Course name: Energy Networks

Project name: Design of a Gas Network System

By: Sina Keyhani

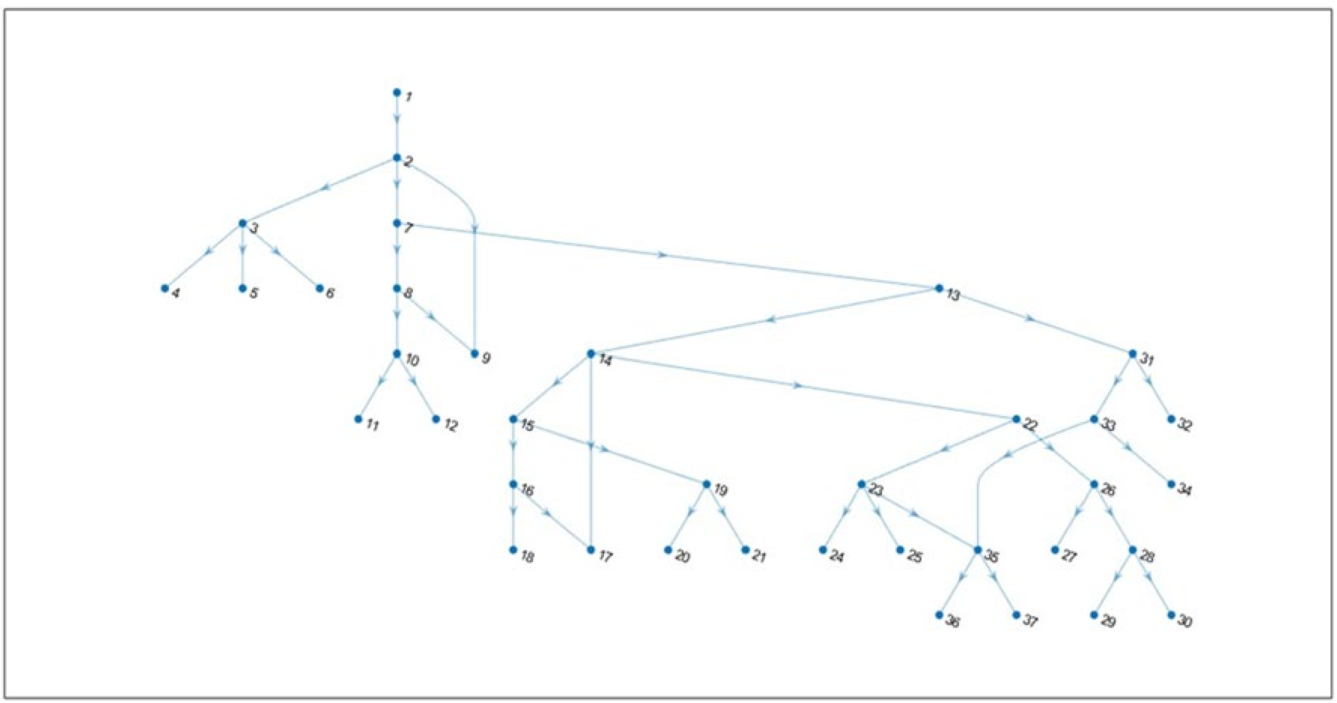
Introduction:

In this project, design and simulation of a 4th species municipal gas network has been done under some specific assumptions with the aid of MATLAB. The sizing of the network and the city-gate reduction station (ReMi) and the analysis of the fluid dynamics has been performed to provide an overview about the gas network and lastly by using the obtained information from sizing and simulation, the network response to two specific scenarios were observed.

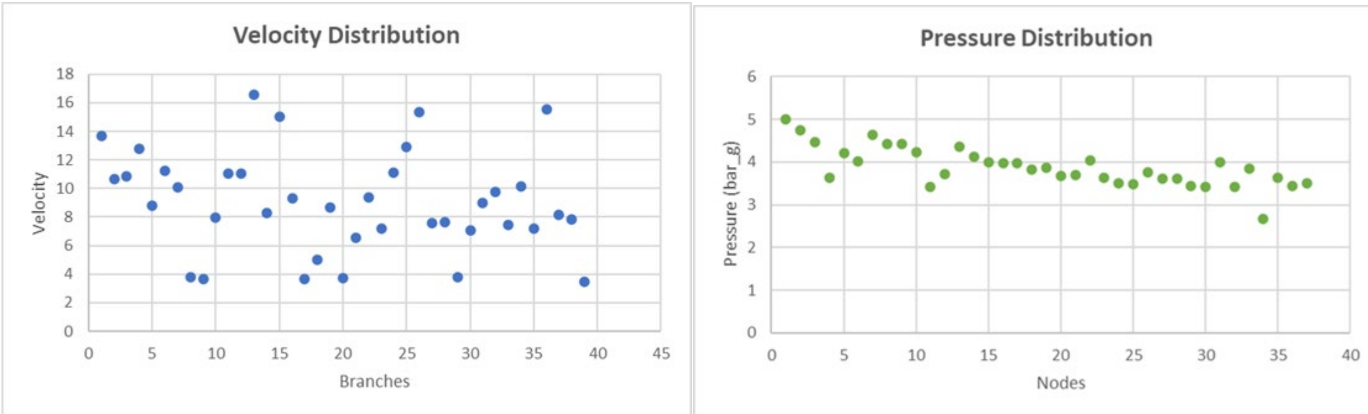
Gas Network Design:

