SIEMENS

ENERGY AND UTILITIES

Open Grid Europe

OGE leverages 1D CFD to design safe gas infrastructure and assess readiness for energy transition

Product

Simcenter

Business challenges

Ensure the safety of gas distribution systems under all emergency scenarios

Assess the readiness of existing infrastructure to be retrofitted to meet new requirements

Maintain supercritical phase flow for carbon dioxide transport for offshore CCUS

Keys to success

Combine knowledge and robust physics in models to quickly calculate complex networks without compromising accuracy

Use a comprehensive enthalpy-based solution to capture supercritical phase flow for CO_2

Meet requirements for energy transition initiatives

Results

Leveraged 1D CFD to design safe gas infrastructure and assess readiness for energy transition

Used Simcenter Flomaster to capture gas flow dynamics to reduce safety risks

Quickly assessed technical feasibility to meet requirements of energy transition initiatives

Using Simcenter Flomaster to capture gas flow dynamics to reduce safety risks

Understanding gas transport infrastructure systems

Energy security has been a challenge in recent years and is further compounded by aging infrastructure, the shift to new gas suppliers and the pressure to cut emissions. In addition to investing in new infrastructure, an important aspect of solving this challenge also involves assessing the readiness of existing pipeline networks and retrofitting those to meet new requirements. “The application of the state of the art digital technologies specifically with regards to new energy technologies require the application of state of the art digital technologies; to overcome limitations and push the boundaries of the possible” says Siemens’ partner Vague Ventures GmbH.

Although the overall puzzle is complex, a key piece to solving it involves having a reliable set of tools and methodologies that help engineers understand fluid flow in complex piping infrastructure spanning hundreds or thousands of kilometers (km).

Open Grid Europe (OGE) provides sustainable energy solutions to customers throughout Germany. The company has a large pipeline network and serves as one of Europe’s transmission system operators.

OGE has partnered with Siemens Digital Industries Software to use Simcenter™ Flomaster™ software, which is part of the Siemens Xcelerator business platform of software, hardware and services, to design safe and efficient systems. As new technologies for carbon capture utilization and sequestration (CCUS) and demand for hydrogen emerge, the company is

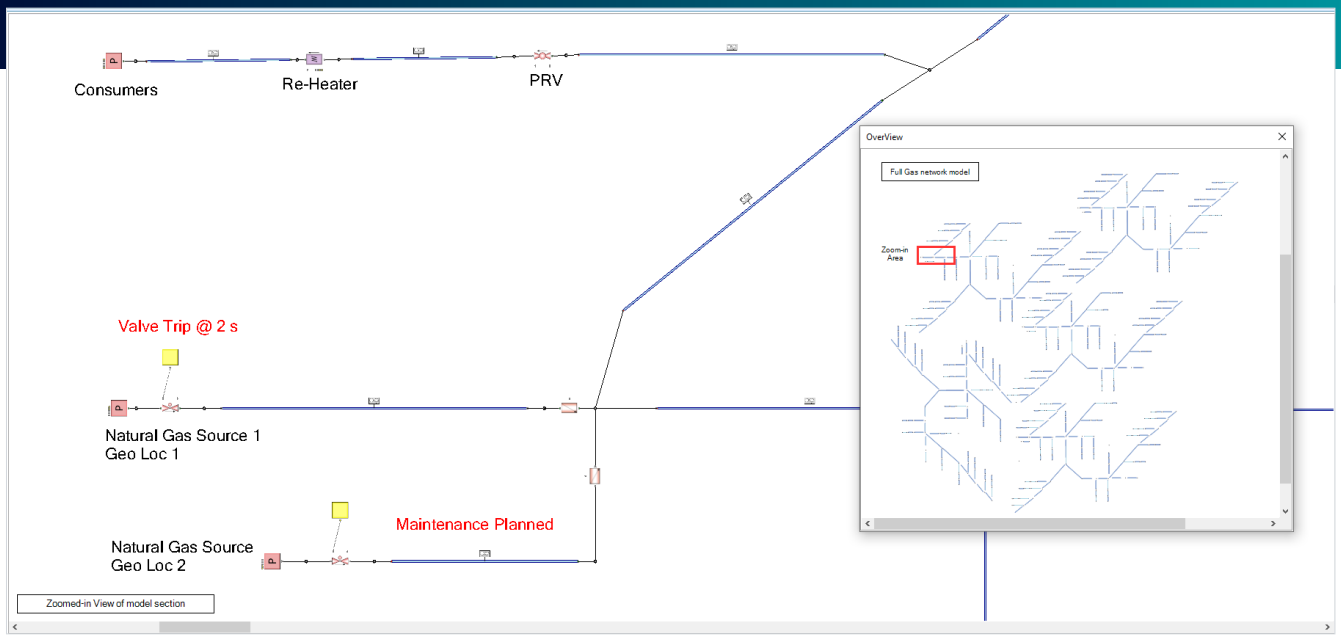


Figure 1. Representative layout of a small section of gas distribution network model.

