

## Notitie

Datum:	7 oktober 2020	Project:	Herinrichting Willemspolder fase 1
Ons kenmerk:	V087286aa.20DENDD.jst	Locatie:	Willemspolder
Versie:	01_001	Betreeft:	Indicatieve beoordeling externe veiligheid

## 1 Inleiding en samenvatting

Het project 'herinrichting Willemspolder fase 1' van Dekker Groep beoogt delfstoffenwinning mogelijk te maken in de Willemspolder. De Willemspolder vormt een uiterwaard rond de Waal; samen met de Gouverneurspolder maakt de Willemspolder deel uit van de Midden-Waal. Voor fase 1 loopt het plangebied vanaf de Nieuweweg in IJzendoorn tot circa 500 m voor de Prins Willem-Alexanderbrug in Echteld.

Met het herinrichting Willemspolder fase 1 wordt het gebied ingericht voor hoogwaterveiligheid, natuurontwikkeling, recreatie, landschapsinrichting, duurzaamheid en mobiliteit. In het kader van hun duurzaamheidsambities onderzoekt Dekker de mogelijkheid tot waterstofproductie dan wel de op- en overslag van waterstof in een vloeibaar medium als brandstof van de binnenvaartschepen.

De opslag en het transport van waterstof onder druk brengt risico's met zich mee: bij lekkage van waterstof ontstaat het gevaar van brand en explosie. We hebben voor de productie van waterstof deze gevaren inzichtelijk gemaakt door middel van een berekening met het wettelijk voorgeschreven Safeti versie 8.2.

In deze notitie zijn deze risico's indicatief beschouwd voor een beoordeling van het aspect externe veiligheid ten gevolge van het gebruik van waterstof. Het is een indicatieve beoordeling omdat de exacte uitvoering van de installatie is nog niet bekend is. Deze notitie dient als onderdeel van de milieueffectrapportage voor de herinrichting van Willemspolder fase 1. In hoofdstuk 2 is een situatieschets (proces) en het wettelijk kader kort beschreven. Hoofdstuk bevat de uitgangspunten voor het rekenmodel. Hoofdstuk 4 geeft de resultaten. De interne afstanden binnen het tankstation volgens een concept-richtlijn zijn opgenomen in hoofdstuk 5. Hoofdstuk 6 bevat de conclusies.



Het bepalende plaatsgebonden risico (rode contour) omvat geen objecten en voldoet aan het beleid. Het groepsrisico is verwaarloosbaar.

Uit de indicatieve beoordeling blijkt dat waterstofproductie dan wel de op- en overslag van waterstof in een vloeibaar medium als brandstof van de binnenvaartschepen door de Dekker Groep relatief laag is en toelaatbaar is volgens het beleid en wet- en regelgeving.

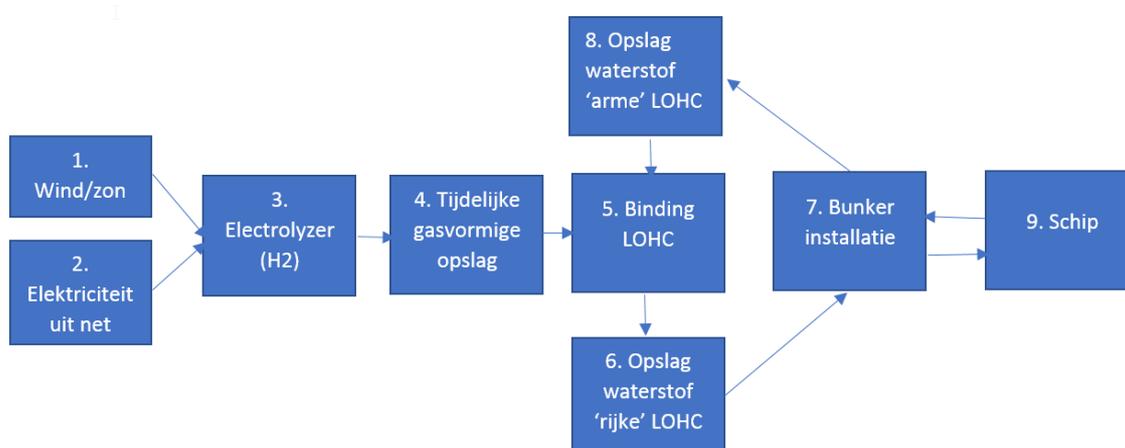
Vanuit de regelgeving voor externe veiligheid zijn er vooralsnog geen juridische belemmeringen. In een vervolgstadium (bij uitwerking van de plannen) zal getoetst moeten worden aan de drempelwaarde voor Brzo-inrichting en de BBT-conclusies en PGS-35-richtlijn.

