PTT Gas Separation Plant 1: Consequence-Based Dispersion Study (Requested Case)

Dispersion simulations
Preliminary Results

Revision 00

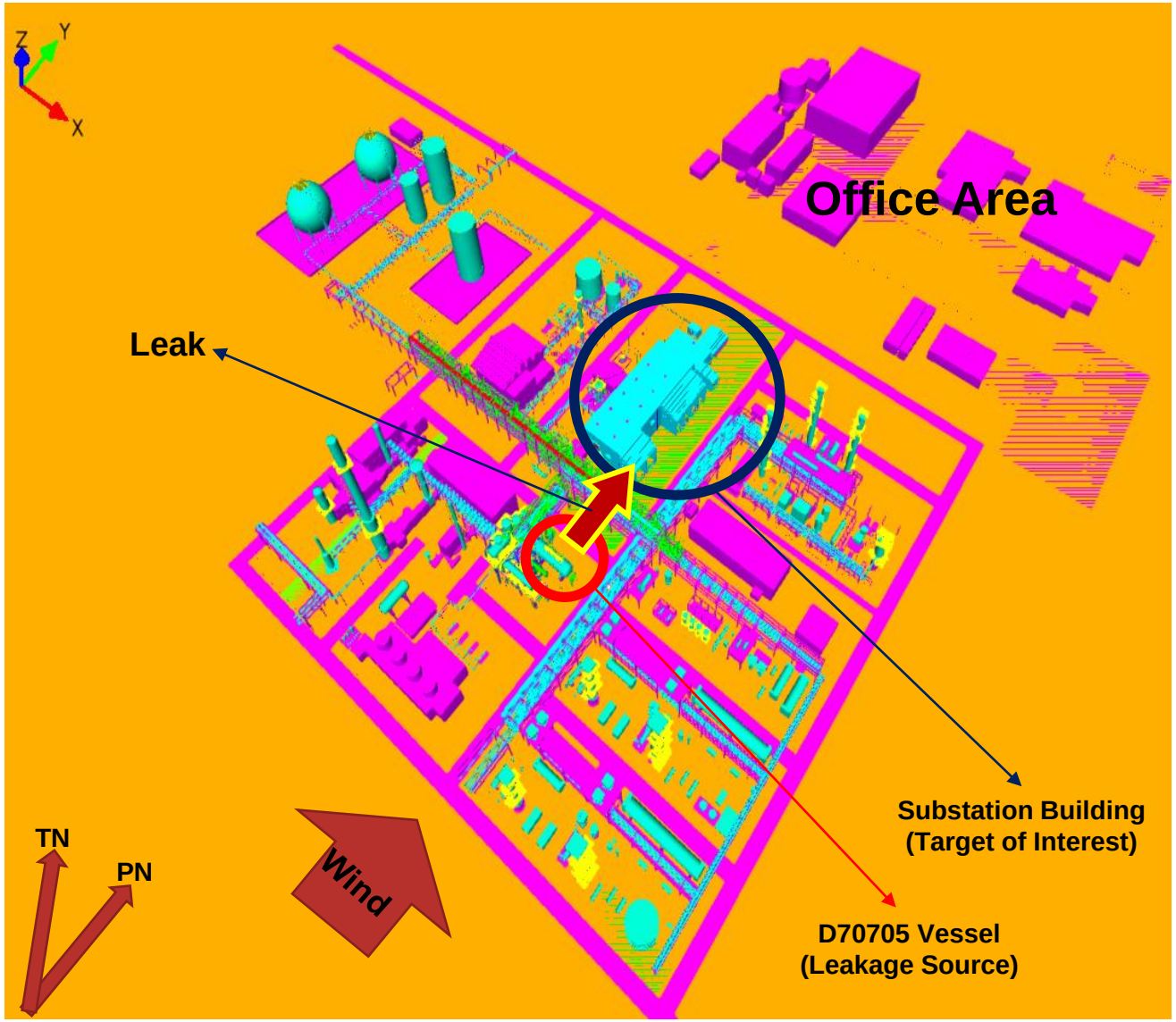
Feb 18th 2020

Flammable Gas Extent

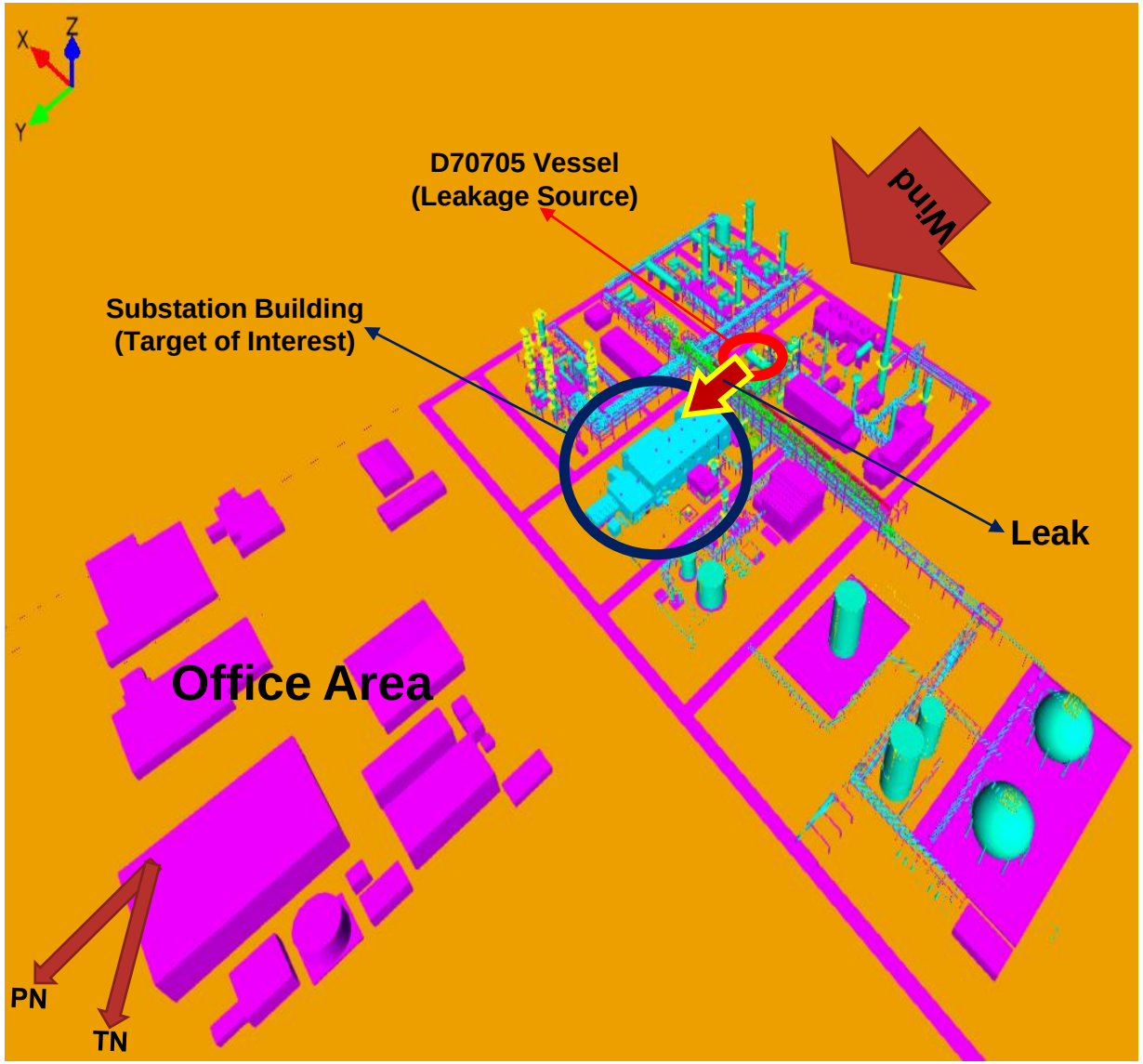
(Liquid Release from Vessel D70705)

