

QRA Steenfabriek De Rijswaard

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Project: Steenfabriek De Rijswaard
 Locatie: Aalst Gld
 Betreft: Externe veiligheid propaantank

1 Inleiding

Steenfabriek De Rijswaard, gelegen aan De Rijswaard 2 te Aalst is voornemens om een propaantank met een inhoud van 100 m³ te plaatsen.

Deze activiteit valt onder het Besluit externe veiligheid inrichtingen (Bevi). In verband daarmee is een kwantitatieve risicoanalyse (QRA) uitgevoerd.

2 Situatie

Voor de QRA bij Steenfabriek De Rijswaard zijn wij uitgegaan van de volgende situatie en uitgangspunten:

- Omvang tank: 100 m³, max. 90% gevuld.
- Doorzet 6 tankwagens per week, ofwel 6 x 52 x 26.700 kg = 8.330 ton propaan per jaar.
- Locatie tankwagen: zie blauw; op 10 m van gebouwen.
- Locatie van de tank: zie onderste blauwe rechthoek.
- Het vulpunt bevindt zich op de tank.
- De tank zal voorzien worden van een elektrische verdamper en het gaas zal met een kunststof leiding onder de weg door en dan door een stalen leiding in de fabriek verder lopen tot een punt waar deze aansluit op het bestaande leidingnet.
- Opstelplaats van de tankwagen: zie bovenste blauwe rechthoek;
- Informatie over de leiding van de propaantank naar de fabriek:
 - diameter leiding (3", 76,2 mm);
 - ondergrondse ligging;
 - propaan in gasfase (via verdamper) op 2 bar (geen pomp).

In de omgeving ligt een betonbedrijf op 200 m en lintbebouwing (woningen en bedrijfsgebouwen) op 425 m en 700 m. Op 800 m ligt de kern van Aalst.



3 Normering en toestemmingen

3.1 Wettelijke normering externe veiligheid

Begrenzing en normering in wettelijke regels

Bij elke risicovolle milieubelastende activiteit en bij nieuwe ruimtelijke ontwikkeling nabij een risicovolle activiteit moeten de effecten in de omgeving van mogelijke ongevallen worden getoetst aan de normen voor het plaatsgebonden risico en het groepsrisico. Deze normen die hieronder kort worden beschreven, liggen vast en worden toegepast in het kader van het Besluit externe veiligheid inrichtingen (Bevi). Het Bevi wijst activiteiten aan en bevat regels voor milieu en ruimtelijke ordening die gelden voor het bevoegd gezag (niet direct voor het bedrijf).

Op basis van de Europese Seveso-richtlijn geldt het Besluit risico's zware ongevallen 2015 (Brzo) voor zeer grote hoeveelheden gevaarlijke stoffen in fabrieken e.d. De bedoeling van Seveso/Brzo is om grote milieuvervuiling in de omgeving en het oppervlaktewater te voorkomen. In de Seveso-richtlijn zijn drempelwaarden opgenomen, waarboven een expliciet veiligheidsbeleid moet worden gevoerd (lage drempel) of daarnaast ook een uitgebreide veiligheidsrapportage wordt opgesteld met de ingrediënten voor adequate rampenbestrijding door de Veiligheidsregio (hoge drempel).

Voor propaan geldt een lage-drempelwaarde van 50 ton. Bij een propaantank van 100 m³ en een 90% vulling is er een maximale hoeveelheid van 90.000 liter x 0,51 kg/liter = 45.900 kg. Dit blijft dus onder de lage drempelwaarde. Gelet op de grote doorzet kan ervan worden uitgegaan dat een tankwagen (60 m³, 80% vulling ofwel 26.700 kg propaan) de locatie in principe alleen bezoekt als de tank zover leeg is dat alle lading past. Dat betekent dat de totale hoeveelheid propaan die aanwezig is altijd onder 50 ton blijft. Het Brzo is daarmee niet van toepassing (los van het feit dat propaan geen aanleiding kan geven tot grote milieu- of oppervlaktewatervervuiling).

Risiconormering

Plaatsgebonden risico (PR): Als "harde" afstandseis tot kwetsbare objecten zoals woningen geldt een norm voor het plaatsgebonden risico (PR). Voor gevaarlijk stoffen is deze grenswaarde $PR = 10^{-6}$ per jaar; de kans om op een bepaalde plaats dodelijk getroffen te worden door een ongeluk met een gevaarlijke stof mag maximaal 1 keer per 1 miljoen jaar bedragen.

Groepsrisico (GR): Binnen het invloedsgebied van een risicovolle activiteit (de afstand tot waar de dodelijke effecten van ongevallen reiken) moet de kans worden nagegaan voor het aantal mensen dat gelijktijdig het dodelijk slachtoffer kan zijn. Het berekende groepsrisico wordt vergeleken met een oriënterende waarde.

De hoogte van het GR moet in een bestuurlijke afweging worden verantwoord, dat wil zeggen de mogelijke gevolgen bij een ongeluk met een groter aantal mensen wordt vergeleken met de mogelijkheden van de hulpdiensten in de regio, en er wordt nagegaan welke maatregelen gewenst

of nodig zijn om het groepsrisico te beperken. De veiligheidsregio brengt advies uit over de beoogde plannen en de mogelijke maatregelen om het groepsrisico te verminderen.

