

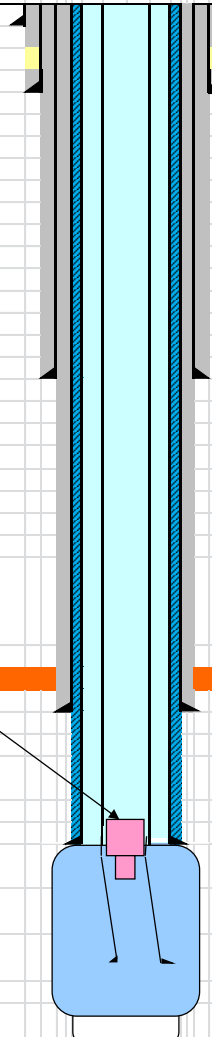
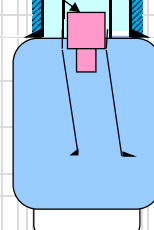
Overview mining activities Q3 2018

Quarterly meeting
Frisia Zout B.V. -SODM
10 October 2018

Contents

1. Updates BAS-1
2. Updates BAS-3O
 - a. Blockage blanket annulus
3. Updates BAS-4
 - a. Reserves
4. Update subsidence
 - a. M&R 2017
 - b. GPS trends
5. Update Havenmond
6. AOB

BAS-1

Item Description	Wellhead and Xmastree BAS 1 140527	Depth	Depth	Pipe OD	Collar OD	Pipe ID
		m tvd	m ah	in	in	in
36" stove pipe		40	40	28,000		
24" x 1/2" casing		494	494	24,000		
Top cement in 18 5/8 " x 13 3/8" annulus						
18 5/8" casing		1175	1175	18,625	20,000	17,688
13.3/8" Annulus filled with diesel/brine solution as of January 2013.						
Straddle Jan 2010; Top at; 2584md Minimum ID: 3.34" Bottom at; 2589 md						
Base of Carnalite 13 3/8" casing		2522 2543	2522 2543			
				13,375	14,375	12,895
Roof height from March 2011 neck echo measurement		2567	2567			
7" Leak at ~2586 m 10 3/4" outer leaching string, internally coated 7" inner leaching string, internally coated		2587	2587	10,75	11,75	9,76
		2787	2787	7,000	7,375	6,276
Sump Dec 2004		2832	2832			
Total Depth Cavern		2882	2882			

	Freshwater
	Water/Diesel Solution
	1.20s.g. brine
	Casing cement
	Carnalite

* All depths are from ground level

Status

- Maintain max pressure 10 3/4" at 232bar
- Bleed-off pressure every 4 weeks
- 13 3/8" contains water, however at higher pressure then 10 3/4"

Planned

- Review and finalization of concept design abandonment

July 2018

9, 10, 23, 24	Pressure bleed-offs
11, 16, 25, 27	Repressurization of 13-3/8" annulus
25	Electricity black-out

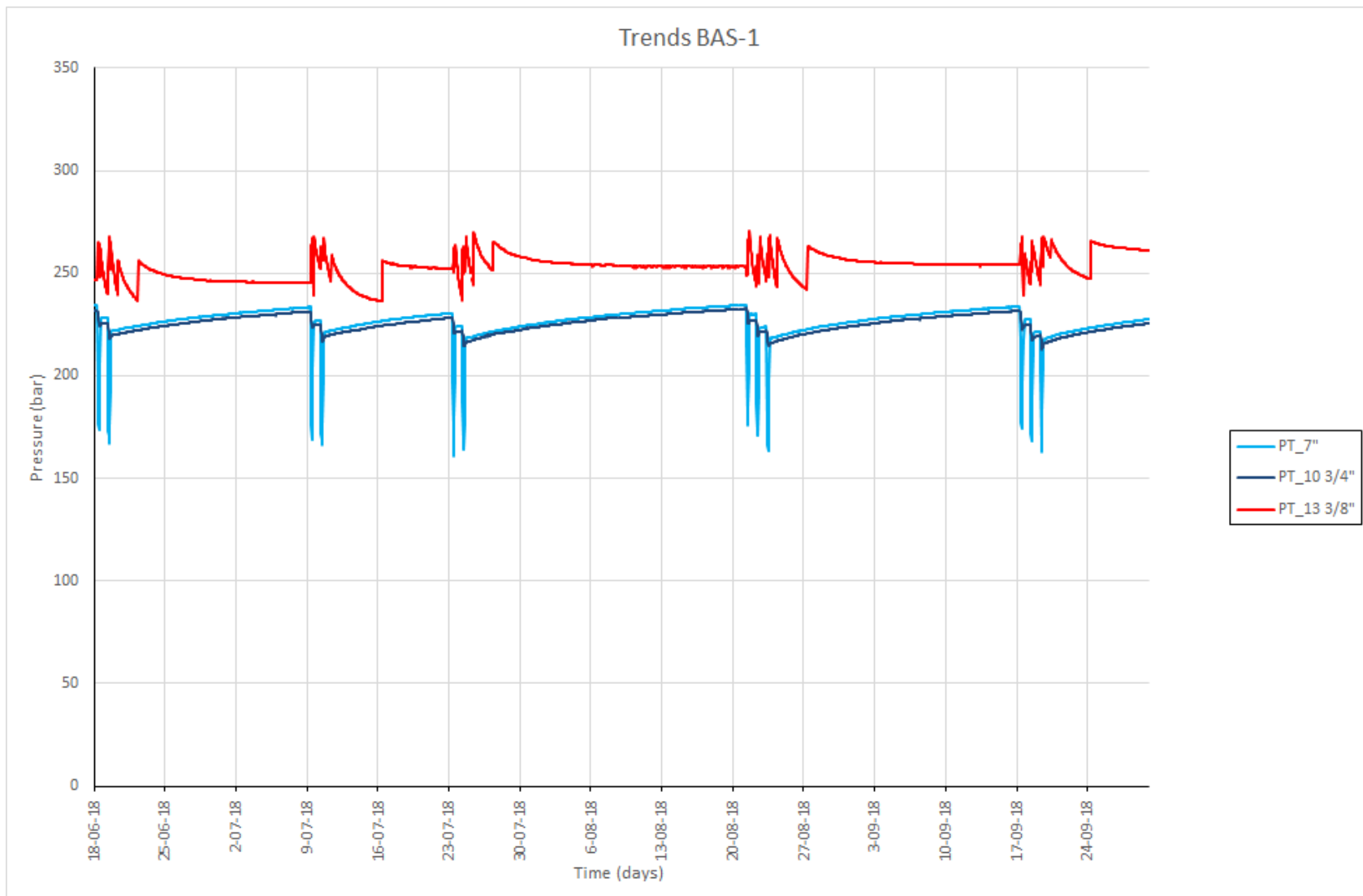
August 2018

21 - 23	Pressure bleed-offs
24, 27	Repressurization of 13-3/8" annulus

September 2018

17 - 19	Pressure bleed-offs.
20, 24	Repressurization of 13-3/8" annulus.