GSP1 – Area for Simulations

GEXCON



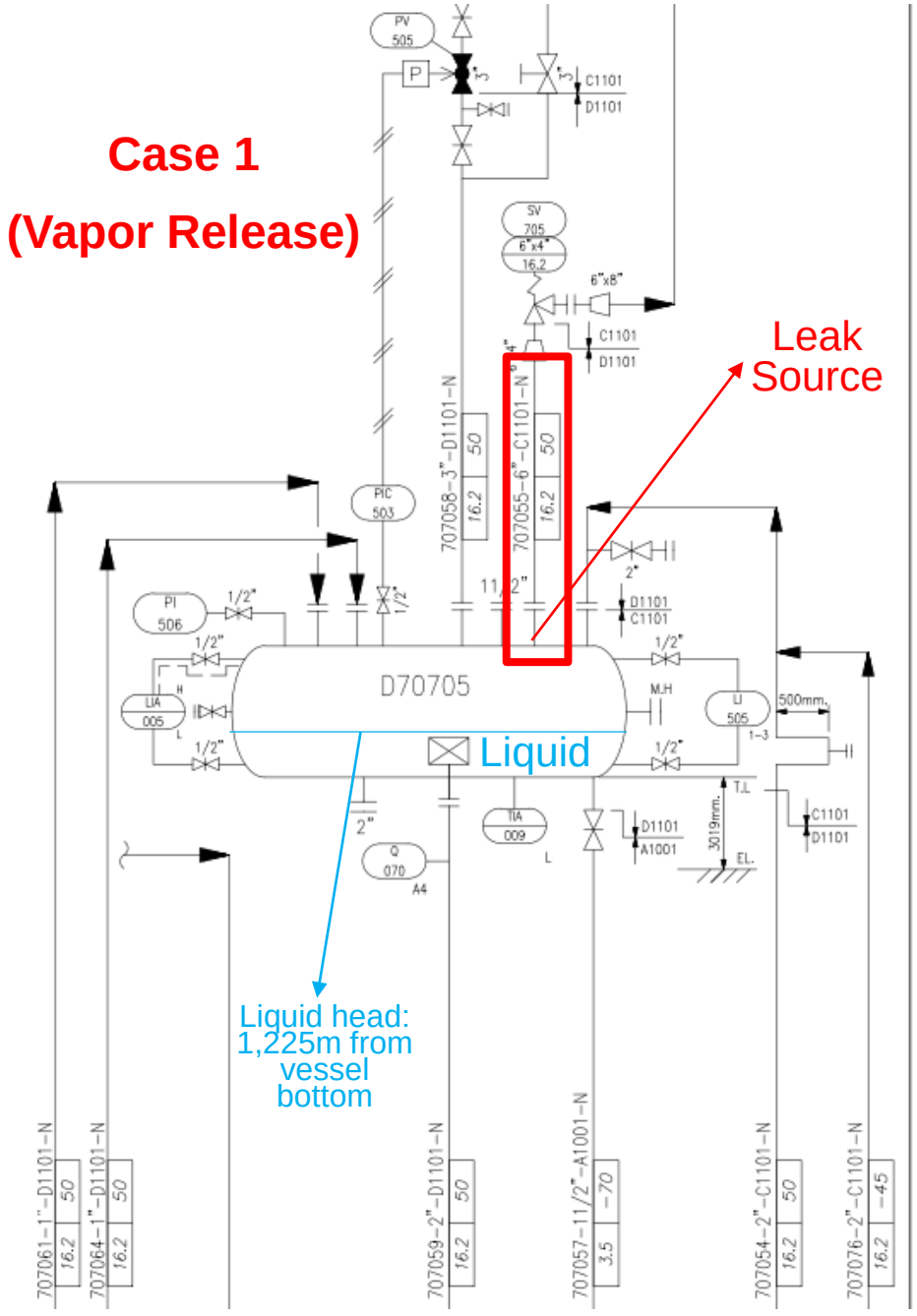
South East View



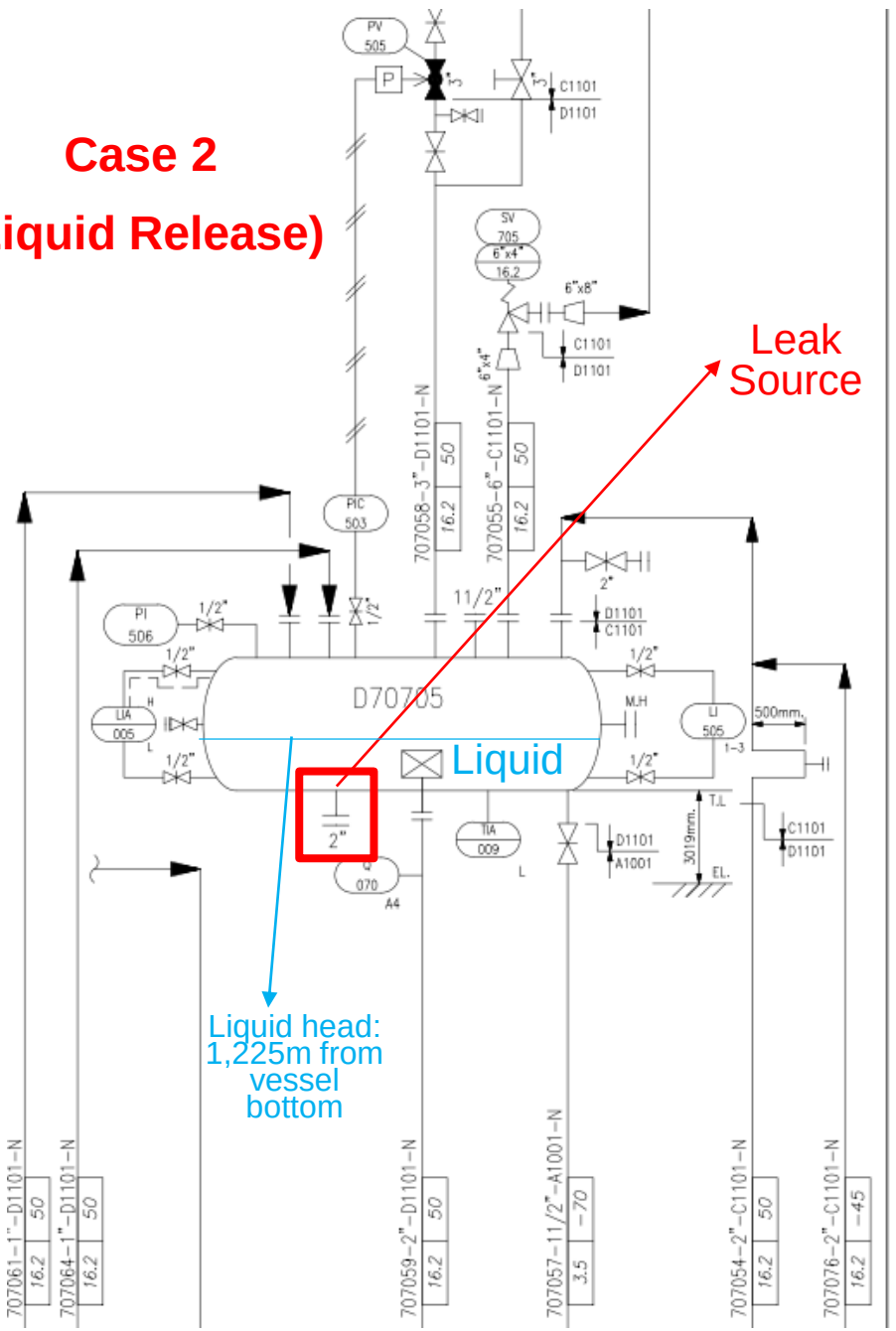
North West View

GSP1 – Leak Scenarios

Case 1
(Vapor Release)



Case 2
(Liquid Release)

