

**VERMILION
E N E R G Y**



Vermilion Energy Netherlands

NSL-01 Water Injectie

Jaarrapportage 2017

Versie 1.0

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Introductie

Op 9 februari 2010 heeft het Ministerie van Economische Zaken toestemming gegeven om formatie water in de diepe ondergrond te injecteren op locatie Nijensleek (NSL) aan de Bosschasteeg te Nijensleek.

In de voorschriften behorende bij deze beschikking is opgenomen dat de meet en registratie verplichtingen jaarlijks worden geëvalueerd en in de vorm van een jaarrapportage worden ingediend. Dit rapport is een samenvatting van de activiteiten in kalenderjaar 2017.

Samenvatting

Gedurende het jaar 2017 is formatiewater van de volgende velden geïnjecteerd in de put Nijensleek-01 (NSL-01):

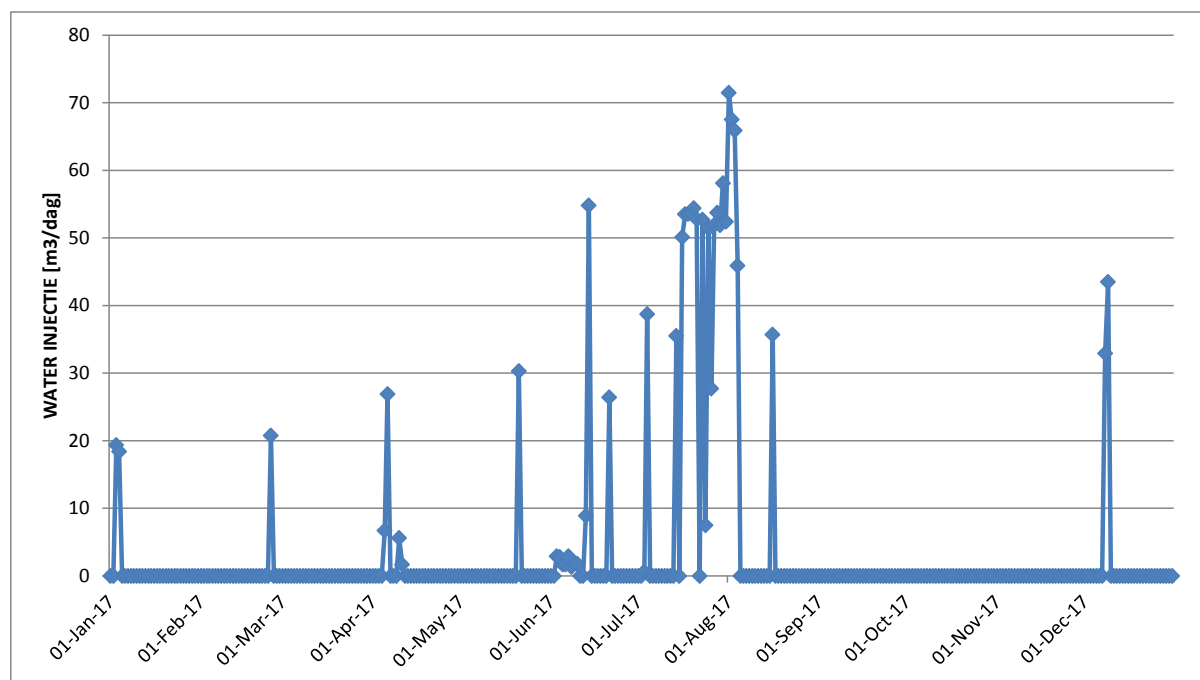
- Eesveen (put ESV-01)
- Middelburen (put MBN-02)
- Brakel (put BRAK-01)
- Langezwaag (putten LZG-01, LZG-02 en LZG-03)
- Slootdorp (putten SLD-06 en SLD-07)

De maximaal te injecteren hoeveelheid productiewater volgens de beschikking bedraagt 350 m³/dag met een maximaal totaal van 240.000 m³. Het totale geïnjecteerde water volume in 2017 is 1.400 m³. Tabel 1 laat zien de jaarlijkse hoeveelheid water injectie in NSL-01.

Samen met het productie water wordt er Cortron RN-518 corrosie remmer geïnjecteerd (1 liter per 40 m³ productie water) Daarnaast worden er geen andere additieven geïnjecteerd.

Tabel 1: Jaarlijks geïnjecteerde hoeveelheid water in NSL-01.