## 2 Situatieschets

### 2.1 Het plan: productie van waterstof

Als uitgangssituatie zijn we uitgegaan van het voorlopige plan voor waterstofproductie “inpassing LOHC” van Dekker groep (bijlage I). In het kort is het plan:

Waterstofgas wordt in een electrolyzer geproduceerd door water te splitsen: hierbij ontstaat waterstof en zuurstof. Het waterstof wordt in tijdelijke vorm opgeslagen in twee buffer vatten. Deze buffer vaten zijn stalen tanks van 40 nm<sup>3</sup> met een druk van 30 bar. In totaal kan er 200 tot 400 kg waterstofgas worden opgeslagen in deze tanks. Het waterstof wordt vervolgens gebonden aan een vloeistof, de zogenaamde LOHC (Liquid Organic Hydrogen Carrier). Dit is een waterstofarme organische vloeistof die nauwelijks ontvlambaar is (nadere specificaties niet bij ons bekend). De binding gebeurt bij een temperatuur van 150 – 300 graden Celcius en een druk van 70 – 80 bar. Na binding van de LOHC met het waterstof kan het waterstofrijke medium op atmosferische druk en temperatuur worden opgeslagen in bufferinstallaties. Vanuit die bufferinstallaties kunnen binnenvaartschepen het LOHC-waterstof mengsel tanken. Op het waterstofschip zit een installatie die de waterstof uit de LOHC onttrekt, waardoor elektriciteit vrijkomt. Het waterstof-arme LOHC kan worden teruggepompt naar de bufferinstallatie op de kade, waar het hergebruikt kan worden als medium voor waterbinding. In Figuur 1 is het proces weergegeven.



**Figuur 1**  
Processchema waterstofproductie Dekker Groep in Willemspolder

### 2.2 Wettelijk kader

De opslag en productie van waterstof valt onder het Activiteitenbesluit Milieubeheer en Besluit externe veiligheid inrichtingen. Daarbij is de PGS35 richtlijn van toepassing: *Waterstofinstallaties voor het afleveren van waterstof aan voertuigen en werktuigen*.

Bij de opslag en productie van meer dan 5 ton waterstof per jaar valt de inrichting ook onder het Besluit risico's zware ongevallen. Volgens de Seveso III-richtlijn, bijlage I, deel 2, geldt voor een inrichting vanaf 5 ton waterstof dat het een lagedrempelinrichting behelst. In dat geval zal de

inrichting een preventief veiligheidsbeleid dienen op te stellen. Voor een hogedrempelinrichting is de eis dat er een veiligheidsrapportage wordt opgesteld.

## **2.3 Veiligheidssituatie en beleid gemeente Neder-Betuwe**

Uit de Beleidsvisie externe veiligheid Gemeente Neder-Betuwe (vastgesteld in 2015)

Uit het externe veiligheidsbeleid van Neder-Betuwe volgt de volgende conclusie:

*Er zijn geen knelpunten met betrekking tot het plaatsgebonden risico vanwege Bevi-bedrijven. Mogelijk is wel sprake van potentiële knelpunten, omdat niet alle relevante risicocontouren als veiligheidszones in vigerende bestemmingsplannen zijn vastgelegd.*

*Binnen de gemeente Neder-Betuwe is er één situatie waar in de huidige situatie bij een Bevi-inrichting de oriëntatiewaarde wordt overschreden. In de relevante vergunning zullen zodanige maatregelen worden vastgelegd dat de oriëntatiewaarde niet meer overschreden zal worden.*

## 3 Ingevoerde gegevens

### 3.1 Risicobronnen

Voor de risicoberekening is gebruik gemaakt van de memo Risico- en effectafstanden waterstof-tankstations (2016)<sup>1</sup> en de Handleiding Risicoberekeningen Bevi 4.1 (2019)<sup>2</sup>. De gebruikte scenario's wijken enigszins af van het model van de RIVM memo, omdat in de situatie bij Dekker namelijk gebruik gemaakt van een waterstofrijke vloeistof, dat dient ter opslag van de waterstof / energie. Over deze vloeistof is nog weinig bekend, behalve dat het de gevaar aanduidingen H302 (harmful if swallowed) en H312 (harmful if in contact with skin) heeft. Verder is het een licht ontvlambare vloeistof, die minder licht ontvlambaar is als benzeen (LF1 stofcategorie).