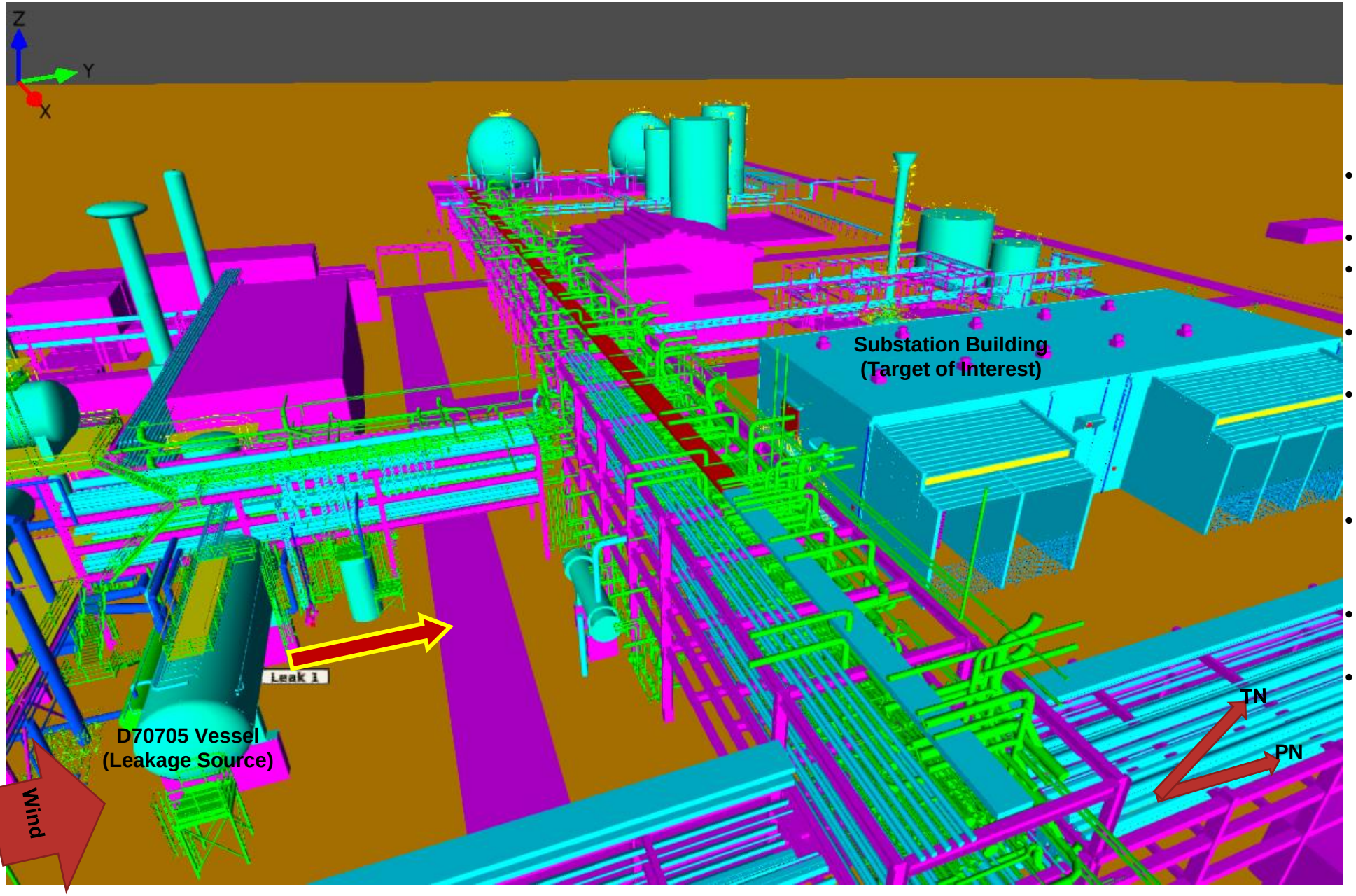


GEXCON

Reference:
S-จก.จบก.-03-A1-707-201_R04

GSP1 – Leak Scenario (Case 2 (Requested))

GEXCON



- **Leak hole diameter: 1/2 inch = 12,7 mm**
- Leak position: 3,5 m from ground
- Leak direction: to Substation Building (Jet +Y / plant north)
- Leak position and direction are depicted as a red-yellow arrow
- Leak starts at 5th second and stops at 427th second of simulation (leak duration: 422 seconds)
- Total duration of simulations: 450 seconds

- Gas composition: 98,98% Propane, 1,02% Ethane
- Mass flow rate: 2,623 kg/s

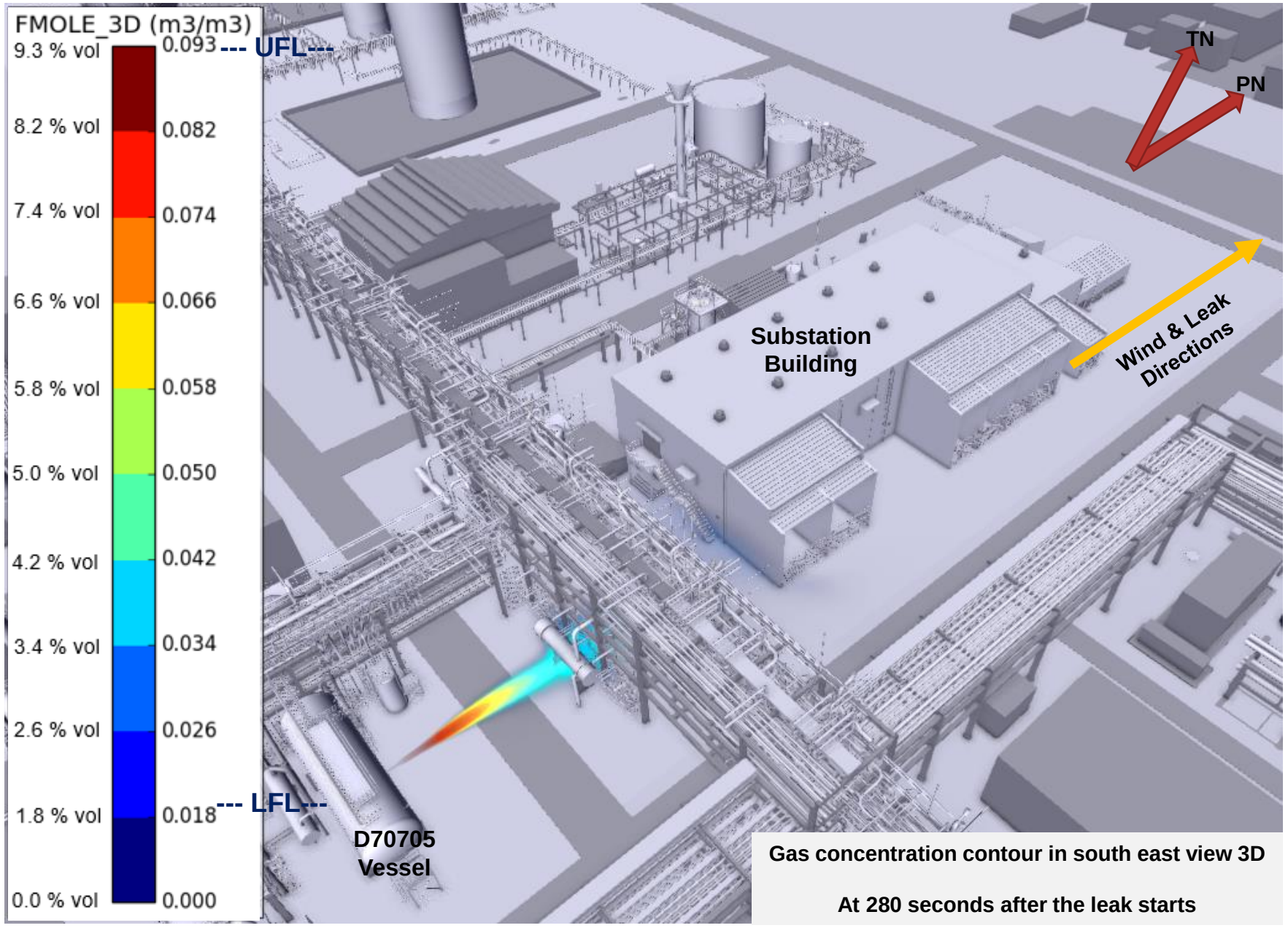
Sample of Dispersion Simulation Results in PTT GSP1

Case 2

Flammable Gas Concentration

Dispersion Simulation Result Sample:
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

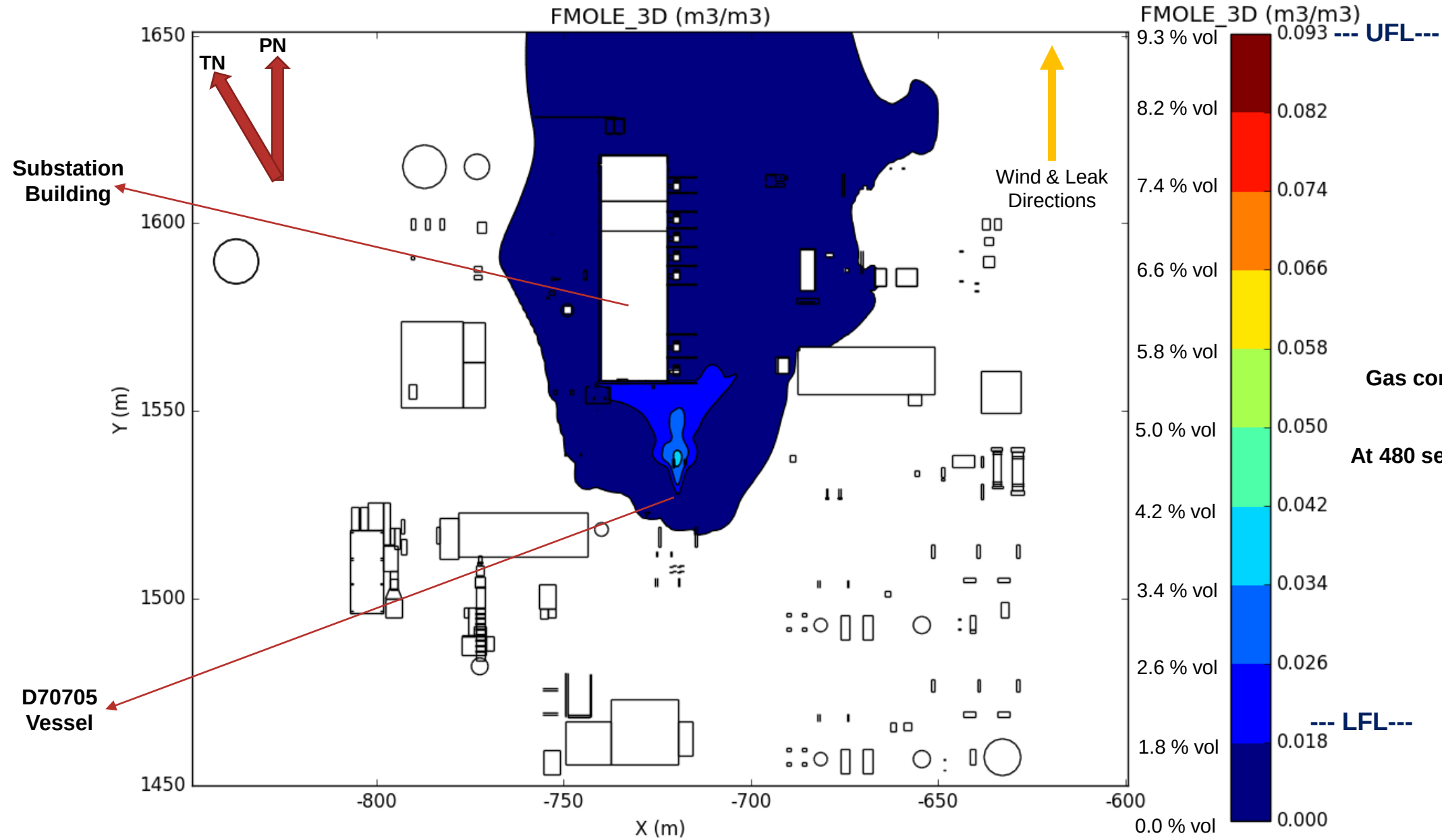


Gas concentration contour in south east view 3D

At 280 seconds after the leak starts

Dispersion Simulation Result Sample:
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

