

## Beschrijving WIMS

In het WIMS worden de richtlijnen voor de technische integriteit van de putten opgesteld die behouden moeten worden gedurende de levensduur van de putten.

Definieert en beschrijft put status en operatie limieten

## Production Philosophy

Het put integriteit beleid beschrijft de verplichting om gezondheid, veiligheid, milieu en reputatie te beschermen. WIMS is het systeem dat garandeert dat de integriteit van de put word gehandhaafd gedurende de gehele levenscyclus van de geothermische putten door de toepassing van technische, operationele en organisatorische processen. Hierbij wordt het risico op het ongecontroleerd vrijkomen van formatie vloeistof gereduceerd tot een minimum

Versie nummer: 1

### Gebruikers

#### handleiding:

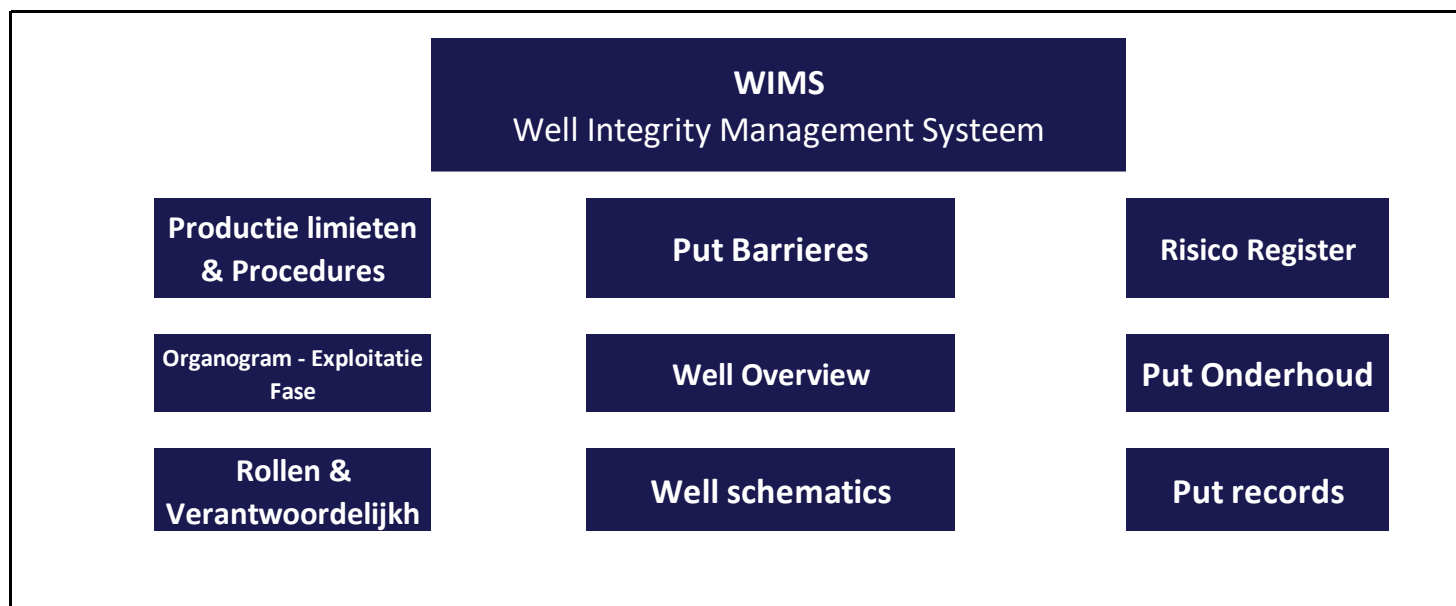
Dashboards zijn geautomatiseerd

Put onderhoud wordt ingevuld en bijgehouden

Beschermde tabs kunnen bekeken worden door iedereen maar alleen bijgewerkt worden door de PT

Iedereen die met dit programma moet werken, krijgt vooraf een werkinstructie van de PT

| Revisie nr. | Datum      | Persoon | Gecommuniceerd? |
|-------------|------------|---------|-----------------|
| 1           | 20/3/2019  | AR      | Ja              |
| 2           | 10/09/2019 | AR      | Ja              |
| 3           | 13/11/2019 | AR      | Ja              |
| 4           |            |         |                 |
| 5           |            |         |                 |







Productie limieten & Procedures

ISO/TS 16530-1 5.8, Mijnbouwwet Art 33 & 33a

| Productieput limieten KHL-GT-02-P |            |         |                     | Injectieput limieten KHL-GT-01-I |         |         |                     |                                               |  |  |  |
|-----------------------------------|------------|---------|---------------------|----------------------------------|---------|---------|---------------------|-----------------------------------------------|--|--|--|
| Omschrijving                      | Minimum    | Maximum | eenheid             | Omschrijving                     | Minimum | Maximum | eenheid             | Opmerkingen                                   |  |  |  |
| Temperatuur                       | 30         | 86      | °C                  | Temperatuur                      | 30      | 86      | °C                  |                                               |  |  |  |
| Druk (Gas scheider)               | 0          | 16      | bar                 | Druk (na injectiepomp)           | 0       | 42      | bar                 | put getest tot 42 bar, max THP SodM is 66 bar |  |  |  |
| ESP frequentie                    | 35         | 55      | Hz                  | Debiet Brijn                     | 120     | 400     | m <sup>3</sup> /h   | ESP depth = 700m, 709 meter, previously 475m  |  |  |  |
| Debiet Brijn                      | 120        | 400     | m <sup>3</sup> /h   | Debiet Gas                       | 0       | 1       | Sm <sup>3</sup> /m3 |                                               |  |  |  |
| Debiet Gas                        | 0          | 1       | Sm <sup>3</sup> /m3 | Fines filtration                 | 0,1     | 1       | micron              |                                               |  |  |  |
| Corrosie inhibitor                | 0          | 15      | ppm                 | Fines concentration              | 0       | 1       | ppm                 |                                               |  |  |  |
| pH                                | 4          | 8       | -                   | pH                               | 4       | 8       | -                   |                                               |  |  |  |
| Reservoir Pressure                | x          | 258     | bar                 | Reservoir pressure               | x       | 263     | bar                 |                                               |  |  |  |
| LPR meting 2020                   | 0,02       | 0,29    | mm/j                |                                  |         |         |                     | Gemiddelde sinds 1-jan 2020 0.16 mm/j         |  |  |  |
| A-Annulus Pressure                | 0          | 16      | bar                 | A-Annulus                        | 0       | 42      | bar                 | max. druk bepaald door rating put (patch)     |  |  |  |
| CI residuals                      | >1         |         | ppm                 |                                  |         |         |                     |                                               |  |  |  |
| Density                           | 1,05       | 1,15    | g/ml                |                                  |         |         |                     |                                               |  |  |  |
| Iron                              | 0          | 100     | mg/L                |                                  |         |         |                     |                                               |  |  |  |
| Chloride                          | 85000      | 95000   | mg/L                |                                  |         |         |                     |                                               |  |  |  |
| Hardness                          | 7500       | 1500    | °dH                 |                                  |         |         |                     |                                               |  |  |  |
| Revisie nummer                    | 1.0        |         |                     |                                  |         |         |                     |                                               |  |  |  |
| Datum                             | 01/04/2020 |         |                     |                                  |         |         |                     |                                               |  |  |  |
| Wijzigingsreferentie (# MOC)      | NA         |         |                     |                                  |         |         |                     |                                               |  |  |  |

Prestatie Limieten stalen behuizing

Wall thickness Producer

Principal pressure: Collapse pressure

Method applied: Lamé thick wall elastic solution

| Casing size | Casing weight [ppf] | Depth interval [mAH] | Minimale dikte [mm]** | Veiligheids- marge | Gewenste minimale dikte [mm] | Minimale levensduur [jaar] | Maximale corrosion rate [mm/y] |
|-------------|---------------------|----------------------|-----------------------|--------------------|------------------------------|----------------------------|--------------------------------|
| 13 3/8      | 72                  | 0-747                | 7,7                   | 10%                | 8,4                          | 30,0                       | 0,15                           |
| 13 3/8      | 68                  | 747-933              | 7,4                   | 10%                | 8,2                          | 30,0                       | 0,13                           |
| 9 5/8       | 47                  | 945-2385*            | 5,6                   | 10%                | 6,2                          | 30,0                       | 0,19                           |
| 9 5/8       | 43,5                | 945-2385*            | 5,6                   | 10%                | 6,2                          | 30,0                       | 0,16                           |

\*The main observation based on the performed data QC is significant offset in the diameter readings from UltraViewtm – CalViewtm tools and assumed expected nominal value to be 220.5mm @ 47lbs casing. Average diameter reading from the SecureView tools over the casing joints that are free of corrosion/pits oscillates around 222.4.0mm, indicating that the possible casing weight is 45.5lbs, with the expected nominal diameter being equal to 222.4mm

\*\* Uitgaande van 40 bar drawdown

Wall thickness Injector

Principal pressure: Burst pressure

Method applied: Barlow equation

| Casing size | Casing weight [ppf] | Depth interval [mAH] | Minimale dikte [mm]* | Veiligheids- marge | Gewenste minimale dikte [mm] | Minimale levensduur [jaar] | Maximale corrosion rate [mm/y] |
|-------------|---------------------|----------------------|----------------------|--------------------|------------------------------|----------------------------|--------------------------------|
| 13 3/8      | 72                  | 0-923                | 1,29                 | 10%                | 1,42                         | 30,00                      | 0,39                           |
| 9 5/8       | 47                  | 923-2655             | 0,93                 | 10%                | 1,02                         | 30,00                      | 0,37                           |

\* Uitgaande van de vergunde maximale injectie druk

Prestatie Limieten stalen behuizing

Wall thickness Producer

Principal pressure: Collapse pressure

Method applied: Lamé thick wall elastic solution

| Casing size | Casing weight [ppf] | Depth interval [mAH] | Minimale dikte [mm]** | Veiligheids marge | Gewenste minimale dikte [mm] | Minimale levensduur [jaar] | Maximale corrosie rate [mm/y] | Nominale wanddikte [mm] | Maximale wanddikte afname & locatie                  | Tijd tot minimale wanddikte bereikt wordt [j] |
|-------------|---------------------|----------------------|-----------------------|-------------------|------------------------------|----------------------------|-------------------------------|-------------------------|------------------------------------------------------|-----------------------------------------------|
| 13 3/8      | 72                  | 0-747                | 4,8                   | 10%               | 5,3                          | 30,0                       | 0,15                          | 13,10                   | Cal: 43.4% @ 734 7.4mm<br>URS: 20.3% @491 6.25mm     | 5,9                                           |
| 13 3/8      | 68                  | 747-933              | 4,9                   | 10%               | 5,4                          | 30,0                       | 0,13                          | 12,20                   | Cal: 55.1% @ 757.46 6.52mm<br>URS: 42.8% @859 6.05mm | 4,1                                           |
| 9 5/8       | 47                  | 945-2385*            | 3,7                   | 10%               | 4,1                          | 30,0                       | 0,19                          | 12,00                   | Cal: 48.6% @951.7m 8.73mm<br>URS: 40% @1416 8.36mm   | 26,6                                          |
| 9 5/8       | 43,5                | 945-2385*            | 3,7                   | 10%               | 4,1                          | 30,0                       | 0,16                          | 11,05                   | Cal: 48.6% @951.7m 8.73mm<br>URS: 40% @1416 8.36mm   | 26,6                                          |