BAS-1



Status

- **Bottom injection mode since January 2018**
- **Last echo measurement in March 2018, measured cavern volume: 554.926 m³**
- **Blockage and pressure increases in diesel annulus**
- **Increased cavern pressure with 10bar**
- **Increased blanket measurement frequency**

Planned

- **Continue bottom injection mode**
- **Continue blockage investigations**
- **Diesel injections via 5 ½" tubing**

July 2018

1 - 31	Blocked cavern neck annulus
1 – 6	Pressure surges in blocked cavern neck annulus
5	Additional backpressure cavern to minimize amplitude of pressure surges
11	Regular blanket measurement
13	Production stop
25	Electricity black-out

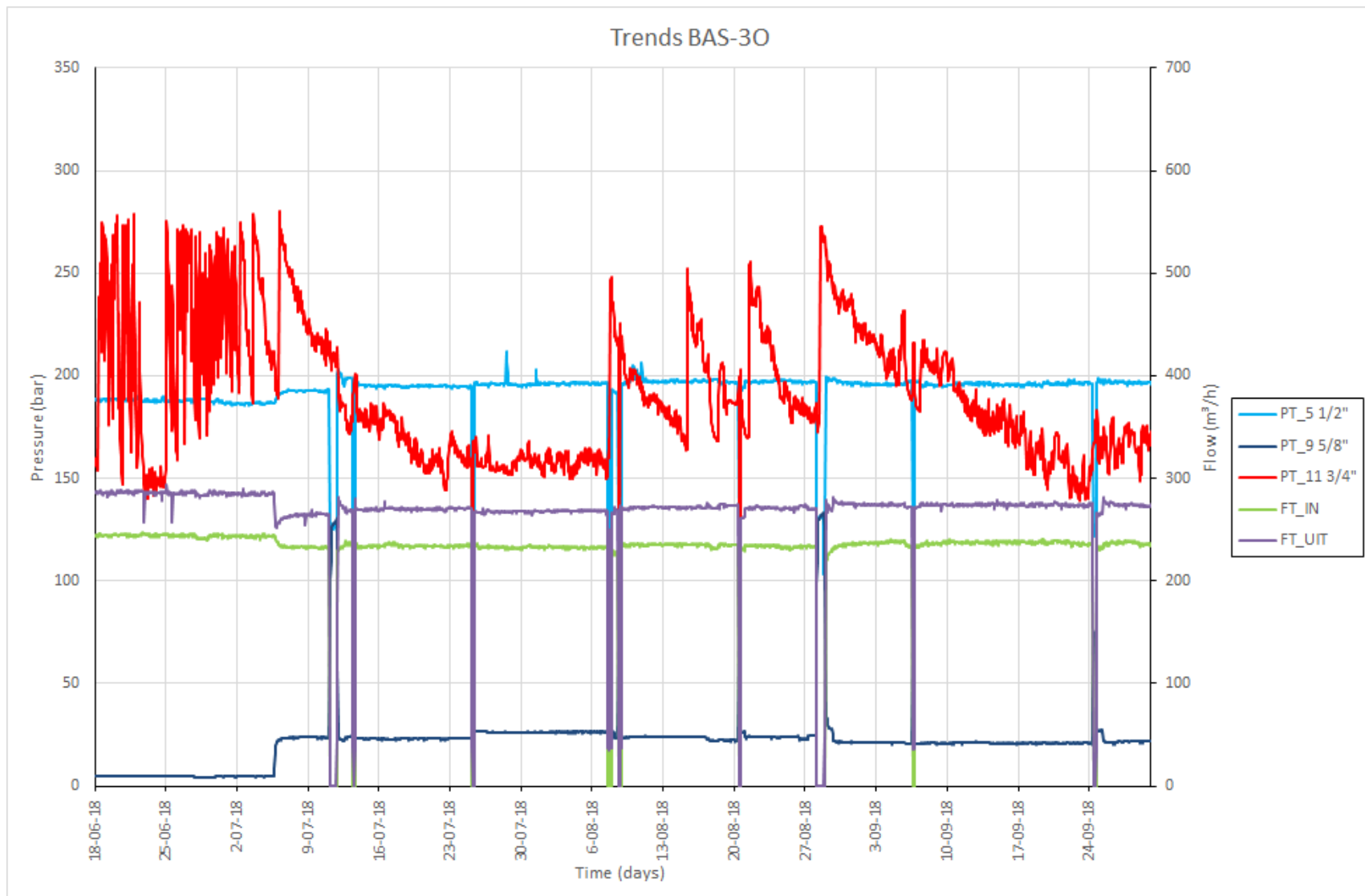
August 2018

1 - 31	Blocked cavern neck annulus, pressure fluctuations due to injection water temperature changes.
7, 15, 21	Diesel injection into 11-3/4" annulus
7, 8, 20	Production stop
28	Pressure surge in blocked cavern neck annulus
28	Regular blanket measurement

