vapor to the low-pressure column. The amount of rich liquid vaporized corresponds one-to-one with the amount of argon condensed.

The plant regulates the flow rate of rich liquid vapor returning to the low-pressure column with a 20-in. Jamesbury butterfly valve. This, in turn, controls the amount of crude argon coming in from the low-pressure column.

BETTER FLOW CONTROL

Because only 3 K separates the boiling points of oxygen and argon, the operational stability of the crude argon column is highly sensitive to the rich-liquid-vapor flow rate.

The previous positioner wasn't properly controlling the butterfly valve — as seen by the swings in rich-liquid-vapor flow rate on the left side of Figure 2.

So, the plant engineers looked for a replacement, concentrating on smart digital units offering tighter control ranges with feedback of the actual valve position. They selected an ABB TZIDC positioner, a compact and modular unit suitable for linear and rotary pneumatic actuators, and created a custom bracket that fit it to the valve.

The right half of Figure 2 shows the rich-liquid-vapor flow rates after installation of the ABB smart positioner. The plant manager notes that flatter flow rates establish better system equilibrium, maximizing product purity. The plant now can run the columns under tighter control, which boosts argon production by roughly 10%.

Following the success of this digital positioner, the plant has installed additional units on expander guide vanes and letdown valves for tighter control of those operations. ●

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