\*The main observation based on the performed data QC is significant offset in the diameter readings from UltraView™ - CalView™ tools and assumed expected nominal value to be 220.5mm @ 47lbs casing. Average diameter reading from the SecureView tools over the casing joints that are free of corrosion/pits oscillates around 222.4.0mm, indicating that the possible casing weight is 46.5lbs, with the expected nominal diameter being equal to 222.4mm

\*\* Uitgaande van 40 bar drawdown

| Datum logging | Logging part | Logging interval | Logging tools                                    | Bevindingen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Opmerkingen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------|--------------|------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15-01-2017    | Weatherford  | 2-955            | URS, MFC (60 arm, high resolution), CCL, GR      | -Minor defect at 930,62m (could be dirt)<br>-Caliper corrected for eccentricity<br>-736,6m (21%)<br>-787,57m (21%)<br>-914,73m (21%)<br>-No major casing ovality or eccentricity observed<br>-Average remaining wall thickness 13,06mm<br>- Obtained ID close to expected nominal (220,49mm)<br>- Class 2 reduction (21-40%) over hardware area 940,75m<br>- 2215,5m 2371m dirt<br>- Average remaining wall thickness 11,5mm<br>- 1276,5m 22% reduction of nominal casing thickness                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|               |              | 924-2378         | URS, MFC (60 arm, high resolution), CIT, CCL, GR | - Obtained ID close to expected nominal (150,4mm and 147,1mm)<br>- Milling pattern visible<br>- Joints with different casing weight                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|               |              | 2786-2390        | MFC (40 arm, high resolution)                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 26-07-2018    | Multiline    | 7-2386           | MFC (40 arm & 20 arm)                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | - Logs niet bruikbaar door foutieve tool calculations based on 68 pdf -funnel vormige diameter toename beide secties                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 18-12-2019    | Weatherford  | 7.3-932.2        | MSC                                              | - 0.0 – 747.0m, 13 3/8in @ 72lbs with expected nominal ID of 313.61mm<br>- 747.0 – 933.0m, 13 3/8in @ 68lbs with expected nominal ID of 315.34mm<br>- 700-932.2m diameter increase<br>- Weakest point @757.4, joint 42 with 55.1% reduction of nominal casing thickness 17789 kPa burst pressure (not visible in 2016)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | good correlation is observed between the diameters from UltraView™ - CalView™ survey recorded in 2019 and the ones from 2017 in the interval from 8.5 – 700.0m<br>good shape free of major defects and lack of the deterioration of the quality of the inner side of the casing between 2017 and 2019 surveys                                                                                                                                                                                                                                                                                                                                                                             |
|               |              | 94-941           | URS                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|               |              | 875-2387         | MSC                                              | - Maximum defect penetration (the weakest point) was identified at 951.7m with the severity of 48.6% reduction of the nominal casing thickness (Class 3 defect with the expected burst pressure of 27803 kPa – based on the Barlow method). Joint summary analysis from the 2017 does not indicates any significant defects over this zone.<br>- It is expected that just below this depth, packer was present (around 952.0 – 957.0m). This feature was excluded from the analysis, so it is not affecting quantitative results.<br>- Below this interval the casing is on good condition indicating no well integrity issues. Good correlation between CalView™ data from 2017 and 2019 is observed (1450.0 – 2382.0m).<br>- 88 joint <20% wall thickness loss<br>- 33 joints 20-40% wall thickness loss<br>- 9 joints 40-60% wall thickness loss (4 in 9 5/8") | expected nominal value to be 220.5mm @ 47lbs casing. Average diameter reading from the SecureView tools over the casing joints that are free of corrosion/pits oscillates around 222.4.0mm, indicating that the possible casing weight is 43.5lbs, with the expected nominal diameter being equal to 222.4mm. logs analysis performed with 47# -some of the casing joints are affected more dominantly by the corrosion than the others. An example can be the joint at the depth ~1364.0 – 1375.7m, where degree of the corrosion is larger than on the adjacent joints. That can suggest different casing composition e.g. casing grade with more susceptibility for corrosion process. |
|               |              | 885-2392         | URS                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Class 1 | Class 2 | Class 3 | Class 4 | Class 5 | Total nr joints |
|---------|---------|---------|---------|---------|-----------------|
| 0-20%   | 20-40%  | 40-60%  | 60-80%  | 80-100% |                 |
| 109     | 76      | 22      | 0       | 0       | 201             |

JOINT SUMMARY

| Joint | OD     | Max wall loss [%] | Casing weight [ppf] | Burst pressure [kPa] | Worst defect depth [m] | Defect type | Joint class | Calculated Min. thickness casing [mm] | Ultraview Min. thickness casing [mm] | Verskil tussen sonic en caliper | Formatie achter casing | Qualiteit cement              |
|-------|--------|-------------------|---------------------|----------------------|------------------------|-------------|-------------|---------------------------------------|--------------------------------------|---------------------------------|------------------------|-------------------------------|
| 1     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        | Free pipe till 47m            |
| 2     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 3     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 4     | 13.374 | 20,1              | 72                  | 33861                | 55                     | GEN         | 2           |                                       |                                      |                                 |                        |                               |
| 5     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 6     | 13.374 | 20,6              | 72                  | 33649                | 77                     | GEN         | 2           |                                       |                                      |                                 |                        | Moderate to good bond quality |
| 7     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 8     | 13.374 | 20                | 72                  | 33903                | 93                     | GEN         | 2           | 10,5                                  | 8,02                                 | 2,5                             |                        |                               |
| 9     | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 10    | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |
| 11    | 13.374 |                   | 72                  |                      |                        |             | 1           |                                       |                                      |                                 |                        |                               |

Wall thickness Injector

Principal pressure: Burst pressure

Method applied: Barlow equation

| Casing size | Casing weight [ppf] | Depth interval [mAH] | Minimale dikte [mm]** | Veiligheids marge | Gewenste minimale dikte [mm] | Minimale levensduur [jaar] | Maximale corrosie rate [mm/y] |
|-------------|---------------------|----------------------|-----------------------|-------------------|------------------------------|----------------------------|-------------------------------|
| 13 3/8      | 72                  | 0-923                |                       | 1,29              | 10%                          | 1,42                       | 30,00                         |
| 9 5/8       | 47                  | 923-2655             |                       | 0,93              | 10%                          | 1,02                       | 30,00                         |

\* Uitgaande van de vergunde maximale injectie druk

| Datum logging | Logging part | Logging interval | Logging tools                          | Bevindingen | Opmerkingen |
|---------------|--------------|------------------|----------------------------------------|-------------|-------------|
| 01-09-2016    | Weatherford  | 0-920            | CCL-GR-URS                             |             |             |
|               |              | 923-2590         | CCL-GR-URS                             |             |             |
| 13-10-2016    | Weatherford  | 0-923            | MFC (60 arm, high resolution), CCL, GR |             |             |
|               |              | 923-2555         | MFC (60 arm, high resolution), CCL, GR |             |             |

[illegible]

## Monitoring & Maintenance Logboek

ISO/TS 16530-1 9.4 & 9.6; Mijnbouwbesluit Art 67 & 71

44373

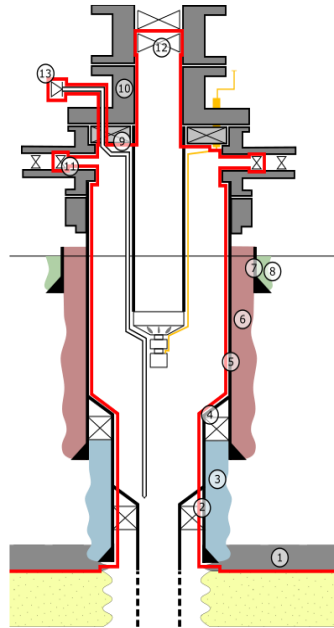
Jaar 2021

1 2 3 4 5 6

Week 30

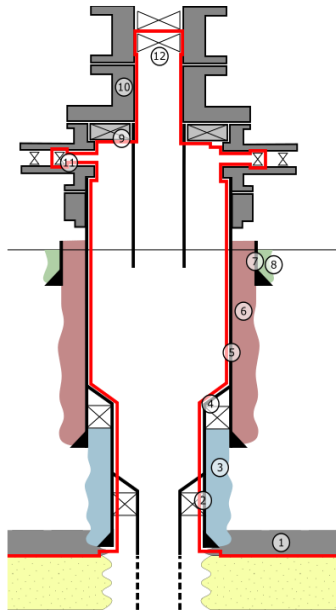
|   | Beschrijving                 | Hoe monitoren                                    | Performance Standard                                                                                                                        | Monitorings Interval | Jaar | Week | MA   | DI   | WO   | DO   | VR   | ZA   | ZO   | Opmerkingen                                                            |
|---|------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|------|------|------|------|------|------|------|------|------------------------------------------------------------------------|
|   |                              |                                                  |                                                                                                                                             |                      |      |      | 19/7 | 20/7 | 21/7 | 22/7 | 23/7 | 24/7 | 25/7 |                                                                        |
| 1 | Process metingen             | Rate, Pressure, Temperature                      | Within operating limits; Zie PI Flowchart                                                                                                   | elke werkdag         | 2019 | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1/1 Inhibitor verhoogd naar 6 ppm<br>3/1 inhibitor verhoogd naar 8 ppm |
| 2 | Wellhead & Valves            | Visuele inspectie                                | - No leaks<br>"- Kleppen alleen testen bij stilstand plant wegens bescherming seals en ophoping van vuil, zout en corrosie in cavity ruimte | elke werkdag         | 2019 | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | Zoutkristallen bij roosters injectiepomp verwijderd met stofzuiger     |
| 3 | Inhibitor line + check valve | Visuele inspectie inhibitor string & koppelingen | no leaks, > 9ppm                                                                                                                            | elke werkdag         | 2019 | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |                                                                        |
| 1 | Process metingen             | Rate, Pressure, Temperature                      | Within operating limits; Zie PI Flowchart                                                                                                   | elke werkdag         | 2019 | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |                                                                        |
| 2 | Wellhead & Valves            | Visuele inspectie                                | - No leaks<br>"- Kleppen alleen testen bij stilstand plant wegens bescherming seals en ophoping van vuil, zout en corrosie in cavity ruimte | elke werkdag         | 2019 | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 8/1 Zoutkristallen bij roosters injectiepomp verwijderd met stofzuiger |
| 3 | Inhibitor line + check valve | Visuele inspectie inhibitor string & koppelingen | no leaks, > 9ppm                                                                                                                            | elke werkdag         | 2019 | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |                                                                        |
| 1 | Process metingen             | Rate, Pressure, Temperature                      | Within operating limits; Zie PI Flowchart                                                                                                   | elke werkdag         | 2019 | 3    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |                                                                        |
| 2 | Wellhead & Valves            | Visuele inspectie                                | - No leaks<br>"- Kleppen alleen testen bij stilstand plant wegens bescherming seals en ophoping van vuil, zout en corrosie in cavity ruimte | elke werkdag         | 2019 | 3    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |                                                                        |