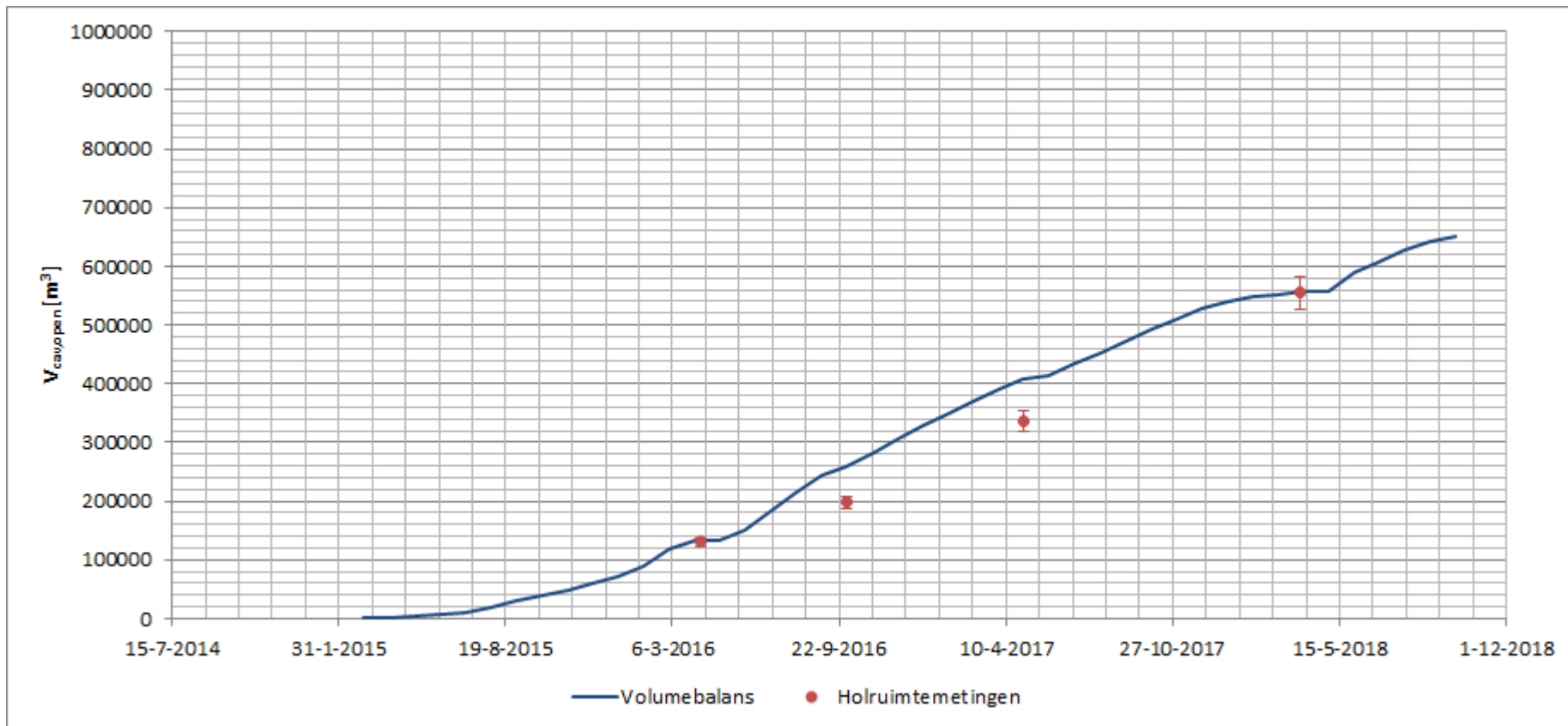
September 2018

1 - 30	Blocked cavern neck annulus, pressure fluctuations due to injection water temperature changes.
6	Production stop.
24	Production stop.

BAS-30

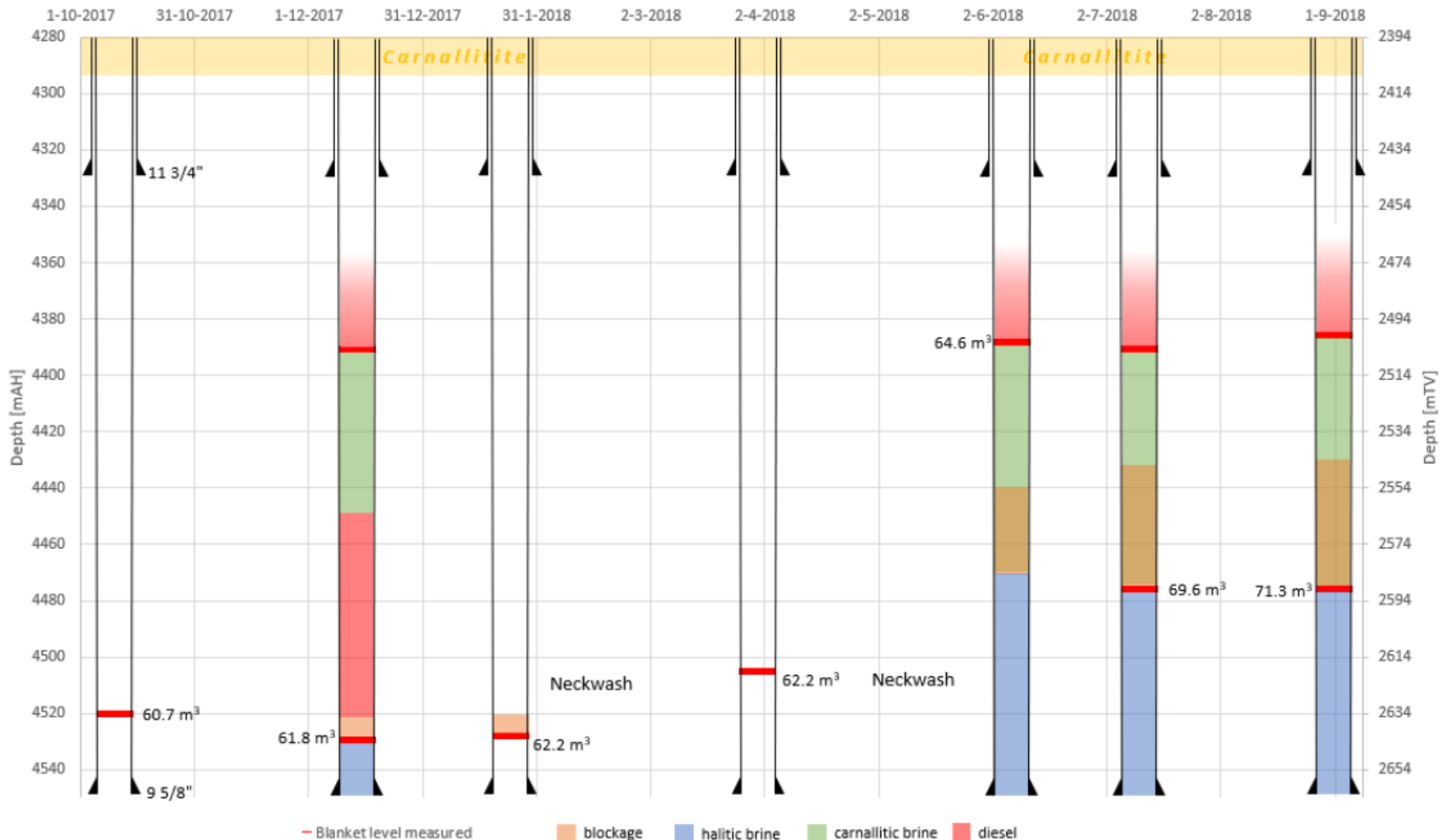


Volume balans BAS-30



BAS-30 blocked

Blanket measurements performed on BAS-30



BAS-3O blocked blanket annulus

Current thoughts:

- Blockage due to potassium and sodium chlorides crystallization (lab test performed)
- Minimum stress at BAS-3O cavern can get upto 30bar lower
- Influx:
 - Potassium rich brine, carnalitic.
 - Influx volume 700-1000ltr, pressure increases from 150bar to 280bar
 - Pressure of influx is ~35bar sub-lithostatic (limited volume or restricted flow)
 - BAS-3 cavern seems source
 - Potentially connection via lateral micro-fracturing through the Carnalite (2-10bar over minimum stress)
 - And vertical/lateral via Halite (20-30bar over minimum stress)
- No fracturing conditions through 80m overlaying Anhydrite (45bar over minimum stress)
- No change in stress Z3 Salt 155m

BAS-3O blocked blanket annulus

Immediate actions

- Reduce amplitude cyclic stress, increase pressure cavern - **done, 10bar additional cavern pressure, since pressure increase one pressure spike**
- No blockage removal operations, pending studies
- Diesel injections via injection string
 - Increased frequency blanket measurements, control on level

Follow up actions

- Additional cyclic stress calculations – **no feedback manufacturer casing, SN curves required for analyses**
- Study possibility BAS-3 cavern as source and identify migration/leaching path (Carnalitite/Polyhalite) – **in progress (see previous slide current thoughts), if fracturing Carnalitite, why towards BAS-3O**
- FEM calculation stress in Z3 (154m Salt and 90m Anhydrite) – **in progress (see previous slide current thoughts)**
- Impact potassium/magnesium influx on production
- Impact on subsidence, production and abandonment

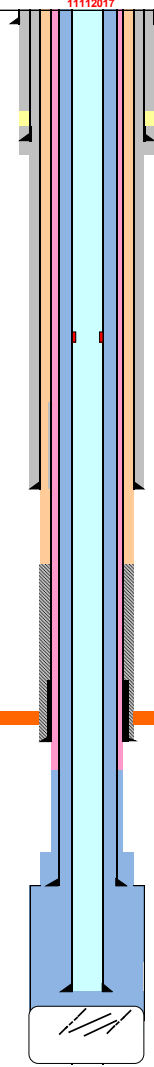
BAS-4

Status

- Production to fit factory requirements
- Issues with pump, cavitation and vibration giving much noise. Noise nuisance complaint from neighbour. Stop production at night.
- Attempted sonar measurement (5sep), HUD in well.
- Wijziging instemmingsbesluit
 - Awaiting EZK, negative advise SODM

Planned

- Continue bottom injection mode
- Blanket measurement (every 6 months)

Item Description	Wellhead and Xmastree BAS 4	Depth GL	Depth GL	Hole ID	Pipe OD	Collar OD	Pipe ID
		m hd	m ah	in	in	in	in
28" x 1" X 52E conductor shoe		15	15	driven	28,000	welded	28,000
7" 29 ppf N80 VAM TOP inner leaching string, internally coated		319	319				
7" 26 ppf L80/N80Q VAM TOP inner leaching string, internally coated		366	366				
24" x 1/2" WT 35 ksi conductor, welded		279	279	26,00	24,000	welded	23,000
7" 29 ppf N80 VAM TOP inner leaching string, internally coated		319	319				
7" 26 ppf L80/N80Q VAM TOP inner leaching string, internally coated		366	366				
7" 29 ppf N80 VAM TOP inner leaching string, internally coated		577	577				
7" 23 ppf N80 VAM TOP inner leaching string, internally coated		591	591				
7" 29 ppf N80 VAM TOP inner leaching string, internally coated		604	604				
7" wireline profile 5.75" Otis 'RPT'		966	966				5,75
Top cement in 18 5/8" x 13 3/8" annulus		916	916				
18 5/8" 87.5 ppf K55 Big Omega casing		1126	1126	22,00	18,625	20,000	17,688
13 3/8" 68 ppf P110 VAM-TOP casing		1980	1980	16,00	13,375	14,375	12,415
14" heavy wall VAM TOP 106 ppf N80		2382	2382	16,00	14,000	14,000	12,500
BM 23-10-2017		2410	2410				
EM (Oct 2015, Roof = 2478m)		2470,6	2470,6				
Mar 2012, Not possible to inject more diesel below 2496m -> indicating leak at that point in 11 3/4" connection.		2506	2506	26	11,750	11,965	10,682
11 3/4" 65 ppf VM 80HC, VAM FUL outer leaching string, internally coated		2509	2509				
7" 26 ppf N80 VAM TOP inner leaching string, internally coated. Explosive cut.		2530	2530				
Sump level Oct 2017 (EM)		2628	2628	17 1/2"	7,000	7,375	6,276
Total Depth Cavern		2639	2639				
		2810	2810				

* All depths are from ground level

July 2018

7, 8, 11-13, 16, 26, 29, 30	Production stop
10	Regular blanket measurement
25	Electricity black-out