Om het worst-case scenario te beschouwen zijn we uitgegaan van 'pentaan' (LF2 stofcategorie) bij de insluitsystemen waar alleen 'waterstofarme LOHC' aanwezig is. In de andere gevallen (bij waterstof en 'waterstofrijke LOHC') is waterstof aangehouden. In werkelijkheid zal het risico kleiner zijn bij de opslag en transport van de 'waterstofrijke LOHC', omdat waterstof reactiever is dan de LOHC vloeistof.

De volgende insluitsystemen worden gebruikt zoals genoemd in tabel 1. Naast deze systemen zullen er nog andere onderdelen zijn, zoals bijv. reduceerventielen, midden- en lagedrukleidingen e.d., maar naar verwachting leveren deze geen wezenlijke bijdrage aan de risico's (dit kan in een officiële vergunningsaanvraag nog worden nagegaan).

**Tabel 1**

Insluitsystemen waterstof

Insluitsysteem	Lengte (meter)	Maat	Inhoud (kg)	Druk (bar)	Temperatuur (°C)	
1	Tijdelijke opslag gasvormige waterstof	-	40 m <sup>3</sup>	100	30	20
2a	Leidingen met waterstof	5	Diameter ~10 mm	4	70-80*	200
2b	Leidingen met waterstofrijk LOHC***	50	Diameter ~5 cm	4	70-80	200
2c	Leidingen met waterstofarm LOHC	50	Diameter ~5 cm	626	1	20
3a	Opslag waterstofrijk LOHC***	-	20 m <sup>3</sup>	800	1	20
3b	Opslag waterstofarm LOHC	-	20 m <sup>3</sup>	800	1	20
4	Afleverzuil (op een schip)		50 l/uur	1	70-80	200
5	Waterstofvoertuig (schip)		50 m <sup>3</sup> **	200	70-80	200

\* uitgegaan van 80 bar voor *worst-case* benadering

\*\* uitgegaan van 50 m<sup>3</sup> puur waterstof voor *worst-case* benadering

\*\*\* beschouwd als waterstof

1 RIVM, kenmerk 20160149 VLH HAS/Sta/sij, van 3 oktober 2016

2 RIVM, Handleiding Risicoberekeningen Bevi, van 1 oktober 2019

**Tabel 2**

Ongevalsscenario's en -frequentie

Insluitsysteem		Model Safeti en scenario's	Ongevingsfrequentie (/jaar)			
#			Kans (/jaar)	Aantal	Tijdsfractie	Totale freq. (/jaar)
1	Tijdelijke opslag gasvormige waterstof	Pressure vessel				
	Opslag onder druk (bovengronds)	1. Instantaan vrijkomen	5.10-7	1	1	5.10-7
		2. Vrijkomen van de gehele inhoud in 10 min	5.10-7	1	1	5.10-7
		3. Vrijkomen uit een gat van 10 mm	1.10-5	1	1	1.10-5
2a	Leidingen met waterstof	1. Breuk van de leiding	1.10-6 /m	5 m		5.10-6
		2. Lek met een diameter van 10% leidingdikte	5.10-6 /m	5 m		2,5.10-5
2b	Leidingen met waterstofrijk LOHC	1. Breuk van de leiding	1.10-6 /m	50 m		5.10-5
		2. Lek met een diameter van 10% leidingdikte	5.10-6 /m	50 m		2,5.10-4
2c	Leidingen met waterstofarm LOHC	1. Breuk van de leiding	1.10-6 /m	50 m		5.10-5
		2. Lek met een diameter van 10% leidingdikte	5.10-6 /m	50 m		2,5.10-4
3a	Opslag waterstofrijk LOHC	Pressure vessel				
	Opslag onder druk (bovengronds)	1. Instantaan vrijkomen	5.10-7		1	5.10-7
		2. Vrijkomen van de gehele inhoud in 10 min	5.10-7		1	5.10-7
		3. Vrijkomen uit een gat van 10 mm	1.10-5		1	1.10-5
3b	Opslag waterstofarm LOHC	Pressure vessel				
	Opslag onder druk (bovengronds)	1. Instantaan vrijkomen	5.10-7		1	5.10-7
		2. Vrijkomen van de gehele inhoud in 10 min	5.10-7		1	5.10-7
		3. Vrijkomen uit een gat van 10 mm	1.10-5		1	1.10-5
4	Afleverzuil LOHC (op een schip)	Pressure vessel				
		1. Instantaan vrijkomen	5.10-7		1	5.10-7
		2. Vrijkomen uit de grootste aansluiting (50 mm)	5.10-7		1	5.10-7
5	Waterstofschip	Vessel				
		1. Instantaan vrijkomen	5.10-7		1	5.10-7
		2. Vrijkomen van de gehele inhoud in 10 min	5.10-7		1	5.10-7
		3. Vrijkomen uit een gat van 10 mm	1.10-5		1	1.10-5