Het gebied waar ongevalsscenario's mogelijk dodelijke effecten kunnen opleveren wordt het invloedsgebied genoemd (begrensd door de lijn waarbuiten minder dan 1% overlijdt). Bij de inrichting van het plangebied worden (zeer) kwetsbare functies (bijv. met minder zelfredzame personen) of hoge populaties dichtbij de risicobronnen bij voorkeur vermeden. "Bijzonder kwetsbare objecten" zijn objecten bedoeld voor verminderd zelfredzame personen. Voorbeelden van "bijzonder kwetsbare objecten" zijn basisschool, kinderdagverblijf, verzorgingstehuis, ziekenhuis enz. Het potentiële aantal dodelijke slachtoffers en gewonden kan daarmee zoveel mogelijk worden beperkt. Deze mogelijkheden en keuzes worden meegenomen met de verantwoording van het groepsrisico dat na deze overwegingen (en maatregelen) overblijft.

3.2 Ruimtelijke regels en milieutoestemming

Bovenstaande normering ligt voor bedrijfsactiviteiten vast in het Besluit externe veiligheid inrichting. Dit werkt niet rechtstreeks voor bedrijven, maar voor het bevoegd gezag in het kader van de Wro en de milieuregelgeving. De gemeente moet de activiteit beoordelen en zorgen dat er gevoelige objecten binnen een risicocontour worden uitgesloten. Ook moet de normering in de vergunning worden vastgelegd.



Figuur 1 Bestemmingsplan Buitengebied Zaltbommel

De geprojecteerde propaantank ligt binnen de bestemming 'Bedrijf – buitendijks', buiten het bouwvlak. In de bestemming Bedrijf worden risicovolle activiteiten expliciet uitgesloten, behoudens bestaande tanks (artikel 6.4). Voor het toevoegen van de propaantank is daarom een planologische toestemming nodig.

De paarse bedrijfsbestemming staat geen kwetsbare objecten toe. Ook de waterbestemming staat dit niet toe. Het bestemmingsplan bevat geen algemene afwijking- of wijzigingsbevoegdheid voor risicovolle inrichtingen. Er zijn geen nieuwe bedrijfswoningen toegestaan. Wel zijn 'beperkt kwetsbare objecten' toegestaan; die vanzelfsprekend bij de baksteenfabriek zullen horen (binnen de inrichting).

Gelet op de bestemmingen zal de risicocontour geen extra ruimtelijke beperkingen opleveren voor de gronden ter plaatse. Het bestemmingsplan hoeft daarvoor niet aangepast te worden. Dit betekent dat de planologische verandering, net als de milieutoestemming, via een omgevingsvergunning geregeld kan worden. Dit op voorwaarde dat de gemeente hieraan wil meewerken. Bij de aanvraag hoort een ruimtelijke onderbouwing, inclusief een verantwoording van het groepsrisico, gebaseerd op het verplichte advies van de Veiligheidsregio.

4 Scenario's en rekenmodel

4.1 Rekensoftware en populatiegegevens

Gegevens over de populatie in de omgeving zijn verkregen via de populatieservice en toegevoegd aan het rekenmodel. Voor het groepsrisico wordt bij het opstellen van de milieuvergunning de aanwezige personen van de eigen bedrijfsgebouwen niet meegenomen. In ruimtelijke besluiten wordt deze bezetting wel meegenomen. Omdat het hier ook gaat om een ruimtelijke besluit is de bezetting van de fabriek meegenomen. De populatiecijfers zijn voor de baksteenfabriek gecorrigeerd naar 50 personen en voor het naburige betonbedrijf naar 25 voor het kantoor en 40 voor de fabriek. Omdat er in ploegen kan worden gewerkt, is deze bezetting in de fabrieken voor dag en nacht gemodelleerd.

Er is gerekend met Safeti-NL, versie 8.5, en volgens de handleiding Bevi (hoofdstuk 12).

4.2 Relevante onderdelen installatie

De exacte onderdelen van de installatie zijn nog niet bekend. In bijlage II is een voorbeeld van een propaantank opgenomen. Het gaat hier om een conventionele toelevering van gasvormig propaan aan een stookinstallatie, zodat wel zeker is dat met de onderstaande scenario's meegenomen processen en installatiedelen zeker 99% van de bijdragen aan het totale risiconiveau is afgedekt.

4.3 Ongevalsscenario's

De propaantank met toebehoren, de ondergrondse leiding naar de fabriek en het vullen van de tank met een tankwagen zijn conform de Handleiding Bevi vertaald naar ongevalsscenario's. Zie tabel 1. De volgende opmerkingen zijn te maken:

- De tankwagen is in totaal 2.15 u aanwezig en aan het lossen.
- Een ontploffing van de tankwagen door externe beschadiging (zgn. koude BLEVE, boiling liquid evaporating vapour explosion) mag buiten beschouwing worden gelaten wanneer de losplaats niet voor een ieder toegankelijk is en er maatregelen getroffen zijn tegen externe beschadiging (m.n. aanrijding). Het bedrijf treft maatregelen om externe beschadiging te voorkomen (ontoegankelijkheid terrein, tijdens laden/lossen ter plaatse geen ander transport). De afstand tussen de losplaats en brandbare opslagen, gebouwen en andere oorzaken van een externe is zodanig (> 10 m) dat een brand in de omgeving is uitgesloten. De scenario's op een grote explosie van de tankwagen als gevolg van brand in de omgeving of beschadiging is uitgesloten door de gekozen opstelling van de tankwagen en het uitsluiten van transport rond dit terrein deel tijdens het lossen door de tankwagen. Alleen de warme BLEVE door opwarming van de tankwagen na ontsteking van de fakkel uit de eigen aansluiting van de losslang is wel meegenomen.
- Volgens de handleiding hoeft de verdamper niet apart te worden gemodelleerd (de verdamper zou worden gemodelleerd als de breuk van 10 pijpen tegelijkertijd met een kleine diameter; de hoeveelheid en het tempo van die vrijkomen is gering en levert geen relevante bijdrage het externe risico).
- Tussen opslagtank en verbrandingsinstallatie is geen pomp gemodelleerd. De diameter van de leiding (76,2 mm) en druk (2 bar) is groot genoeg om het proces te voeden.
- De leiding vanaf de tank naar de fabriek is conform de handleiding gemodelleerd als een korte leiding (short pipe). De verhouding tussen lengte 45 en diameter 0,0762 L/D is nl. lager dan 1.000. Ofwel $45 / 0,0762 = 590$.
- De faalkans van de doorstroombegrenzer bij het lossen is gesteld op 0,06 (uitstroomdebiet > $1,2 \times \text{instelwaarde}$).

Tabel 1 Scenario's voor de risicoberekening

Scenario	Naam Scenario	Coord. X	Coord. Y	Massa propaan	Volume propaan	Temperatuur	Overdruk (bar)	Hoeveelheid / debiet	Duur scenario	Lengte of factor	Duur activiteit	Standaard-frequentie	Totale Kans
		m	m	kg	m ³	°C	bar	kg, kg/s	sec.	m, #	uur	/j, /u/j of /i/jaar	
Scenario's tank	TW.1 Instantaan	138027	420042	26.700	51,8	9	5,18	26.700	0,0	312	2,25	5,00E-07	4,01E-08
Scenario's tank	TW.2 Vrijkomen via grootste aansluiting	138027	420042	26.700	51,8	9	5,18	26.700	0,0	312	2,25	5,00E-07	4,01E-08
Scenario's do	Standalone B.1 BLEVE brand verlading 100%	138027	420042	26.700	51,8	9	5,18	26.700	0,0	312	2,25	5,00E-10	3,51E-07
Scenario's fal	L.1 breuk losslang doorstroombegrenzer sluit	138027	420042	42	0,08	9	5,18	8,4	5,0	312	2,25	3,76E-06	2,64E-03
Scenario's fal	L.2 breuk losslang doorstroombegrenzer sluit niet	138027	420042	26.700	51,8	9	5,18	8,4	1.800,0	312	2,25	2,40E-07	5,40E-07
Scenario's fal	L.3 lek losslang	138027	420042	26.700	51,8	9	5,18	0,3	1.800,0	312	2,25	4,00E-05	9,00E-05
Scenarios fale	R.1 reservoir - Instantaan falen	138022	420003	46.398	90	9	5,18	46.398	0,0			5,00E-07	5,00E-07
Scenarios fale	R.2 reservoir - 10 minuten	138022	420003	46.398	90	9	5,18	46.398	600,0			5,00E-07	5,00E-07
Scenarios fale	R.3 reservoir - 10 mm gat	138022	420003	46.398	90	9	5,18	1,1	1.133,0			1,00E-05	1,00E-05
Scenario's lei	A.1 Leiding Breuk gasfase - 76 mm	138040	419999	46.398	90	9	2,00	2.929,0	1.800,0	45		5,00E-07	2,25E-05
Scenario's lei	A.2 Leiding Leckage gasfase - 20 mm	138040	419999	46.398	90	9	2,00	399,0	1.800,0	45		1,50E-06	6,75E-05

5 Resultaten

5.1 Plaatsgebonden risico

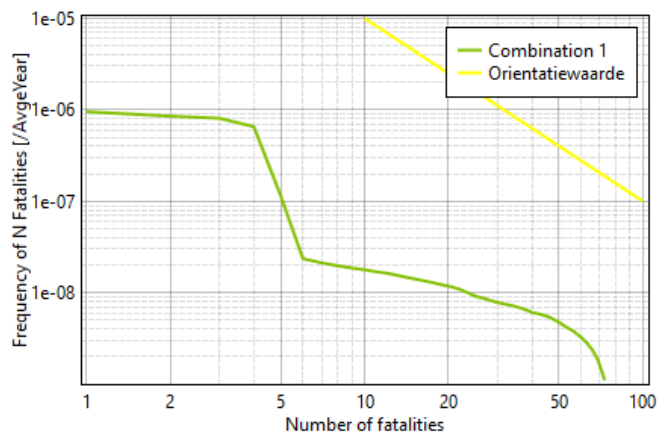
In onderstaande figuur 2 is wordt met een rode contour de kans op overlijden door een ongeval met propaan van 1 keer in 1 miljoen jaar, ofwel 10^{-6} per jaar aangeduid.



Figuur 2 Plaatsgebonden risicocontour

5.2 Groepsrisico

In figuur 3 hieronder is het groepsrisico uitgedrukt in een kans op gelijktijdig overlijden van een groep personen van een bepaald aantal, vergeleken met de oriëntatiewaarde die het bevoegd gezag gebruik bij het verantwoorden van de risico's.



Figuur 3 Groepsrisico vergeleken met de oriëntatiewaarde

Het groepsrisico blijft een factor 50 onder de oriëntatiewaarde.