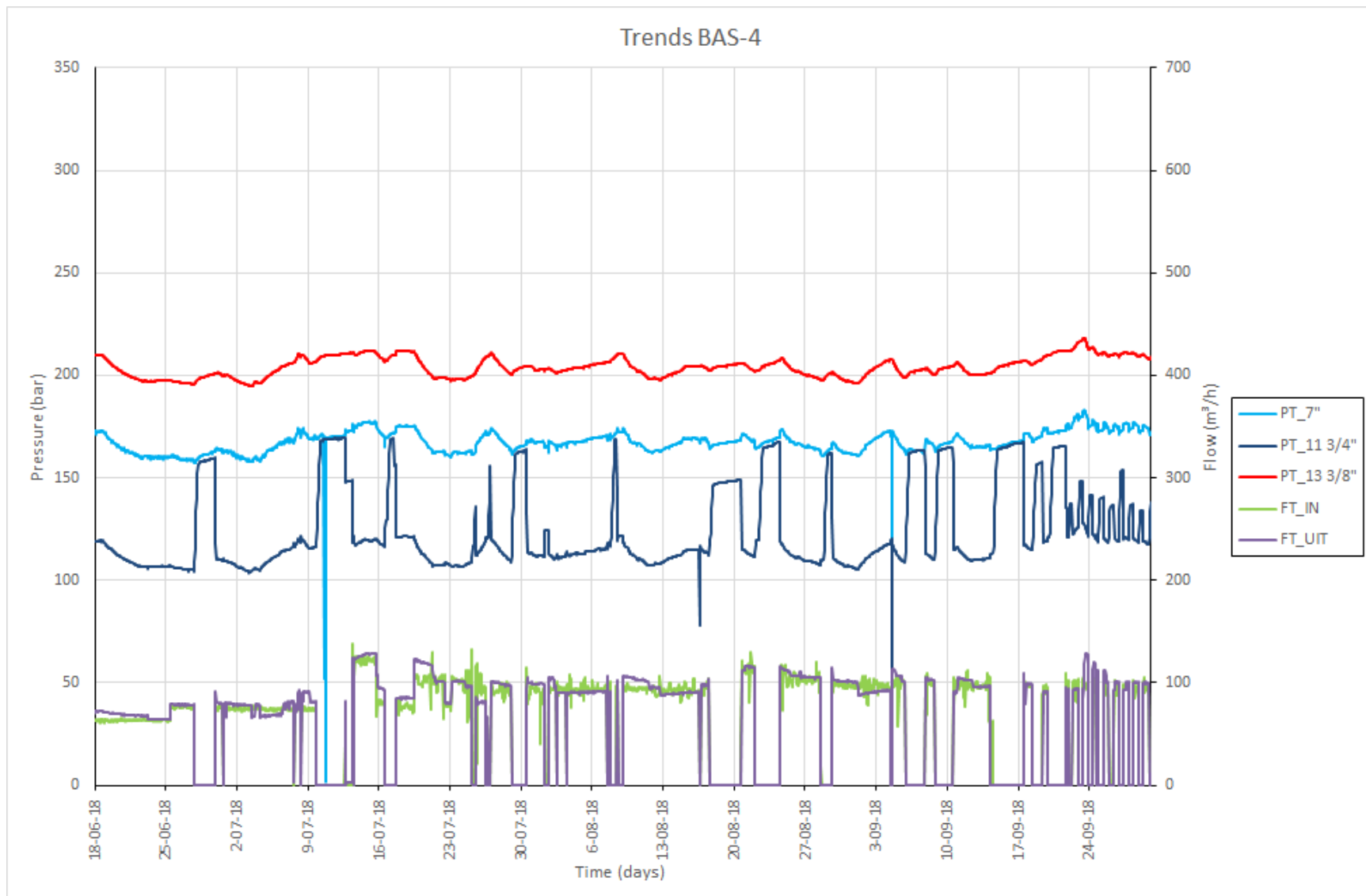
August 2018

1, 2, 3, 7, 8, 16, 17, 22, 28	Production stop
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September 2018

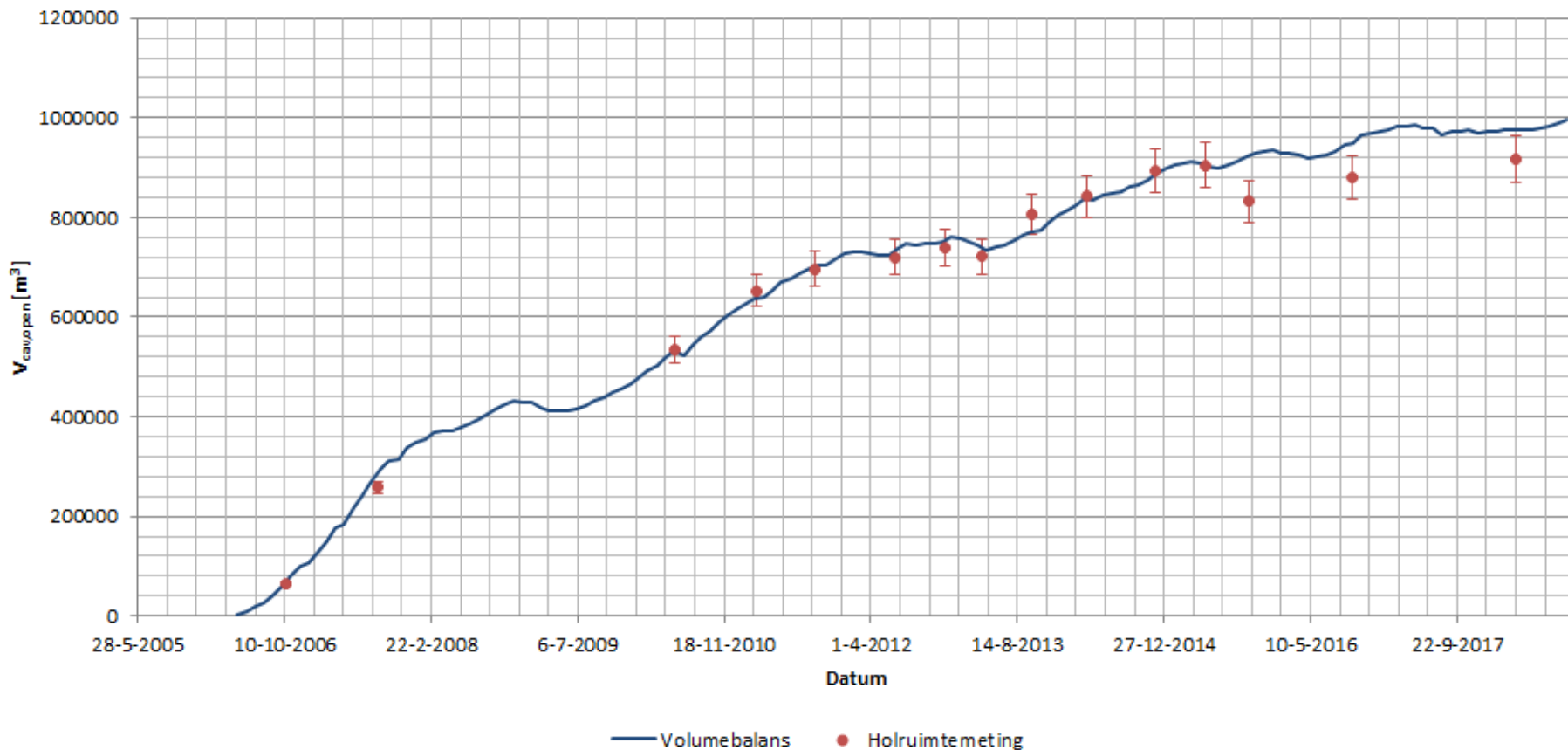
4, 5, 6, 7, 8, 14, 18, 19	Production stop.
21 – 30	Production stop during night time after sound nuisance complaint.