The OGE team uses Simcenter Flomaster to generate detailed gas physics models in an easy-to-use graphical interface with postprocessing capabilities that allow engineers to quickly gain valuable insights.

continuing this collaboration driven by common ideals of sustainability and developing safe and financially viable solutions.

Planning and maintaining traditional natural gas infrastructure

One key aspect of designing safe gas processing and transporting infrastructure involves mitigating risks and ensuring the integrity of the assets under any undesired scenario. Unplanned events, such as a consumer suddenly going offline or a power trip in the compression station, can trigger severe pressure disturbances in an already highly pressurized gas network. Figure 1 shows a small section of an overall gas supply network model in Simcenter Flomaster where many disturbance scenarios can be investigated.

In some cases, a build-up caused by one anomaly can further trigger other emergency procedures that can lead to significant increase in unplanned downtime. In addition to avoidable maintenance overhead, this also impedes steady revenue flow that would have resulted from otherwise stable operations. OGE has relied on using Simcenter Flomaster for detailed engineering of gas flow networks for over a decade to ensure safety and reduce risks of unplanned downtimes thereby improving the overall operational efficiency.

The analysis often requires a careful and rigorous assessment of operating parameters such as gas pressures, temperatures or specie concentrations, not just at the

This presents a challenge as well as an opportunity for the OGE team to leverage the benefits of the supercritical phase behavior for more efficient transport.

OGE engineers are using Simcenter Flomaster to provide enthalpy-based vapor cycle solver technology so they can study critical parameters under various operational scenarios and thoroughly assess the feasibility of the existing infrastructure.

points of metering but also how they propagate along the lengths. Over the years, OGE has developed proprietary knowledge to streamline the workflow and make quick decisions to resolve the entire system into points of calculation that are then simultaneously computed using Simcenter Flomaster.

The implicit Courant-Friedrichs-Lewy (CFL) criteria ensures that no transient gas flow physics is left uncaptured, which optimizes the calculation speed without compromising accuracy. The simulation produces insights that allow engineers to assess the safety implications of any design or operational changes.

One instance shown in figure 2 demonstrates the impact of a small change in the same design that increases peak pressures by four times the original amount and may make the system highly unstable. The OGE team uses Simcenter Flomaster to generate detailed gas physics models in an easy-to-use graphical interface with postprocessing capabilities that allow engineers to quickly gain valuable insights. The ease of interoperability via Excel spreadsheets further helps save time and automate workflows.

Supporting new technologies and energy transition

Carbon dioxide (CO_2) is a major by-product in several industrial processes like steel

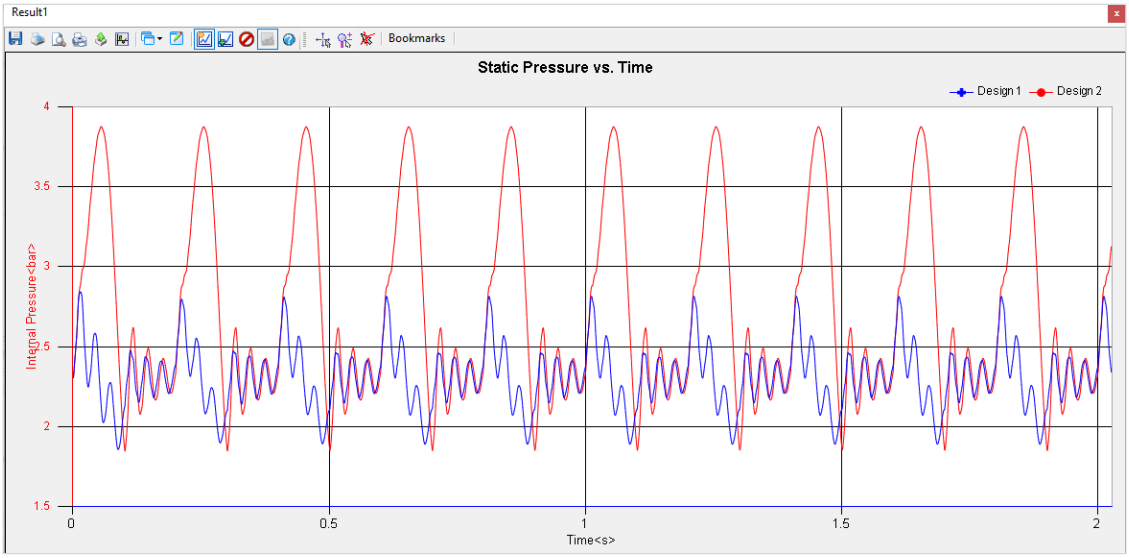
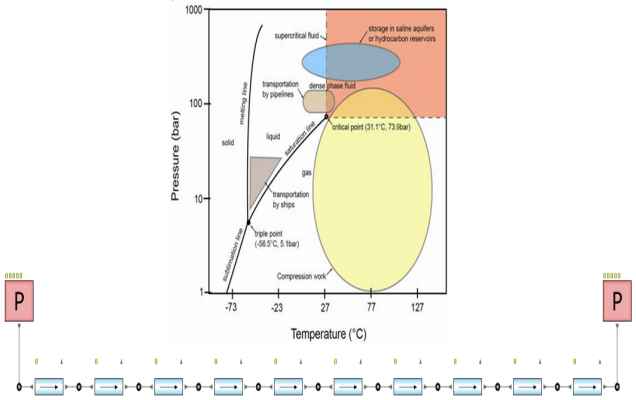