6 Calamiteiten en effecten in de omgeving

Bij calamiteiten met propaan treden de volgende warmtestralingseffecten op in de omgeving.

Tabel 2

Effectafstanden (1% letaliteit)

Ongevalsscenario	Hoeveelheid [kg]	Vrijkomende massa		Duur [s]	Afstand tot 1% letaliteit [m]
		[kg]	[kg/s]		
R.1 reservoir - Instantaan falen	46.398	46.398			375
TW.1 reservoir - Instantaan falen	26.700	26.700			298
B.1 BLEVE tijdens verlading 100%		26.700			248
R.2 reservoir - 10 minuten	46.398		77	600	180
TW.2 reservoir - lek grootste aansluiting	26.700		66	404	167
L.2 breuk losslang begrenzer sluit niet	26.700		8	1.800	58
L.1 breuk losslang begrenzer sluit	42		8	6	49
R.3 reservoir - 10 mm gat	46.398		1	1.800	24

De grootste afstand met hoge warmtestraling van enige duur is 180 m.

7 Conclusie

De bepalende risicocontour ligt op ca. 55 m en treedt alleen over het water buiten de erfgrens. Dit is geen probleem. Het groepsrisico en daarmee het aantal potentiële slachtoffers in de omgeving is een factor 100 onder de oriëntatiewaarde. Dit is acceptabel te achten.

De planologische toestemming kan, net als de milieutoestemming, geregeld worden via een omgevingsvergunning. Bij de aanvraag hoort een ruimtelijke onderbouwing, inclusief een verantwoording van het groepsrisico, gebaseerd op het verplichte advies van de Veiligheidsregio.

LBP|SIGHT BV



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Bijlagen:

I Invoerbestand Safeti-NL

II Detailtekening propaantank

Bijlage I Invoerbestand Safeti-NL

Input Report

Workspace: Rijswaard4

Scenarios falen tankwagen

Study

Rijswaard4

Tab	Group	Field	Value	Units
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land	
		Type of pool substrate and bunds	Concrete, no bund	
Toxic parameters	Indoor toxic calculations	Specify the downwind building type	Unselected	
		Building type (downwind building type)		
Dispersion	Distances of interest	Distances of interest		m

TW.1 tankwagen - Instantaan falen

Pressure vessel

Rijswaard4\Scenarios falen tankwagen

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	26700kg	
		Volume inventory	51,7916m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9degC	
		Pressure (gauge)	5,17915bar	
		Fluid state	Liquid	
Risk	Type of risk effects to model	Liquid mole fraction	1fraction	
		Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
	Scenario	Pipe dimensions		
		Pipe length	10m	
		Release location	Elevation	1 m

	Direction	Tank head	0m
		Outdoor release direction	Horizontal
Short pipe	Pipe characteristics	Outdoor release angle	0deg
		Pipe roughness	0,045mm
	Frequencies	Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
		Frequency of excess flow valves	0/m
	Frequencies of valves	Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0bar
		Inventory data for time-varying releases	51,7916m3
		Tank vapour volume	0m3
		Tank liquid volume	51,7916m3
		Tank liquid level	0m
		Maximum vapour release height	m
		Minimum mass inventory	0kg
		Maximum mass inventory	1E+09kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s

	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138027m
		North	420042m
		Apply location offset	No

TW.1 tankwagen - Instantaan falen Rupture

Catastrophic rupture

Rijswaard4\Scenarios falen tankwagen\TW.1 tankwagen - Instantaan falen

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation		1 m
		Tank head		0 m
	Fireball emissive power	Use vessel burst pressure	Yes	
		Vessel burst pressure - gauge	19,1 bar	
Risk	Event frequency	Event frequency	4,01E-08/AvgYear	
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
Dispersion	Dispersion scope	Concentration of interest		ppm

		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

TW.2 tankwagen - gat 76.2 mm

Pressure vessel

Rijswaard4\Scenarios falen tankwagen

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	26700 kg	
		Volume inventory	51,7916 m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9 degC	
		Pressure (gauge)	5,17915 bar	
		Fluid state	Liquid	
		Liquid mole fraction	1 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Scenario	Pipe dimensions	Pipe length	10 m	
	Release location	Elevation	1 m	
		Tank head	1 m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm	
	Frequencies	Frequency of bends in pipe	0/m	

		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	51,7916 m ³
		Tank vapour volume	0 m ³
		Tank liquid volume	51,7916 m ³
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land

		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138027 m
		North	420042 m
		Apply location offset	No

TW.2 tankwagen - gat 76,2 mm Leak

Leak

Rijswaard4\Scenarios falen tankwagen\TW.2 tankwagen - gat 76,2 mm

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	76,2 mm	
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1 m	
		Tank head	1 m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Risk	Event frequency	Event frequency	4,01E-08 / AvgeYear	
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Phase to be released	Liquid	
Dispersion	Dispersion scope	Concentration of interest		ppm

		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

Scenario's domino-effecten tankauto tijdens verlading

Study

Rijswaard4

Tab	Group	Field	Value	Units
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land	
		Type of pool substrate and bunds	Concrete, no bund	
Toxic parameters	Indoor toxic calculations	Specify the downwind building type	Unselected	
		Building type (downwind building type)		
Dispersion	Distances of interest	Distances of interest		m