BAS-4



Volume balance BAS-4

Open caverne volume BAS-4



BAS-4 Reserves

- Reserves:
 - Remaining production from the 1st of December 2017 onwards: 300.000 tons (within current winningsplan)
 - Produced 1dec17 to 30sep18; 137,502 tons (2.0sg)
 - Independed study reserves BAS-4 Deltaris
 - Density Halite 2.16sg (cores BAS 1-2-4)
 - Evaluation Gausion-Kriging
 - Sonar measurement

Waterpassing

M&R 2017

- Measurements were performed November/December 2017 by ANTEA and analyzed
- Modeling contour Gaussian in progress, draft report end October

➤ Subsidence winningsplan:

- Winningsplan (Barradeel II):
- Current GPS (8-Oct-2018):
- Subsidence deepest point**:

BAS-3/30

300 mm
171 mm
191 mm

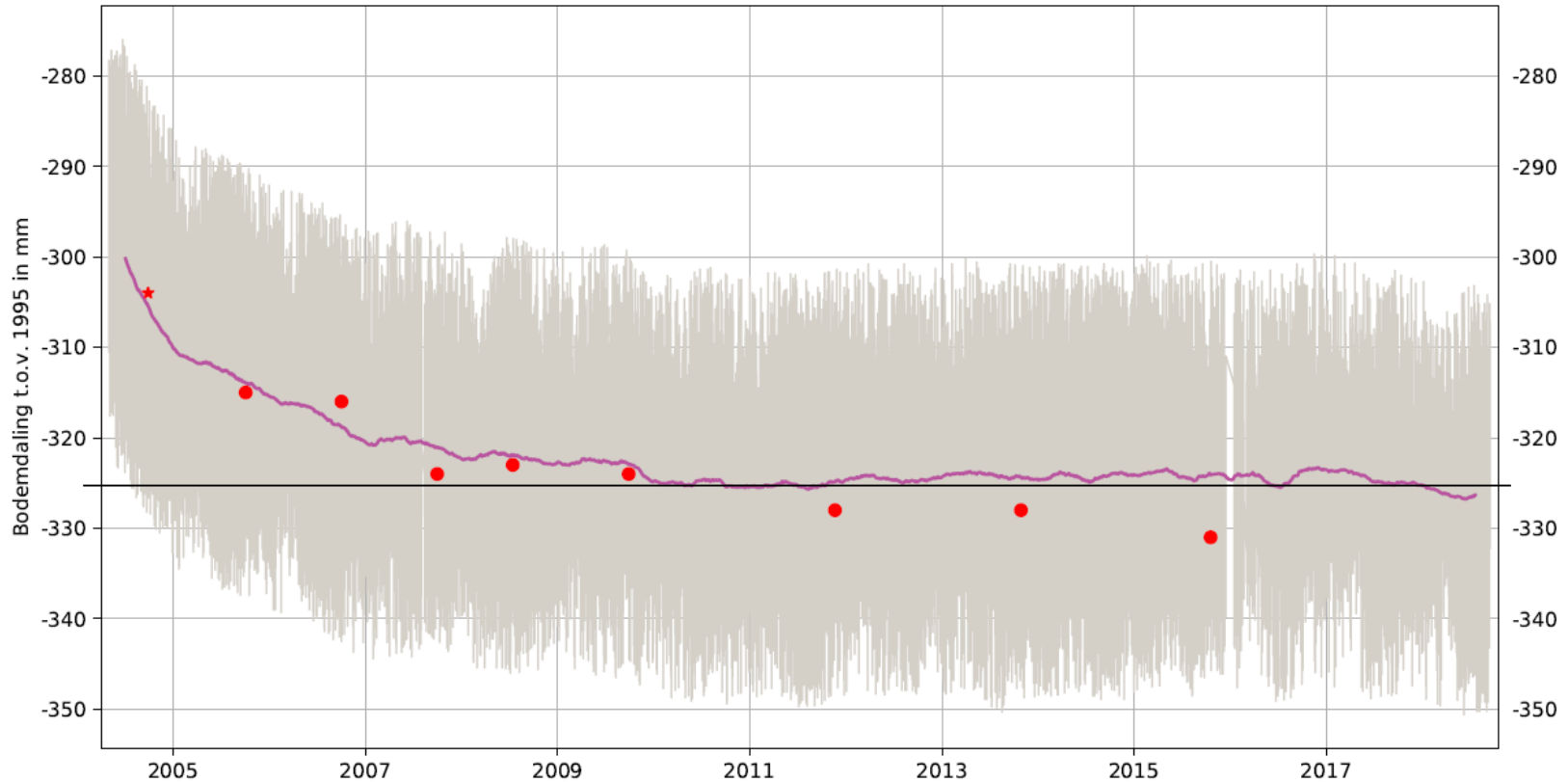
BAS-4

300 mm
279 mm
282 mm

*** Based on M&R 2015*

GPS BAS 1/2

Bodemdaling GPS station Barradeel*
Resultaten uit permanente GPS meting***



- GNSS observaties
- Moving Average 16 weken
- ★ week 40 2004 = -30.4cm**
- week 40 2005 = -31.5cm**
- week 40 2006 = -31.6cm**
- week 40 2007 = -32.4cm**
- week 29 2008 = -32.3cm**
- week 40 2009 = -32.4cm**
- week 47 2011 = -32.8cm**
- week 44 2013 = -32.8cm**
- week 43 2015 = -33.1cm**

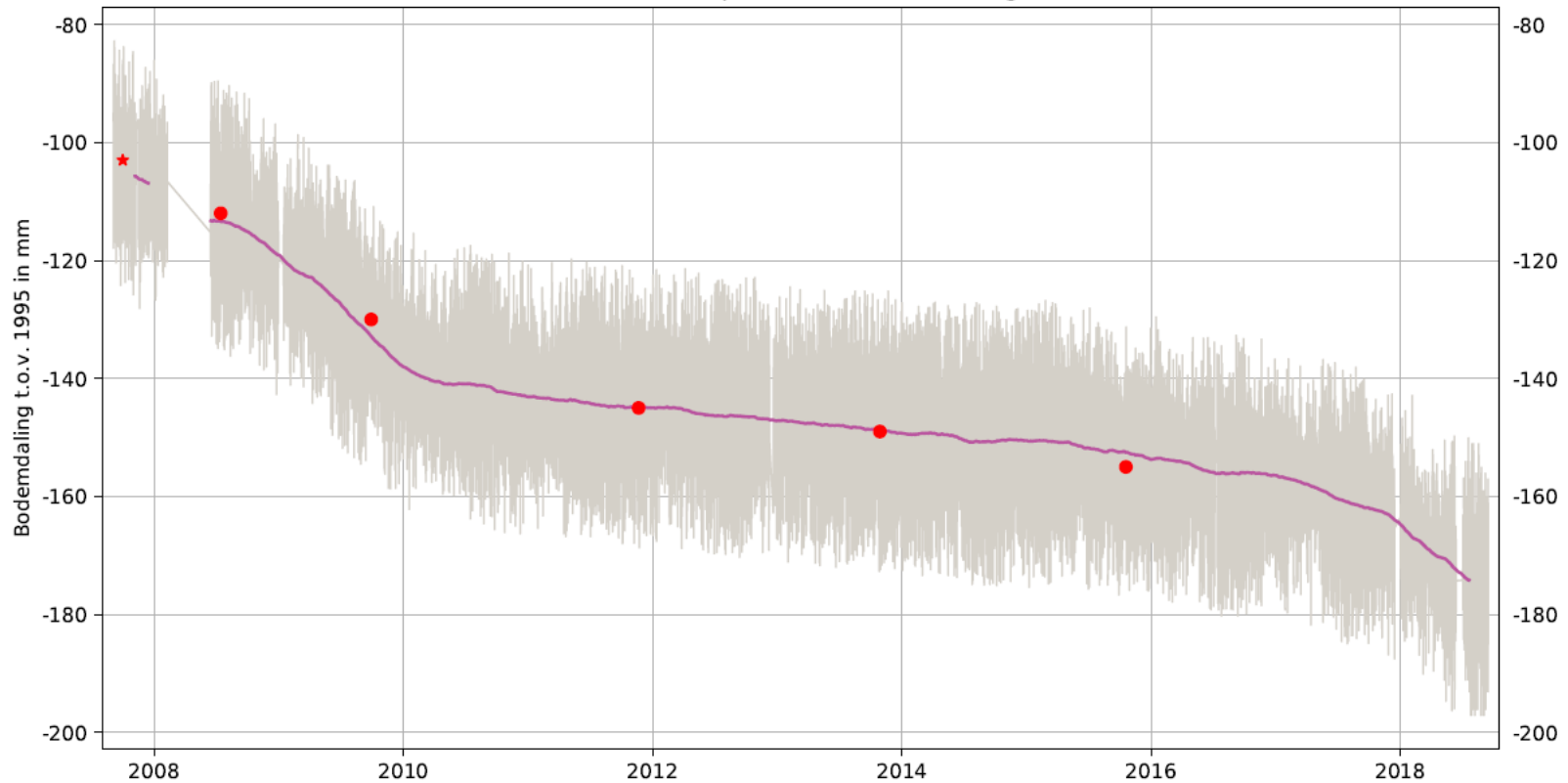
* Op basis van WEB analyse WP 2015 bedraagt in 2015 de daling van diepste punt in de winningsvergunning Barradeel 1,65 cm meer dan daling van GPS-station Barradeel.