Building Num.	Required Power (kW)	Volume Required (Sm^3/s)	Mass Required (Kg/s)
1	4442.66	0.125	0.092
2	16007.14	0.453	0.333
3	5398.02	0.153	0.112
4	4802	0.136	0.099
5	3679.57	0.104	0.076
6	3794.93	0.107	0.078
7	10194.23	0.288	0.212
8	5691.25	0.161	0.118
9	12364.8	0.351	0.257
10	6049.06	0.171	0.125
11	9543.7`	0.271	0.198
12	6157.66	0.174	0.128
13	9104.55	0.258	0.189
14	12182.49	0.345	0.253
15	5961.6	0.169	0.124
16	3288.13	0.093	0.068
17	4575.2	0.129	0.095
18	6289.41	0.178	0.131
19	9183.08	0.261	0.191

General information for each of the residential buildings.



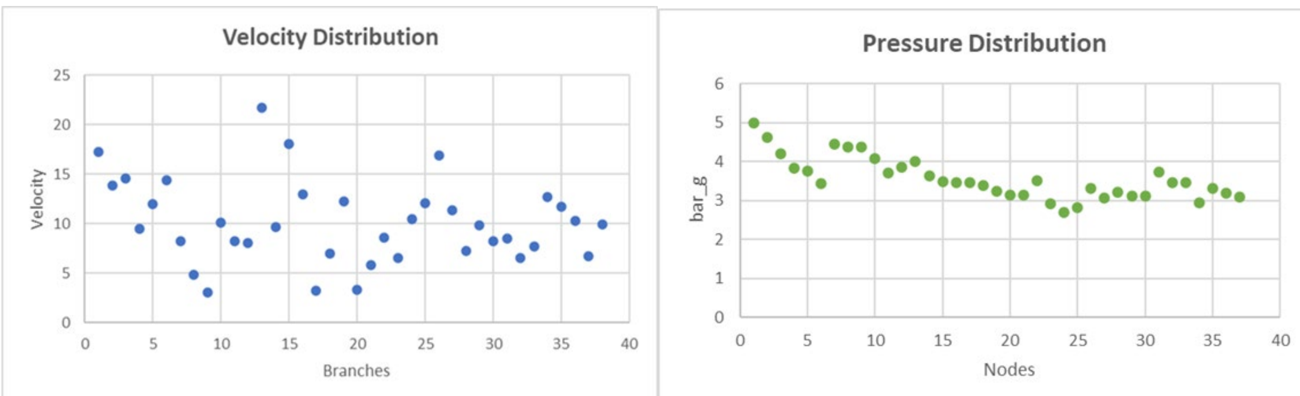
Simulated network by MATLAB.



Left: Velocity of gas within the branches. Right: Pressure of the gas in each of nodes.

Scenario One:

Opening one the loops of the network and then increase the consumption to 25% and analyzing the network response.

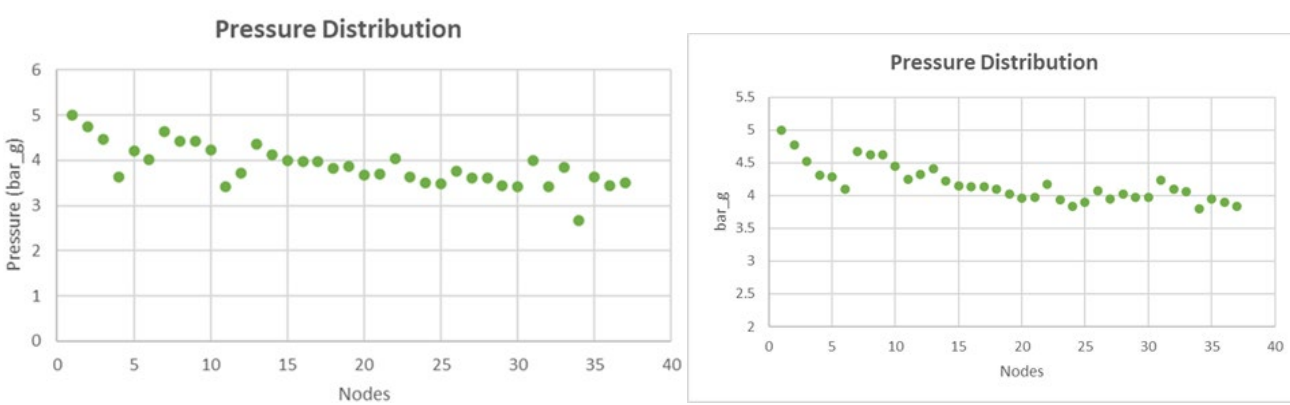


Left: Velocity of gas in new situation. Right: Pressure of the gas in new situation.