## Well Barriers KHL-GT-01-I



| #  | Description                        | Functie                                                                                                     | Failure modes                                                                                                           | Effect                                                                                                           | Consequentie                                                                                                     | Hoe monitoren                                                                                                                         | Performance Standard                                                                                                                               | Monitorings Interval                                             |
|----|------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| 1  | Reservoir top seal                 | Prevent leaking to upper aquifers                                                                           | Van toepassing op injector                                                                                              |                                                                                                                  |                                                                                                                  |                                                                                                                                       |                                                                                                                                                    |                                                                  |
| 2  | Intermediate liner (9-5/8")        | Prevent fluid interaction between wellbore and shallower aquifers                                           | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectiedrukken<br>Beschadiging door temperatuurschommelingen | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/ grondwater                                    | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Gebruik inhibitors<br>KPI metingen (rate, pressure, temperature)                                                                      | > 9 ppm<br>Within operating limits<br>Zie PI Flowchart                                                                                             | elke werkdag<br>continue                                         |
| 3  | Cement (9-5/8")                    | Support casing, Prevent communication between shallower aquifers                                            | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Preventatieve casing integrity logs<br>Water bemonstering<br>Check filters                                                            | iron losses < loss tolerance<br>Minimale afwijking samenstelling<br>Geen afwijking, Filtraat + frequentie<br>visselen                              | elke 2-5 jaar<br>elke 3 maanden<br>Elke wissel                   |
| 4  | Liner Hanger (13-3/8" X 9-5/8")    | Prevent fluid interaction between wellbore and shallower aquifers                                           | Loss of seal van liner-hanger packer                                                                                    | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                  | •Herstelkosten casing<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                              | Corrosie coupon analyse/ magneet<br>CBL<br>Groundwater monitoring (4 peilbuizen)                                                      | Corrosionrate < 0.05mm/yr<br>voldoende bonding<br>significant change in composition                                                                | elke 3 maanden<br>elke 10 jaar<br>elk jaar                       |
| 5  | Surface Casing (13-3/8")           | Prevent fluid interaction between wellbore and shallower aquifers                                           | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectiedrukken<br>Beschadiging door temperatuurschommelingen | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/ grondwater                                    | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | KPI metingen (rate, pressure, temperature)<br>Pressure test<br>Gebruik inhibitors<br>KPI metingen (rate, pressure, temperature)       | Within operating limits<br>Zie PI Flowchart<br>100 bar<br>> 9 ppm<br>Within operating limits<br>Zie PI Flowchart                                   | continue<br>In case expected failure<br>elke werkdag<br>continue |
| 6  | Cement (13-3/8")                   | Support casing, Prevent communication between shallower aquifers                                            | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Preventatieve casing integrity logs<br>Water bemonstering<br>Corrosie coupon analyse<br>Check filters                                 | iron losses < loss tolerance<br>Minimale afwijking samenstelling<br>Corrosionrate < 0.05mm/yr<br>Geen afwijking, Filtraat + frequentie<br>visselen | elke 2-5 jaar<br>elke 3 maanden<br>elke 3 maanden<br>Elke wissel |
| 7  | Conductor casing (16")             | Prevent fluid interaction between wellbore and shallow fresh-water aquifers                                 | Casing corrosie<br>Lekkende casing koppelingen                                                                          | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/ grondwater                                    | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Visuele inspectie putkelder<br>Groundwater monitoring (4 peilbuizen)                                                                  | Geen lekken<br>voldoende bonding<br>significant change in composition                                                                              | elke werkdag<br>elke 10 jaar<br>elk jaar                         |
| 8  | Conductor cement                   | Support casing, Prevent communication between shallower aquifers                                            | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Visual inspection annulus conductor x 13-3/8"                                                                                         | No fluid coming out of annulus                                                                                                                     | elke maand                                                       |
| 9  | Tubing Hanger + Penetrator systems | Prevent fluid interaction between wellbore and atmosphere, while letting power and inhibitor fluid in.      | Slechte drukseal van hanger/ slijtage                                                                                   | Lekkage formatiewater                                                                                            | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Visuele inspectie putkelder<br>Groundwater monitoring (4 peilbuizen)                                                                  | no leaks<br>Minimale afwijking samenstelling                                                                                                       | elke maand<br>elk jaar                                           |
| 10 | Wellhead                           | Prevent fluid interaction between wellbore and atmosphere                                                   | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                | •Lekkage formatiewater<br>•Lekkage gas (Explosiegevaar)<br>•Verontreiniging ondergrond<br>•Lekkage formatiewater | Pressure test tijdens workovers<br>Visuele inspectie                                                                                  | no leaks<br>Meet LEL tijdens inspectie<br>0% LEL<br>Pressure test tijdens workovers<br>Max leak rate: Gas - 0.43 Sm3/min;<br>Liquid - 400 Sm3/min  | elke werkdag<br>elke werkdag<br>elke 2-5 jaar<br>elke werkdag    |
| 11 | Wing valves                        | Prevent fluid interaction between wellbore and atmosphere                                                   | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                | •Lekkage formatiewater<br>•Verontreiniging ondergrond<br>•Lekkage gas                                            | Pressure test tijdens workovers<br>Check valve functionaliteit                                                                        | 210 bar<br>???turns                                                                                                                                | elke 2-5 jaar<br>Elke stop                                       |
| 12 | Main valves                        | Close well in case of emergency                                                                             | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                | •Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater             | Visuele inspectie<br>Pressure test tijdens workovers<br>Check valve functionaliteit                                                   | Max leak rate: Gas - 0.43 Sm3/min;<br>Liquid - 400 Sm3/min<br>100 bar<br>???turns                                                                  | elke werkdag<br>elke 2-5 jaar<br>Elke stop                       |
| 13 | Inhibitor line + check valve       | Let inhibitor fluid in to prevent casing damage (corrosion), while preventing flow from well to atmosphere. | Falen van check-valve<br>Slijtage/corrosie inhibitor lijn<br>Breek van inhibitor lijn                                   | Lekkage inhibitor<br>Lekken gas en vloeistof vanuit de put naar oppervlakte<br>Versnelde corrosie door verkeerde | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                       | Monitor het inhibitor verbruik<br>Test check-valve functionaliteit<br>Visuele inspectie inhibitor string & koppelingen<br>Tracer test | >9ppm<br>Goede werking tot 100 bar<br>no leaks<br>Dosering top Liner                                                                               | elke werkdag<br>Elke stop<br>elke werkdag<br>elke 2 jaar         |

## Well Barriers KHL-GT-02-P



| #  | Description                        | Functie                                                                                                | Failure modes                                                            | Effect                                                                            | Consequentie                                                                                                                                                                                   | Hoe monitoren                                                                              | Performance Standard                                               | Metings Interval                                    |
|----|------------------------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------|
| 1  | Reservoir top seal                 | Prevent leaking to upper aquifers                                                                      | Te hoge injectedrukken                                                   | Verlies reservoir top seal integriteit                                            | Lekkage formatiewater<br>Seismiciteit                                                                                                                                                          | Monitoring tubing head pressure injector.                                                  | max 44.5 bar                                                       | continue                                            |
| 2  | Intermediate liner (9-5/8")        | Prevent fluid interaction between wellbore and shallower aquifers                                      | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectedrukken | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | Gebruik inhibitors<br>KPI metingen (rate, pressure, temperature)                           | > 9 ppm<br>Within operating limits<br>Zie PI Flowchart             | eke werkdag<br>continue                             |
| 3  | Cement (9-5/8")                    | Support casing, Prevent communication between shallower aquifers                                       | Slechte cementering van de casing                                        | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                   | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | Preventatieve casing integrity logs<br>Water bemonstering                                  | iron losses < loss tolerance<br>Minimale afwijking samenstelling   | eke 2-5 jaar<br>eke 3 maanden                       |
| 4  | Liner Hanger (13-3/8" X 9-5/8")    | Prevent fluid interaction between wellbore and shallower aquifers                                      | Loss of seal van liner-hanger packer                                     | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                   | •Herstelkosten casing<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                            | Check filters<br>Corrosie coupon analyse                                                   | Geen afwijking, Filtraat + frequentie<br>Corrosionrate < 0.05mm/yr | EK jaar<br>eke 3 maanden                            |
| 5  | Surface Casing (13-3/8")           | Prevent fluid interaction between wellbore and shallower aquifers                                      | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectedrukken | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | CBL<br>Groundwater monitoring (4 peilbuizen)                                               | voldoende bonding<br>significant change in composition             | eke 10 jaar<br>ek jaar                              |
| 6  | Cement (13-3/8")                   | Support casing, Prevent communication between shallower aquifers                                       | Slechte cementering van de casing                                        | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                   | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | KPI metingen (rate, pressure, temperature)                                                 | Within operating limits<br>Zie PI Flowchart                        | continue                                            |
| 7  | Conductor casing (16")             | Prevent fluid interaction between wellbore and shallow fresh-water aquifers                            | Casing corrosie<br>Lekkende casing koppelingen                           | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater  | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | Pressure test<br>Gebruik inhibitors<br>KPI metingen (rate, pressure, temperature)          | 100 bar<br>> 9 ppm<br>Within operating limits<br>Zie PI Flowchart  | In case expected failure<br>eke werkdag<br>continue |
| 8  | Conductor cement                   | Support casing, Prevent communication between shallower aquifers                                       | Slechte cementering van de casing                                        | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                   | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | Preventatieve casing integrity logs<br>Water bemonstering                                  | iron losses < loss tolerance<br>Minimale afwijking samenstelling   | eke 2-5 jaar<br>eke 3 maanden                       |
| 9  | Tubing Hanger + Penetrator systems | Prevent fluid interaction between wellbore and atmosphere, while letting power and inhibitor fluid in. | Slechte drukseal van hanger/ slijage                                     | Lekkage formatiewater                                                             | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                                                                     | Check filters<br>Corrosie coupon analyse                                                   | Geen afwijking, Filtraat + frequentie<br>Corrosionrate < 0.05mm/yr | Eke wissel<br>eke 3 maanden                         |
| 10 | Wellhead                           | Prevent fluid interaction between wellbore and atmosphere                                              | Suboptimaal designfunctioneren well head / X-tree                        | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing | •Lekkage formatiewater<br>•Lekkage gas (Explosiegevaar)<br>•Verontreiniging ondergrond<br>•Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater | CBL<br>Groundwater monitoring (4 peilbuizen)                                               | voldoende bonding<br>significant change in composition             | ek jaar                                             |
| 11 | Wing valves                        | Prevent fluid interaction between wellbore and atmosphere                                              | Suboptimaal designfunctioneren well head / X-tree                        | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing | •Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                           | Visual inspection annulus conductor x 13-3/8"                                              | No fluid coming out of annulus                                     | eke maand                                           |
| 12 | Main valves                        | Close well in case of emergency                                                                        | Suboptimaal designfunctioneren well head / X-tree                        | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing | •Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                                                           | Visuele inspectie<br>Meet LEL tijdens visuele inspectie<br>Pressure test tijdens workovers | no leaks<br>0%LEL<br>100 bar                                       | eke werkdag<br>eke werkdag<br>eke 2-5 jaar          |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Pressure test tijdens workovers                                                            | 100 bar                                                            | eke 2-5 jaar                                        |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Visuele inspectie                                                                          | no leaks                                                           | eke werkdag                                         |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Meet LEL tijdens visuele inspectie                                                         | 0%LEL                                                              | eke werkdag                                         |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Pressure test tijdens workovers                                                            | 100 bar                                                            | eke 2-5 jaar                                        |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Visuele inspectie                                                                          | Max leak rate: Gas - 0.43 Sm3/min;<br>Liquid - 400 Scm3/min        | eke werkdag                                         |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Pressure test tijdens workovers                                                            | 100 bar                                                            | eke 2-5 jaar                                        |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Check valve functionaliteit                                                                | ???turns                                                           | eke stop                                            |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Visuele inspectie                                                                          | Max leak rate: Gas - 0.43 Sm3/min;<br>Liquid - 400 Scm3/min        | eke werkdag                                         |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Pressure test tijdens workovers                                                            | 100 bar                                                            | eke 2-5 jaar                                        |
|    |                                    |                                                                                                        |                                                                          |                                                                                   |                                                                                                                                                                                                | Check valve functionaliteit                                                                | ???turns                                                           | Eke stop                                            |

