



N₂O DELIVERY SYSTEM FOR SEMICONDUCTOR FABRICATION



This case study shows how Flownex was used to simulate a Nitrous oxide (N₂O) delivery system for semiconductor fabrication, ensuring stable flow rates, preventing condensation, and identifying optimal heater configurations to avoid icing and maintain performance.

N₂O plays an important role in semiconductor manufacturing, where it is commonly used as a process gas in oxidation and deposition steps that demand tightly controlled flow and temperature conditions. Semiconductors themselves are fundamental to modern technology, forming the basis of integrated circuits used in electronics, communications, energy systems, and advanced manufacturing.

CHALLENGE

CollabraTech Solutions developed an N₂O autocross delivery system for semiconductor fabrication and needed to confirm that the system could maintain the specified flow rate in standard liters per minute (SLPM). Engineers also needed to ensure the process fluid remained fully vaporized during delivery and to assess potential external icing on the system.

BENEFITS:

Flownex allowed CollabraTech to simulate conjugate heat transfer throughout the delivery system, providing engineers with detailed insight into temperature profiles, flow behaviour, and heat requirements. This enabled identification of areas needing heating to prevent condensation and surface icing without relying on costly physical prototypes.

SOLUTION:

Using Flownex, the delivery system was modelled under multiple operating scenarios. The simulation revealed regions where gas exit temperatures were unnecessarily high and provided guidance for optimizing heater placement and configuration. These insights allowed the team to maintain target SLPM flow rates, ensure the fluid stayed fully vaporized, and prevent exterior icing during operation.

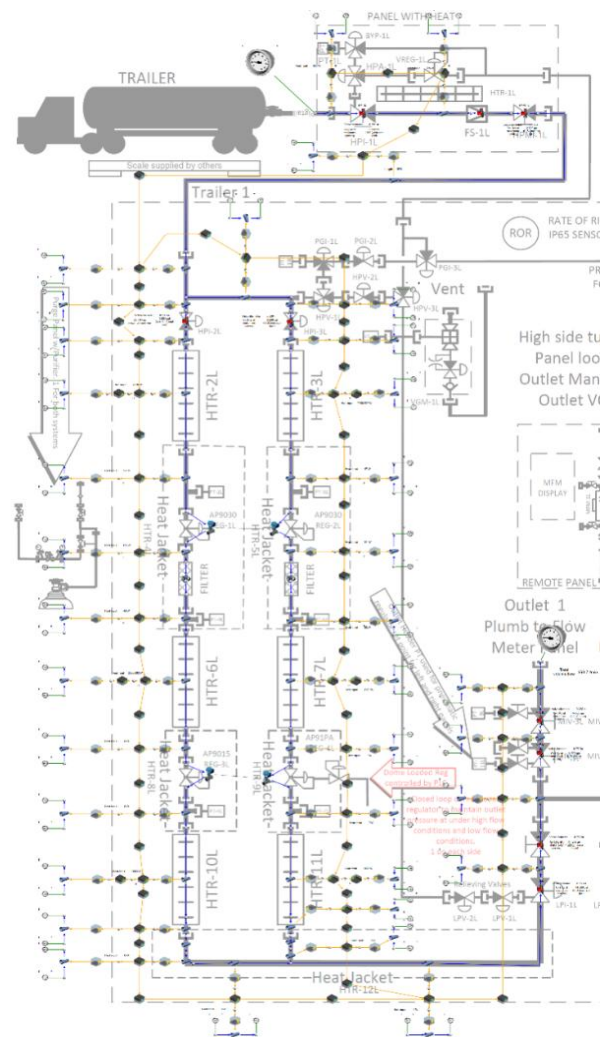


Figure 1: Flownex model of N₂O delivery system

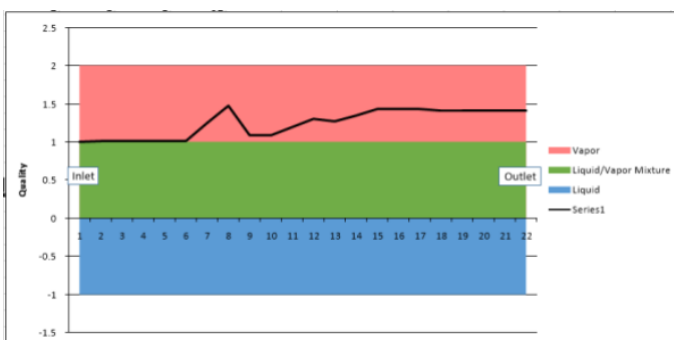


Figure 3: Fluid quality along the delivery system

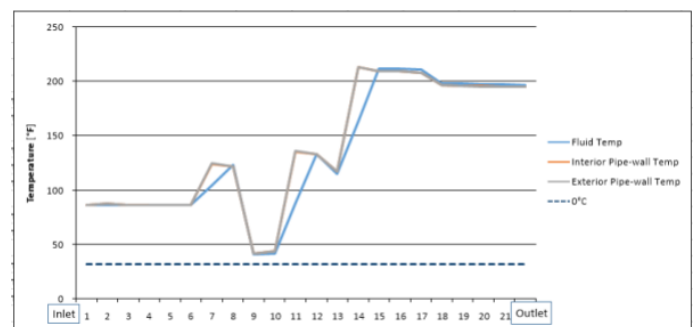


Figure 3: Fluid as well as interior and exterior pipe wall temperatures along the delivery system