B.1 BLEVE door brand tijdens verlading - vulgraad 100%

Standalones

Rijswaard4\Scenario's domino-effecten tankauto tijdens verlading

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
Geometry	Geometry	East	138027m	
		North	420042m	
		Apply location offset	No	

B.1 BLEVE door brand tijdens verlading - vulgraad 100%

Fireball

Rijswaard4\Scenario's domino-effecten tankauto tijdens verlading\B.1 BLEVE door brand tijdens verlading - vulgraad 100%

Tab	Group	Field	Value	Units
Fireball	Released mass	Released mass	26700kg	
		Vapour mass fraction	1 fraction	
	Burst pressure	Supply burst pressure - gauge	Yes	
		Burst pressure - gauge	19,1 bar	
	Surface emissive power	Calculation method for surface emissive power	Calculate SEP	
		Flame surface emissive power		kW/m2
	Flame shape definition	Fireball radius		m
		Fireball duration		s

		Use shape correlation	Use Correlation
Risk	Event frequency	Event frequency	3,51E-07/AvgYear
Calculations	Type of results required	Radiation at a point	No
		Radiation vs distance	No
		Radiation ellipse	No
		Radiation contours	No

Scenario's falen losslang

Study

Rijswaard4

Tab	Group	Field	Value	Units
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land	
		Type of pool substrate and bunds	Concrete, no bund	
Toxic parameters	Indoor toxic calculations	Specify the downwind building type	Unselected	
		Building type (downwind building type)		
Dispersion	Distances of interest	Distances of interest		m

L.1 breuk losslang doorstroombegrenzer sluit

Pressure vessel

Rijswaard4\Scenario's falen losslang

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	42 kg	
		Volume inventory	0,0814699 m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9 degC	
		Pressure (gauge)	5,17915 bar	
		Fluid state	Liquid	
		Liquid mole fraction	1 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	

		Immediate ignition probability	fraction
Scenario	Pipe dimensions	Pipe length	5m
	Release location	Elevation	1m
		Tank head	1m
	Direction	Outdoor release direction	Horizontal
		Outdoor release angle	0deg
Short pipe	Pipe characteristics	Pipe roughness	0,045mm
		Frequencies	
		Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0bar
		Tank volume	0,0814699m3
	Inventory data for time-varying releases	Tank vapour volume	0m3
		Tank liquid volume	0,0814699m3
		Tank liquid level	0m
		Maximum vapour release height	m
		Minimum mass inventory	0kg
		Maximum mass inventory	1E+09kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	

		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138027m
		North	420042m
		Apply location offset	No

L.1 breuk losslang doorstroombegrenzer sluit line rupture

Short pipe

Rijswaard4\Scenario's falen losslang\L.1 breuk losslang doorstroombegrenzer sluit

Tab	Group	Field	Value	Units
Scenario	Scenario	Scenario type	Line rupture	
	Pipe dimensions	Pipe internal diameter	50,8mm	
		Pipe length	5m	
	Hole	Orifice diameter	mm	
	Release location	Elevation	1m	
		Tank head	1m	
	Flow control	Flow controller	None	
		Input option	Not applicable	
		Fixed flow rate	kg/s	
		Pump head	m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Risk	Event frequency	Event frequency	0,00264/AvgeYear	
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability	fraction	

Immediate ignition probabilities		Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Material	Material	Material characteristics	Flammable only
		Material to track	PROPANE
		Type of risk effects to model	Flammable only
		Phase	Liquid
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm
		Frequencies	Frequency of bends in pipe
			0/m
			Frequency of couplings in pipe
			0/m
			Frequency of junctions in pipe
			0/m
		Frequencies of valves	Frequency of excess flow valves
			0/m
			Frequency of non-return valves
			0/m
			Frequency of shut-off valves
			0/m
		Velocity head losses	Excess flow valve velocity head losses
			0
			Non-return valve velocity head losses
			0
			Shut-off valve velocity head losses
			0
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
		Distances of interest	m
		Averaging time for reports	NLIV [1 hr]
			No
			IDLH [30 mins]
			No
			STEL [15 mins]
			No

L.2 breuk losslang doorstroombegrenzer sluit niet

Pressure vessel

Rijswaard4\Scenario's falen losslang

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	26700 kg	
		Volume inventory	51,7916 m3	

		Material to track	PROPANE
		Type of risk effects to model	Flammable only
	Phase	Specified condition	Temperature/bubble point
		Temperature	9degC
		Pressure (gauge)	5,17915bar
		Fluid state	Liquid
		Liquid mole fraction	1fraction
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only
		Reduce risks for mounded / underground tanks	No
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability
		Non-ignition probability	fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Scenario	Pipe dimensions	Pipe length	5m
	Release location	Elevation	1m
		Tank head	1m
	Direction	Outdoor release direction	Horizontal
		Outdoor release angle	0deg
Short pipe	Pipe characteristics	Pipe roughness	0,045mm
	Frequencies	Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating

		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	51,7916 m ³
		Tank vapour volume	0 m ³
		Tank liquid volume	51,7916 m ³
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138027 m
		North	420042 m
		Apply location offset	No

L.2 breuk losslang doorstroombegrenzer sluit niet line rupture

Short pipe

Rijswaard4\Scenario's falen losslang\L.2 breuk losslang doorstroombegrenzer sluit niet