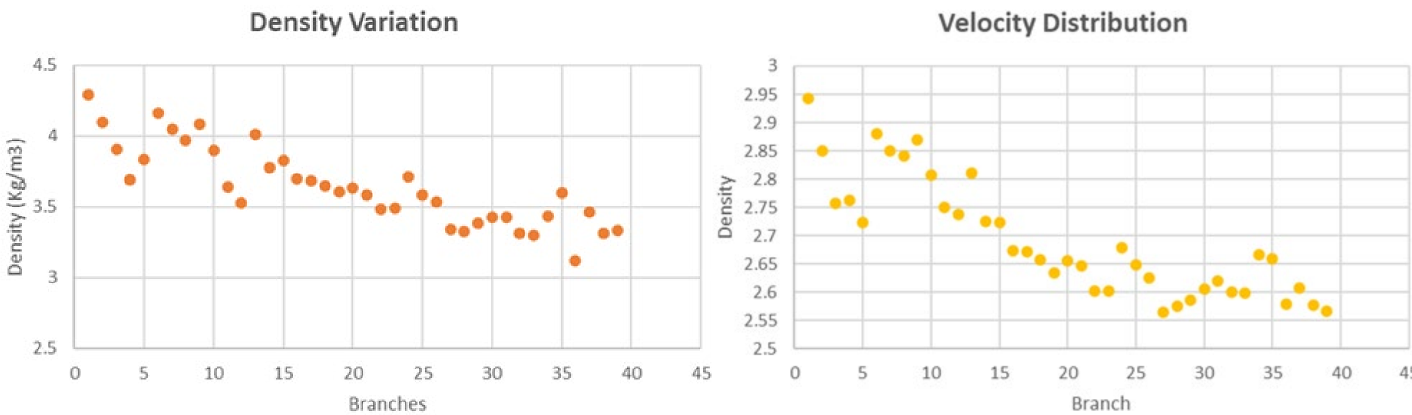
The network's response to this contingency was excellent. All the consumers are receiving their necessary gas flow. There were pressure drops in several nodes, but all of the pressures are within range of 4th species. The same thing can be said about velocity in branches.

Scenario Two:

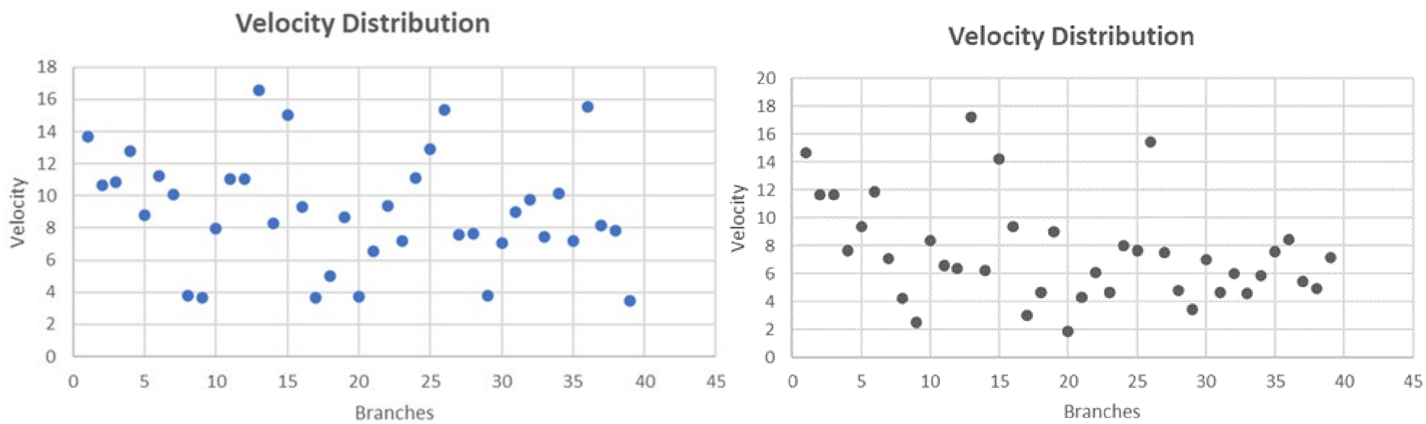
In this scenario, 20% Hydrogen is added to the gas mixture and the effects of this is examined within the network.



Left: Gas pressure in each node, normal situation. Right: Gas Pressure in each node, Hydrogen added.



Left: Gas density in different branches, normal situation. Right: Gas density in different branches, Hydrogen added.



Left: Gas velocity in different branches, normal situation. Right: Gas velocity in different branches, Hydrogen added.

The hydrogen blend gas is lighter and its LHV is therefore lower compared to the normal natural gas however, this did not affect the mass flow rates drastically and the lower density of gas mixture also somewhat mitigate larging flow rates. The network dimension was already a bit large for the normal gas flow and this over size is showing itself with the new type of gas.

Conclusion:

The result showed that overall network can operate with normal conditions however it is a bit oversized which cause lower than usual velocities, this shows that the network can benefit from a bit of downsizing. The network's response to the new situation was also acceptable and within the standards.