## 3.2 Populatie

De bevolkingsgegevens van juli 2020 volgens de BAG Populatieservice zijn toegevoegd aan het Safeti model.

## 4 Resultaten berekeningen

### 4.1 Plaatsgebonden risico

Hieronder is de bepalende risicocontour (kans op overlijden een keer per miljoen jaar, ofwel  $10^{-6}$  per jaar).



**Figuur 2**  
Risicocontour (rood:  $10^{-6}$ /jaar, paars:  $10^{-5}$ /jaar)

### 4.2 Effectafstanden

De brand- en explosiescenario's leiden tot de volgende grootste effecten in de omgeving (tabel 3) – uitgaande van weertype D met 1,5 m/s.

**Tabel 3**  
Grootste effectafstanden (overdruk en warmtestraling)

	<i>Insluitsysteem</i>	<i>Scenario</i>	<i>lengte vlam (m)</i>	<i>Afstand tot overdruk 0,3 bar (m)</i>	<i>Afstand tot warmte-straling 3 kW/m<sup>2</sup> (m)</i>
1	Tijdelijke opslag gasvormige waterstof	Instantaan falen	27,0	31,0	129
		10 min uitstroming	6,3	9,3	7,6
		10 mm gat	5,6	8,0	6,7
2a	Leidingen met waterstof	Breuk	4,8	6,4	5,8
		5 mm gat	3,9	5,0	4,9
2b	Leidingen met waterstofrijke LOHC	Breuk	19,3	42,6	19,3
		50 mm gat	30,3	46,2	30,3
2c	Leidingen met waterstofarme LOHC	Breuk	86,8	139,7	233

<i>Insluitsysteem</i>		<i>Scenario</i>	<i>lengte vlam (m)</i>	<i>Afstand tot overdruk 0,3 bar (m)</i>	<i>Afstand tot warmte-straling 3 kW/m<sup>2</sup> (m)</i>
		50 mm gat	112,0	146,5	299,3
3a	Opslag waterstofrijk LOHC	Instantaan falen	53,8	61,5	248,3
		10 min uitstroming	15,4	31,2	23,8
		10 mm gat	14,8	29,6	22,5
3b	Opslag waterstofarm LOHC	Instantaan falen	13,9	37,4	39,2
		10 min uitstroming	11,7	8,3	28,1
		10 mm gat	33,1	267,0	69,1
4	Afleverzuil (op een schip)	Instantaan falen	5,8	6,7	30,0
		Vrijkomen grootste aansluiting	30,3	25,7	49,4
5	Waterstofvoertuig (schip)	Instantaan falen	33,9	40,0	160,8
		10 min uitstroming	8,1	40,8	10,3
		10 mm gat	7,3	10,7	9,1