Figure 2. Small design change leading to pressure peaks being amplified by a factor of four.

OGE has relied on using Simcenter Flomaster for detailed engineering of gas flow networks for over a decade to improve safety and reduce the risk of unplanned downtimes thereby increasing overall operational efficiency.

making. With the steel industry in Germany predominantly being centered around the Ruhr region, moving the generated CO_2 to offshore facilities where CCUS technologies can be applied using existing pipeline infrastructure will offer a pragmatic way forward. However, with carbon dioxide's properties and behavior being very peculiar and significantly different from natural gas, there is no simple answer to gauging the suitability and readiness of the existing infrastructure to cope with this new requirement.

Figure 3 shows the supercritical phase region of CO_2 where its properties are indistinguishable between incompressible or compressible flows. This presents a



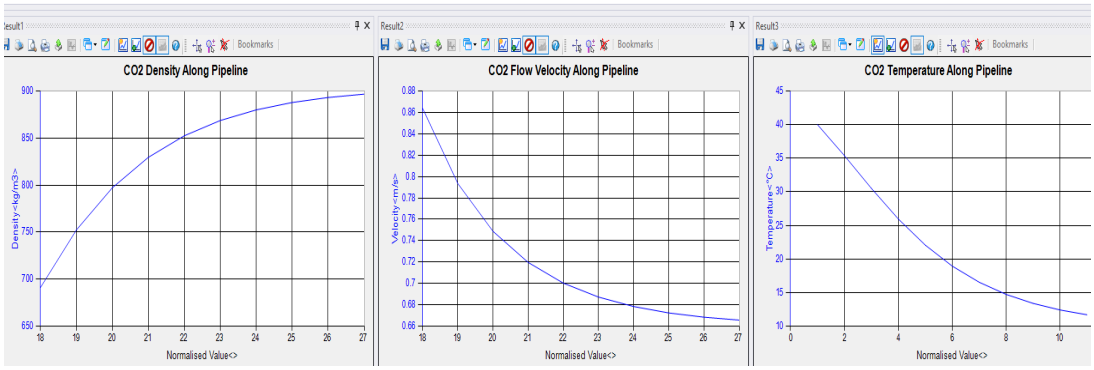


Figure 3. Analyzing supercritical carbon dioxide transport piping network.

challenge as well as an opportunity for the OGE team to leverage the benefits of the supercritical phase behavior for more efficient transport.

For that to happen, a critical aspect is to understand pressure-temperature-enthalpy distribution and phase split of carbon dioxide across the entire transport network while fully considering various points of generation, branching and merges, elevations and heat transfer. OGE engineers will be using Simcenter Flomaster's enthalpy-based vapor cycle solver technology. Siemens local partner SMART Engineering GmbH will continue to support OGE's efforts to assess the critical aspects of the existing infrastructure.

As the solution time is fast, even for complex networks spanning thousands of kms with branching, OGE may explore the potential for using online models for robust operational planning as an integrated part of the wider internet of things (IoT) ecosystem providing real-time insights on the as operated state of the assets.

Solutions/Services

Simcenter Flomaster
siemens.com/simcenter-flomaster

Customer's primary business

Open Grid Europe provides sustainable energy solutions to customers throughout Germany. The company has a large pipeline network and serves as one of Europe's transmission system operators.
www.oge.net

Customer location

Essen
Germany

Solution Partner

SMART Engineering GmbH
www.smart-fem.de/

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Asia-Pacific	001 800 03061910

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