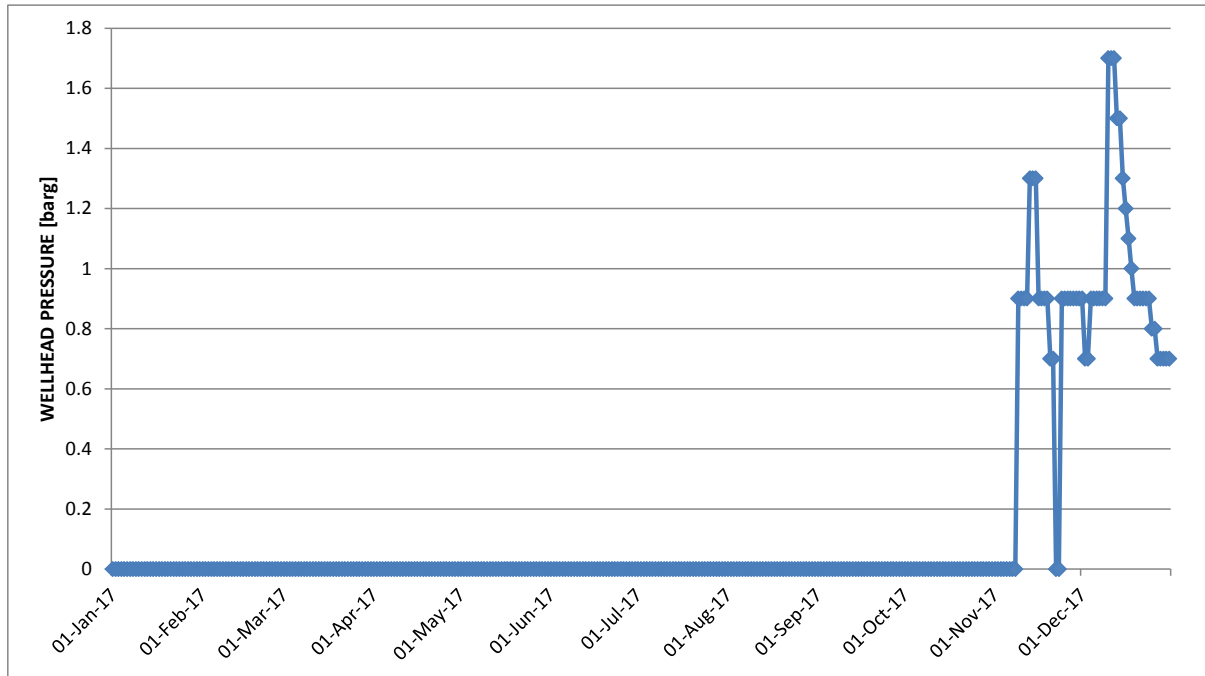
Jaar	Geïnjecteerd volume [in m ³]
2011	13.314
2012	3.654
2013	2.006
2014	7.640
2015	12.434
2016	5.750
2017	1.400
Totaal	46.198



Figuur 1: NSL-01 water injectie snelheid in 2017.