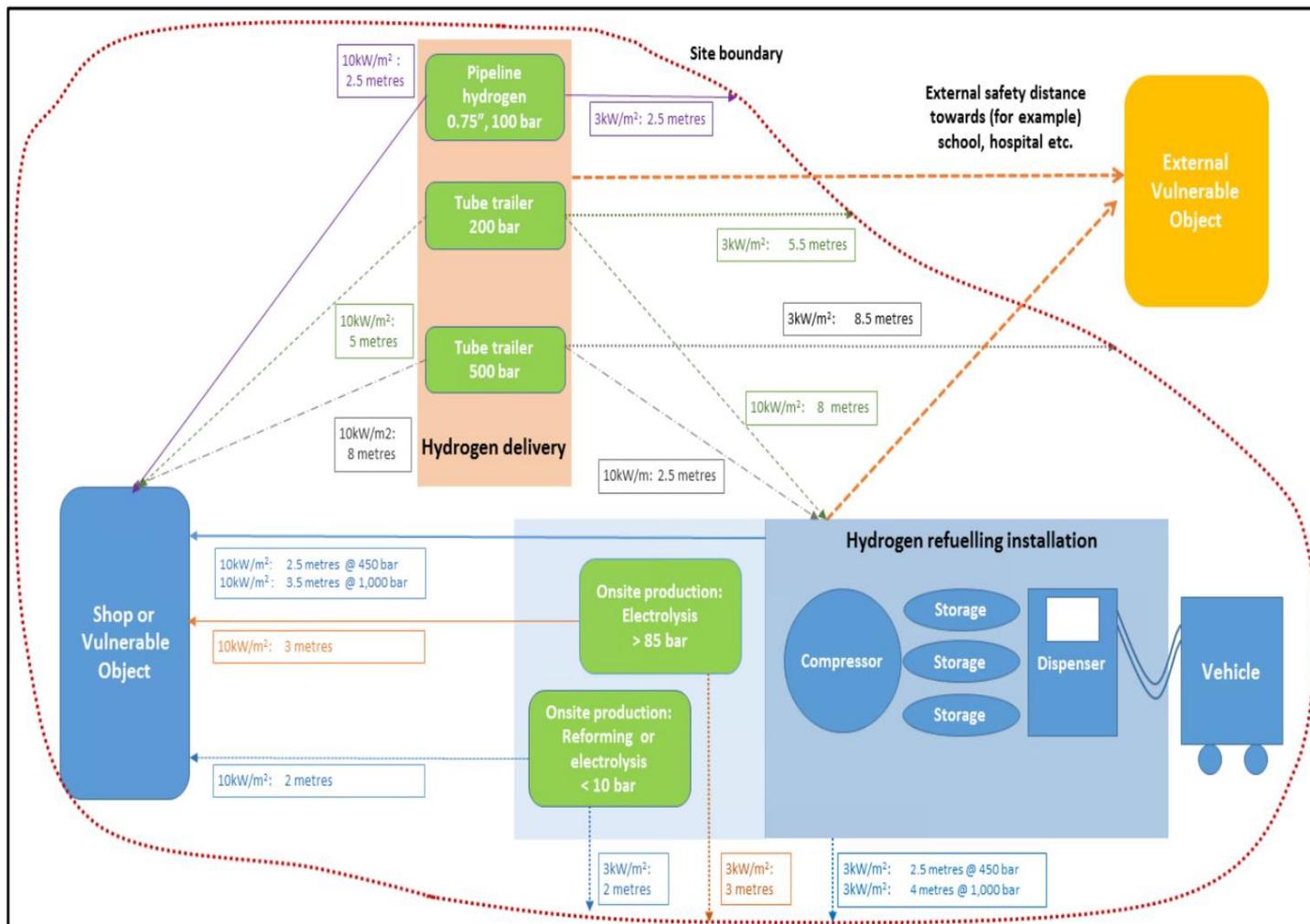
Binnen de hoogste maximale afstand ( $3 \text{ kW/m}^3$  wat overeenkomt met 1% letaliteit) telt de aanwezige populatie mee voor het groepsrisico.

### 4.3 Groepsrisico

Het groepsrisico is verwaarloosbaar en dermate klein dat het niet zichtbaar is in de FN-grafiek. Voor 3 personen ligt het groepsrisico op een niveau van  $9,5 \cdot 10^{-13}$ . Dit is ver beneden de oriëntatiewaarde (ter illustratie: de oriëntatiewaarde is voor 10 personen gelijk aan  $1 \cdot 10^{-5}$ ).