Risk Assessment Matrix

| Nr.                                                                                                                             | Taak / Oorzaak                                                                                              | Risico                                                                           | Consequentie / Gevolg                                                                                            | Aanwezige maatregel om risico te voorkomen                                                                                                                                                            | Risiko=WxExE |      |     |        |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------|-----|--------|
|                                                                                                                                 |                                                                                                             |                                                                                  |                                                                                                                  |                                                                                                                                                                                                       | W            | B    | E   | Score  |
| 1                                                                                                                               | Casing corrosie                                                                                             | Lekkage formatiewater naar ondergrond/grondwater                                 | *Verontreiniging ondergrond<br>*Verontreiniging grondwater                                                       | *Water analyses<br>*KPI metingen (rate, pressure, temperature)<br>*Preventatieve casing integrity logs elke 5 jaar<br>*Corrosie monitoring (LPR, corrosie coupons, magnet, caliper logs, andere logs) | 2,5          | 6,3  | 7,0 | 110,25 |
| 2                                                                                                                               | Lekkende casing koppelingen                                                                                 | Lekkage formatiewater naar ondergrond/grondwater                                 | *Verontreiniging ondergrond<br>*Verontreiniging grondwater                                                       | *Gebruik inhibitors<br>*KPI metingen (rate, pressure, temperature)<br>*Preventatieve casing integrity logs elke 5 jaar<br>*Corrosie monitoring (corrosie coupons, caliper logs, andere logs)          | 2,5          | 6,3  | 7,0 | 110,25 |
| 3                                                                                                                               | Slechte cementering van de casing                                                                           | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                  | *Verontreiniging ondergrond<br>*Verontreiniging grondwater                                                       | *Run Inside Cement Bond Log (CBL) voor het meten van cement kwaliteit<br>*CBL elke 10 jaar<br>*Grondwater monitoring (minimaal jaarlijks, 4 peilbuizen op de locatie)                                 | 1,2          | 12,5 | 7,0 | 105    |
| 4                                                                                                                               | Lekkage chemicalen vanaf het oppervlakte                                                                    | Grondverontreiniging                                                             | *Verontreiniging ondergrond<br>*Verontreiniging grondwater                                                       | *Fluid tight asphalt<br>*Chemicalen in vloeistofdichte container<br>*Grondwater monitoring (jaarlijks, 4 peilbuizen op de locatie)                                                                    | 1,2          | 12,5 | 3,0 | 45     |
| 5                                                                                                                               | Slijtage screen                                                                                             | Meer reservoir materiaal productie                                               | *Verhoogde mechanische corrosie (erosie)                                                                         | *Monitoring filter exchange                                                                                                                                                                           | 2,5          | 6,3  | 7,0 | 110,25 |
| 6                                                                                                                               | Te hoge injectiedrukken                                                                                     | Casing burst (evi icm risk 1)                                                    | *Lekkage formatiewater                                                                                           | *Monitoring tubing head pressure injector.<br>*Bijstellen maximale injectiedruk bij vermindering casing dikte: update operating standards after logging                                               | 2,5          | 3,1  | 7,0 | 54,25  |
| 7                                                                                                                               | Te weinig voordruk op ESP                                                                                   | Gas cusping                                                                      | *Defecte ESP                                                                                                     | *Druk beveiliging bij de ESP van ~7?bar                                                                                                                                                               | 2,5          | 6,3  | 3,0 | 47,25  |
| 8                                                                                                                               | Opwarm en afkoel effecten van de casing                                                                     | Beschadiging conductor, casing, screens, putkelder                               | *Herstekosten conductor/casing/screens/putkelder<br>*Verminderde flow rate door kleinere diameter (frictie)      | *Ontwerp uitgangspunten hanteren, Casing logging<br>*Visuele inspectie putkelder<br>*KPI metingen (rate, pressure, temperature)                                                                       | 1,2          | 6,3  | 7,0 | 52,92  |
| 9                                                                                                                               | Mechanische erosie rondom hoog turbulente gedeelten : ESP inlet, linerhanger, x-overs, ESP-outlet, wellhead | Versnelde slijtage casing & wellhead                                             | *Herstekosten wellhead & casing                                                                                  | *Ontwerp uitgangspunten hanteren, ESP op verschillende diepten<br>*Check filters (productie)<br>*KPI metingen (rate, pressure, temperature)                                                           | 1,2          | 12,5 | 7,0 | 105    |
| 10                                                                                                                              | Suboptimaal design/functionerenen well head / X-tree                                                        | Lekkage barriers: hoofdafsluters, afdichtingen op casing, afdichting prod tubing | *Lekkage formatiewater<br>*Lekkage gas<br>*Verontreiniging ondergrond<br>*Verontreiniging grondwater             | *Ontwerp uitgangspunten hanteren.<br>*Visuele inspectie<br>*Pressure test na installatie<br>*Pressure test tijdens workovers<br>*Check valve functionaliteit                                          | 1,2          | 3,1  | 3,0 | 11,10  |
| 11                                                                                                                              | Niet functioneren corrosie inhibitor string                                                                 | Versnelde corrosie                                                               | (Zie Risk ID 1.2)                                                                                                | *Monitor het inhibitor verbruik<br>*Monitor het inhibitor injectie skid druk<br>*water analyses<br>*Tracer test<br>*Visuele inspectie inhibitor string & koppelingen                                  | 1,2          | 6,3  | 7,0 | 52,92  |
| 12                                                                                                                              | Te hoge annulus druk                                                                                        | Gas cusping ESP (niet merkbaar door ESP drukmetingen)                            | Defecte ESP                                                                                                      | *Monitor annulus druk<br>*Tracing gas line to prevent freezing                                                                                                                                        | 1,2          | 3,1  | 3,0 | 11,10  |
| 13                                                                                                                              | Warmte-radiatie rondom geothermisch doublet                                                                 | Opwarmen oppervlakte water                                                       | Verstoren natuurlijk systeem: Verontreiniging grondwater / schade ecosysteem                                     | *Grondwater monitoring (minimaal jaarlijks, 4 peilbuizen op de locatie)                                                                                                                               | 1,2          | 0,8  | 7,0 | 6,72   |
| 14                                                                                                                              | Te hoge injectiedrukken                                                                                     | Verlies reservoir top seal integriteit                                           | *Lekkage formatiewater                                                                                           | *Monitoring tubing head pressure injector.<br>*Ontwerp uitgangspunten hanteren: Maximale injectiedruk onder track-gradient                                                                            | 1,2          | 0,8  | 7,0 | 6,72   |
| 15                                                                                                                              | Te hoge injectiedrukken                                                                                     | Seismiciteit                                                                     | *Schade aan gebouwen/infrastructuur in omgeving<br>*Eventueel lekkage formatiewater via (gecreeerde) breuk/frack | *Seismische Risico Analyse opgesteld<br>*Monitoring tubing head pressure injector.<br>*Maximale injectiedruk onder frack-gradient<br>*Monitoren seismiciteit met KNMI station/netwerk                 | 1,2          | 3,1  | 7,0 | 26,04  |
| *) Beheersmaatregelen benoemen in de volgende volgorde: 1. Oorzaak wegnemen 2. Omgeving veiligstellen 3. Persoonlijke acties 4. |                                                                                                             |                                                                                  |                                                                                                                  |                                                                                                                                                                                                       |              |      |     |        |

| Waarschijnlijkheid |                                 | Blootstelling |                        | Effecten |                                  |
|--------------------|---------------------------------|---------------|------------------------|----------|----------------------------------|
| W                  | Mogelijk risico                 | B             | Blootstellingsduur     | E        | Mogelijke Effecten               |
| 10                 | Zo goed als zeker               | 10            | Voortdurend            | 100      | Ramp (meerdere doden)            |
| 6                  | Zeer goed mogelijk              | 6             | Regelmatig (Dagelijks) | 40       | Calamiteit (1 dode)              |
| 3                  | Waarschijnlijk                  | 3             | Af en toe (wekelijks)  | 15       | Zeer ernstig (blijvend letsel)   |
| 1                  | Mogelijk, maar onwaarschijnlijk | 2             | Soms (Maandelijks)     | 7        | Ernstig (zwaar letsel)           |
| 0.5                | Zeer onwaarschijnlijk           | 1             | Zelden (Jaarlijks)     | 3        | Zware verwonding (met verzuim)   |
| 0.2                | Praktisch onmogelijk            | 0.5           | Zeer zelden            | 1        | Lichte verwonding (geen verzuim) |
| 0.1                | Zo goed als ondenkbaar          |               |                        |          |                                  |

