

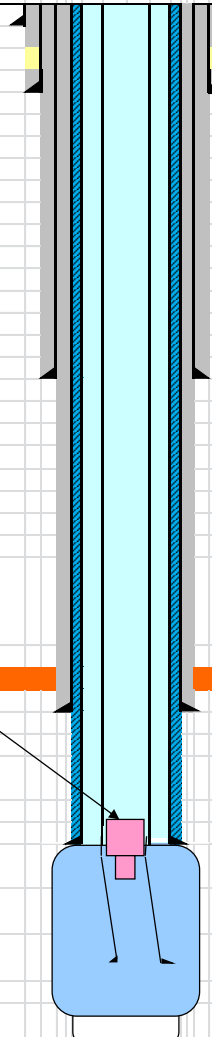
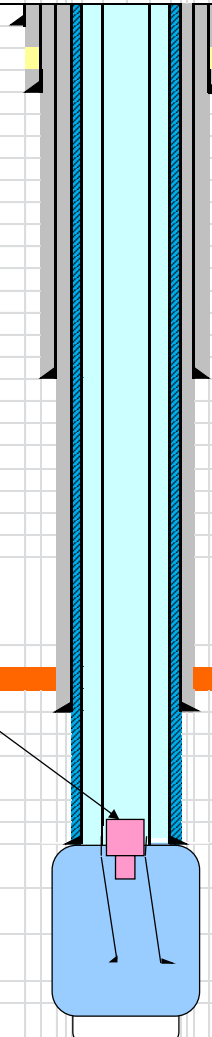
Overview mining activities Q2 2018

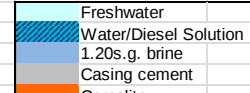
Quarterly meeting
Frisia Zout B.V. -SODM
11th of July 2018

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1. Updates BAS-1
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3. Updates BAS-4
 - a. Cavern end volume and production
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 - b. Permitting
 - c. General progress
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 - a. Bevindingen well integrity

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		2522	2522			
13 3/8" casing		2543	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

BAS-1

April 2018

23 - 25	Pressure bleed-off
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Mei 2018

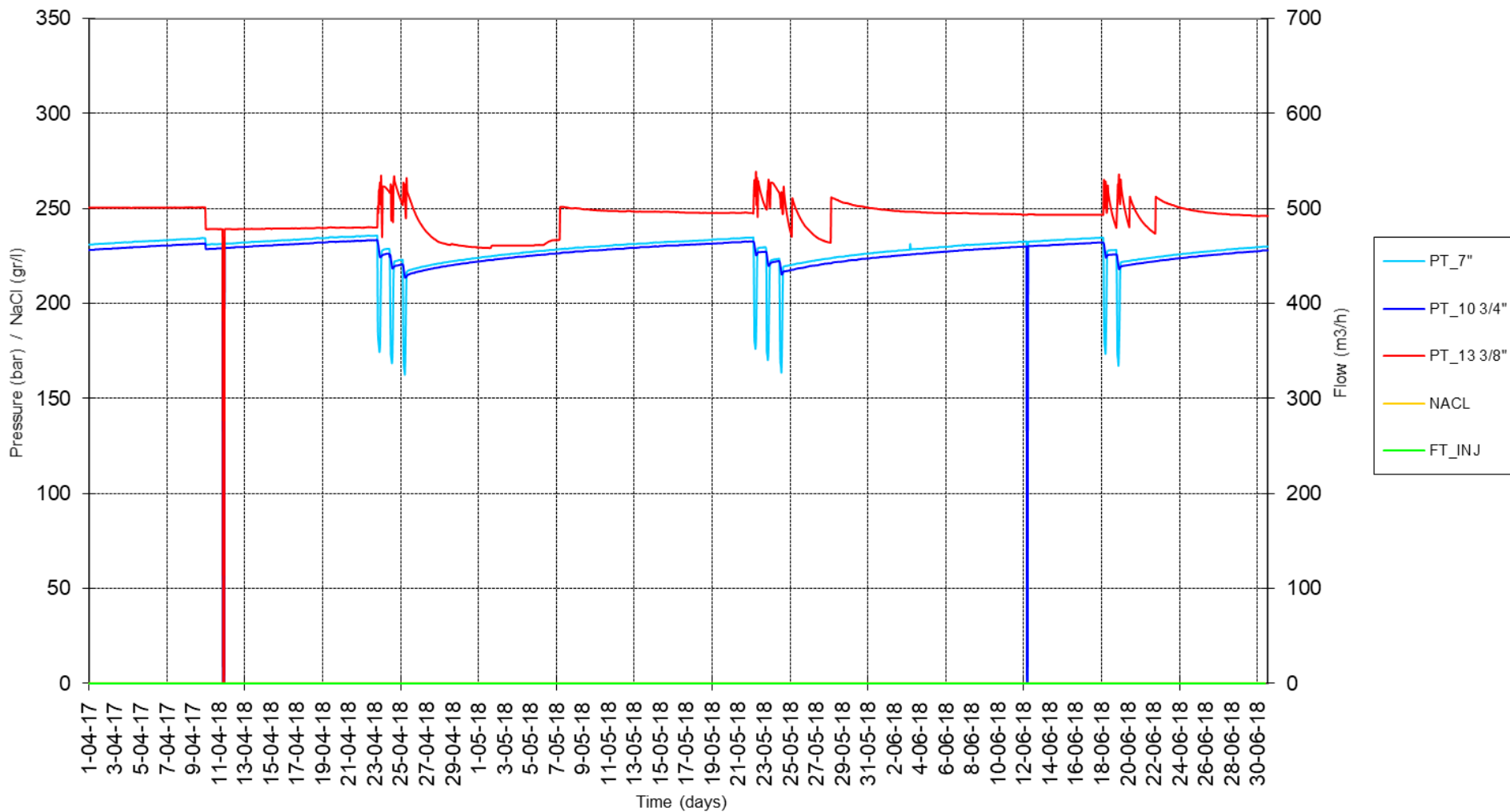
7, 28	Repressurization of 13-3/8" annulus
22 – 24	Pressure bleed-off

