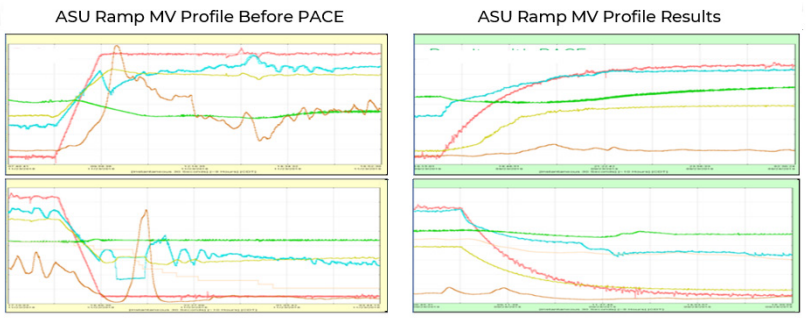
CASE STUDY

KBC
A Yokogawa Company



MPC Update Increases Air Liquide's Efficiency and Profitability with Sustainable Benefits

Industrial gas leader adopts Yokogawa's PACE tool for remote operations

Key Benefits

- Improved MPC performance
- Increased production efficiency
- Reduced operator interventions during load modulation and steady-state operation
- Reduced engineering labor

Background

- Looking to upgrade legacy MPC software
- Maximize production efficiency
- Align remote operation strategy with MPC goals and drivers

KBC Solution and Results

- Implemented the upgrade of legacy MPC software to PACE
- Improved MPC performance

Client Challenge

For more than twenty years, Air Liquide has leveraged multi-variable model predictive control (MPC) technology to help optimize the performance of its air separation units (ASUs).

Many of these gas production units reside at customer facilities and run with limited operational oversight. They automatically adapt to changing customer demand and real-time electrical power market pricing.

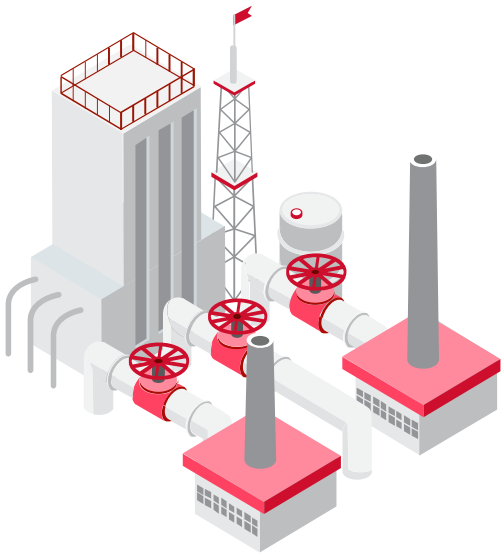
However, their legacy MPC software technology was becoming outdated and not meeting their value expectations. It was time to make a change and upgrade to the next-generation MPC technology.

The Solution

Enter Yokogawa's Platform for Advanced Control and Estimation (PACE). Air Liquide selected this solution as their new MPC standard because it addresses many of the issues that were inherent in their legacy MPC software.

An ASU separates air into its main components (oxygen, nitrogen, and argon) to produce a gas or liquid for end users .The large compressors used by the cryogenic ASU are energy intensive. A single large ASU can consume over fifty Megawatt/hour. Thus making electricity the largest variable operating cost which impacts the plant's overall profitability.

Many factors can affect ASU operating efficiency. These include changing production rates to adapt to supply and demand, front



end purification cycle disturbances, and changes in weather conditions. The operator needs to control these issues and failure to quickly adapt results in product loss, increases operating costs and ultimately decreases profits.

Air Liquide adapts to changes in customer demand and real time energy pricing using several optimization strategies to make production decisions to operate efficiently. Their legacy MPC applications used scripting to achieve many of these objectives which was time consuming for control engineers.

PACE eliminated the need for scripting making the MPC solutions more robust and sustainable. The model structure with intermediate variables allowed control designers to specify the dynamic model structure to represent the actual system more accurately.

The model predictive control performance eliminated the need for operator interventions during steady state operation or during production load changes.

PACE has empowered Air Liquide's control engineers to develop and deploy better advanced process control strategies for the increasingly autonomous remote operation of their ASUs.

The fact that PACE is co-developed with Shell, which uses it internally across their many plants, provided Air Liquide a strong level of comfort. Since operational feedback was guiding development, cost of ownership would decrease over the long term.

Results

The promise of MPC is the ability to tell the MPC engine how the plant works, determine the goals and constraints, and have the platform go about achieving them. Air Liquide's legacy MPC software was never able to get to this level. This was mostly due to limitations with the model structure, solver, and tuning that led the APC engineers to achieve their control objectives with time-consuming workarounds and extended maintenance support.

Although Air Liquide's MPC modernization goal to align plant operations with sustainability drivers is still in Phase 1, the PACE solution has provided immediate tangible benefits. By limiting the need for excessive scripting while maximizing run time, they reduced engineering labor and maximized efficiency.

A multi-year campaign is now underway to deploy PACE MPC controllers across Air Liquide's manufacturing sites in the U.S and around the world.

They will leverage the upgraded MPC solution to drive continuous improvement and higher operations acceptance.

Additionally, PACE's capabilities are proving applicable for generating value at other Air Liquide process technologies, such as hydrogen and CO production plants

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