Afwijkingen in injectiedrukken

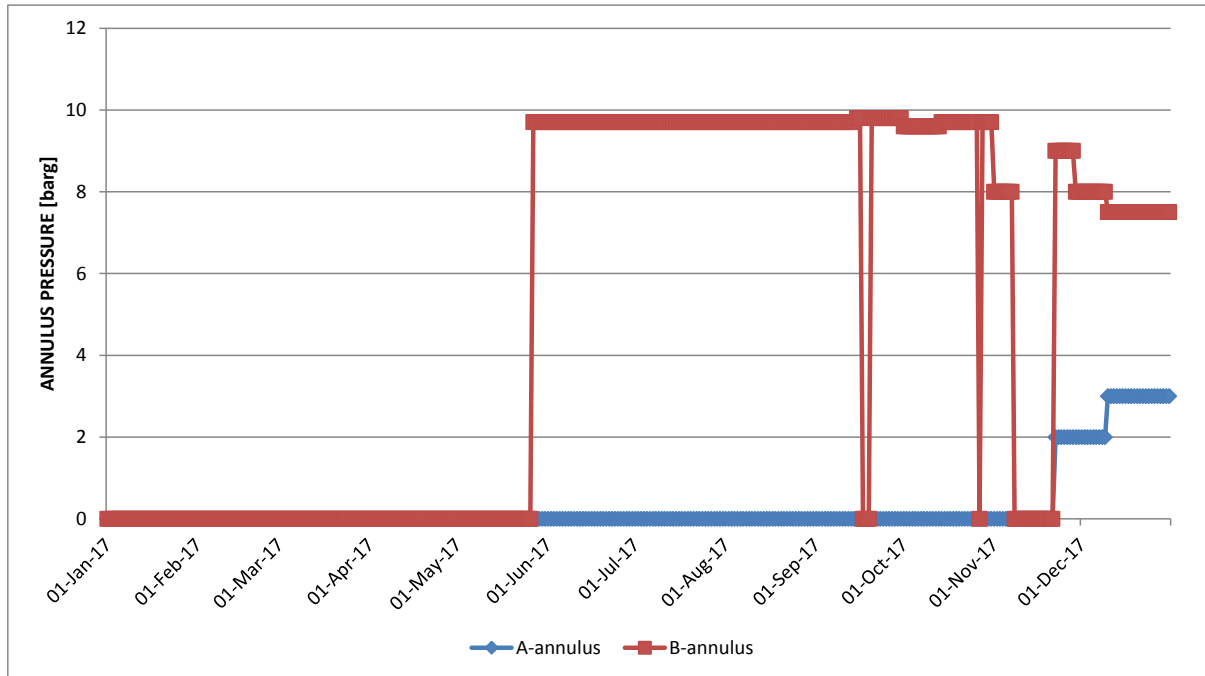
De injectie druk wordt regelmatig genoteerd tijdens routine rondes. Alle waarnemingen in 2017 zijn in Figuur 2 weergegeven.



Figuur 2: NSL-01 water injectiedruk in 2017.

Afwijkingen in annulaire drukken

De annulaire druk wordt regelmatig genoteerd tijdens routine rondes. Alle waarnemingen uit 2017 zijn in de tabel hieronder weergegeven.



Figuur 3: NSL-01 annulus drukken in 2017.

Mechanische zaken en onderhoud

De volgende werkzaamheden zijn uitgevoerd in 2017:

Datum	Omschrijving
31/mei/2017	Bijvullen accumulator druk van wellhead control panel.
24/jul/2017	Op druk brengen van het wellhead control panel.
6/sep/2017	SCSSV leak rate test; all OK.
9/sep/2017	Hydraulic Master Valve leak rate test; all OK.
27/sep/2017	Het opnemen van een caliper log in put NSL-01. De caliper log geeft aan tubing wall loss en een aantal gaten tussen 500 – 1500 mMD.

Water injectie is gestopt na de interpretatie van de caliper log waaruit bleek dat er gaten zaten in de tubing. Een tubing – A-annulus communicatie test heeft dit na het nemen van de caliper log bewezen.

Momenteel onderzoekt Vermilion de mogelijkheid om de tubing in NSL-01 te vervangen.

Incidenten of lekkages

Er hebben zich in 2017 geen incidenten of lekkages voor gedaan.

Injectie is gestopt nadat bekend werd dat er communicatie was tussen de tubing en A-annulus.

Vloeistof analyses

Op de volgende bladzijdes zijn de resultaten van een uitgebreide analyse van het geïnjecteerde water weergegeven.



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ANALYTICAL REPORT SR-1777067.01.A01

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grade	PROCESWATER
sample 001	Sample received from client Sample packed in plastic, quantity approx. 3 L Sample marked as Location: Slootdorp-1 08-03-2017
date received	09.03.2017

Q Density at 20°C, g/cm3
(ASTM D 4052) 1.0998

pH at 20°C
(ASTM E 70) 6.17

Flash point, Pensky Martens closed cup, oC
(ASTM D 93 procedure A, modified) >80

Chloride as Cl-, mg/L
(SGS SPI 158) 74800

Ionchromatographic analysis
(SGS SPI 164)

- Sulphate as SO_4^{2-} , mg/kg 740

Total Suspended Solids (>5um), mg/kg
(NEN 872) 2.0

Metals
(NEN6961/NEN 6966/C1)

- Arsene, µg/l <10
- Cadmium, µg/l <1.0
- Chrome, µg/l 130
- Copper, µg/l 10
- Iron, µg/l 13000
- Lead, µg/l 10
- Nickel, µg/l <10
- Zinc, µg/l 240

Mercury, µg/L <0.10
(NEN EN 1483)

Bicarbonate as HCO₃, mg/L 41
(WAC/III/A/006)