Juni 2018

11, 12	Wellhead integrity testing
18, 19	Pressure bleed-off

BAS-1

Trends BAS-1



Status

- ## Planned

- 6

April 2018

1 – 16	Workover
4	Disconnect 5-1/2" digital pressure sensor
10	Disconnect 9-3/4" digital pressure sensor
1 – 30	Blocked 11-3/4" annulus
18, 19, 23, 24, 25	11-3/4" blockage removal: fresh water injections
18	Reconnect 5-1/2" and 9-3/4" pressure sensors
18 - 24	Intermittent production due to salt demand

Mei 2018

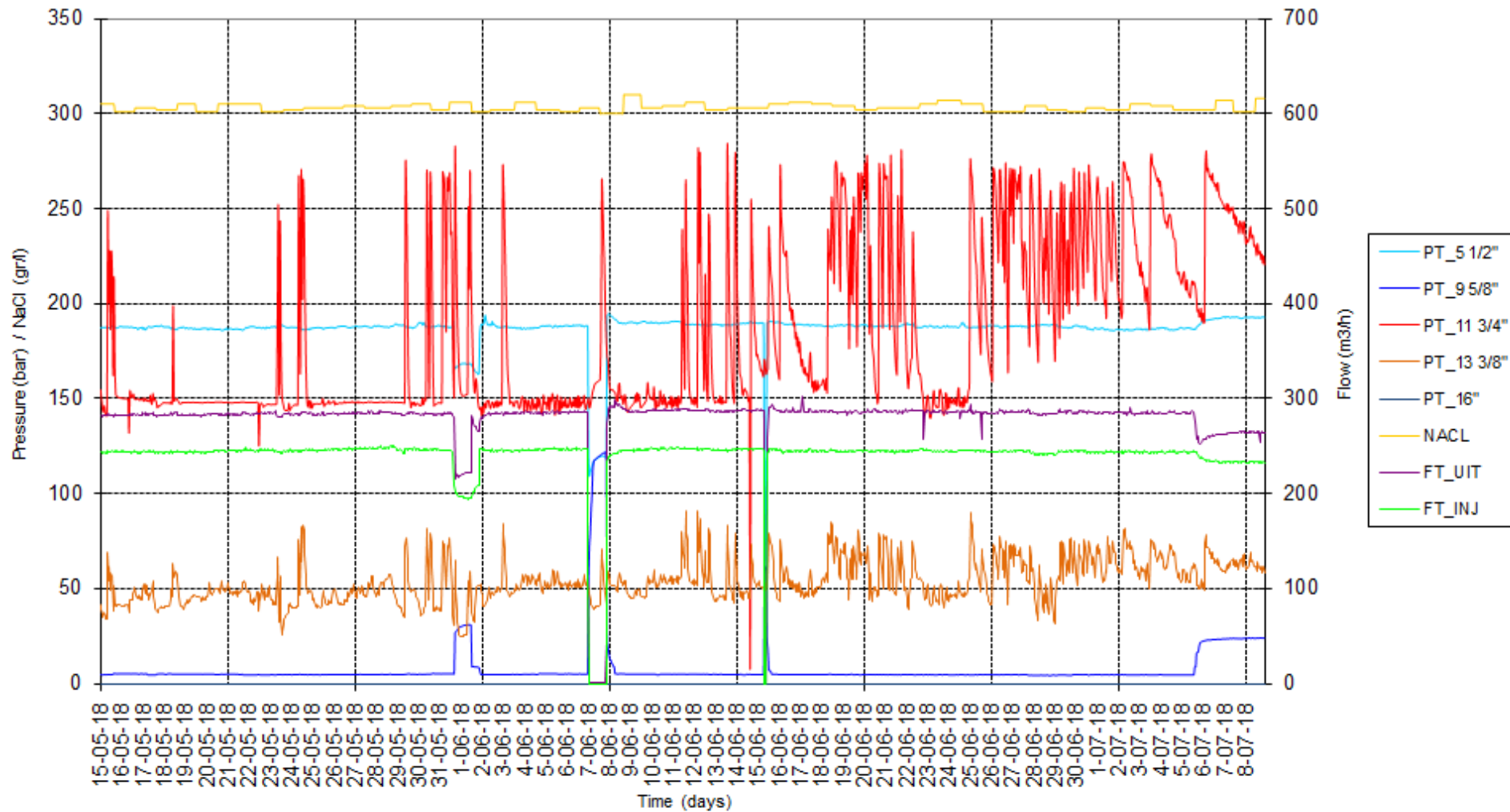
1 – 2	Fresh water injections in 11-3/4" blanket annulus (blockage removal operation)
3 – 7	Regained cavern communication with 11-3/4" blanket annulus
7 – 15	Neck wash operations, blockage reappeared
15 – 31	Fresh water injections in 11-3/4" blanket annulus (blockage removal operation)