## 5 Interne veiligheidsafstanden H2-tankstation

Uit de concept PGS 35:2020 volgen de volgende intern aan te houden veiligheidsafstanden:



**Figuur 3**  
Interne veiligheidsafstanden versie 1.0 (afbeelding 7) van PGS15:2020 concept

In bovenstaande figuur staan de aan te houden veiligheidsafstanden met de bepalende warmtestraling tussen de onderdelen van een waterstof tank en objecten op het eigen terrein. Hieronder een eerste beoordeling van deze afstanden

Onderdelen	Veiligheidsafstand	Oordeel / aanwezig binnen afstand
Ergrens – Waterstofinstallatie 80 bar, 3 kW/m <sup>2</sup> :	3,0 m	voldoet
Ergrens - Buisleiding 80 bar, 3 kW/m <sup>2</sup> :	2,5 m	voldoet
Ergrens - Opslag 80 bar, 3 kW/m <sup>2</sup> :	2,5 m	openbaar water
Eigen kantoor - Aflevering 450 bar, 10 kW/m <sup>2</sup> :	2,5 m	voldoet
Eigen kantoor – Buisleiding 80 bar, 10 kW/m <sup>2</sup> :	2,5 m	voldoet
Eigen kantoor – Opslag 80 bar, 3 kW/m <sup>2</sup> :	8,5 m	voldoet

## 6 Conclusie

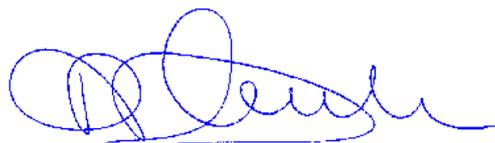
Uit bovenstaande indicatieve beoordeling blijkt dat waterstofproductie dan wel de op- en overslag van waterstof in een vloeibaar medium als brandstof van de binnenvaartschepen door de Dekker Groep een geringe risicocontour ( $10^{-6}$ /jaar) oplevert. Deze contour treedt net buiten de eigen inrichtingsgrens, maar raakt geen bebouwing omdat de contour op openbaar water is gelegen. Het groepsrisico blijft ruim onder de oriëntatiewaarde. Het voldoet hiermee aan het gemeentelijk beleid waarbij geen overschrijding van het plaatsgebonden risico en de oriëntatiewaarde plaatsvindt.

Vanuit de regelgeving voor externe veiligheid zijn er vooralsnog geen juridische belemmeringen. In een vervolgstadium (bij uitwerking van de plannen) zal getoetst moeten worden aan de drempelwaarde voor Brzo-inrichting en de BBT-conclusies en PGS-35-richtlijn.

LBP|SIGHT BV



ir. J.J. (Judith) Strik



ing. P.A.G. (Paul) van der Vleuten

## Bijlage Input report Safeti

### Input Report

Workspace: 087286aa - risicocontour waterstof Dekker

### Study

Study

087286aa - risicocontour waterstof Dekker

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)	Buildings\Building type	
Dispersion	Distances of interest	Distances of interest		m

### Tijdelijke opslag gasvormige waterstof

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Opslag

Tab	Group	Field	Value	Units
Material	Material	Material	HYDROGEN	
		Specify volume inventory?	Yes	
		Mass inventory	100,383	kg
		Volume inventory	40	m3
		Material to track	HYDROGEN	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	20	degC
		Pressure (gauge)	30	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		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	40	m3
		Tank vapour volume	40	m3
		Tank liquid volume	0	m3
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164575	m
		North	434213	m
		Apply location offset	Yes	

## 10 min uitstroming

Fixed duration release

087286aa - risicocontour waterstof Dekker\Study\Opslag\Tijdelijke opslag gasvormige waterstof

Tab	Group	Field	Value	Units
Scenario	Scenario	Duration for fixed duration release	600	s
	Hole	Orifice diameter		mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## 10 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Opslag\Tijdelijke opslag gasvormige waterstof

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	10	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## instantaan falen

Catastrophic rupture

087286aa - risicocontour waterstof Dekker\Study\Opslag\Tijdelijke opslag gasvormige waterstof

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation	1	m
		Tank head	0	m
	Fireball emissive power	Use vessel burst pressure	No	
		Vessel burst pressure - gauge		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	HYDROGEN	
		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	

## Opslag waterstofrijke LOHC

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Opslag

Tab	Group	Field	Value	Units
Material	Material	Material	HYDROGEN	
		Specify volume inventory?	No	
		Mass inventory	800	kg
		Volume inventory	39,1703	m3
		Material to track	HYDROGEN	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	20	degC
		Pressure (gauge)	300	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		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	39,1703	m3
		Tank vapour volume	39,1703	m3
		Tank liquid volume	0	m3
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164568	m
		North	434175	m
		Apply location offset	Yes	