Tab	Group	Field	Value	Units
Scenario	Scenario	Scenario type	Line rupture	

	Pipe dimensions	Pipe internal diameter	50,8 mm
		Pipe length	5 m
	Hole	Orifice diameter	mm
	Release location	Elevation	1 m
		Tank head	1 m
	Flow control	Flow controller	None
		Input option	Not applicable
		Fixed flow rate	kg/s
		Pump head	m
	Direction	Outdoor release direction	Horizontal
		Outdoor release angle	0 deg
Risk	Event frequency	Event frequency	5,4E-07 /AvgeYear
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability
		Non-ignition probability	fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Material	Material	Material characteristics	Flammable only
		Material to track	PROPANE
		Type of risk effects to model	Flammable only
	Phase	Phase to be released	Liquid
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm
	Frequencies	Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Dispersion	Dispersion scope	Concentration of interest	ppm

	Averaging time for concentration of interest	
	Specify user-defined averaging time	No
	User defined averaging time	s
Distances of interest	Distances of interest	m
Averaging time for reports	NLIV [1 hr]	No
	IDLH [30 mins]	No
	STEL [15 mins]	No

[L.3 lek losslang](#)

Pressure vessel

Rijswaard4\Scenario's falen losslang

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	26700 kg	
		Volume inventory	51,7916 m ³	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9 degC	
		Pressure (gauge)	5,17915 bar	
		Fluid state	Liquid	
		Liquid mole fraction	1 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Scenario	Pipe dimensions	Pipe length	5 m	
	Release location	Elevation	1 m	
		Tank head	1 m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm	
	Frequencies	Frequency of bends in pipe	0/m	

		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	51,7916 m ³
		Tank vapour volume	0 m ³
		Tank liquid volume	51,7916 m ³
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land

		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138027 m
		North	420042 m
		Apply location offset	No

L.3 lek losslang leak

Leak

Rijswaard4\Scenario's falen losslang\L.3 lek losslang

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	5,08 mm	
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1 m	
		Tank head	1 m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Risk	Event frequency	Event frequency	9E-05 / AvgeYear	
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Phase to be released	Liquid	
Dispersion	Dispersion scope	Concentration of interest		ppm

		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

Scenarios falen reservoir 100 m3 - bovengronds

Study

Rijswaard4

Tab	Group	Field	Value	Units
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land	
		Type of pool substrate and bunds	Concrete, no bund	
Toxic parameters	Indoor toxic calculations	Specify the downwind building type	Unselected	
		Building type (downwind building type)		
Dispersion	Distances of interest	Distances of interest		m

R.1 reservoir - Instantaan falen

Pressure vessel

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	Yes	
		Mass inventory	46397,5kg	
		Volume inventory	90m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9degC	
		Pressure (gauge)	5,17915bar	
		Fluid state	Liquid	
		Liquid mole fraction	1 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction

	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Scenario	Pipe dimensions	Pipe length	10 m
	Release location	Elevation	1 m
		Tank head	0 m
	Direction	Outdoor release direction	Horizontal
		Outdoor release angle	0 deg
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm
		Frequencies	Frequency of bends in pipe
			0/m
	Frequencies		Frequency of couplings in pipe
			0/m
			Frequency of junctions in pipe
			0/m
	Frequencies of valves		Frequency of excess flow valves
			0/m
			Frequency of non-return valves
			0/m
	Velocity head losses		Frequency of shut-off valves
			0/m
			Excess flow valve velocity head losses
Time varying releases	Modelling of time-varying leaks and line ruptures		0
			Non-return valve velocity head losses
			0
	Inventory data for time-varying releases		Shut-off valve velocity head losses
			0
			Vacuum relief valve
	Safety system modelling for time-varying releases		Operating
			Vacuum relief valve set point
			0 bar
	Dispersion		Tank volume
			90 m ³
			Tank vapour volume
Dispersion	Dispersion scope		0 m ³
			Tank liquid volume
			90 m ³
	Concentration of interest		Tank liquid level
			0 m
			Maximum vapour release height
	Safety system modelling for time-varying releases		m
			Minimum mass inventory
			0 kg
	Dispersion scope		Maximum mass inventory
			1E+09 kg
			Safety system modelling (isolation and blowdown)
Dispersion	Dispersion scope		No
			Safety system modelling (isolation and blowdown)
			No
	Concentration of interest		ppm
			ppm
			ppm
	Safety system modelling for time-varying releases		ppm
			ppm
			ppm
	Dispersion		ppm
			ppm
			ppm

		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138022m
		North	420003m
		Apply location offset	No

R.1 reservoir - Instantaan falen Rupture

Catastrophic rupture

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds\R.1 reservoir - Instantaan falen

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation		1 m
		Tank head		0 m
	Fireball emissive power	Use vessel burst pressure		Yes
		Vessel burst pressure - gauge		19,1 bar
Risk	Event frequency	Event frequency		5E-07/AvgeYear
	Type of risk effects to model	Reduce risks for mounded / underground tanks		No
	Non-ignition probabilities	Specify probability of non-ignition		Calculate non-ignition probability
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition		Stationary - use material reactivity
		Immediate ignition probability		fraction

Material	Material	Material characteristics	Flammable only
		Material to track	PROPANE
		Type of risk effects to model	Flammable only
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