Juni 2018

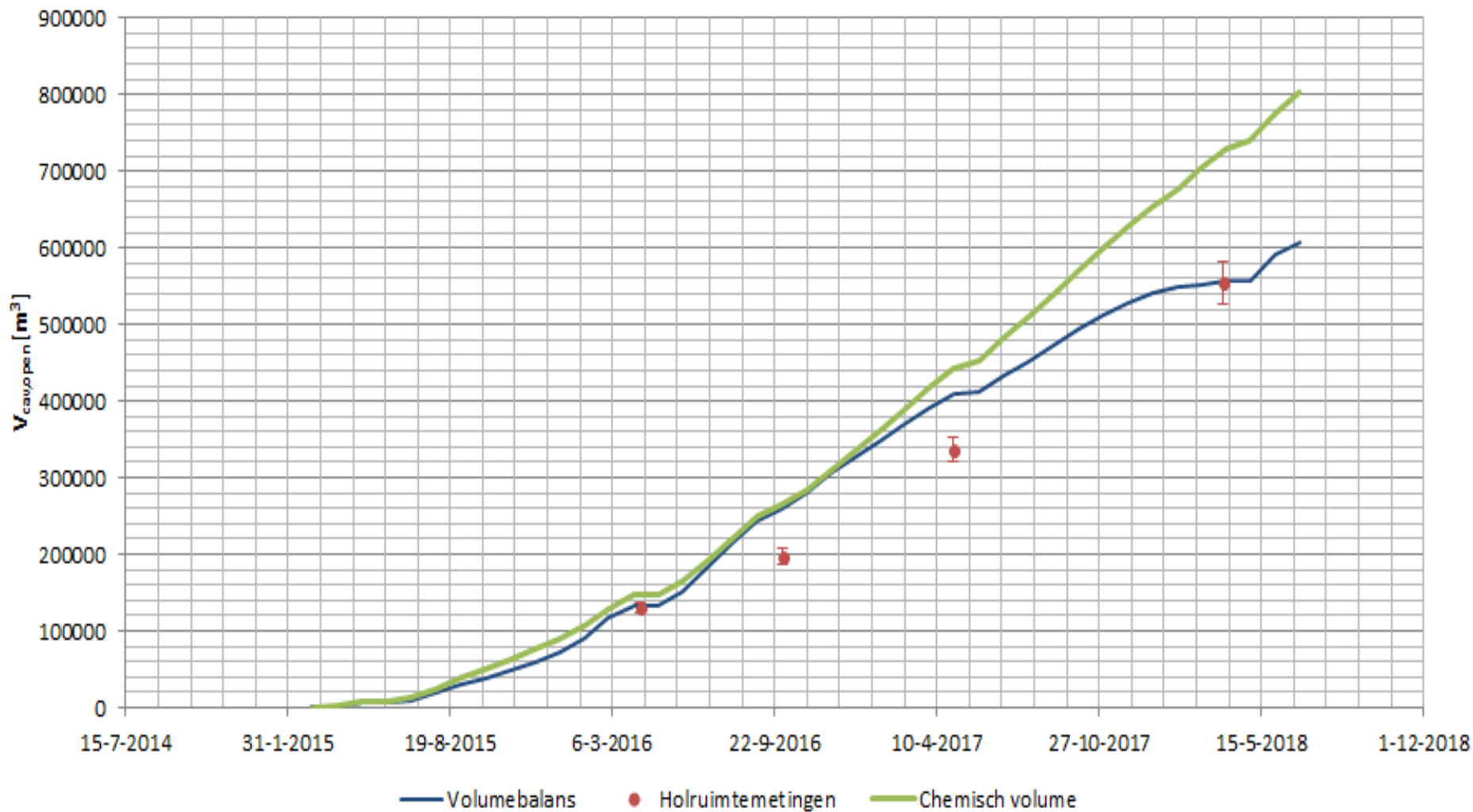
1 – 29	Fresh water and diesel injections in 11-3/4" blanket annulus (blockage removal operation)
6	Regular blanket measurement
14, 15	Wellhead integrity testing