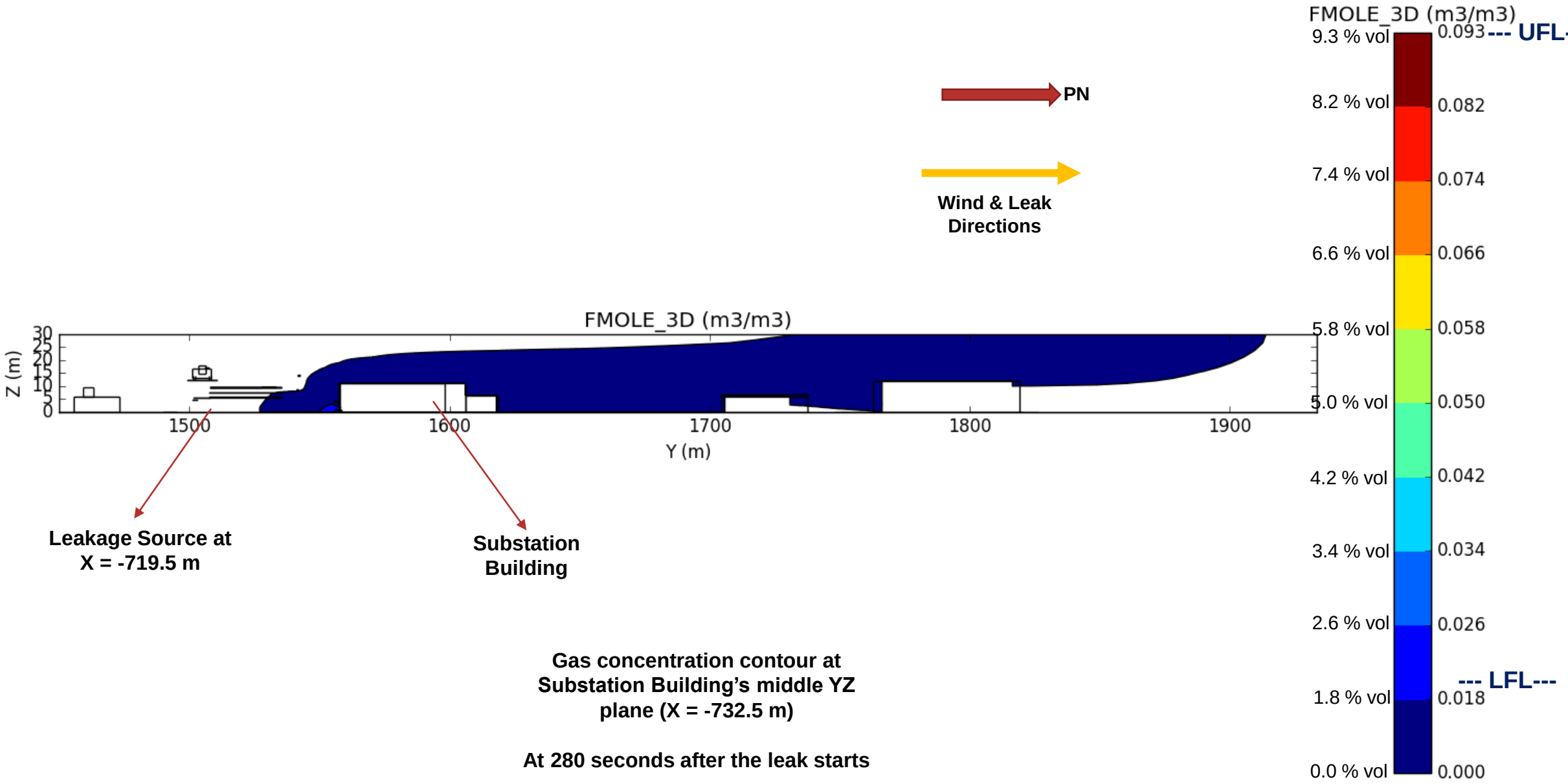


Gas concentration contour at el. 1.5 m

At 480 seconds after the leak starts

Dispersion Simulation Result Sample:
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