W

10,0

X

B

6,0

X

E

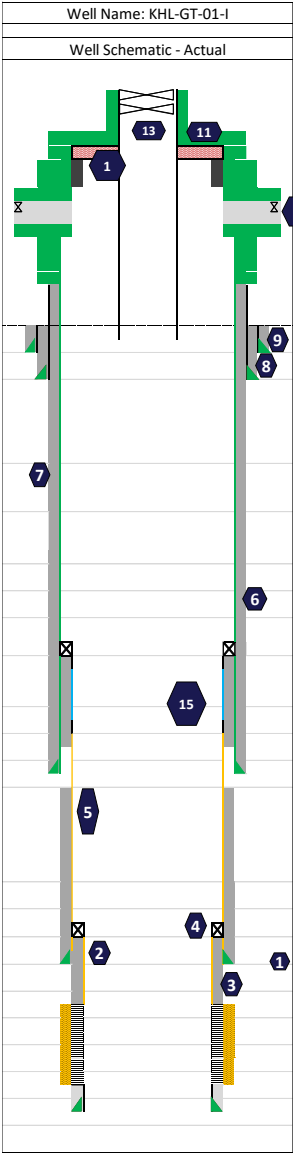
3

R =

180

| R      | Risico     | Maatregelen                                                |
|--------|------------|------------------------------------------------------------|
| 200>   | Zeer groot | Directe actie is noodzakelijk (werk tijdelijk stil leggen) |
| 70-199 | Groot      | Actie is noodzakelijk.                                     |
| 20-69  | Mogelijk   | Actie is wenselijk.                                        |
| <20    | Klein      | Actie overwegen                                            |

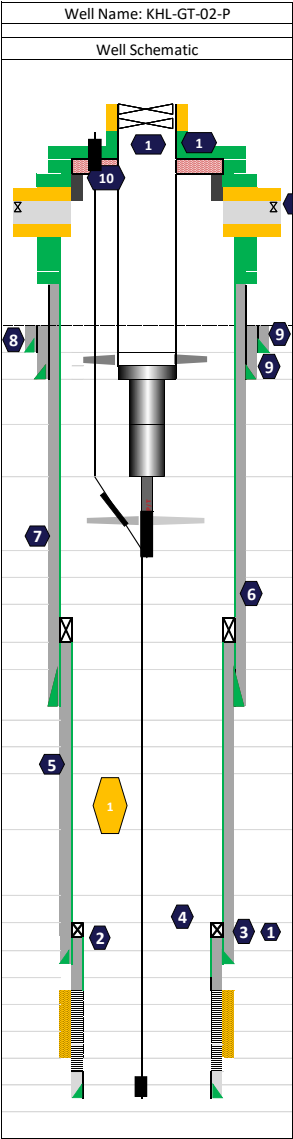
Well Barrières



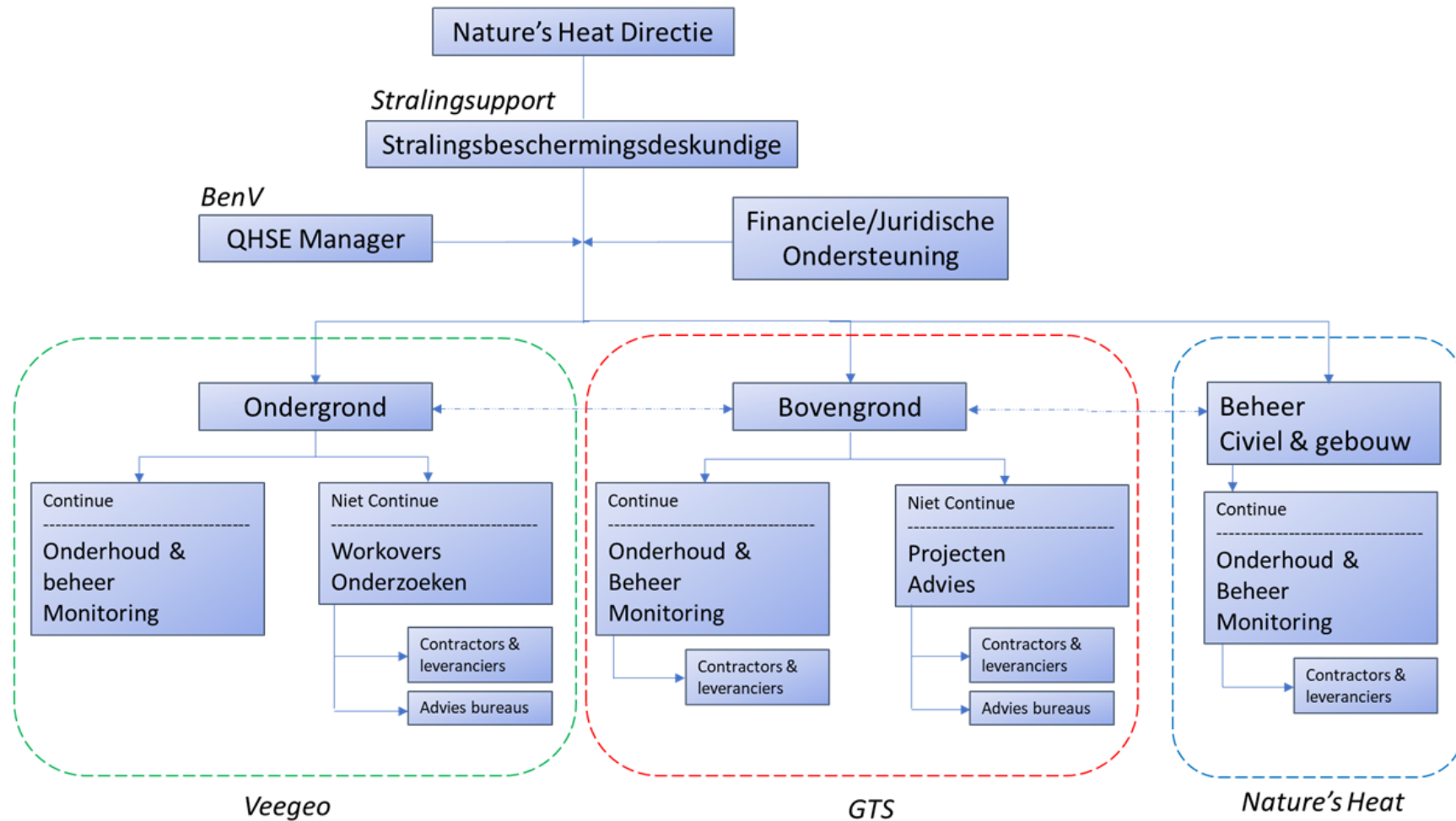
ISO/TS 16530-1 5.7.3; Mijnbouwbesluit Art 67 & 71; Mijnbouwregeling Art 8.4.1 & 8.4.4

- Barrier getest
- Barrier niet getest
- Barrier gefaalt

| #  | Barriere element type          | Functie                                                                                                                  | Performance standard                                                                                                       | Faal karakteristieken                                                                                                   | Effect                                                                                                                    | Consequentie                                                                                                          |
|----|--------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1  | Reservoir top seal             | Weerhoudt lekkage naar hoger gelegen sedimenten                                                                          | Corrosierate <0.1mm/year<br>Monitoren dmw corrosie coupon, LPR<br>Logging                                                  | Van toepassing op injector                                                                                              |                                                                                                                           |                                                                                                                       |
| 2  | Intermediate liner (6-5/8")    | Weerhoudt vloeistof interactie tussen het boorgat en lager gelegen aquifers                                              | Corrosierate <0.1mm/year<br>Monitoren dmw corrosie coupon, LPR<br>Logging                                                  | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectiedrukken<br>Beschadiging door temperatuurschommelingen | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater                                          | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 3  | Cement (6-5/8")                | Ondersteunt casing en weerhoudt communicatie tussen lager gelegen aquifers                                               | Voldoende bonding<br>Monitoren: CBL log                                                                                    | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                           | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 4  | Liner Hanger (9-5/8" x 6-5/8") | Weerhoudt vloeistof interactie tussen het boorgat en lager gelegen aquifers                                              | Pressure test = 42 bar                                                                                                     | Loss of seal van liner-hanger packer                                                                                    | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                           | •Herstelkosten casing<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                                   |
| 5  | Liner (9-5/8")                 | Weerhoudt vloeistof interactie tussen het boorgat en lager gelegen aquifers                                              | Corrosierate <0.1mm/year<br>Monitoren dmw corrosie coupon, LPR<br>en logging                                               | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectiedrukken<br>Beschadiging door temperatuurschommelingen | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater                                          | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 6  | Surface Casing (13 3/8")       | Weerhoudt vloeistof interactie tussen het boorgat en lager gelegen aquifers                                              | Corrosierate <0.1mm/year<br>Monitoren dmw corrosie coupon, LPR en logging                                                  | Casing corrosie<br>Lekkende casing koppelingen<br>Te hoge injectiedrukken<br>Beschadiging door temperatuurschommelingen | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater                                          | •Verontreiniging ondergrond/<br>grondwater                                                                            |
| 7  | Cement (13-3/8")               | Ondersteunt casing en weerhoudt communicatie tussen lager gelegen aquifers                                               | Voldoende bonding<br>Monitoren: CBL log                                                                                    | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                           | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 8  | Conductor casing (20")         | Weerhoudt vloeistof interactie tussen het boorgat en laag gelegen zoet water aquifers                                    | Corrosierate <0.1mm/year<br>Monitoren dmw corrosie coupon, LPR en logging                                                  | casing corrosie<br>Lekkende casing koppeling                                                                            | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater                                          | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 9  | Conductor cement               | Support casing, Prevent communication between shallow aquifers                                                           | Voldoende bonding<br>Monitoren: CBL log                                                                                    | Slechte cementering van de casing                                                                                       | Lekkage formatiewater naar hogere lagen (via buitenkant casing)                                                           | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 10 | Tubing Hanger                  | Weerhoudt vloeistof interactie tussen het boorgat en de lucht, terwijl het wel stroom en inhibitor vloeistof binnen laat | Pressure test = 42 bar                                                                                                     | Slechte drukseal van hanger/ slijtage                                                                                   | Lekkage formatiewater                                                                                                     | •Verontreiniging ondergrond<br>•Verontreiniging grondwater                                                            |
| 11 | Wellhead                       | Prevent fluid interaction between wellbore and atmosphere                                                                | Pressure test = 42 bar<br>no leaks                                                                                         | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                         | •Lekkage formatiewater<br>•Lekkage gas (Explosiegevaar)<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater |
| 12 | Wing valves                    | Prevent fluid interaction between wellbore and atmosphere                                                                | Pressure test = 42 bar<br>no leaks<br>Max leak rate: Gas - 0.43 Sm3/min; Liquid - 400 Scm3/min                             | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                         | •Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                  |
| 13 | Main valves                    | Close well in case of emergency                                                                                          | Kleppen alleen testen bij stilstand plant wegens bescherming seals en ophoping van vuil, zout en corrosie in cavity ruimte | Suboptimaal design/functioneren well head / X-tree                                                                      | Lekkage barriers: hoofdafsluiters, afdichtingen op casing, afdichting prod tubing                                         | •Lekkage formatiewater<br>•Lekkage gas<br>•Verontreiniging ondergrond<br>•Verontreiniging grondwater                  |
| 14 | Inhibitor line + check valve   | Let inhibitor fluid in to prevent casing damage (corrosion), while preventing flow from well to atmosphere.              | Pressure test = 42 bar<br>no leaks                                                                                         | Falen van check-valve<br>Slijtage/corrosie inhibitor lijn<br>Breek van inhibitor lijn                                   | Lekkage inhibitor<br>Lekken gas en vloeistof vanuit de put naar oppervlakte<br>Versnelde corrosie door verkeerde dosering | •verontreiniging ondergrond/grondwater                                                                                |
| 15 | Patch                          | These perforations were shot to cement the 9 5/8" Liner in place after the accidental setting of the XTS Packer          | No leaks, pressure test                                                                                                    |                                                                                                                         | Verlies casing integrity<br>Lekkage formatiewater naar ondergrond/<br>grondwater                                          |                                                                                                                       |