BAS-30

Trends BAS-30

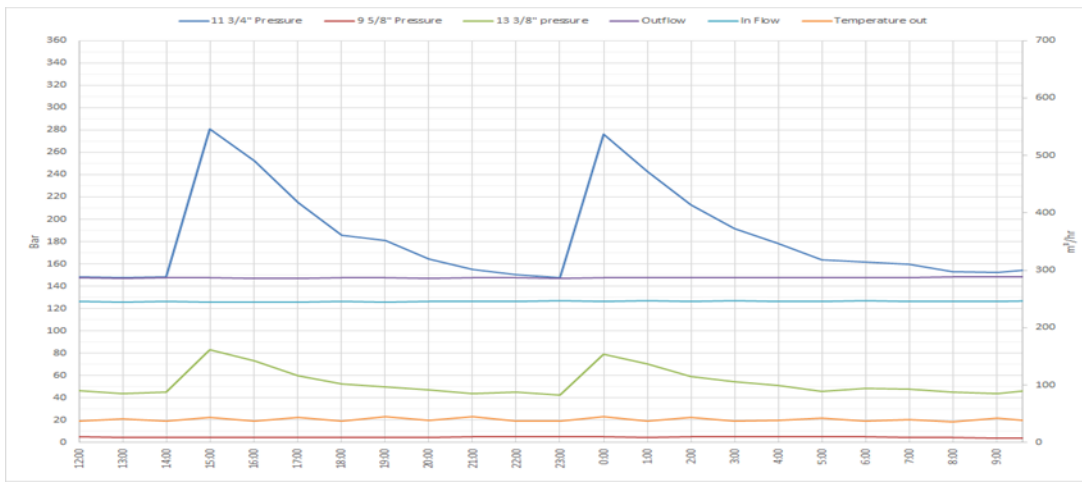


BAS-30



BAS-3O blocked blanket annulus

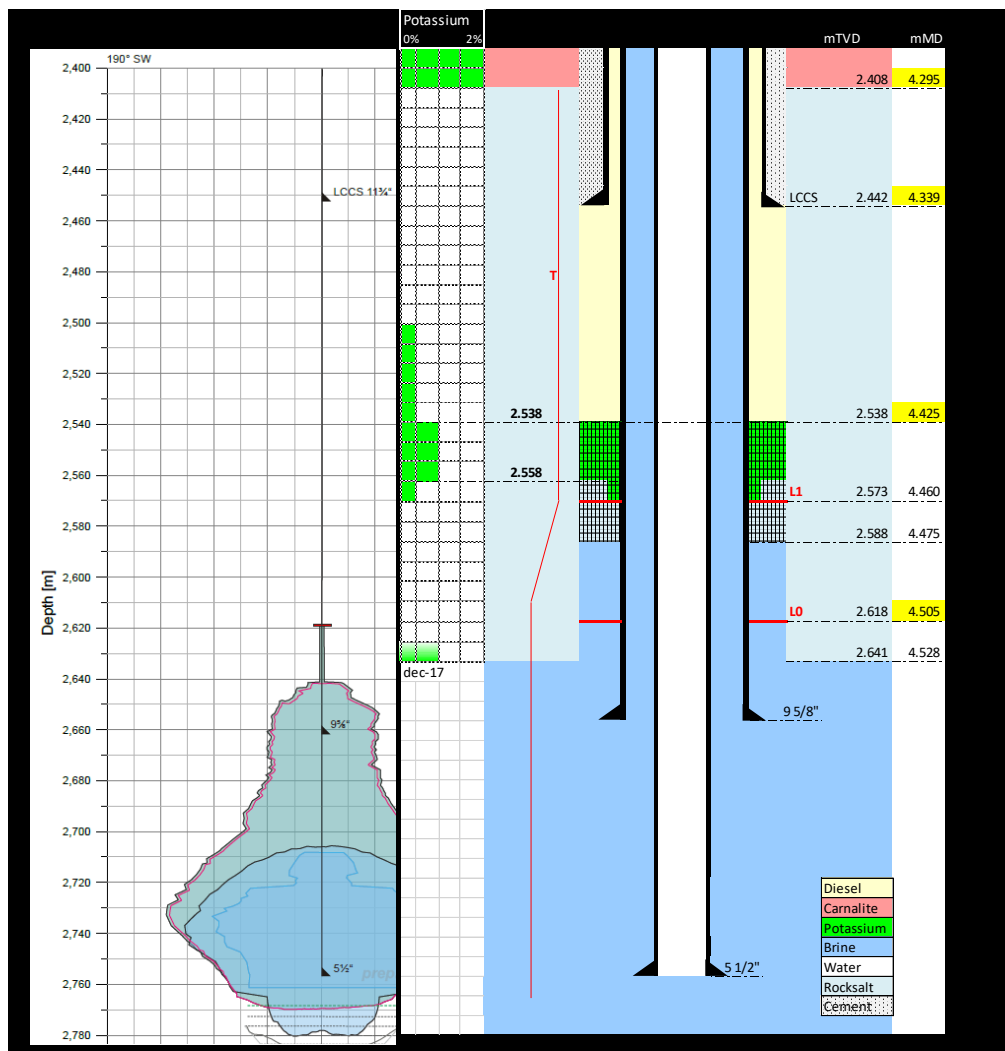
- First sign of blockage nov17
- Blockage is partial, some communication with cavern
- Pressure increase to ~280bar
- Initially thought; squeezed neck and temperature or mini cavern driving the pressure increase