Carbonate as CO₃, mg/L <2.5
(WAC/III/A/006)

PAH, µg/L <20
(SGS 12-01)

Volatile components
(SIKB3001 / AS-3130)

- Benzene, µg/l	2500
- Ethylbenzene, µg/l	6.1
- Toluene, µg/l	260
- m,p Xylene, µg/l	30
- o-Xylene, µg/l	39
- sum of Xylenes, µg/l	69
- sum of BTEX, µg/l	2800
- Naphthalenes, µg/l	37

Hardness, mgCaCO₃/L 18702
(calculated from Ca/Mg)

Minerals Oil
(NEN-EN-ISO 9377-2)

- Fraction C10-C12, µg/l	630
- Fraction C12-C22, µg/l	4800
- Fraction C22-C30, µg/l	340
- Fraction C30-C40, µg/l	<250
-Total C10-C40, µg/l	5700

Sum of Arsene, + Mercury + Benzene, µg/L <2510
(Calculated)

Total Sulfide as S, mg/L <0.050
(WAC/III/C/040)

Gaschromatographic analysis

(SGS 2005-18)

- Methylglycol , mg/L	<2.5
- Ethylglycol, mg/L	<2.5
- Isopropylglycol , mg/L	<2.5
- Butylglycol , mg/L	<2.5
- Dimethylglycol, mg/L	<2.5
- Ethyleenglycol, mg/L	<2.5
- Diethyleenglycol, mg/L	<2.5

^Q Tests marked with Q are performed under RvA ISO 17025 Accreditation (L092)

Samples will be retained for 3 months unless instructed otherwise.

End of analytical results

Spijkenisse, the 27th March 2017
SGS Nederland B.V. - Oil, Gas and Chemicals

Laboratory Manager

The results shown in this test report specifically refer to the sample(s) tested as received unless otherwise stated. All tests have been performed using the latest revision of the methods indicated, unless specifically marked otherwise on the report. Precision parameters apply in the determination of the above results. Users of the data shown on this report should refer to the latest published revisions of ASTM D-3244; IP 367; ISO 4259 and Appendix E of IP Standard Methods for Analysis and Testing when utilizing the test data to determine conformance with any specification or process requirement. SGS' sole responsibility is to its client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Warning: The sample(s) to which the findings recorded herein (the "Findings") relate was (were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.



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ANALYTICAL REPORT SR-1781770.01.A01

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grade	PROCESWATER
sample 001	Sample received from client Sample packed in plastic, quantity approx. 3 L Sample marked as Location: Gorredijk NSL Injectiewater Sample date: 24-03-2017 15:00h
date received	31.03.2017

Q Density at 20°C, g/cm³
(ASTM D 4052) 1.0748

pH at 20°C
(ASTM E 70) 5.49

Flash point, Pensky Martens closed cup, °C
(ASTM D 93 procedure A, modified) >80

Chloride as Cl⁻, mg/L
(SGS SPI 158) 95000

Ionchromatographic analysis
(SGS SPI 164)

- Sulphate as SO₄²⁻, mg/kg 250

Total Suspended Solids (>5µm), mg/kg
(NEN 872) 82.0

Metals
(NEN6961/NEN 6966/C1)

- Arsene, µg/l <10

- Cadmium, µg/l <1.0

- Chrome, µg/l 120

- Copper, µg/l 19

- Iron, µg/l 53000

- Lead, µg/l 31

- Nickel, µg/l 26

- Zinc, µg/l 4900

Mercury, µg/L <0.10
(NEN EN 1483)

Bicarbonate as HCO₃, mg/L 96
(WAC/III/A/006)

Carbonate as CO₃, mg/L <2.5
(WAC/III/A/006)

PAH, µg/L <6.7
(SGS 12-01)

Volatile components
(SIKB3001 / AS-3130)

- Benzene, µg/l 1700
- Ethylbenzene, µg/l <20
- Toluene, µg/l 290
- m,p Xylene, µg/l 48
- o-Xylene, µg/l 36
- sum of Xylenes, µg/l 84
- sum of BTEX, µg/l <2100
- Naphthalenes, µg/l 12

Hardness, mgCaCO₃/L 11716
(calculated from Ca/Mg)

Minerals Oil
(NEN-EN-ISO 9377-2)

- Fraction C10-C12, µg/l 3600
- Fraction C12-C22, µg/l 12000
- Fraction C22-C30, µg/l 1800
- Fraction C30-C40, µg/l 900
- Total C10-C40, µg/l 18300