** Daling GPS station berekend uit "best fit" dalingskommen. (ref. WP 2015 Zweins, glijdende PM, 3 kommen v1.2- Dkrit 13 mm, gamma 4,3)

*** GPS is een relatieve meting tussen station Barradeel en het station Zweins. De relatieve GPS meting is gekoppeld aan de absolute datering vastgesteld in WP 2004 (rode ster).

GPS BAS 3/30

Bodemdaling Barradeel II GPS station BAS-3* & BAS-3-O
Resultaten uit permanente GPS meting***

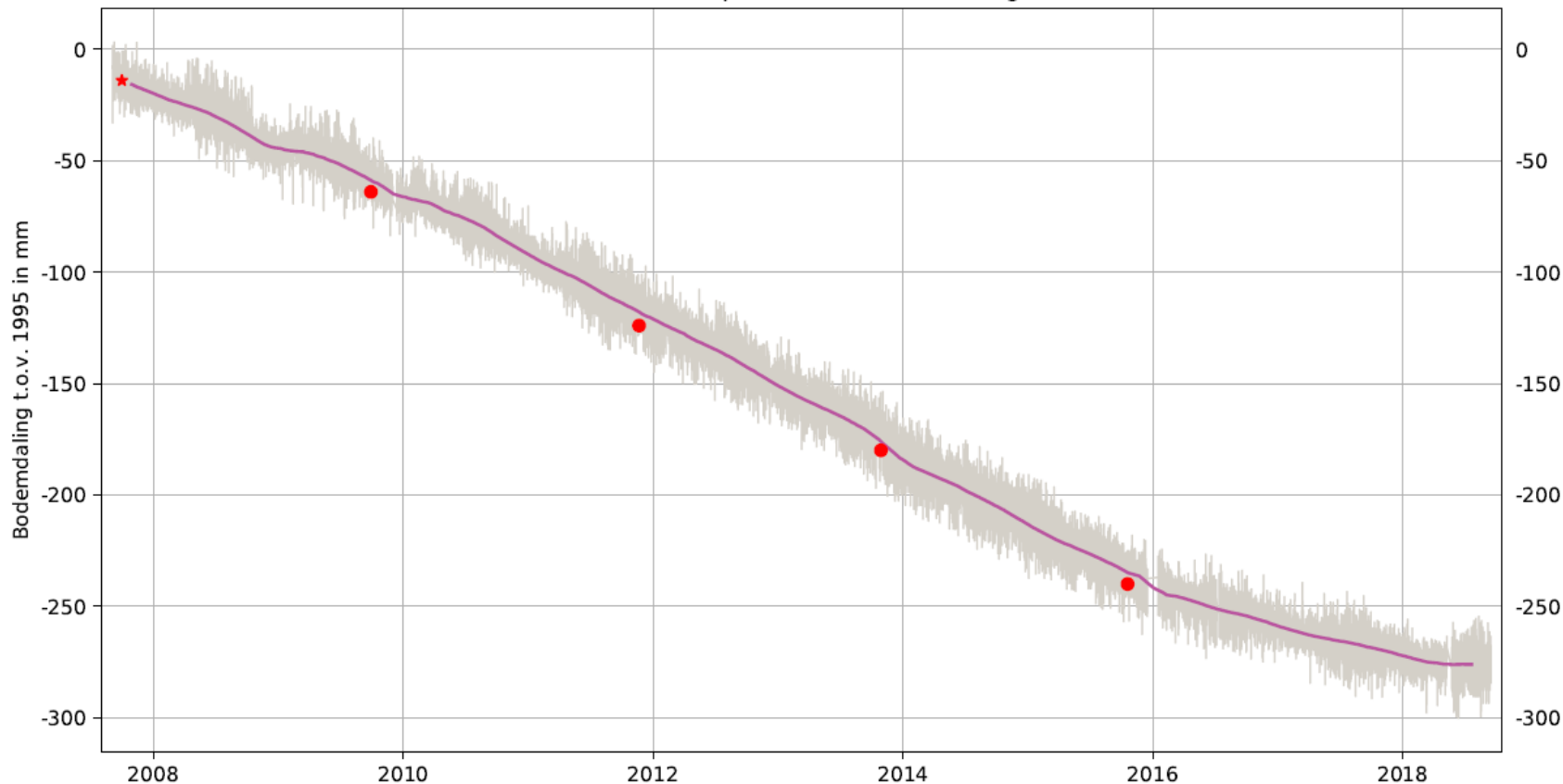


- GNSS observaties
- Moving Average 16 weken
- ★ week 40 2007 = -10.3cm**
- week 29 2008 = -11.2cm**
- week 40 2009 = -13.0cm**
- week 47 2011 = -14.5cm**
- week 44 2013 = -14.9cm**
- week 43 2015 = -15.5cm**

*Op basis van WEP analyse WP 2015 bedraagt in 2015 de bodemdaling boven
caverne BAS-3 1,95 meer dan de daling van GPS-station BAS-3.
** Daling GPS station berekend uit "best fit" dalingskommen. (ref. WP 2015 Zweins,
glijdende PM, 3 kommen v1.2- Dkrit 13 mm, gamma 4,3)
*** GPS is een relatieve meting tussen station BAS-3 en het station Zweins. De
relatieve GPS meting is gekoppeld aan de absolute dating vastgesteld in WP 2007
(rode ster).