BAS-3O blocked blanket annulus

- Blanket level measurement 6June18, level at ca. 4460m. Preceding measurement level at 4505m (March18). Next measurement 11July18.
- Blockage seen from 4440m to 4475m.
- Spectral gamma: elevated potassium measured from 4425m to 4445m
- Volume diesel injected over lifetime 86,1m³

BAS-3O blocked blanket annulus



BAS-3O blocked blanket annulus

Current thoughts:

- Blockage due to potassium and sodium chlorides crystallization
- Influx is well independent,
 - Potassium rich brine.
 - Influx volume 700-1000ltr, pressure increases from 150bar to 280bar.
 - Pressure increase 2-4min, then a gradual pressure drop.
 - Pressure of influx is sub-lithostatic (either limited volume or restricted flow)
 - Close by (482m) is the BAS-3 cavern, which could be the potential source

BAS-3O blocked blanket annulus

Integrity system

- System barriers are Leine Salt, cement and 11 $\frac{3}{4}$ " casing.
- Pressure increase gives cyclic stress.
 - Cement is a remedial to cyclic stress, but can degrade over time due to cyclic stress
 - Initial calculations indicate that the amplitude 150-290bar gives too much cyclic stress, possible failure
 - Impact on Z3 (244m TVD thick) to be defined

BAS-3O blocked blanket annulus

Immediate actions

- Reduce amplitude cyclic stress, increase pressure cavern
- No blockage removal operations, pending studies
- Diesel injections via blanket or injection string
 - Increased frequency blanket measurements, control on level

Follow up actions

- Additional cyclische stress calculation
- Study possibility BAS-3 cavern as source and identify migration/leaching path (Carnalite/Polyhalite)
- FEM calculation stress in Z3 (154m Salt and 90m Anhydrite)
- Impact potassium/magnesium influx on production
- Impact on subsidence, production and abandonment

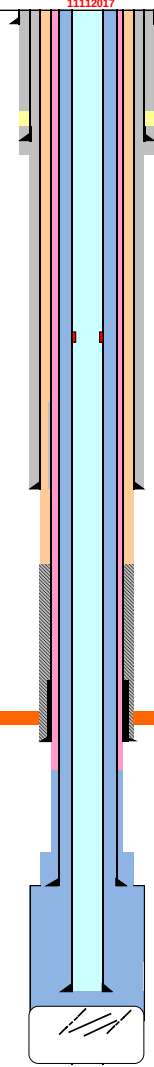
BAS-4

Status

- Production to fit factory requirements
- Increased back pressure
- Sonar measurements were unable to enter cavern, observed a new HUD → changed toolstring configuration
- Performed sonar measurement 12th of April.

Planned

- Continue bottom injection mode
- Blanket measurement (every 6 months)
- Wijziging instemmingsbesluit
- Additional sonar measurement

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		2470,6	2470,6				
EM (Oct 2015, Roof = 2478m) 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 FJL 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

BAS-4

April 2018

1 – 30	No production due to factory maintenance period (1 – 18) and salt demand
20	Reconnect 7" and 11-3/4" digital pressure sensors
30	Water injection