## Organogram - Exploitatie Fase



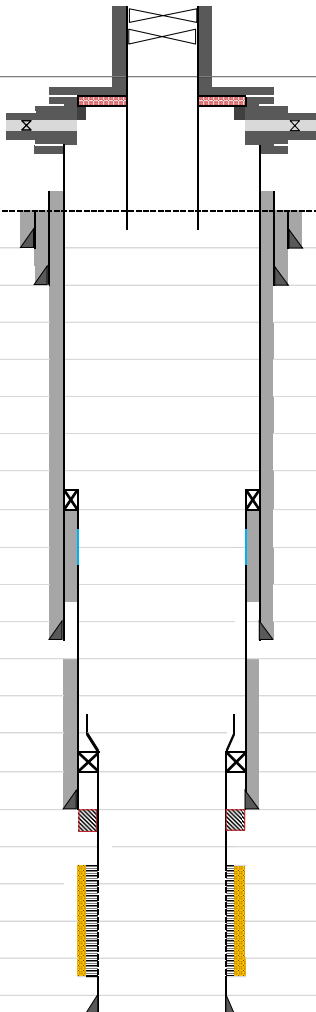
## well records

| Type of record               | well      | Type of record        | Date of record | Company      | Results updated in WIMS | Link to record                                                                                                                                                                                                                    |
|------------------------------|-----------|-----------------------|----------------|--------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Well logs                    |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Well log                     |           | Advies 3e logging     |                | Veegeo       |                         | <a href="https://www.dropbox.com/s/iw42nuqjm1t322m/Advies%203e%20logging%20operatie_AR.pdf?dl=0">https://www.dropbox.com/s/iw42nuqjm1t322m/Advies%203e%20logging%20operatie_AR.pdf?dl=0</a>                                       |
| Well log                     | KHL-GT-01 | Litholog              | 09/10/2016     | Daldrup      |                         | <a href="https://www.dropbox.com/s/dzeii94qhs33xtp/Litholog%20KHL_GT_01_to_2974%20m%20Final.pdf?dl=0">https://www.dropbox.com/s/dzeii94qhs33xtp/Litholog%20KHL_GT_01_to_2974%20m%20Final.pdf?dl=0</a>                             |
| Well log                     | KHL-GT-02 | Litholog              | 10/1/1017      | Daldrup      |                         | <a href="https://www.dropbox.com/s/479522jhajx78oa/Litholog%20KHL_GT_02_to_2802_Final.pdf?dl=0">https://www.dropbox.com/s/479522jhajx78oa/Litholog%20KHL_GT_02_to_2802_Final.pdf?dl=0</a>                                         |
| Well test                    |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Well test                    | KHL-GT-01 | Well test             | 27/10/2016     | GEOS         |                         | <a href="https://www.dropbox.com/s/x2rbb29xetgnq1c/20161027%20Report%20Welltest%20KHL-GT-01.pdf?dl=0">https://www.dropbox.com/s/x2rbb29xetgnq1c/20161027%20Report%20Welltest%20KHL-GT-01.pdf?dl=0</a>                             |
| Well test                    | KHL-GT-02 | Well test             | 31/01/2017     | GEOS         |                         | <a href="https://www.dropbox.com/s/0wkh0y2c38acfzg/20170131%20Report%20Welltest%20KHL-GT-02.pdf?dl=0">https://www.dropbox.com/s/0wkh0y2c38acfzg/20170131%20Report%20Welltest%20KHL-GT-02.pdf?dl=0</a>                             |
| well test                    |           | Testplan              | 19/02/2018     | NH           |                         | <a href="https://www.dropbox.com/s/fmqgbyk25dqe08c/00%20Beschrijving%20Nature%27s%20Heat%20testplan%20Rv5.pdf?dl=0">https://www.dropbox.com/s/fmqgbyk25dqe08c/00%20Beschrijving%20Nature%27s%20Heat%20testplan%20Rv5.pdf?dl=0</a> |
| Water samples                |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Water samples                | KHL-GT-01 | PVT rapport           | 01/11/2016     | PanTerra     |                         | <a href="https://www.dropbox.com/s/rmzkj3v79mks6i6/20161101%20PVT%20Report%20KHL-GT-01.pdf?dl=0">https://www.dropbox.com/s/rmzkj3v79mks6i6/20161101%20PVT%20Report%20KHL-GT-01.pdf?dl=0</a>                                       |
| Water samples                | KHL-GT-02 | PVT rapport           | 27/02/2017     | PanTerra     |                         | <a href="https://www.dropbox.com/sh/zlrb19vkvrgvpv/AADFIIQPun8a7-Jccl9xo9VMa?dl=0">https://www.dropbox.com/sh/zlrb19vkvrgvpv/AADFIIQPun8a7-Jccl9xo9VMa?dl=0</a>                                                                   |
| Water samples                |           | Water analyse         | 09/11/2018     | SGS          |                         | <a href="https://www.dropbox.com/s/qjaouuz5j0wjvuv4/20181109%20SGS%20water%20analyse.pdf?dl=0">https://www.dropbox.com/s/qjaouuz5j0wjvuv4/20181109%20SGS%20water%20analyse.pdf?dl=0</a>                                           |
| Water samples                |           | Peilbuis analyse      |                | AquaTerra    |                         |                                                                                                                                                                                                                                   |
| Downhole sampling            |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Downhole sampling            |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Filter samples               |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Filter samples               |           | Filter sample         | 14/08/2018     | BH           |                         | <a href="https://www.dropbox.com/s/6qetnykaikc757k/20180531%20Baker%20Hughes%20Filter%20sample.pdf?dl=0">https://www.dropbox.com/s/6qetnykaikc757k/20180531%20Baker%20Hughes%20Filter%20sample.pdf?dl=0</a>                       |
| Filter samples               |           | NORM                  | 24/11/2018     | Applus + RTD |                         | <a href="https://www.dropbox.com/s/7jzubuxlrbtrvbu/20181124%20NORM%20analyse%20filter.pdf?dl=0">https://www.dropbox.com/s/7jzubuxlrbtrvbu/20181124%20NORM%20analyse%20filter.pdf?dl=0</a>                                         |
| Filter samples               |           | Filter sample         | 16/08/2019     | Applus + RTD |                         | <a href="https://www.dropbox.com/s/6uk7d1nltiyjdh/16082019%20Nature%27sHeat-Filter%20Rapportage.pdf?dl=0">https://www.dropbox.com/s/6uk7d1nltiyjdh/16082019%20Nature%27sHeat-Filter%20Rapportage.pdf?dl=0</a>                     |
| Logboek                      |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Logboek                      |           | Logboek 2019          |                |              |                         | <a href="https://www.dropbox.com/s/dvfii74538prkpr/Logboek%202019%20%286%29.xlsx?dl=0">https://www.dropbox.com/s/dvfii74538prkpr/Logboek%202019%20%286%29.xlsx?dl=0</a>                                                           |
| Logboek                      |           | Logboek 2018          |                |              |                         | <a href="https://www.dropbox.com/s/zugs4tr2ybwhtr0/Logboek%202018.xlsx?dl=0">https://www.dropbox.com/s/zugs4tr2ybwhtr0/Logboek%202018.xlsx?dl=0</a>                                                                               |
| Logboek                      |           | Sampling database     |                |              |                         | <a href="https://www.dropbox.com/s/iyfwzvuiw51jl1/Sampling%20database_NH.xlsx?dl=0">https://www.dropbox.com/s/iyfwzvuiw51jl1/Sampling%20database_NH.xlsx?dl=0</a>                                                                 |
| Handover documenten          |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Handover documenten          | KHL-GT-01 | EOWR                  | 20/07/2017     | Daldrup      |                         | <a href="https://www.dropbox.com/s/iaavkm59e1xwy8q1/EoWR_v2.0_KHL-GT-01.pdf?dl=0">https://www.dropbox.com/s/iaavkm59e1xwy8q1/EoWR_v2.0_KHL-GT-01.pdf?dl=0</a>                                                                     |
| Handover documenten          | KHL-GT-02 | EOWR                  | 20/02/2017     | Daldrup      |                         | <a href="https://www.dropbox.com/s/ie6ionhfbajw6h9/EoWR_v2.0_KHL-GT-02.pdf?dl=0">https://www.dropbox.com/s/ie6ionhfbajw6h9/EoWR_v2.0_KHL-GT-02.pdf?dl=0</a>                                                                       |
| Handover documenten          | KHL-GT-02 | Memo putintegriteit   | 09/11/2018     | Veegeo       |                         | <a href="https://www.dropbox.com/s/b4i10rz0fn6fj1y/Memo%20put%20integriteit%20KHL-GT-02_FV.docx?dl=0">https://www.dropbox.com/s/b4i10rz0fn6fj1y/Memo%20put%20integriteit%20KHL-GT-02_FV.docx?dl=0</a>                             |
| Put locatie gegevens         |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Put locatie gegevens         | KHL-GT-01 | Puttraject            |                | Daldrup      |                         | <a href="https://www.dropbox.com/s/9wnfzah8vjon5dc/Puttraject%20KHL-GT-01.csv?dl=0">https://www.dropbox.com/s/9wnfzah8vjon5dc/Puttraject%20KHL-GT-01.csv?dl=0</a>                                                                 |
| Put locatie gegevens         | KHL-GT-02 | Puttraject            |                | Daldrup      |                         | <a href="https://www.dropbox.com/s/hlr6ptimaqghczf/Puttraject%20KHL-GT-02.csv?dl=0">https://www.dropbox.com/s/hlr6ptimaqghczf/Puttraject%20KHL-GT-02.csv?dl=0</a>                                                                 |
| Productiecijfers en analyses |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Productiecijfers en analyses |           | SodM maandrapportages |                | SodM         |                         | <a href="https://www.dropbox.com/sh/891k28xfsm72irn/AACTSKzVOH7RvXwzjDesr4Dma?dl=0">https://www.dropbox.com/sh/891k28xfsm72irn/AACTSKzVOH7RvXwzjDesr4Dma?dl=0</a>                                                                 |
| Productiecijfers en analyses |           | Kwartaalrapportages   |                | Veegeo       |                         | <a href="https://www.dropbox.com/sh/ql0jnv92znkoba/AAClZHB0UA8lleHQKtQycaZa?dl=0">https://www.dropbox.com/sh/ql0jnv92znkoba/AAClZHB0UA8lleHQKtQycaZa?dl=0</a>                                                                     |
| Verplichte rapportages       |           |                       |                |              |                         |                                                                                                                                                                                                                                   |
| Verplichte rapportages       |           | 5 jaren plan          | 01/11/2018     | Veegeo       |                         | <a href="https://www.dropbox.com/s/wyfb05w7w3z9ger/20181101%205%20jaren%20plan_V1.5.docx?dl=0">https://www.dropbox.com/s/wyfb05w7w3z9ger/20181101%205%20jaren%20plan_V1.5.docx?dl=0</a>                                           |
| Verplichte rapportages       |           | Winningsplan          |                |              |                         | <a href="https://www.dropbox.com/s/npm3x85yu2coajk/Winningsplan_Nature%27s%20Heat.pdf?dl=0">https://www.dropbox.com/s/npm3x85yu2coajk/Winningsplan_Nature%27s%20Heat.pdf?dl=0</a>                                                 |
| Verplichte rapportages       |           | Winningsvergunning    |                |              |                         | <a href="https://www.dropbox.com/sh/55b2cz65fhar0ay/AAAWj2pNYP60IeJ-FDI9jX83a?dl=0">https://www.dropbox.com/sh/55b2cz65fhar0ay/AAAWj2pNYP60IeJ-FDI9jX83a?dl=0</a>                                                                 |