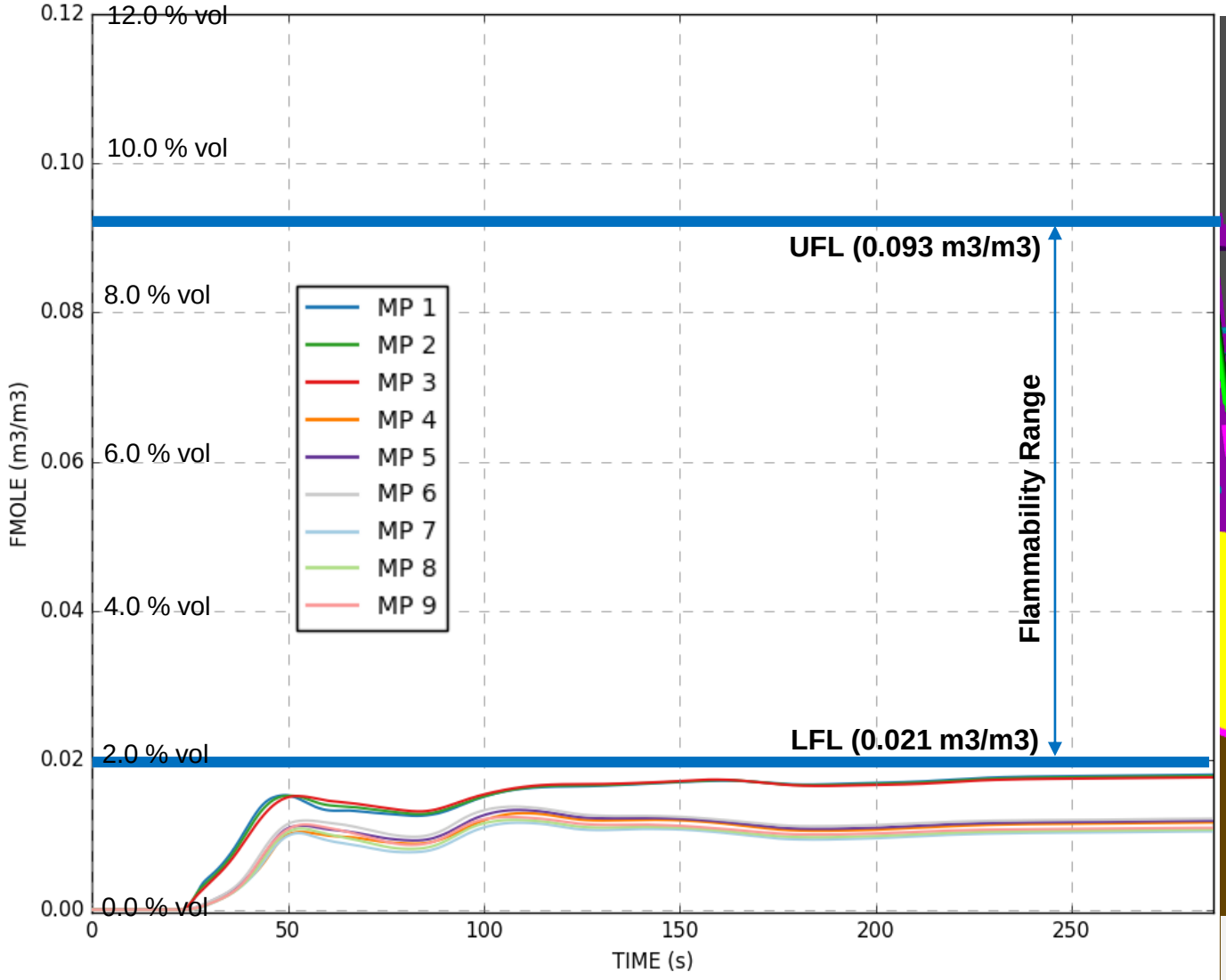


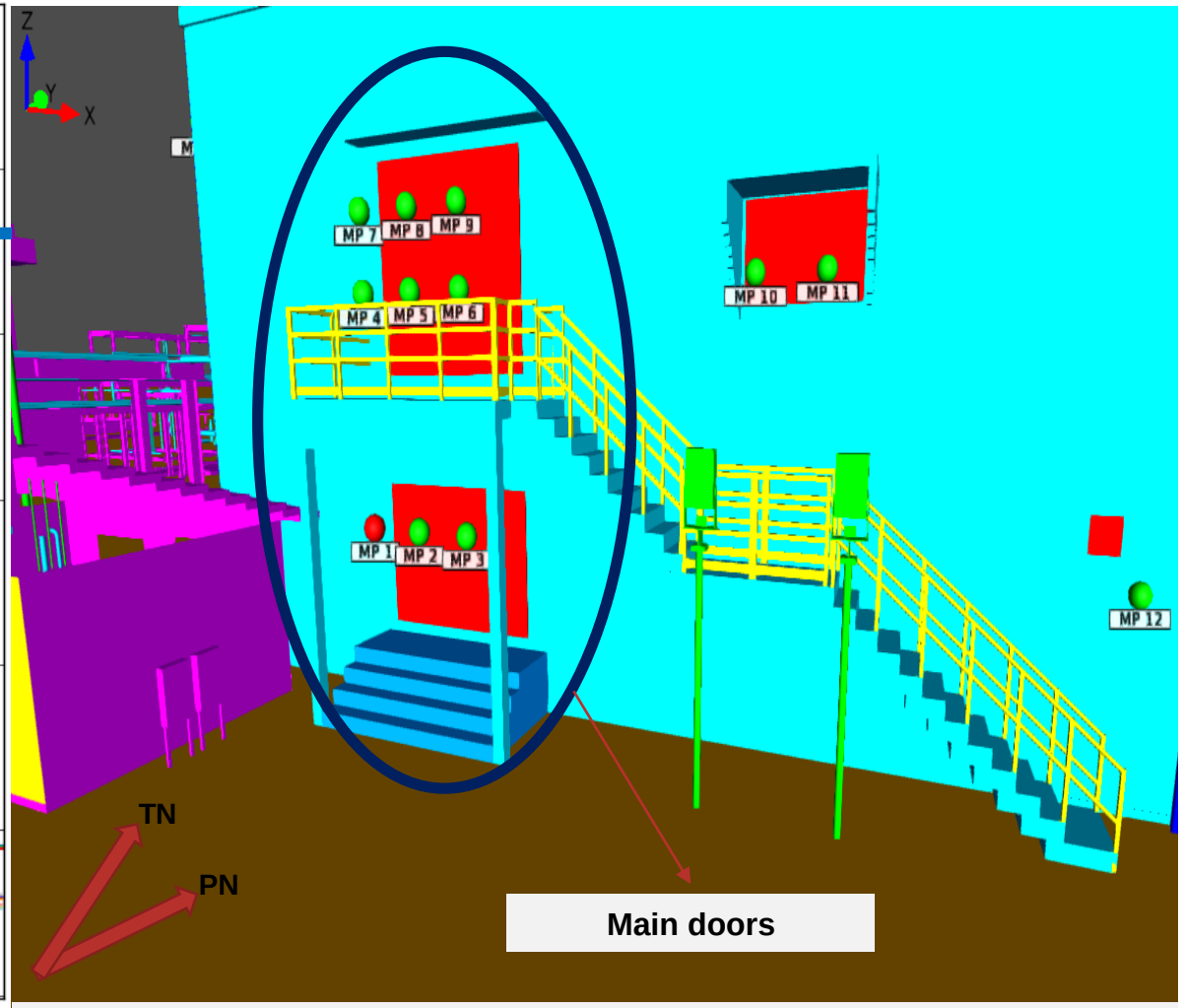
Gas concentration contour at Substation Building's middle YZ plane (X = -732.5 m)

At 280 seconds after the leak starts

Monitor Points (FMOLE) Reading at Southern Substation's Main Doors
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