Sum of Arsene, + Mercury + Benzene, µg/L <1710
(Calculated)

Total Sulfide as S, mg/L 3
(WAC/III/C/040)

Gaschromatographic analysis
(SGS 2005-18)

- Methylglycol , mg/L <2.5

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- Ethylglycol, mg/L	<2.5
- Isopropylglycol , mg/L	<2.5
- Butylglycol , mg/L	<2.5
- Dimethylglycol, mg/L	<2.5
- Ethyleenglycol, mg/L	<2.5
- Diethyleenglycol, mg/L	170

^Q Tests marked with Q are performed under RvA ISO 17025 Accreditation (L092)

End of analytical results

Spijkenisse, the 13th April 2017
SGS Nederland B.V. - Oil, Gas and Chemicals

M. Audier
Laboratory Manager

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ANALYTICAL REPORT SR-1831897.01.A01

P.1/3

grade	PROCESWATER
sample 001	Sample received from client Sample packed in glass, quantity approx. 3 L Sample marked as Vermilion Nijensleek D165A 29-11-2017
date received	05.12.2017

Density at 20°C, g/cm³ 1.1198
(ASTM D 4052)

pH at 20°C 5.80
(ASTM E 70)

Flash point, Pensky Martens closed cup, °C >80
(ASTM D 93 procedure A, modified)

Chloride as Cl⁻, mg/L 106100
(SGS SPI 158)

Ionchromatographic analysis
(SGS SPI 164)

- Sulphate as SO₄²⁻, mg/kg 200

Total Suspended Solids (>5um), mg/l 40
(NEN 872)

Metals
(NEN6961/NEN 6966/C1)

- Arsene, µg/l 17

- Cadmium, µg/l 76

- Chrome, µg/l 110

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- Copper, µg/l	<10
- Lead, µg/l	840
- Nickel, µg/l	410
- Zinc, µg/l	42000
<u>Mercury, µg/L</u> (NEN EN 1483)	<0.10
<u>Bicarbonate as HCO₃, mg/L</u> (WAC/III/A/006)	95
<u>Carbonate as CO₃, mg/L</u> (WAC/III/A/006)	<2.5
<u>PAH, µg/L</u> (SGS 12-01)	<250
<u>Volatile components</u> (SIKB3001 / AS-3130)	
- Benzene, µg/l	880
- Ethylbenzene, µg/l	<20
- Toluene, µg/l	250
- m,p Xylene, µg/l	160
- o-Xylene, µg/l	180
- sum of Xylenes, µg/l	340
- sum of BTEX, µg/l	1470
- Naphthalenes, µg/l	220
<u>Hardness, mgCaCO₃/L</u> (calculated from Ca/Mg)	31550
<u>Minerals Oil</u> (NEN-EN-ISO 9377-2)	
- Fraction C10-C12, µg/l	30000
- Fraction C12-C22, µg/l	59000
- Fraction C22-C30, µg/l	2900
- Fraction C30-C40, µg/l	<2500
-Total C10-C40, µg/l	93000
<u>Sum of Arsene, + Mercury + Benzene, µg/L</u> (Calculated)	<900
<u>Total Sulfide as S, mg/L</u> (WAC/III/C/040)	<0.1

Gaschromatographic analysis

(SGS 2005-18)

- 1.2 Propyleenglycol, mg/l	<25
- 1.3 Propyleenglycol, mg/l	<25
- Dietyleenglycol, mg/l	<25
- Monoethyleenglycol, mg/l	<25
- Triethyleenglycol, mg/l	<25
- Tripropyleenglycol, mg/l	40

^Q Tests marked with Q are performed under RvA ISO 17025 Accreditation (L092)

End of analytical results

Spijkensisse, the 15th December 2017
SGS Nederland B.V. - Oil, Gas and Chemicals

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Laboratory Manager

The results shown in this test report specifically refer to the sample(s) tested as received unless otherwise stated. All tests have been performed using the latest revision of the methods indicated, unless specifically marked otherwise on the report. Precision parameters apply in the determination of the above results. Users of the data shown on this report should refer to the latest published revisions of ASTM D-3244; IP 367; ISO 4259 and Appendix E of IP Standard Methods for Analysis and Testing when utilizing the test data to determine conformance with any specification or process requirement. SGS' sole responsibility is to its client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Warning: The sample(s) to which the findings recorded herein (the "Findings") relate was (were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.