## Roles & Responsibilities

| Activiteit                                                     | omschrijving/<br>instructie doc | Production Manager | Tommies | Production Engineer | Projectmanager geothermiebronnen |
|----------------------------------------------------------------|---------------------------------|--------------------|---------|---------------------|----------------------------------|
| Wijziging workover planning                                    |                                 | VT                 | I       | G                   | G                                |
| Wijziging productie limieten                                   |                                 | VT                 | I       | G                   | G                                |
| Put Overdracht documenten (projecten)                          |                                 | VT                 | I/G     | I/G                 | VT                               |
| Completeer en valideer put status                              |                                 | VT                 | I       | G                   |                                  |
| Workover rapport                                               |                                 | G                  | I       | I                   | VT                               |
| Validatie constructie specificaties                            |                                 | G                  | G       | VT                  |                                  |
| Handtekening handover documenten                               |                                 | V                  | T       | G                   |                                  |
| Definieer operatie envelope; high production alarm en triggers |                                 | I                  | G       | VT                  |                                  |
| Monitoren put and annulii                                      |                                 | -                  | VT      | I                   |                                  |
| Manage annulus drukken                                         |                                 | I                  | G       | VT                  |                                  |
| Well maintenance                                               |                                 | V                  | VT      | G                   |                                  |
| Afwijkingen onderzoek                                          |                                 | G                  | V       | T                   |                                  |
| Well integriteits review                                       |                                 | G                  | G       | VT                  |                                  |
| Checken en bijwerken WIMS nakoming                             |                                 | -                  | G       | G                   |                                  |
| Review, maintain and update process                            |                                 | I                  | I       | I                   |                                  |
| Put abandonneering                                             |                                 | V                  | T       | G                   |                                  |

| Symbool | Betekenis                  |
|---------|----------------------------|
| V       | Verantwoordelijk           |
| T       | Toerekenbaar               |
| I       | Informerer                 |
| G       | Geraadpleegd/ondersteunend |

| Injector |          | Well Name: KHL-GT-01-I |                                                                                    | Revision Date: 30/10/2018 |         | Drawing is not to scale!                                       |        |        |        |       |
|----------|----------|------------------------|------------------------------------------------------------------------------------|---------------------------|---------|----------------------------------------------------------------|--------|--------|--------|-------|
| Depth    |          | Geology                | Well Schematic - Actual                                                            | Depth                     |         | Items                                                          | OD     | ID     | Drift  | Notes |
| m AHGL   | m TVD GL |                        |                                                                                    | mAHGL                     | m TVDGL |                                                                | In     | In     | In     |       |
|          |          |                        |  | -7,7                      | -7,7    | RT                                                             |        |        |        |       |
|          |          |                        |                                                                                    | 0                         | 0       | 1x 7-1/16 + 3k Wing Valve, 1 x 7-1/16 + 3K Master Valve        |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | Ground level                                                   |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | Rotating Flange + Tubing hanger + Penetrator                   |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | 2 x 2-1/16" - 5000PSI Ball Valve                               |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | Slip on Wellhead                                               |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | Bottom Cellar                                                  |        |        |        |       |
|          |          |                        |                                                                                    | 4                         | 4       | 8 5/8" 32ppf L80 Tubing                                        | 8,625  | 7,921  | 7,796  |       |
|          |          |                        |                                                                                    | ?                         | ?       | Static Fluid Level                                             |        |        |        |       |
|          |          |                        |                                                                                    | 65                        | 65      | 20" welded Conductor/Stove pipe                                | 20,000 | 19,330 |        |       |
|          |          |                        |                                                                                    | 120                       | 120     | 18" Welded Conductor                                           | 18,000 | 17,240 |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
|          |          |                        |                                                                                    | 242                       | 242     | 8 5/8" injection tubing                                        | 8,625  |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                | 13,375 | 12,415 | 12,259 |       |
|          |          |                        |                                                                                    | 62                        | 662     | KOP                                                            |        |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
|          |          |                        |                                                                                    | 915                       | 911     | 13 3/8" x 9 5/8" liner hanger + packer                         |        |        |        |       |
|          |          |                        |                                                                                    | 927/928                   | 923     | (148m above 13 3/8" shoe) 1/2" perforations - 13 shots in-line |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | 6m casing patch                                                |        |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
|          |          |                        |                                                                                    | 1076                      | 1057    | 13 3/8" 72 ppf L80 VAM TOP                                     | 9,150  | 7,840  | 7,750  |       |
|          |          |                        |                                                                                    |                           |         |                                                                | 13,375 | 12,415 | 12,259 |       |
|          |          |                        |                                                                                    | 1142                      | 1115    | TOC 9 5/8" cementation                                         |        |        |        |       |
|          |          |                        |                                                                                    | 1341                      | 1272    | End of build to 46°                                            |        |        |        |       |
|          |          |                        |                                                                                    |                           |         | PBR                                                            |        |        |        |       |
|          |          |                        |                                                                                    | 2617                      | 2178    | 9 5/8" 47ppf L80 VAM 21                                        | 9,675  | 6,681  | 8,525  |       |
|          |          |                        |                                                                                    | 2695                      |         | Swellpacker                                                    |        |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
| 2713     | 2242     | Top Delft Sandstone    |                                                                                    |                           |         | 8 x 6 5/8" WWS on 28# L80 VAGT                                 |        |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
|          |          |                        |                                                                                    |                           |         |                                                                |        |        |        |       |
| 2897     | 2380     | Top Alblasserdam       |                                                                                    | 2952                      |         | 7" L80 BTC Shoetrack                                           | 7,000  | 5,921  | 5,796  |       |
|          |          |                        |                                                                                    | 2966                      | 2431    | Total Depth                                                    |        |        |        |       |

| General information |                             |        |  |       |              |                              |            |  |         |
|---------------------|-----------------------------|--------|--|-------|--------------|------------------------------|------------|--|---------|
| Name                | KHL-GT-01                   |        |  |       | Shape        | J-shape                      |            |  | degrees |
| Status              | Injecting                   |        |  |       | max Incl     | 44,5                         |            |  |         |
| Designation         | Geothermal Exploration      |        |  |       | Total Dep    | 2376                         |            |  | m tv    |
| City, Country       | Kwintsheul, The Netherlands |        |  |       | Lat longs    |                              |            |  | RD      |
| Lat/Longs Surface   | 78288                       | 447042 |  | RD    | RT Elev      | 5,08                         | rel to NAP |  |         |
| End Drilling date   | 28-10-2016                  |        |  |       | Drilling co  | Dalldrup & Sohne             |            |  |         |
| Age                 | 4,74                        |        |  | Years | Drilling rig | DS-20 (Drillmec HH300 272Mt) |            |  |         |

| Operating Envelope |     |       | Notes                          |
|--------------------|-----|-------|--------------------------------|
| Max Flow-rate      | 400 | m3/h  | Based on 6 m/s                 |
| MAASP              | 16  | bar   | max. surface facility pressure |
| Max THP            | 42  | bar   | Max injection pressure + extra |
| Max Temperature    | 87  | °C    |                                |
| Min Temperature    | 30  | °C    |                                |
| Designed well life | 30+ | Years |                                |

| Voorgaande Workovers |
|----------------------|
| Date                 |
|                      |