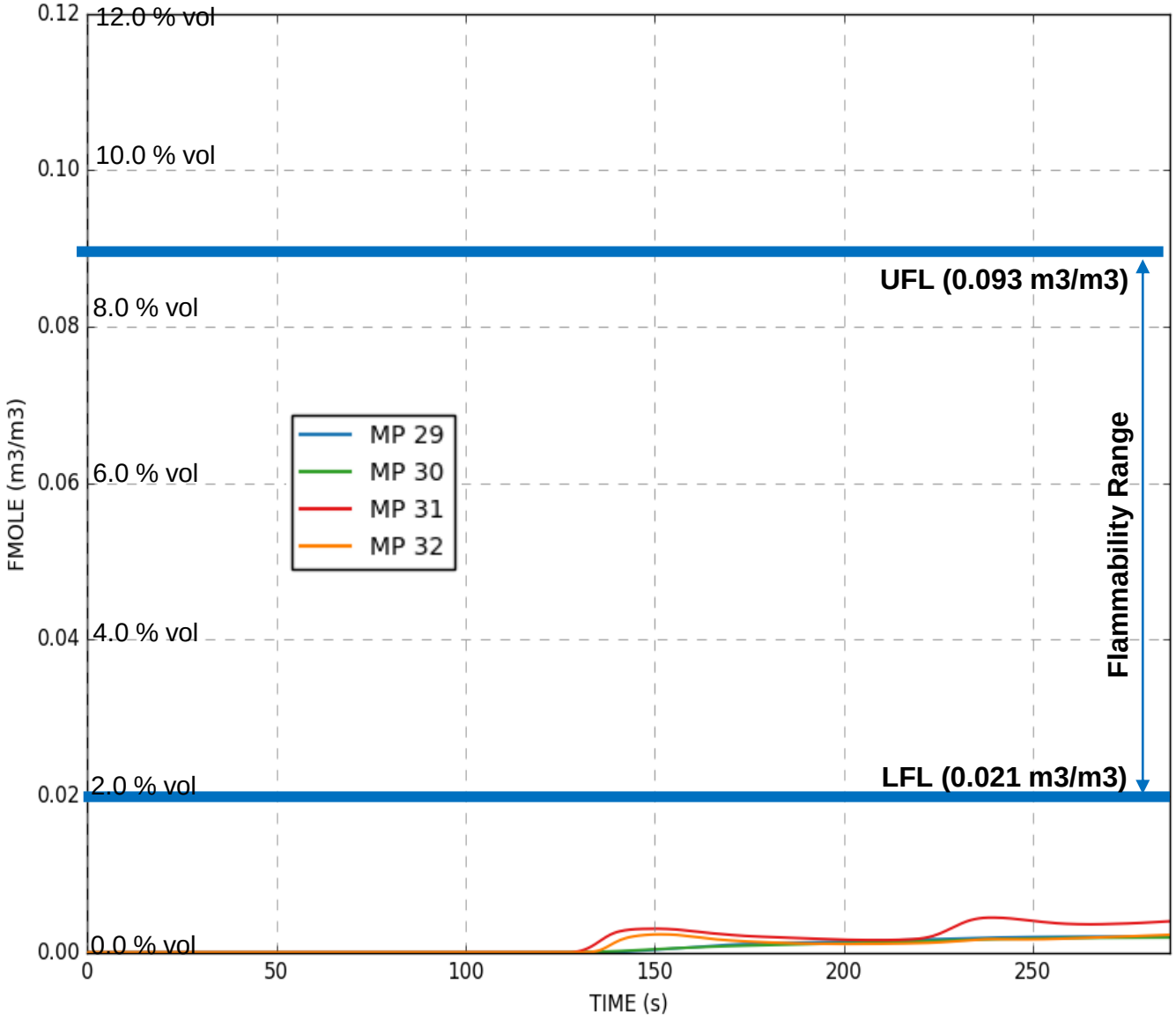


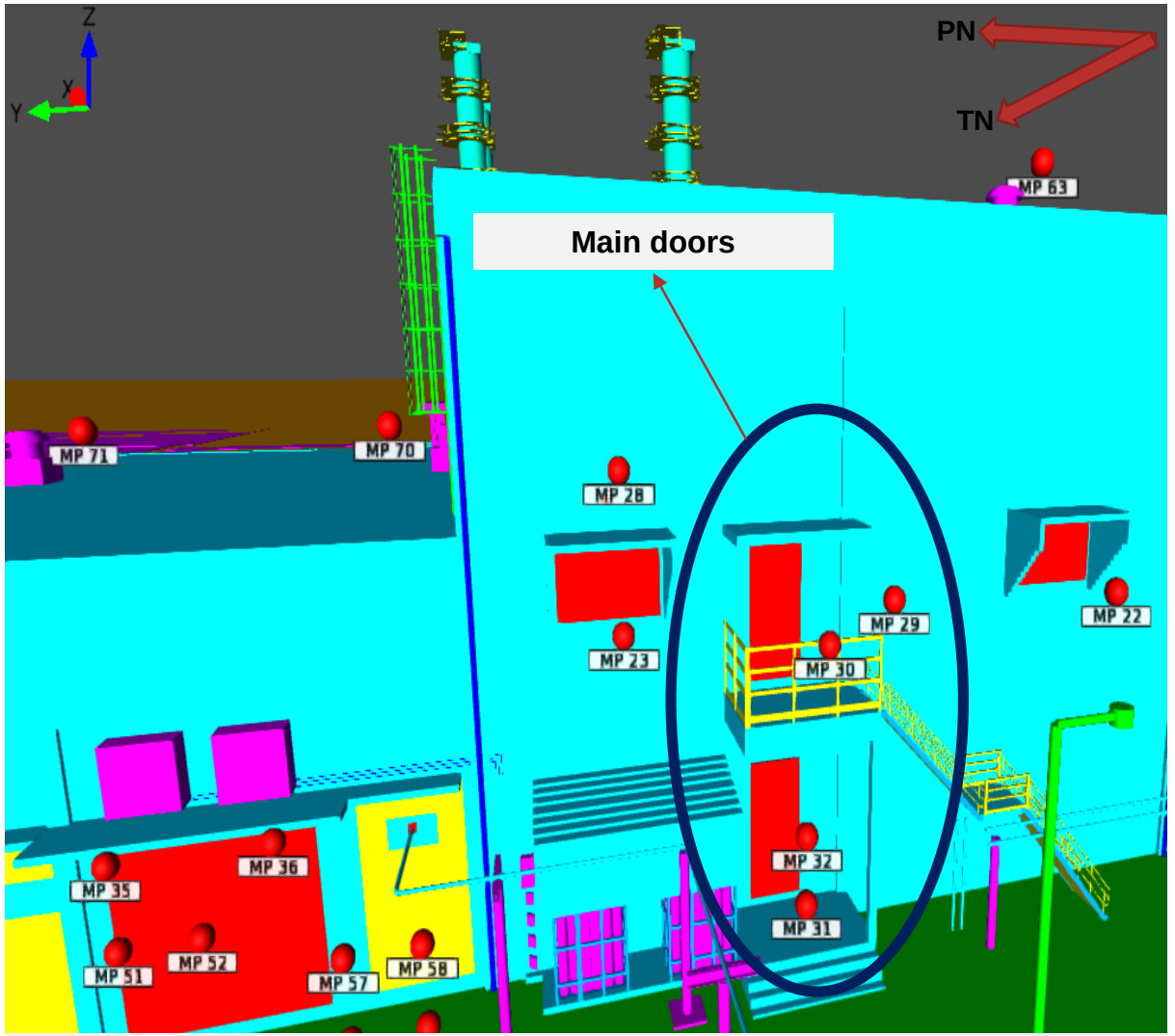


Gas concentration measurement nearby the main doors is depicted on the left graph

Monitor Points (FMOLE) Reading at Western Substation's Main Doors
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON





Gas concentration measurement nearby the main doors is depicted on the left graph

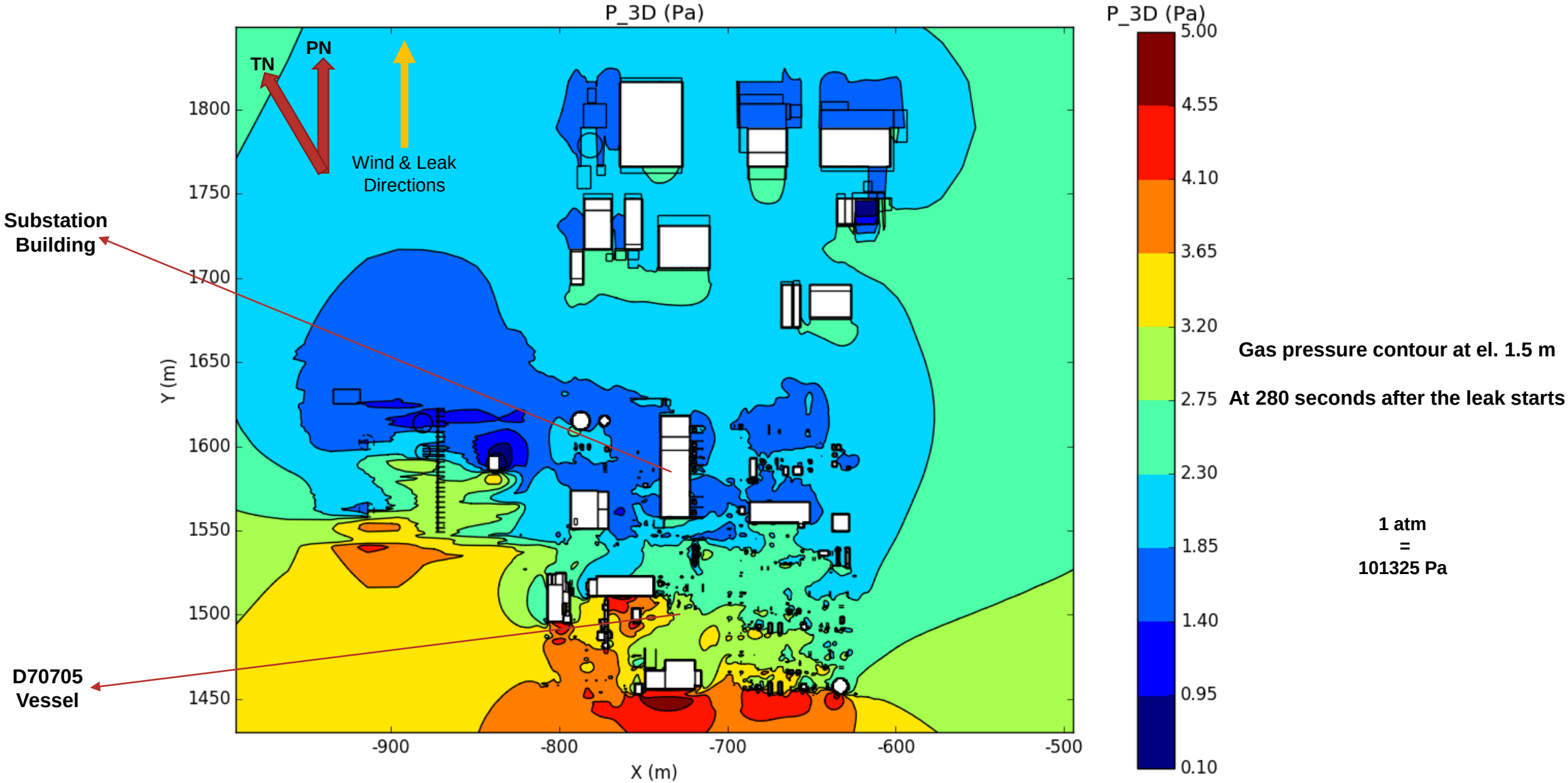
Sample of Dispersion Simulation Results in PTT GSP1

Case 2

Flammable Gas Pressure

Dispersion Simulation Result Sample:
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON



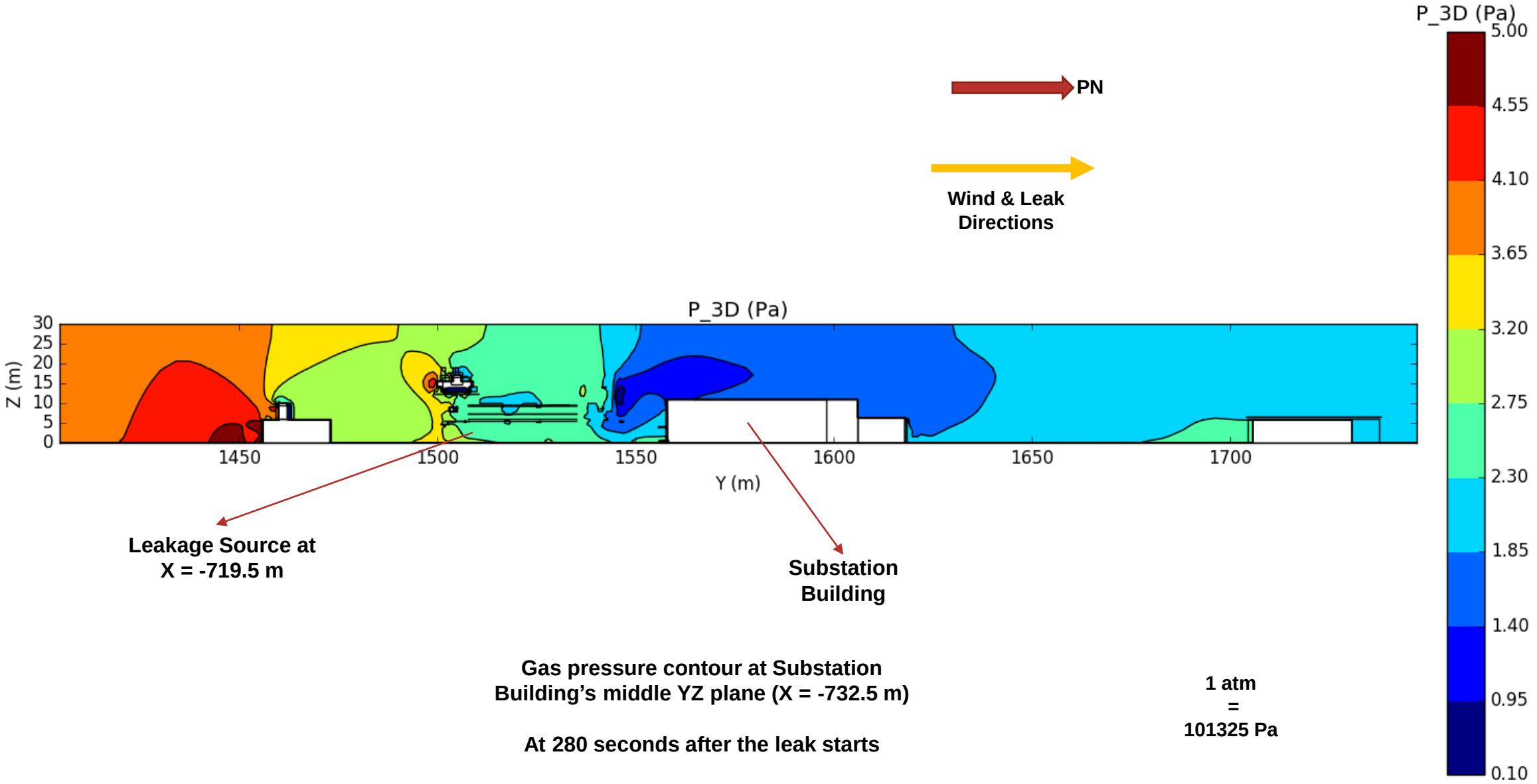
Gas pressure contour at el. 1.5 m

At 280 seconds after the leak starts

1 atm = 101325 Pa

Dispersion Simulation Result Sample:
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON



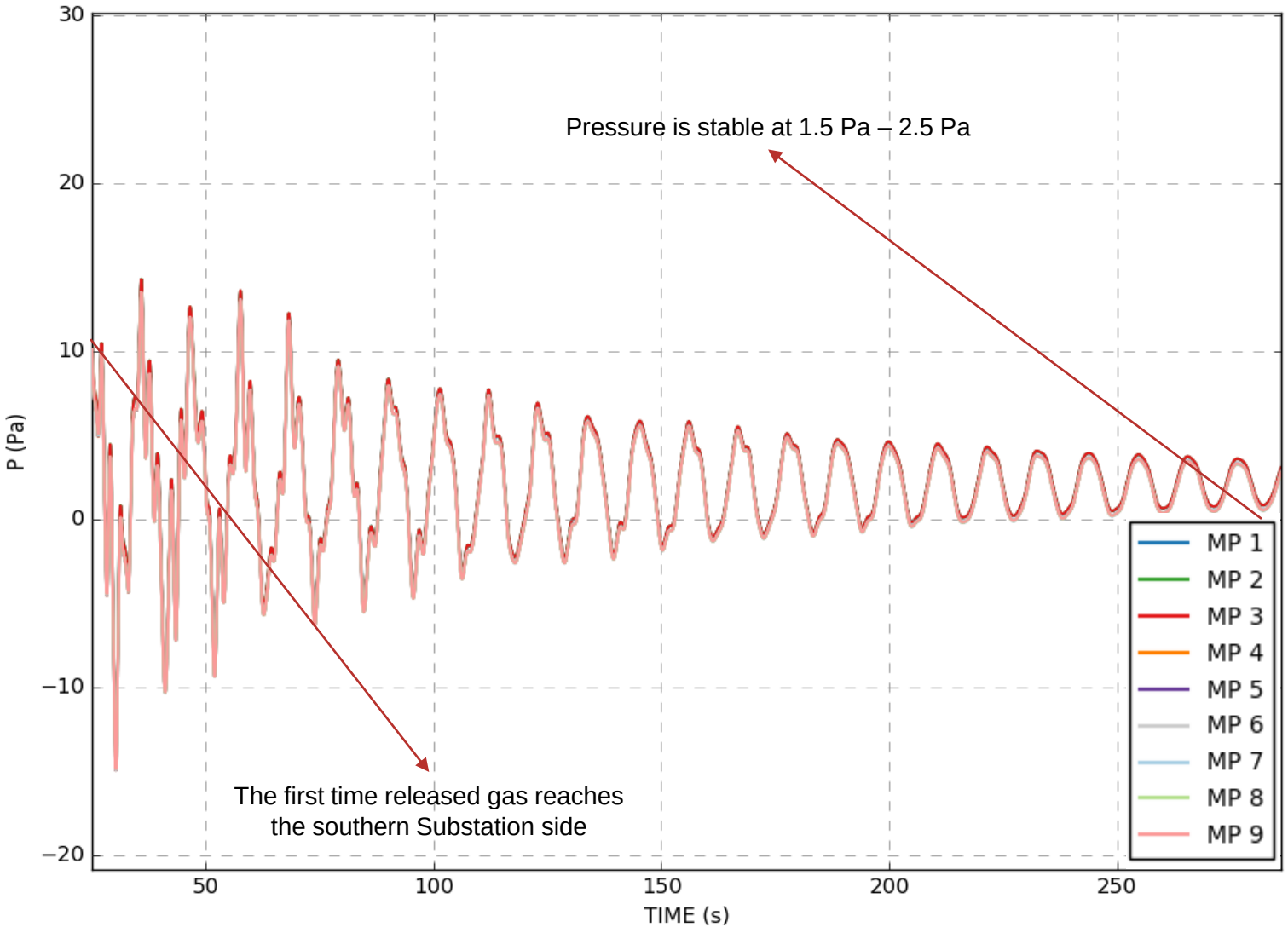
Gas pressure contour at Substation Building's middle YZ plane (X = -732.5 m)

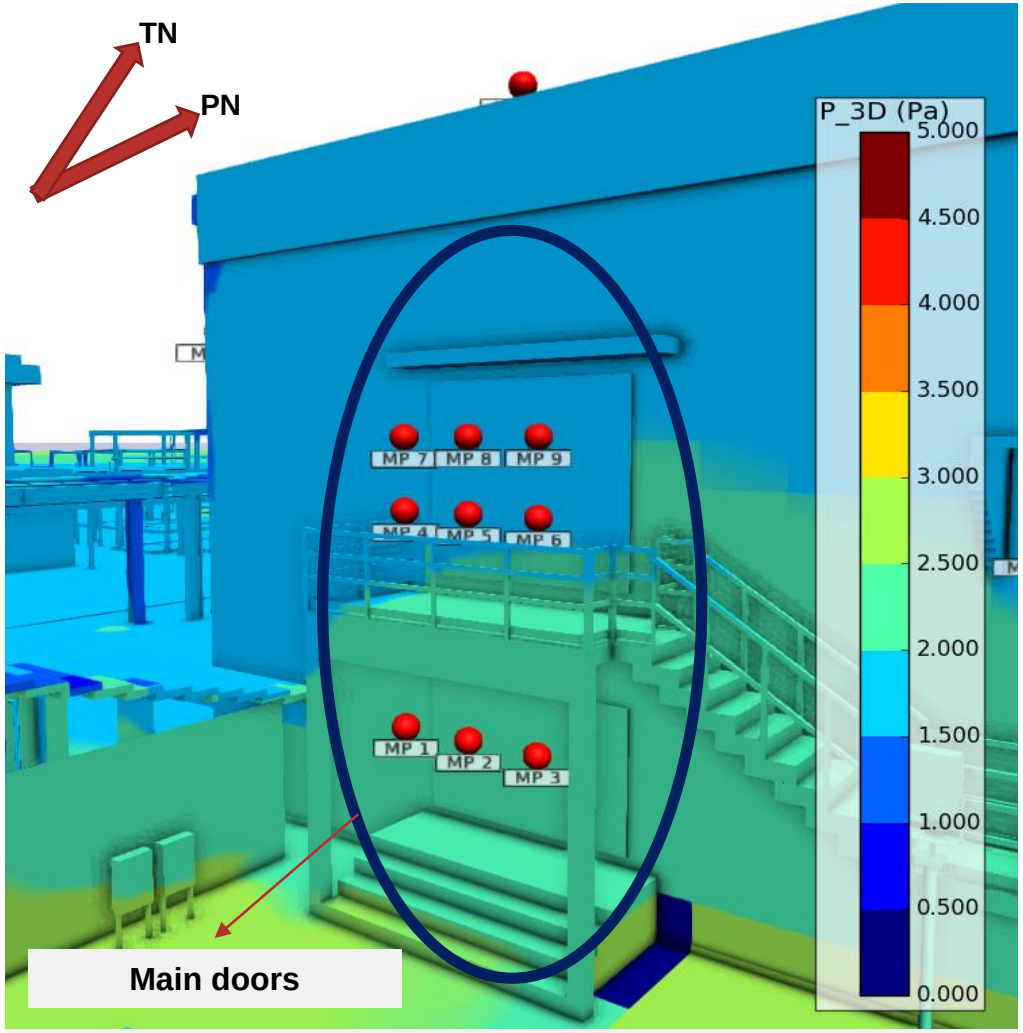
At 280 seconds after the leak starts

1 atm = 101325 Pa

Monitor Points (P) Reading at Southern Substation's Main Doors
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