Mei 2018

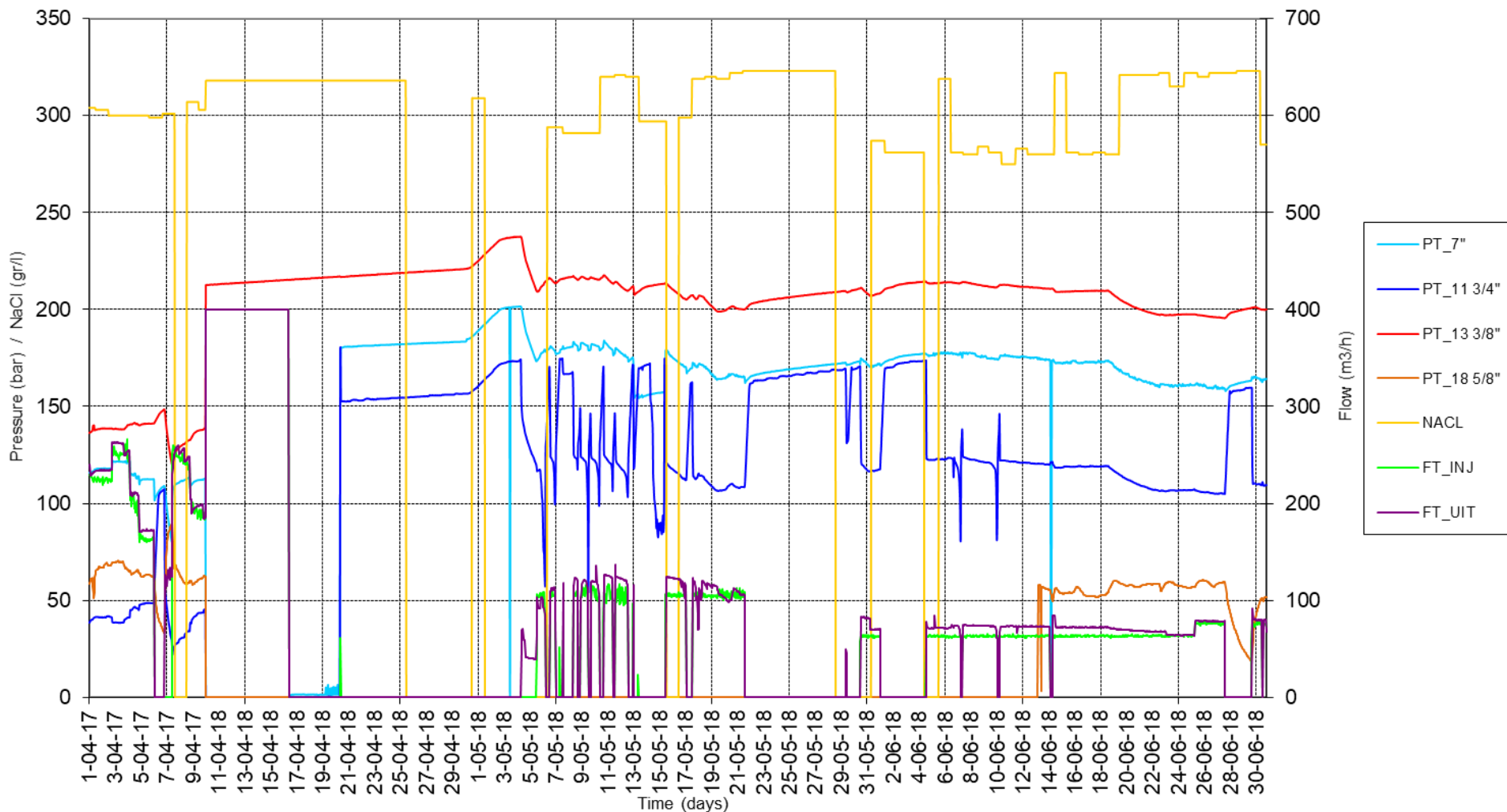
1 – 2	Water injection
3	Isolation of 7" pressure sensor
4 – 21	Intermittent production due to salt plugging because of high concentration brine
21 – 30	Repair/maintenance pump
30	Start production

Juni 2018

1-4	Production stop
7, 10	Production stop due to salt plugging because of high concentration brine
12, 13	Wellhead integrity testing
27	Production stop to install buffer tank on injection pump