| Well Barrier Element   |      |      | Well Construction |      |        |        |         |            | Depth ref.: | Tied Down Bolts (TDB) |            |                            |     |     |
|------------------------|------|------|-------------------|------|--------|--------|---------|------------|-------------|-----------------------|------------|----------------------------|-----|-----|
| Casing + Tubing        |      |      | Top               |      | Bottom |        | Size ID | Drift      | Weight      | Grade                 | Connection | Pressure tested at surface |     |     |
|                        | m AH | m TV | m AH              | m TV | Inch   | Inch   | Inch    | ppf (#)    |             |                       |            | Bar                        | Bar | Bar |
| 1 Conductor/stove pipe | 0    | 0    | 65                | 65   | 20     | 19,133 |         | ~106.5 ppf |             |                       | Welded     |                            |     |     |
| 2 Conductor            | 0    | 0    | 112               | 112  | 18     | 17,24  |         | 94 ppf     |             |                       |            |                            |     |     |
| 3 Surface Casing       | 0    | 0    | 1076              | 1057 | 13 3/8 | 12,415 | 12,259  | 72 ppf     | L80         | VAM TOP               |            |                            | 50  |     |
| 4 Intermediate Liner   | 915  | 911  | 2617              | 2178 | 9 5/8  | 8,681  | 8,525   | 47 ppf     | L80         | VAM 21                |            |                            | 42  |     |
| 4 WWS                  | 2537 | 2118 | 2952              | 2420 | 6 5/8  | 5,921  | 5,796   | 24/28 ppf  | L80         | VAGT                  |            |                            |     |     |
|                        |      |      |                   |      |        |        |         |            |             |                       |            |                            |     |     |
| KOP                    | 662  | 662  |                   |      |        |        |         |            |             |                       |            |                            |     |     |

| Liner Hangers + Packers   |          | Pressure |        |  |  | Notes |
|---------------------------|----------|----------|--------|--|--|-------|
| Depth                     | Supplier | Nominal  | Tested |  |  |       |
| m AH                      |          | Bar      | Bar    |  |  |       |
| 3 Surf x interm. Lin.     | 907      |          |        |  |  |       |
| 4 Interm. Lin x Prod Lin. |          |          |        |  |  |       |
| 5 swellpacker             | 2695     |          |        |  |  |       |

| Cement           |           | Cement type      |      | Volume Pumped |         |      | Bad bond |  |           | Notes |
|------------------|-----------|------------------|------|---------------|---------|------|----------|--|-----------|-------|
| TOC              | Lead      | Tail             | Lead | Tail          | Returns | Top  | Bottom   |  |           |       |
| m AH             |           |                  | m3   | m3            | m3      | m AH | m AH     |  |           |       |
| 1 20" stove pipe | 0         |                  |      | 8,5           |         |      |          |  |           |       |
| 2 18" conductor  | 0         |                  |      | 12,6          |         |      |          |  | 1.77 s.g. |       |
| 3 13 3/8" casing | surface   | CEM-III/B        |      | 190,8         | 9,5     |      |          |  | 1.58 s.g. |       |
|                  |           |                  |      |               |         |      |          |  | 1.67 s.g. |       |
| 4 9 5/8 liner    | 1150* USF | Class G lite cmt |      | 90,1          | 12,8    |      |          |  | 1.40 s.g. |       |
|                  |           |                  |      |               |         |      |          |  | 1.9 s.g.  |       |

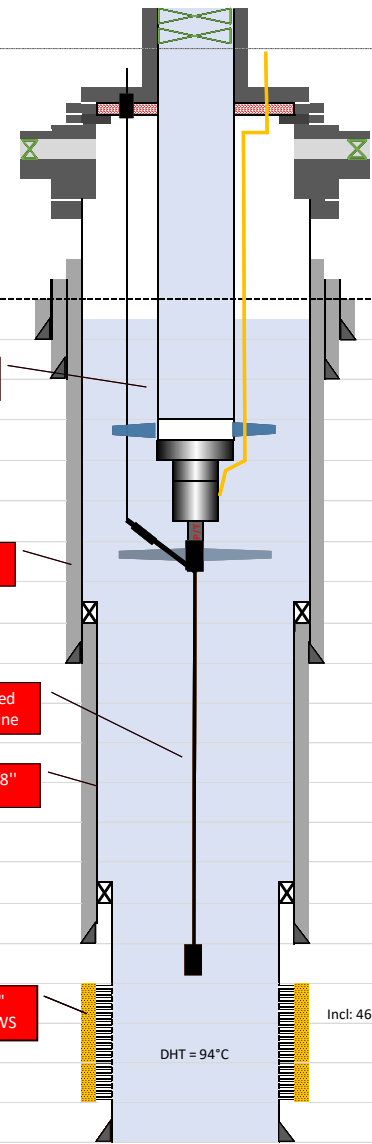
| Critical Formations |      |      |        |      |        |
|---------------------|------|------|--------|------|--------|
| Name                | Top  |      | Bottom |      | Reason |
|                     | m AH | m TV | m AH   | m TV |        |
|                     |      |      |        |      |        |

| Formation Strenght | Top  |      |      |          |          |       |
|--------------------|------|------|------|----------|----------|-------|
|                    | Date | m AH | m TV | Gradient | Gradient | Notes |
|                    |      |      |      | s.g      | bar/10m  |       |
| LOT 1              |      | 2626 |      |          | 1,34     |       |
| LOT 2              |      | 2688 |      |          | 1,346    |       |

| Reservoir(s)   |                 | Top  |      | Bottom |      | Type                      |
|----------------|-----------------|------|------|--------|------|---------------------------|
| Name           |                 | m AH | m TV | m AH   | m TV |                           |
| -1 Reservoir 1 | Delft sandstone | 2713 | 2242 |        |      | Fluvial Friable Sandstone |
| -1 Reservoir 2 | Alblasserdam    | 2897 | 2380 |        |      |                           |

| Annulus Fluids |                   |                   |                 |      |                                                   |
|----------------|-------------------|-------------------|-----------------|------|---------------------------------------------------|
|                | Inner pipe        | Outer pipe        | Fluid           | S.g. | Hazardous components                              |
| A- Annulus     | Production tubing | Production casing | Formation Brine |      | Traces from acid job can still be present, PH = 5 |
| B-Annulus      |                   |                   |                 |      |                                                   |

| Reservoir           |                          |                 |                |                                     |  |
|---------------------|--------------------------|-----------------|----------------|-------------------------------------|--|
| Pres regime         | Hydrostatic              |                 | NORM           | YES, Measured around ESP            |  |
| GWR                 | 1 Sm3/m3                 |                 | Scale Risk     | Medium (possible cause of plugging) |  |
| OWR                 | 0 g/L (max expected)     |                 | Corrosion risk | High (CO2 Corrosion)                |  |
| Last Integrity logs |                          |                 |                |                                     |  |
| 01-09-2016          | URS                      |                 |                |                                     |  |
| 13-10-2016          | 60/40 arm Hi Res Caliper | 13 3/8<br>9 5/8 |                |                                     |  |

| Producer |          | Well Name: KHL-GT-02-P |                                                                                    | Revision Date: 07-01-2020 |         | Drawing is not to scale!                                                                                    |        |        |        |                                   |
|----------|----------|------------------------|------------------------------------------------------------------------------------|---------------------------|---------|-------------------------------------------------------------------------------------------------------------|--------|--------|--------|-----------------------------------|
| Depth    |          | Geology                | Well Schematic                                                                     | Depth                     |         | Items                                                                                                       | OD     | ID     | Drift  | Notes                             |
| m AHGL   | m TVD GL |                        |                                                                                    | m AHGL                    | m TVDGL |                                                                                                             | In     | In     | In     |                                   |
|          |          |                        |  | -8                        | -8      | WELLHEAD Hartmann 5k psi<br>1x 7-1/16 + 3000PSI Main Valve + 1x 7-1/16 + 3000PSI Wing Valve<br>Ground Level |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         | Rotating Flange + Tubing hanger + Penetrator                                                                |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         | 2 x 2-1/16" - 3000PSI Ball Valve<br><br>Slip on Wellhead                                                    |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         | Bottom Cellar                                                                                               |        |        |        |                                   |
|          |          |                        |                                                                                    | 4                         | 4       | 8 5/8" 32ppf L80 Tubing Joint                                                                               | 8,625  | 7,921  | 7,796  |                                   |
|          |          |                        |                                                                                    | 72                        | 72      | Static Fluid Level                                                                                          |        |        |        |                                   |
|          |          |                        |                                                                                    | 11                        | 11      | 24" stove pipe                                                                                              |        |        |        |                                   |
|          |          |                        |                                                                                    | 138                       | 138     | 18 5/8" BTC 87.5ppf K55 Conductor                                                                           | 18,625 | 17,755 | 17,566 |                                   |
|          |          |                        |                                                                                    | 329                       | 329     | Nudge well to 1,6"                                                                                          |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         |                                                                                                             |        |        |        |                                   |
|          |          |                        |                                                                                    | 690                       | 690     | Inlet ESP                                                                                                   |        |        |        |                                   |
|          |          |                        |                                                                                    | 705                       | 713     | Bottom ESP sensor on 8 5/8" production tubing<br>1/4" Hastelloy inhibitor line<br>1/4" swagelock connector  | 8,625  |        |        |                                   |
|          |          |                        |                                                                                    | 740                       | 740     | KOP                                                                                                         |        |        |        | 752 - 1092m 22.6 degrees build up |
|          |          |                        |                                                                                    | 931                       | 929     | 13 3/8 x 9 5/8" liner hanger + packer                                                                       |        |        |        |                                   |
|          |          |                        |                                                                                    | 1080                      | 1071    |                                                                                                             | 13,375 | 12,347 | 12,250 |                                   |
|          |          |                        |                                                                                    | 1354                      | 1321    | End of Build to 30°                                                                                         |        |        |        |                                   |
|          |          |                        |                                                                                    | 2016                      | 1888    | KOP II                                                                                                      |        |        |        |                                   |
|          |          |                        |                                                                                    | 2233                      | 2061    | End of Build to 45°                                                                                         |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         |                                                                                                             |        |        |        |                                   |
|          |          |                        |                                                                                    | 2377                      | 2165    | 9 5/8 x 6 5/8" Liner Hanger + packer                                                                        |        |        |        |                                   |
|          |          |                        |                                                                                    | 2421                      | 2195    | 9 5/8" VAM21 47ppf, L80                                                                                     | 9 5/8  | 8,681  | 8,525  |                                   |
| 2492     | 2248     | Top Delft Sandstone    |                                                                                    | 2629                      | 2357    | Depth 1/4" inhibitor line inclusief weight 2.5m                                                             |        |        |        |                                   |
|          |          |                        |                                                                                    | 2518                      | 2357    | Top Screens                                                                                                 |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         |                                                                                                             |        |        |        |                                   |
|          |          |                        |                                                                                    |                           |         |                                                                                                             |        |        |        |                                   |
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