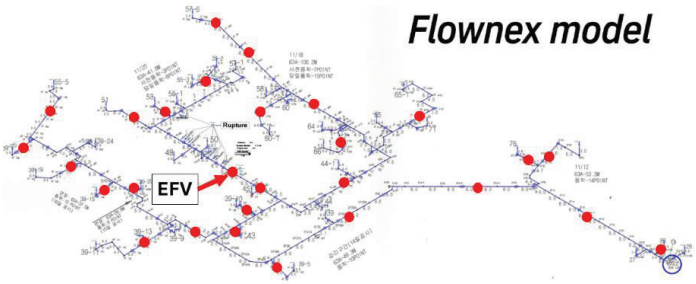
EXCESS FLOW VALVE (EFV) DEVELOPMENT FOR KOREAN GAS SAFETY



KOREA GAS SAFETY CORPORATION

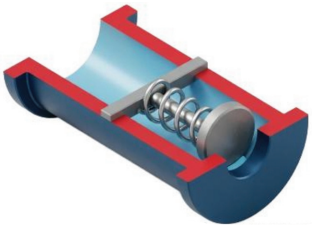
An Excess Flow Valve (EFV) is a protection device designed to isolate sections of a gas distribution network in the event of a rupture. Korean Gas Safety (KGS) developed a new EFV design for commercial LPG distribution systems. As shown on the left, the EFV design was evaluated in Flownex using a distribution network containing 29 newly developed EFVs.

CHALLENGE:

The effects of a rupture could not be predicted analytically, making it difficult to determine the appropriate bypass-channel size. An undersized bypass channel could significantly delay EFV reopening, while oversizing could allow excessive gas escape through the bypass during the EFV's closed state.

SOLUTION:

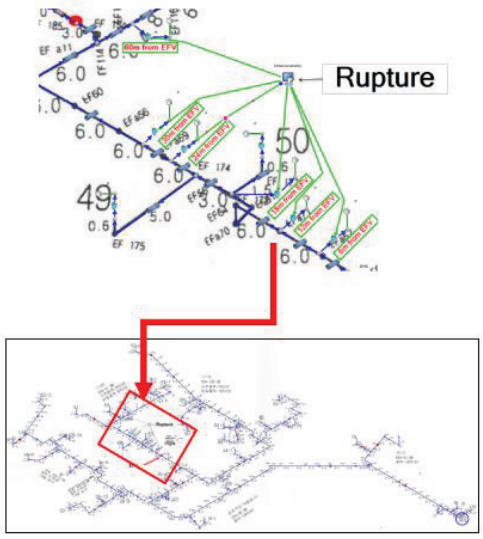
The standard Flownex EFV component was used to model the new KGS valve design. The model combines fundamental flow relationships with valve performance characterisation to predict EFV protection behaviour at a system level.



Flownex Excess Flow Valve component

Flownex's transient, compressible-flow simulation capabilities enabled accurate modelling of the rapid blowdown caused by a rupture.

As shown on the right, ruptures were simulated at various points along the pipeline to evaluate their effect on EFV closing and reopening times. Each case considered a 6.3 mm diameter rupture. Adaptive timesteps reduced simulation time, allowing 2x real-time speed on a standard laptop. This made it possible to test multiple bypass-channel sizes on the same day.



RESULTS:

The first study investigated the effect of rupture location. The rupture distance from the EFV was varied from 6 m to 60 m while maintaining a constant bypass diameter of 1.1 mm. Valve closing time increased from 0.115 s to 0.400 s as the rupture occurred farther downstream. Reopening time, however, remained constant at 33 minutes, since the same isolated pipe volume had to be repressurised before the valve could reopen. Despite having multiple EFVs in the network, only the valve protecting the affected section responded to the rupture.

The second study investigated the effect of bypass-channel diameter. With the rupture fixed at 18 m from the EFV, the bypass diameter was varied from 0.1 mm to 1.5 mm. Valve closing time remained unchanged at approximately 0.165 s across all cases. Reopening time, however, varied dramatically, decreasing from 67 hours for a 0.1 mm bypass channel to only 18 minutes for a 1.5 mm bypass channel. Increasing the bypass diameter beyond this point was undesirable, as excessive gas could escape through the bypass during valve closure.

CONCLUSION:

Flownex allowed KGS to evaluate EFV behaviour efficiently across a wide design range. The simulations provided clear guidance on rupture sensitivity, bypass sizing, and valve-reopening performance. Without Flownex, evaluating these scenarios at full network scale would have required lengthy and costly physical experiments. The project demonstrated the value of Flownex as an engineering tool for analysing gas-distribution safety systems.