R.2 reservoir - 10 minuten

Pressure vessel

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	Yes	
		Mass inventory	46397,5 kg	
		Volume inventory	90 m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9 degC	
		Pressure (gauge)	5,17915 bar	
		Fluid state	Liquid	
		Liquid mole fraction	1 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Scenario	Pipe dimensions	Pipe length	10 m	
	Release location	Elevation	1 m	
		Tank head	1 m	
	Direction	Outdoor release direction	Horizontal	

Short pipe	Pipe characteristics	Outdoor release angle	0 deg
		Pipe roughness	0,045 mm
	Frequencies	Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
		Frequency of excess flow valves	0/m
	Frequencies of valves	Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
		Excess flow valve velocity head losses	0
	Velocity head losses	Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	90 m ³
		Tank vapour volume	0 m ³
		Tank liquid volume	90 m ³
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
	Safety system modelling for time-varying releases	Maximum mass inventory	1E+09 kg
		Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
	Distances of interest	User defined averaging time	s
		Distances of interest	m

Bund, building and terrain	Terrain and bund definition	Averaging time for reports	NLIV [1 hr]	No
			IDLH [30 mins]	No
			STEL [15 mins]	No
		Type of terrain for dispersion		Land
		Type of pool substrate and bunds		Concrete, no bund
		Building definition	Release building	
			In-building release?	Outdoor
			Building wake effect	Roof/lee
			Wind or release angle from North	0 deg
			Handling of droplets	Trapped
Geometry	Geometry		Indoor mass modification factor	3
			East	138022m
			North	420003m
			Apply location offset	No

R.2 reservoir - 10 minuten fixed duration release

Fixed duration release

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds\R.2 reservoir - 10 minuten

Tab	Group	Field	Value	Units
Scenario	Scenario	Duration for fixed duration release	600s	
		Hole	Orifice diameter	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
		Release location	Elevation	1m
	Direction	Tank head		1m
		Outdoor release direction	Horizontal	
		Outdoor release angle		0 deg
Risk	Event frequency	Event frequency	5E-07/AvgeYear	
	Type of risk effects to model	Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	

		Type of risk effects to model	Flammable only
	Phase	Phase to be released	Liquid
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

R.3 reservoir - 10 mm gat

Pressure vessel

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	Yes	
		Mass inventory	46397,5kg	
		Volume inventory	90m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Temperature/bubble point	
		Temperature	9degC	
		Pressure (gauge)	5,17915bar	
		Fluid state	Liquid	
		Liquid mole fraction	1fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability	fraction	
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability	fraction	
Scenario	Pipe dimensions	Pipe length	10m	
	Release location	Elevation	1m	
		Tank head	1m	
	Direction	Outdoor release direction	Horizontal	

Short pipe	Pipe characteristics	Outdoor release angle	0 deg
		Pipe roughness	0,045 mm
		Frequency of bends in pipe	0/m
	Frequencies	Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
		Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
	Velocity head losses	Frequency of shut-off valves	0/m
		Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Shut-off valve velocity head losses	0
		Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	90 m ³
		Tank vapour volume	0 m ³
		Tank liquid volume	90 m ³
		Tank liquid level	0 m
	Safety system modelling for time-varying releases	Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg
Dispersion	Dispersion scope	Safety system modelling (isolation and blowdown)	No
		Concentration of interest	ppm
		Averaging time for concentration of interest	
	Distances of interest	Specify user-defined averaging time	No
		User defined averaging time	s
		Distances of interest	m

Bund, building and terrain	Terrain and bund definition	Averaging time for reports	NLIV [1 hr]	No
			IDLH [30 mins]	No
			STEL [15 mins]	No
		Type of terrain for dispersion		Land
		Type of pool substrate and bunds		Concrete, no bund
		Building definition	Release building	
			In-building release?	Outdoor
			Building wake effect	Roof/lee
			Wind or release angle from North	0 deg
			Handling of droplets	Trapped
Geometry	Geometry		Indoor mass modification factor	3
			East	138022m
			North	420003m
			Apply location offset	No

R.3 reservoir - 10 mm gat leak

Leak

Rijswaard4\Scenarios falen reservoir 100 m3 - bovengronds\R.3 reservoir - 10 mm gat

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	10mm	
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1m	
		Tank head	1m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Risk	Event frequency	Event frequency	1E-05/AvgeYear	
		Type of risk effects to model	Reduce risks for mounded / underground tanks	No
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	

	Phase	Phase to be released	Liquid
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

[Scenario's leidingen - ondergronds](#)

Study
Rijswaard4

Tab	Group	Field	Value	Units
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land	
		Type of pool substrate and bunds	Concrete, no bund	
Toxic parameters	Indoor toxic calculations	Specify the downwind building type	Unselected	
		Building type (downwind building type)		
Dispersion	Distances of interest	Distances of interest	m	

[A.1 Breuk gasfase - 76 mm](#)

Pressure vessel
Rijswaard4\Scenario's leidingen - ondergronds

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	46398 kg	
		Volume inventory	7722,88 m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	9 degC	
		Pressure (gauge)	2 bar	
		Fluid state	Vapour	
		Liquid mole fraction	0 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	

	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability
		Non-ignition probability	fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Scenario	Pipe dimensions	Pipe length	45 m
	Release location	Elevation	1 m
		Tank head	0 m
	Direction	Outdoor release direction	Horizontal
		Outdoor release angle	0 deg
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm
	Frequencies	Frequency of bends in pipe	0 /m
		Frequency of couplings in pipe	0 /m
		Frequency of junctions in pipe	0 /m
	Frequencies of valves	Frequency of excess flow valves	0 /m
		Frequency of non-return valves	0 /m
		Frequency of shut-off valves	0 /m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	7722,88 m3
		Tank vapour volume	7722,88 m3
		Tank liquid volume	0 m3
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg

	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3
Geometry	Geometry	East	138040m
		North	419999m
		Apply location offset	No

A.1 Breuk gasfase - 76 mm line rupture

Short pipe

Rijswaard4\Scenario's leidingen - ondergronds\A.1 Breuk gasfase - 76 mm

Tab	Group	Field	Value	Units
Scenario	Scenario	Scenario type	Line rupture	
	Pipe dimensions	Pipe internal diameter	76,2mm	
		Pipe length	45m	
	Hole	Orifice diameter	mm	
	Release location	Elevation	1m	
		Tank head	0m	
	Flow control	Flow controller	None	
		Input option	Not applicable	
		Fixed flow rate	kg/s	
		Pump head	m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Risk	Event frequency	Event frequency	2,25E-05/AvgeYear	

	Type of risk effects to model	Reduce risks for mounded / underground tanks	No
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability
		Non-ignition probability	fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity
		Immediate ignition probability	fraction
Material	Material	Material characteristics	Flammable only
		Material to track	PROPANE
		Type of risk effects to model	Flammable only
	Phase	Phase to be released	Vapour
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm
	Frequencies	Frequency of bends in pipe	0/m
		Frequency of couplings in pipe	0/m
		Frequency of junctions in pipe	0/m
	Frequencies of valves	Frequency of excess flow valves	0/m
		Frequency of non-return valves	0/m
		Frequency of shut-off valves	0/m
	Velocity head losses	Excess flow valve velocity head losses	0
		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No

A.2 Leakage gasfase - 20 mm

Pressure vessel

Rijswaard4\Scenario's leidingen - ondergronds

Tab	Group	Field	Value	Units
Material	Material	Material	PROPANE	
		Specify volume inventory?	No	
		Mass inventory	46398 kg	
		Volume inventory	7722,88 m3	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	9 degC	
		Pressure (gauge)	2 bar	
		Fluid state	Vapour	
		Liquid mole fraction	0 fraction	
Risk	Type of risk effects to model	Jet fire modelling for horizontal releases	Horizontal jet only	
		Reduce risks for mounded / underground tanks	No	
	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Scenario	Pipe dimensions	Pipe length	45 m	
	Release location	Elevation	1 m	
		Tank head	0 m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0 deg	
Short pipe	Pipe characteristics	Pipe roughness	0,045 mm	
	Frequencies	Frequency of bends in pipe	0/m	
		Frequency of couplings in pipe	0/m	
		Frequency of junctions in pipe	0/m	
	Frequencies of valves	Frequency of excess flow valves	0/m	
		Frequency of non-return valves	0/m	
		Frequency of shut-off valves	0/m	
	Velocity head losses	Excess flow valve velocity head losses	0	

		Non-return valve velocity head losses	0
		Shut-off valve velocity head losses	0
Time varying releases	Modelling of time-varying leaks and line ruptures	Vacuum relief valve	Operating
		Vacuum relief valve set point	0 bar
	Inventory data for time-varying releases	Tank volume	7722,88 m3
		Tank vapour volume	7722,88 m3
		Tank liquid volume	0 m3
		Tank liquid level	0 m
		Maximum vapour release height	m
		Minimum mass inventory	0 kg
		Maximum mass inventory	1E+09 kg
	Safety system modelling for time-varying releases	Safety system modelling (isolation and blowdown)	No
Dispersion	Dispersion scope	Concentration of interest	ppm
		Averaging time for concentration of interest	
		Specify user-defined averaging time	No
		User defined averaging time	s
	Distances of interest	Distances of interest	m
	Averaging time for reports	NLIV [1 hr]	No
		IDLH [30 mins]	No
		STEL [15 mins]	No
Bund, building and terrain	Terrain and bund definition	Type of terrain for dispersion	Land
		Type of pool substrate and bunds	Concrete, no bund
	Building definition	Release building	
		In-building release?	Outdoor
		Building wake effect	Roof/lee
		Wind or release angle from North	0 deg
		Handling of droplets	Trapped
		Indoor mass modification factor	3

Geometry	Geometry	East	138040m
		North	419999m
		Apply location offset	No

A.2 Lekkage gasfase - 20 mm leak

Leak

Rijswaard4\Scenario's leidingen - ondergronds\A.2 Lekkage gasfase - 20 mm

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	20mm	
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1m	
		Tank head	0m	
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0deg	
	Event frequency	Event frequency	6,75E-05/AvgYear	
		Type of risk effects to model	No	
Risk	Non-ignition probabilities	Specify probability of non-ignition	Calculate non-ignition probability	
		Non-ignition probability		fraction
	Immediate ignition probabilities	Probability of immediate ignition	Stationary - use material reactivity	
		Immediate ignition probability		fraction
Material	Material	Material characteristics	Flammable only	
		Material to track	PROPANE	
		Type of risk effects to model	Flammable only	
	Phase	Phase to be released	Vapour	
Dispersion	Dispersion scope	Concentration of interest		ppm
		Averaging time for concentration of interest		
		Specify user-defined averaging time	No	
		User defined averaging time		s
	Distances of interest	Distances of interest		m
		Averaging time for reports	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

Bijlage II Detailtekening propaantank