POWER FOR A SUSTAINABLE FUTURE: REDUCING DOWNTIME

Simulation helps to improve productivity, performance and engineering innovation at a PTT gas separation plant.

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Oil and gas companies around the world share a common objective: Reduce downtime while maintaining and growing production levels. To prevent operating losses of $650,000 U.S. per day due to downtime, Gas Separation Plant (GSP) — an operation of PTT Public Company Limited (PTT) in Thailand — turned to simulation using ANSYS software.

PTT owns extensive submarine gas pipelines in the Gulf of Thailand and a network of liquefied petroleum gas (LPG) terminals throughout the country. Involved in electricity generation, petrochemical products, oil and gas exploration and production, and gasoline retailing businesses, PTT is the largest operator of gas separation plants in Thailand. GSP began operation in 1985; the maintenance department there chose ANSYS from the beginning as a supplier of proven tools to diagnose and rectify problems to improve production and save costs.

▲ **PTT, the largest petroleum company in Thailand, is ranked 95th on the *FORTUNE* 500 list.**
PHOTO BY SAWANG SAPOONKHUM.

GSP has a computing cluster of 144 processors customized for ANSYS Fluent and ANSYS Mechanical software that allows the company to perform large simulations (up to 20 million cells) in a reasonable amount of time. High-performance computing with high-quality support from CAD-IT Consultants (an ANSYS service provider and distributor in Southeast Asia) allows the GSP team to quickly and accurately perform structural mechanics, fluid dynamics and fluid–structure interaction simulations to address a wide variety of operational issues. ANSYS software helps to support the team's design and engineering decisions, and ANSYS HPC technology is a key enabler for solving high-fidelity simulations and increasing engineering productivity.

BURNER OPTIMIZATION

A recent project simulated combustion in the burner of a waste heat recovery unit. The goal was to prevent overheating of a diffuser section that was causing days of downtime. Operating conditions and complexity of the geometry made it impossible to measure and obtain a detailed temperature profile inside the burner unit. Actual temperature measurements were available only at some locations, making it very difficult to justify improvement options with empirical data. GSP decided to use Fluent to simulate four different new burner designs to analyze flow behavior and combustion characteristics.

Simulation for each design required approximately two weeks of computational time on 128 cores. This allowed engineers to determine temperature distribution in the existing diffuser and to compare those results to revised designs. After determining that the original design operated at around 1,050 C based on the measurements available, the team used

Fluent's combustion and radiation models to develop a new burner diffuser design that operates at a maximum temperature of approximately 950 C. The diffuser material (stainless steel grade 310 that has good resistance to oxidation in intermittent service up to 1,040 C) can withstand this temperature. Combining combustion with radiation models allowed engineers to ascertain the cause of the overheating, enhance their knowledge of flow behavior and temperature distribution inside the burner, and resolve the problem permanently by making minor changes to the diffuser wing geometry that resulted in changes in the flow pattern inside the burner. This alteration made a big difference in terms of maximum temperature in the system, and it allowed engineers to choose the appropriate material for the new operating conditions. The burner has a maintenance period of about four years; since implementation of this improvement, it has been running smoothly without any problems. The new design developed with simulation saves the company at least $650,000 U.S. per day in costs that would have been incurred by lost productivity due to shutdown to solve unexpected problems or to check reliability of the improvement.

Simulation saved the company at least $650,000 U.S. per day in costs that would have been incurred by shutdown.

PIPING SYSTEMS STRESS AND VIBRATION

GSP operations include complex equipment — pipes, tanks, columns, support structures and heat exchangers — that must be correctly designed and maintained to ensure continuous operation 24 hours a day, seven days a week, with minimum shutdown time. Engineers at GSP rely on simulation to fulfill specifications and maintain equipment reliability and structural integrity during operation. They use ANSYS structural mechanics software to examine and improve these structures as well as to ensure that the company's investment in these complex systems is secure.

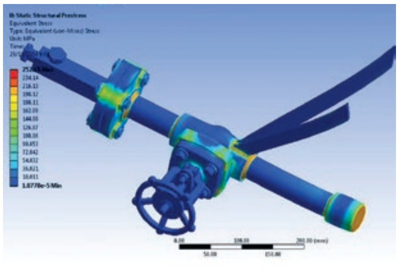
Without ANSYS Fluent, we would not have been able to understand the cause of failure, because it is extremely difficult to measure all parameters in the burner diffuser unit.

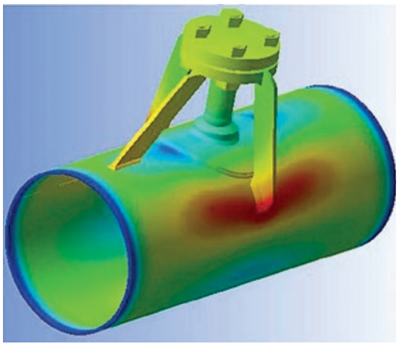
— Sunvaris Uywattana, Senior Mechanical Engineer

For example, vibration issues in small branches of piping have been resolved using structural mechanics software. In these simulations, engineers perform stress analysis followed by fatigue life analysis. The geometry is set up in SolidWorks® and imported into ANSYS Mechanical to carry out nonlinear transient analysis. The team performed design improvements by adding some additional support elements then ran a stress analysis to verify the changes.

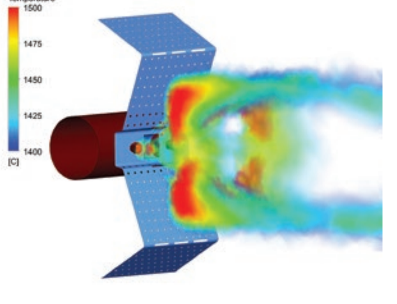
To ensure that temperature changes from elements added inside the pipe system had no external effect, the team performed thermal–stress analysis. The thermal load from CFD analysis was passed to ANSYS Mechanical, showing how the thermal load from the fluids influenced the structure of the new piping system design.

Engineering simulation helps the team to make certain that the system is not overengineered while ensuring that operating shutdowns are as short as possible. The team faces high safety-factor requirements that lead to increased piping support structures; these, in turn, constrain thermal expansion of the piping material. Simulation helps GSP to make the correct trade-offs in terms of engineering improvement and investment. Moreover, team members gain skill and knowledge through simulation, thereby enabling increased organizational know-how and encouraging sustained innovation.





Structural mechanics simulation predicted stress and deformation of pipes.



Volume rendering of temperature around burner diffuser using ANSYS Fluent