## 10 min uitstroming

Fixed duration release

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofrijke LOHC

Tab	Group	Field	Value	Units
Scenario	Scenario	Duration for fixed duration release	600	s
	Hole	Orifice diameter		mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## 10 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofrijke LOHC

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	10	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction

	Release location	Elevation	1	m
		Tank head	0	m
	Direction	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## instantaan falen

Catastrophic rupture

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofrijke LOHC

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation	1	m
		Tank head	0	m
	Fireball emissive power	Use vessel burst pressure	No	
		Vessel burst pressure - gauge		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	HYDROGEN	
		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	

## Opslag waterstofarme LOHC

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Opslag

Tab	Group	Field	Value	Units
Material	Material	Material	N-PENTANE	
		Specify volume inventory?	No	
		Mass inventory	800	kg
		Volume inventory	1,27646	m3
		Material to track	N-PENTANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	20	degC
		Pressure (gauge)	300	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		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	1,27646	m <sup>3</sup>
		Tank vapour volume	0	m <sup>3</sup>
		Tank liquid volume	1,27646	m <sup>3</sup>
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164584	m
		North	434176	m
		Apply location offset	No	

## 10 min uitstroming

Fixed duration release

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofarme LOHC

Tab	Group	Field	Value	Units
Scenario	Scenario	Duration for fixed duration release	600	s
	Hole	Orifice diameter		mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	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	N-PENTANE	
		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	

## 10 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofarme LOHC

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	10	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	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	N-PENTANE	
		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

## instantaan falen

Catastrophic rupture

087286aa - risicocontour waterstof Dekker\Study\Opslag\Opslag waterstofarme LOHC

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation	1	m
		Tank head	0	m
	Fireball emissive power	Use vessel burst pressure	No	
		Vessel burst pressure - gauge		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	N-PENTANE	
		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		m
		Averaging time for reports	NLIV [1 hr]	No
			IDLH [30 mins]	No
		STEL [15 mins]	No	

## Afleverzuil LOHC

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Afleverstation

Tab	Group	Field	Value	Units
Material	Material	Material	HYDROGEN	
		Specify volume inventory?	No	

		Mass inventory	1	kg
		Volume inventory	0,249868	m3
		Material to track	HYDROGEN	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	200	degC
		Pressure (gauge)	80	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		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	0,249868	m <sup>3</sup>
		Tank vapour volume	0,249868	m <sup>3</sup>
		Tank liquid volume	0	m <sup>3</sup>
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164606	m
		North	434113	m
		Apply location offset	No	

## Instantaan vrijkomen van de gehele inhoud

Catastrophic rupture

087286aa - risicocontour waterstof Dekker\Study\Aflieverstation\Aflieverzuil LOHC

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation	1	m

		Tank head	0	m
	Fireball emissive power	Use vessel burst pressure	No	
		Vessel burst pressure - gauge		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	HYDROGEN	
		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	

## Vrijkomen van de gehele inhoud uit de grootste aansluiting

Leak

087286aa - risicocontour waterstof Dekker\Study\Afleverstation\Afleverzuil LOHC

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	50	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## Waterstofschip

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Afleverstation

Tab	Group	Field	Value	Units
Material	Material	Material	HYDROGEN	
		Specify volume inventory?	Yes	
		Mass inventory	200,106	kg
		Volume inventory	50	m3
		Material to track	HYDROGEN	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	200	degC
		Pressure (gauge)	80	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		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	50	m <sup>3</sup>
		Tank vapour volume	50	m <sup>3</sup>
		Tank liquid volume	0	m <sup>3</sup>
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164602	m
		North	434120	m
		Apply location offset	No	

## 10 min uitstroming

Fixed duration release

087286aa - risicocontour waterstof Dekker\Study\Afleverstation\Waterstofschip

Tab	Group	Field	Value	Units
Scenario	Scenario	Duration for fixed duration release	600	s
	Hole	Orifice diameter		mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## 10 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Afleverstation\Waterstofschip

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	10	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## instantaan falen

Catastrophic rupture

087286aa - risicocontour waterstof Dekker\Study\Afleverstation\Waterstofschip

Tab	Group	Field	Value	Units
Scenario	Release location	Elevation	1	m
		Tank head	0	m
	Fireball emissive power	Use vessel burst pressure	No	
		Vessel burst pressure - gauge		bar
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	HYDROGEN	
		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	