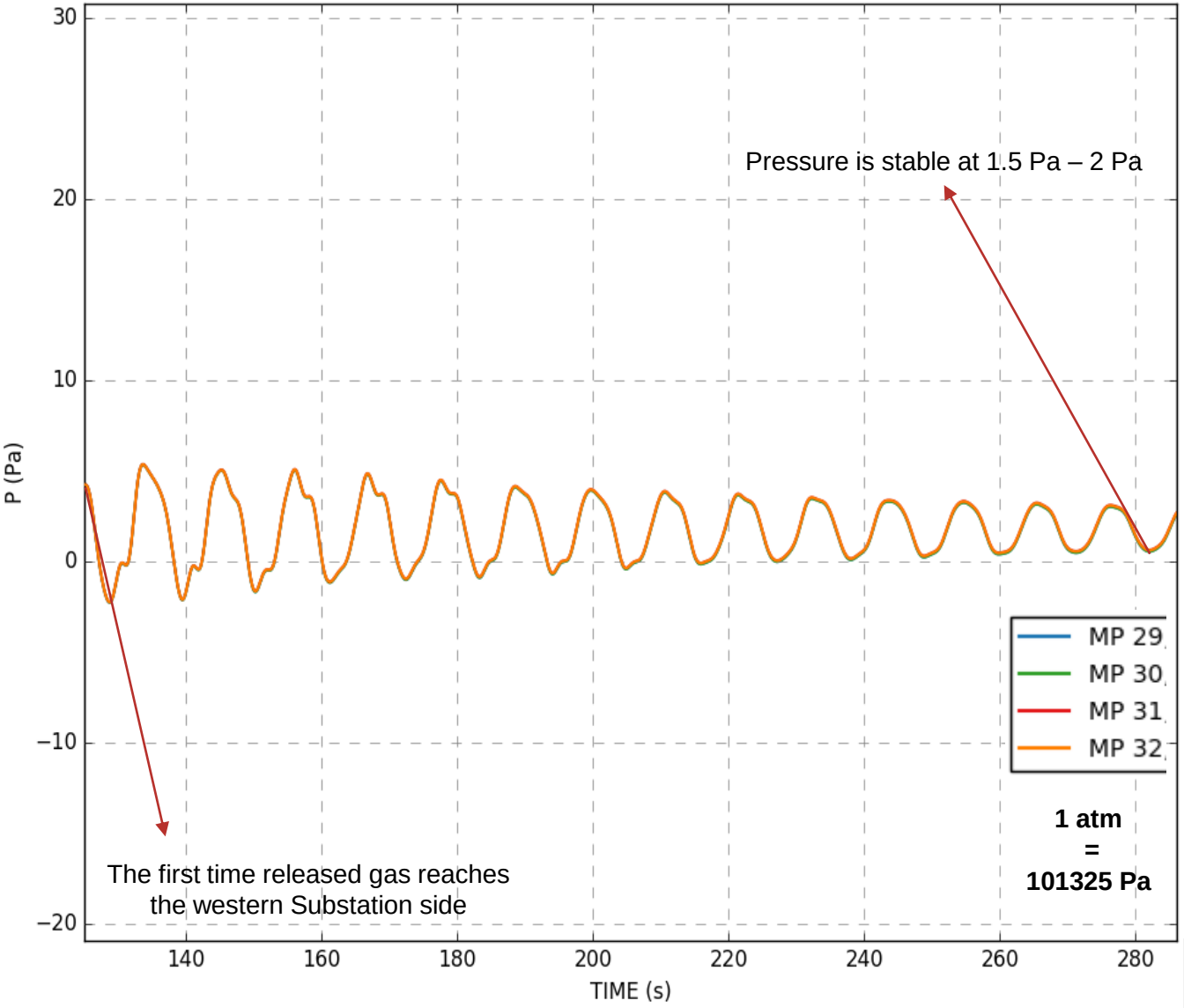


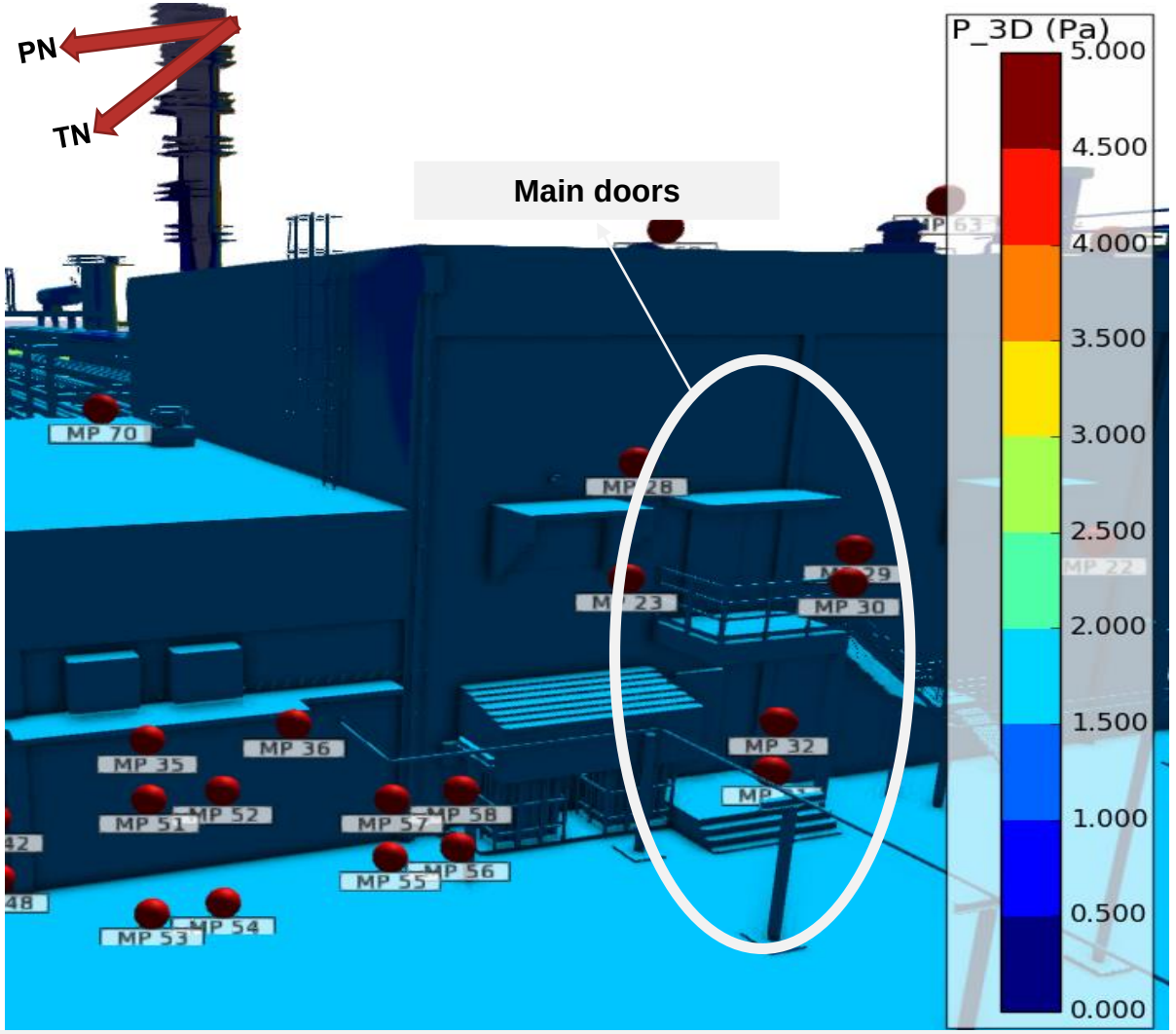


Gas pressure contour at 280th second after leaks.

Monitor Points (P) Reading at Western Substation's Main Doors
GSP 1 – Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON





Gas pressure contour at 280th second after leaks.

General Discussion

PTT GSP 1 Dispersion Study General Discussion: Wind Speed 2.0 m/s – Leak Hole ½ inch

- The gas concentration spread within the area for this case doesn’t exceed the LFL.
- For both locations, the average pressures after the released gas reaches the intended openings are below 3 Pa.
- It can be said that for this case, the gas dispersion phenomena doesn’t contribute significantly to Substation environment’s pressure change. (Ref: 1 atm = 101325 Pa).
- Note that other cases of dispersion may not be typical with this study. Variables such as geometry, atmospheric condition, and leakage scenario contribute to the spreading behaviour.

Recommendation

PTT GSP 1 Dispersion Study Recommendation: Wind Speed 2.0 m/s – Leak Hole ½ inch

GEXCON

Based on NFPA 496-2003: Purged and Pressurized Enclosures for Electrical Equipment in section 7.4 (Requirements for Positive Pressure Air Systems), the recommendations for this study shall be as following below.

> (1) Maintain a pressure of at least **25 Pa** (0.1 in of water) in the control room with all opening closed,
> (2) Provide a minimum outward velocity of **0.305 m/sec** (60ft/min) through all openings capable of being opened. The velocity shall be measured with all these openings simultaneously open, and a drop in pressure below the 25 Pa specified in 7.4.1 (1) shall be permitted while meeting this requirement.

Also, it is stated in IEC 79-13 First Edition 1982 section 6.2 that:

> A minimum overpressure of 25 Pa (0.25mbar) with respect to the outer atmosphere should be maintained at all points inside the room and its associated ducts at which leaks are liable to occur, all doors and windows being closed.

Since the average stable pressure generated by dispersion in this study is around 3 Pa, the minimum positive pressure suggested by the standard is expected to be able preventing the environment gas to get into the Substation Building during the dispersion time.

Thank You!

PT. Gexcon Indonesia

18 Office Park, 10th Floor Unit 10B, Jl. TB. Simatupang
No.18, Jakarta, 12520, Indonesia

Phone : +62 27806866
Email : indonesia@gexcon.com