GPS BAS-4

Bodemdaling Barradeel II GPS station BAS-4*
Resultaten uit permanente GPS meting***



- GNSS observaties
- Moving Average 16 weken
- ★ week 40 2007 = -1.4cm**
- week 40 2009 = -6.3cm**

- week 47 2011 = -12.4cm**
- week 44 2013 = -18.0cm**
- week 43 2015 = -24.0cm**

* Op basis van WEP analyse WP 2015, bedraagt in 2015 de bodemdaling boven caverne BAS-4 0,3 cm meer dan de daling van GPS-station BAS-4
 ** Daling GPS station berekend uit "best fit" dalingskommen (ref. WP 2015, glijdende PM, 3 kommen v1.2- Dkrit 13 mm, gamma 4,3)
 *** GPS is een relatieve meting tussen station BAS-4 en het station Zweins. De relatieve GPS meting is gekoppeld aan de absolute datering vastgesteld in WP 2007 (rode ster).

GPS logbook

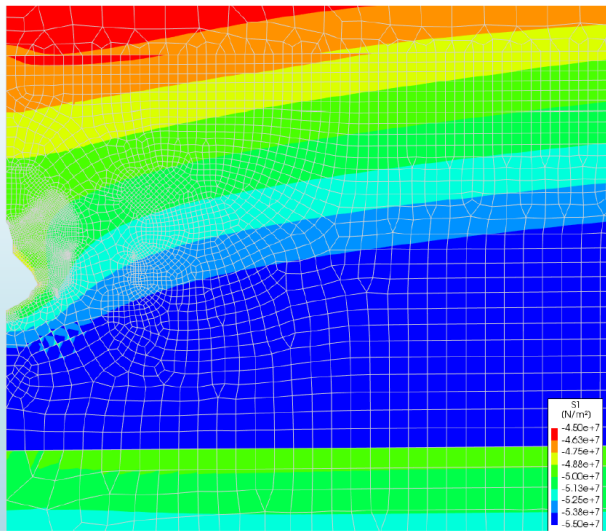
15-05-2018 t/m 23-05-2018	BAS4	<i>Onderbreking data ontvangst van BAS4 van 15-05-2018 0:59 t/m 23-05-2018 13:59.</i>
7-06-2018 t/m 8-06-2018	BAS4	<i>Onderbreking data ontvangst van BAS4 van 7-06-2018 8:59 t/m 8-06-2018 6:59.</i>
3-07-2018 t/m 4-7-2018	BAS12/BAS4	<i>Onderbreking data ontvangst van BAS12 en BAS4 van 3-07-2018 7:59 t/m 4-07-2018 6:59.</i>
16-06-2018 t/m 2-07-2018	BAS3	<i>Onderbreking data ontvangst van BAS3 van 16-06-2018 0:00 t/m 2-07-2018 7:59.</i>
5-07-2018 t/m 6-07-2018	BAS3 / BAS4	<i>Onderbreking data ontvangst van BAS3 en BAS4 van 5-07-2018 12:59 t/m 6-07-2018 8:59.</i>
7-08-2018 t/m 9-08-2018	BAS3 / BAS4	<i>Onderbreking data ontvangst van BAS3 van 7-08-2018 10:59 t/m 9-08-2018 6:59.</i>
12-08-2018 t/m 16-08-2018	BAS 4	<i>Onderbreking data ontvangst van BAS4 van 12-08-2018 9.35 t/m 16-08-2018 12:59. 14-08 is contact geweest met Frisia om BAS4 te resetten, op 16-08 is station gereset.</i>

Havenmond

- Seperate meeting held with SODM on 13 September 2018.
- Update M&R, ready end October18
 - Zero measurements can start, Permanent poles installed, GPS to be installed.
- Update “Aanmeldnotitie MER”, submit Oct18
- Alternative blanket fluid study
 - Nitrogen impossible
- Finalized detailed design
- Omgevingsvergunning mid Nov18
- Start drilling summer 2019
- Winningsplan requirements:
 - Volume balance report
 - Review BAS-3 abandonment
 - Sluitingsplan before start production

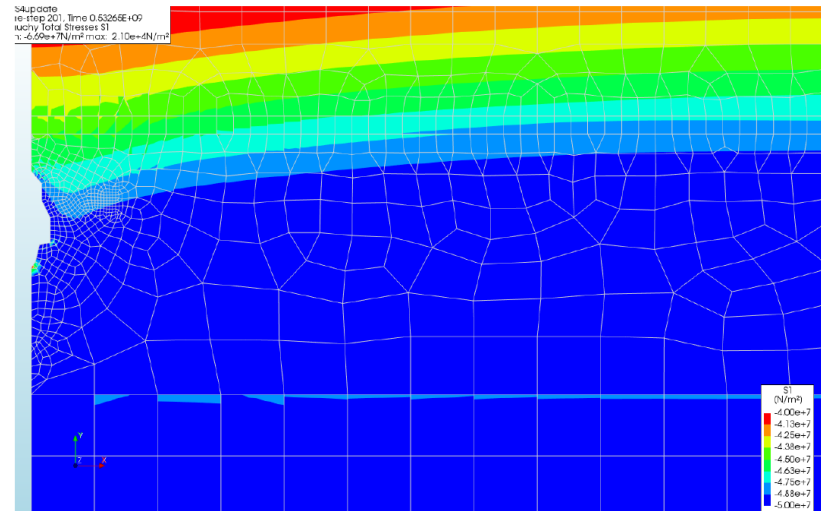


BAS300018
Time-step 250, Time 0.23332E+09
Cauchy Total Stresses S1
min: -6.78e+7N/m² max: 5.02e+3N/m²



Figuur 1 Minimum principal stress voor BAS-30 bij 20 cm bodemdaling. Kleurenranges van 45 tot 55 MPa.

S4update
ie-step 201, Time 0.53265E+09
Cauchy Total Stresses S1
min: -6.50e+7N/m² max: 2.10e+4N/m²



Figuur 2: Minimum spanningen rondom BAS4 bij 30 cm bodemdaling. Kleurenranges van 40 tot 50 MPa.

WVTTK

- Next quarterly meeting