BAS-4

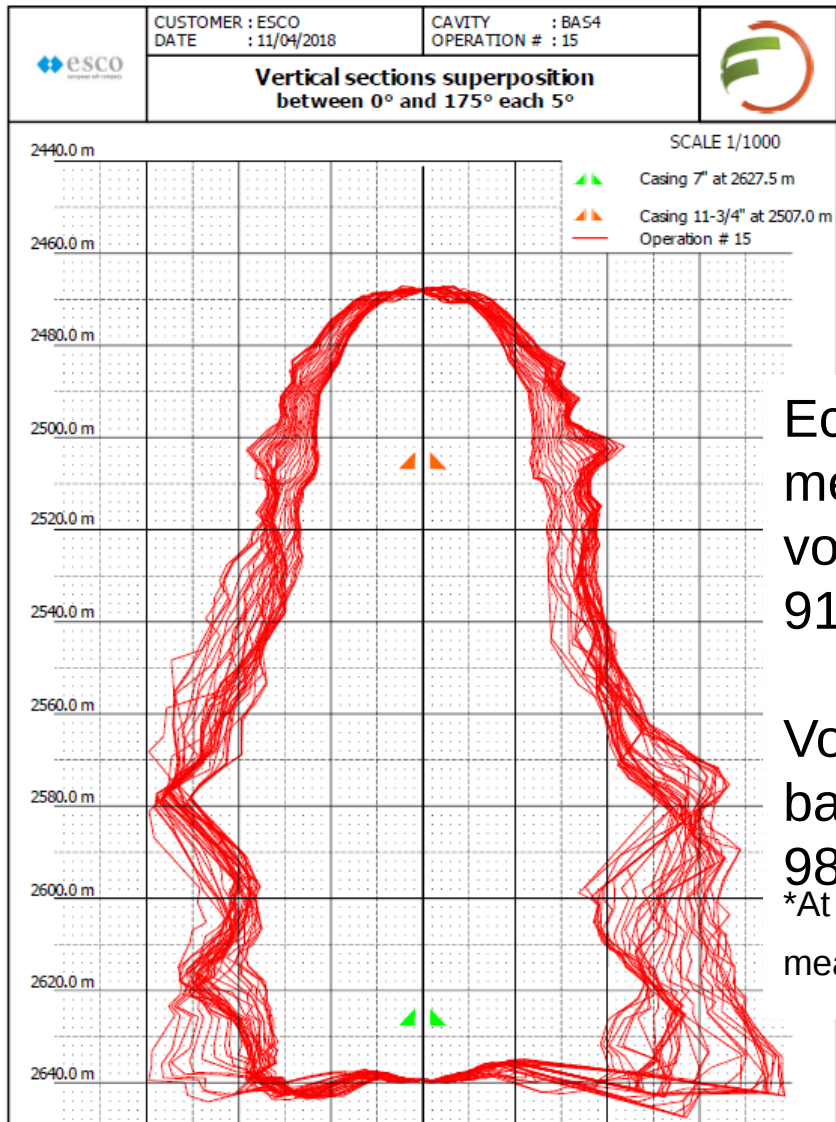
Trends BAS-4



BAS-4 Sonar

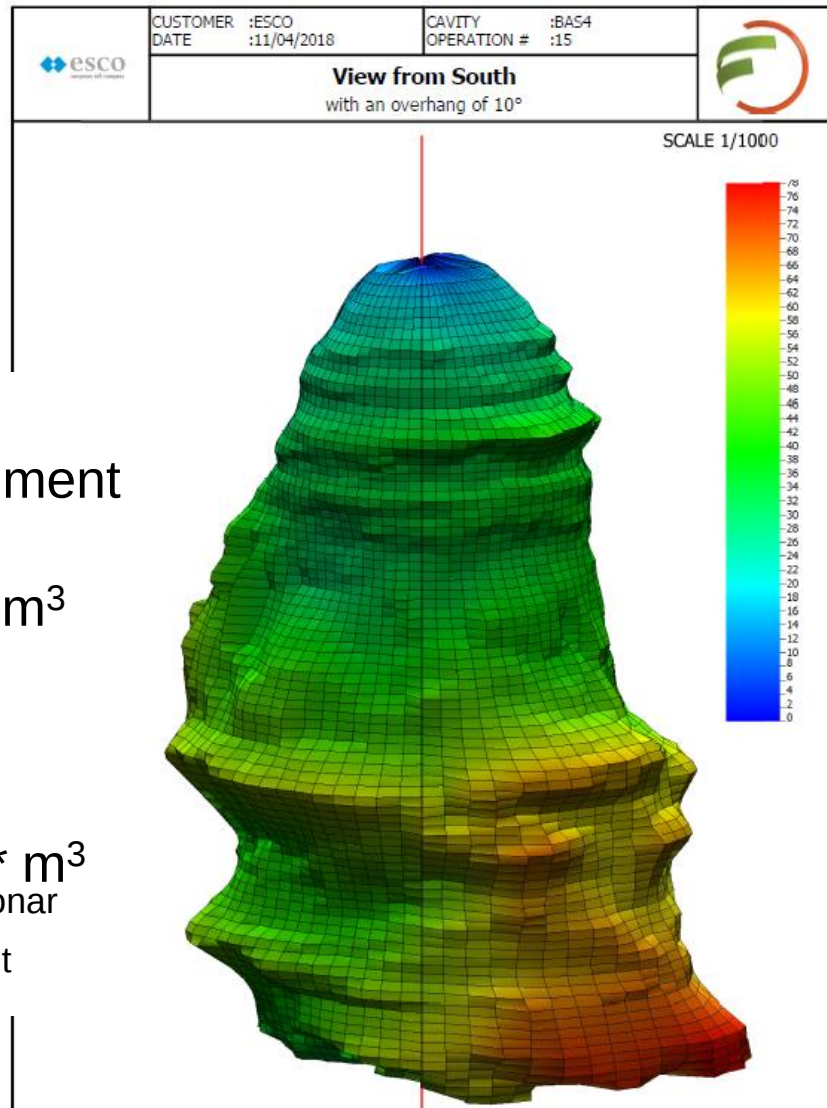
- Combined log October (from top 1,042,989m³) and April (from bottom 883,399m³) for cross correlation of measurement points (917,567m³)
- Cavern volume in equilibrium
 - Salt production between measurements ca. 38,000 m³
 - Calculated squeeze between measurements 37,000m³
- Volume combined log corresponds to echo survey 29sep2016 and volume produced till April 2018

