

Leakage of a hydrogen-pipeline due to an inadequate inspection philosophy

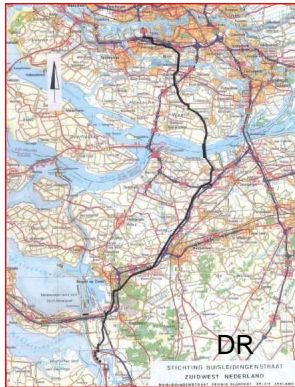
12 October 2007

Binnenmaas (South Holland)

The Netherlands

Leak
Pipeline
Hydrogen
Cathodic Protection
Stressing factors
Inspection

THE FACILITIES INVOLVED



The site:

The Netherlands Pipeline Corridor (location of the accident: 300 metres from the village of Heinenoord (municipality of Binnenmaas) in the province of South Holland).

The involved unit:

A pipeline, transporting pressurized hydrogen gas (75 bar, 6 inch, steel) from Antwerp (Belgium) to Rotterdam (the Netherlands). The leakage occurred at a location at which the pipeline entered a building and contained a “CP coupling” (a device to interrupt the cathodic protection).

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:



D.R.

corridor. The ignition resulted in a small fire on top of the soil covering several existing pipelines transporting several types of gases.



D.R.

The investigation, as carried out by the Inspectorate of the Ministry for the Environment, has provided evidence that an underground pipeline, in which hydrogen gas is transported, developed a leak resulting in an escape of hydrogen gas. The leakage lasted for at least several hours but it can not be excluded that the leakage started weeks or even months prior to the discovery of the leak.

The leak occurred at a specific “weak spot” in the pipeline in which tensions could mount, resulting in the partial failure of a so-called “CP coupling”.

The escaping hydrogen gas was ignited on the 12th October 2007 by welding activities which at that time were taking place in the vicinity of the leak as part of a construction project to add another pipeline in the

Because of the fact that at the start of the accident it was unclear what the nature of the escaping gas was several precautionary measures were taken by the police and the fire brigade. The inhabitants of the village nearby were advised to stay indoors for about three hours. Busy traffic on a nearby waterway to and from the Rotterdam harbour area was halted for several hours. After the conclusion that it was a hydrogen release and fire restrictions were lifted.

Although the transport of hazardous substances by pipeline along the route of the pipeline corridor is considered to be a safe means of transport, and the management of the pipeline corridor is meticulous, deficiencies in that management have been identified, mainly in the way supervision is carried out during construction activities in the corridor.

Consequences of the accident:



Given the fact that hydrogen gas is not toxic, and that a limited gas escape and fire were concerned, there has been no imminent danger to people living nearby.

Nevertheless, the incident has been classified as serious, because the gas escape could have been more extensive, and other transport pipelines that were lying nearby might have developed leaks for the same reason, which might have caused the release of poisonous gases.

The European scale of industrial accidents

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the 'SEVESO II' directive on handling hazardous substances, and in light of the information available, this accident can be characterised by the four following indices:



Dangerous materials: At least 8.4 kilograms of hydrogen have escaped during the period at which the leakage was noticed, which lasted about 7 hours. Maybe the leakage has started even weeks of months earlier. It has not been possible to identify the start of the leakage suggesting that the amount of hydrogen released is probably in excess of 50 kilograms (Seveso threshold between 0.1% and 1% - Parameter Q1).

Human and social consequences :All inhabitants of the village of Heinenoord (3 400 people) were advised to stay indoors during 2.45 hours. ('Parameter H7')

Environmental damage: None because of the nature of the escaping hydrogen.

Economical damage: No serious estimate about the cost of the property damage has been made by anyone but the damage can be estimates at least 1 million Euros. ('Parameter €16')

The parameters composing these indices and their corresponding rating protocol are available from the following Website: <http://www.aria.developpement-durable.gouv.fr>

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THE ACCIDENT



The leakage was caused by a mix of several tension factors executed on the hydrogen pipeline. The predominant stressing factor was the gradual settlement of the pipeline and the earth surrounding it. The settlement took place over a time span of several years and resulted in the bending of the pipeline at a spot where the pipeline got stuck on a fixed structure, e.g. a feed through in which the pipeline enters a building. The bending forces caused tensions on the CP coupling nearby in the pipeline, which eventually started to leak.

Other stressing factors that might have contributed to the occurrence of the accident were unallowed heavy traffic and the placement of heavy equipment on the soil covering the pipeline.

The investigation has identified at least four supervising bodies that in some way or another were responsible for inspections with regard to the safety of the pipelines in the corridor. It were inspectors from the foundation, inspectors from the separate pipeline owners, inspectors from the consortium that carried out the construction works when the accident occurred and last but not least a notified body that was hired to inspect safety aspects of the construction of the new pipeline. The Inspectorate of the Ministry for the Environment concluded that these inspection activities were not well coordinated and that they resulted in a situation in which

inspectors did not feel responsible for overall safety. The inspectors all assumed that “the other inspection bodies” would do the inspections they did not do.

The accident has caused a lot of concern under the people living nearby the pipeline corridor and generated discussions in Dutch parliament and the local counsel of Binnenmaas.

ACTIONS TAKEN

Immediate actions: Repairing the pipeline, checking pipelines with similar constructions and tightening supervision during activities in the pipeline corridor.

Long term actions: Revising technical and procedural safeguards against the stressing of pipelines.

LESSONS LEARNT

Specific lessons (mostly of a technical nature):

- Criteria had to be established for the quality of CP couplings in pipelines and the installation and maintenance conditions associated with them in order to safeguard that the couplings are not exposed to any type of stress during their operational lifetime.
- Policies with regard to the measurement and interpretation of ground settlement had to be reassessed.
- A strict surveillance policy had to be developed to prevent infringements on rules regulating activities on top of pipelines in order to prevent the possible damage of these pipelines.

General lesson (of a organisational nature):

- An abundant series of supervisors and inspectors on a project does not necessarily mean that the essential requirements to safeguard a safe environment are met. On the contrary, one might conclude.
- All parties involved in the management of the pipeline corridor (the management of the foundation as well as all individual pipeline operators) had to redefine supervision and inspection policies in order to get a clear division between each other’s tasks and responsibilities, particularly during construction activities in the pipeline corridor. The additional supervisory role of external parties, like “notified bodies” and “independent supervisors” had to be included in this survey of responsibilities.