## Leiding met waterstof

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Leidingen

Tab	Group	Field	Value	Units		
Material	Material	Material	HYDROGEN			
		Specify volume inventory?	Yes			
		Mass inventory	4,00212	kg		
		Volume inventory	1	m3		
		Material to track	HYDROGEN			
		Type of risk effects to model	Flammable only			
		Phase	Specified condition	Pressure/temperature		
			Temperature	200	degC	
			Pressure (gauge)	80	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	5	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	1	m3
		Tank vapour volume	1	m3
		Tank liquid volume	0	m3
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164574	m
		North	434192	m
		Apply location offset	No	

**breuk**  
Short pipe

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstof

Tab	Group	Field	Value	Units	
Scenario	Scenario	Scenario type	Line rupture		
	Pipe dimensions	Pipe internal diameter	10	mm	
		Pipe length	5	m	
	Hole	Orifice diameter		mm	
	Release location	Elevation	1	m	
		Tank head	0	m	
	Flow control	Flow controller	None		
		Input option	Not applicable		
		Fixed flow rate		kg/s	
	Direction	Pump head		m	
		Outdoor release direction	Horizontal		
		Outdoor release angle	0	deg	
		Event frequency	Event frequency	5E-06	/AvgeYear
	Risk	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	HYDROGEN		
		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	

## 5 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstof

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	5	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0	deg
Risk	Event frequency	Event frequency	2,5E-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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## Leiding met waterstofrijke LOHC

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Leidingen

Tab	Group	Field	Value	Units
Material	Material	Material	HYDROGEN	
		Specify volume inventory?	Yes	
		Mass inventory	4,00212	kg
		Volume inventory	1	m <sup>3</sup>
		Material to track	HYDROGEN	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	200	degC
		Pressure (gauge)	80	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	50	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	1	m <sup>3</sup>
		Tank vapour volume	1	m <sup>3</sup>
		Tank liquid volume	0	m <sup>3</sup>
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164584	m
		North	434160	m
		Apply location offset	No	

## breuk

Short pipe

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstofrijke LOHC

Tab	Group	Field	Value	Units
Scenario	Scenario	Scenario type	Line rupture	
	Pipe dimensions	Pipe internal diameter	50	mm
		Pipe length	50	m
	Hole	Orifice diameter		mm
	Release location	Elevation	1	m
		Tank head	0	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	5E-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	HYDROGEN	
		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	

## 50 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstofrijke LOHC

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	50	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0	deg
Risk	Event frequency	Event frequency	0,00025	/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	HYDROGEN	
		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	NLIV [1 hr]	No	
		IDLH [30 mins]	No	
		STEL [15 mins]	No	

## Leiding met waterstofarme LOHC

Pressure vessel

087286aa - risicocontour waterstof Dekker\Study\Leidingen

Tab	Group	Field	Value	Units
Material	Material	Material	N-PENTANE	
		Specify volume inventory?	Yes	
		Mass inventory	626,734	kg
		Volume inventory	1	m3
		Material to track	N-PENTANE	
		Type of risk effects to model	Flammable only	
	Phase	Specified condition	Pressure/temperature	
		Temperature	20	degC
		Pressure (gauge)	300	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	50	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	1	m3
		Tank vapour volume	0	m3
		Tank liquid volume	1	m3
		Tank liquid level	0	m
		Maximum vapour release height		m
		Minimum mass inventory	0,1	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	164572	m
		North	434156	m
		Apply location offset	No	

## breuk

Short pipe

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstofarme LOHC

Tab	Group	Field	Value	Units
Scenario	Scenario	Scenario type	Line rupture	
	Pipe dimensions	Pipe internal diameter	50	mm
		Pipe length	50	m
	Hole	Orifice diameter		mm
	Release location	Elevation	1	m
		Tank head	0	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	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	N-PENTANE	
		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	

## 50 mm gat

Leak

087286aa - risicocontour waterstof Dekker\Study\Leidingen\Leiding met waterstofarme LOHC

Tab	Group	Field	Value	Units
Scenario	Hole	Orifice diameter	50	mm
		Use specified discharge coefficient?	No	
		Discharge coefficient		fraction
	Release location	Elevation	1	m
		Tank head	0	m
	Direction	Outdoor release direction	Horizontal	
		Outdoor release angle	0	deg
Risk	Event frequency	Event frequency	0,00025	/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	N-PENTANE	
		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	