

# CONSEQUENCE ASSESSMENT OF LOC

Appendix 1 shows and explains the effects of different LOC scenarios from a low pressure pipeline: aboveground, underground, at a waterway crossing and in a tunnel. For each LOC scenario the maximum concentration profile has been calculated and for most scenarios also the lethality footprint.

The maximum concentration profile shows a side view of the maximum concentration distances. For all scenarios three concentrations are displayed: the alarm value, the 1% lethality and the 100% lethality concentration (see also Paragraph 2.1.2). It is important to note that the lethality concentrations are derived from a 30 minutes exposure time and that the maximum concentration distances are not sustained for such a long time.

Therefore, the lethality footprint is displayed containing the 1%, 10% and 100% lethality contours. Safeti-NL calculates the lethality of a certain LOC scenario by calculating the dose at a location and using the CO<sub>2</sub> probit function. The dose is a combination of concentration and exposure time. The lethality contours are always smaller than the maximum lethal concentration.

The consequence assessment will only look at the *effects* of the different LOC scenarios (so assuming it will happen) and does not take into account the *probability* of a LOC (is it likely to happen).

Table 7-3 summarizes the results of Appendix 1. It shows the effect distances for the different LP scenarios.

**Table 7-3:** Effect distances LP pipeline scenarios

| Location          | Scenario | Distance 50,000 ppm (m) |      | Distance 1% lethality (m) |      |
|-------------------|----------|-------------------------|------|---------------------------|------|
|                   |          | F1.5                    | D5   | F1.5                      | D5   |
| Aboveground       | Rupture  | 140                     | 130  | 90                        | 83   |
|                   | Leak     | 17                      | 15.5 | 15.5                      | 14   |
| Underground       | Rupture  | <1.5                    | <1.5 | <1.5                      | <1.5 |
|                   | Leak     | <0.5                    | <0.5 | <0.5                      | <0.5 |
| Tunnel            | Rupture  | 420                     | 245  | 370                       | 135  |
| Waterway crossing | Rupture  | 440                     | 186  | 380                       | 155  |
|                   | Leak     | 22                      | 14   | <1                        | <1   |

### 7.4.1 Conclusion consequence results

In this section the consequences, concentration and lethality, have been calculated for different LOC scenarios of a low pressure pipeline: aboveground, underground, crossing a waterway and tunnel pipeline.

- Dangerous CO<sub>2</sub> concentrations (50,000 ppm) at ground level due to a LOC of an underground pipeline are minor because the CO<sub>2</sub> jet is directed

vertically and the CO<sub>2</sub> concentration is quickly diluted before reaching the ground again.

- Dangerous CO<sub>2</sub> concentrations (50,000 ppm) at ground level due to a LOC of an aboveground pipeline can reach up to 140 meters and the 1% lethality contour reaches 90 meters.
- Although the release of a LOC of a pipeline in a tunnel or crossing a waterway is directed vertically, as for the underground pipeline, dangerous CO<sub>2</sub> concentrations (50,000 ppm) at ground level can reach up to 420 meters for a pipeline in a tunnel and 440 meters for a waterway crossing. This is caused by the loss of momentum of the jet which lowers the air entrainment and thereby lowers the dilution of CO<sub>2</sub>. The 1% lethality contour for a pipeline in a tunnel reaches 370 meters and 380 meters for a waterway crossing.

Source: <http://hub.globalccsinstitute.com/publications/co2-liquid-logistics-shipping-concept-llsc-safety-health-and-environment-she-report/74>