BAS-4 Sonar



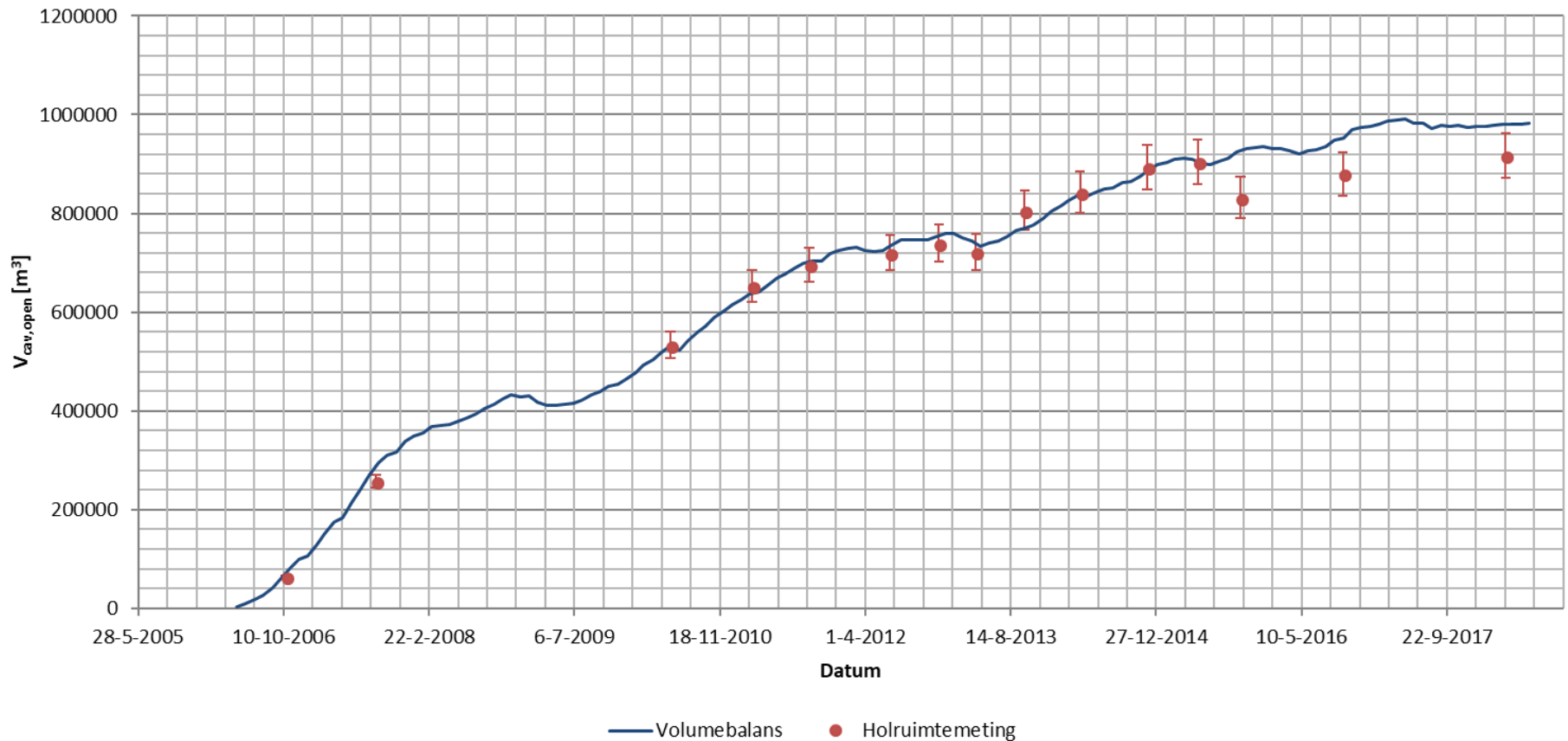
Echo
measurement
volume:
917.567 m³

Volume
balance:
981.330* m³
*At time of sonar
measurement



Volume balance BAS-4

Open caverne volume



BAS-4

Cavern end volume

Brief SodM aan Frisia: 5 december 2017

- Cavern end volume of 1.000.000 m³ until approval of actualisation of winningsplan
- Cavern volume over 1.000.000 m³ will be deducted from subsidence budget
- Production at higher pressures is within limits of current winningsplan
- Remaining production from the 1st of December 2017 onwards: 300.000 tons (within current winningsplan)
 - Produced 1dec17 to 30jun18; 102,757 tons

BAS-4

Cavern end volume

Brief SodM aan Frisia: 28 juni 2017

- SODM cannot conclude if the cavern is smaller than 1mil m³
 - Two partial sonar measurements
- The density of salt is indeed 2.16sg (8% higher than SODM uses), but this correction gives a limited change in reference to the uncertainty of the other parameters
- Subsidence at the deepest point is difficult to estimate exactly, with $\gamma=4.0 \cdot 10^{-7}$ & $\delta=2.0$ the relation is 78,000m³/cm

Waterpassing

M&R 2017

- Measurements were performed November/December 2017 by ANTEA and analyzed
- Modeling contour with Kriging, so far not successful

➤ Subsidence winningsplan:

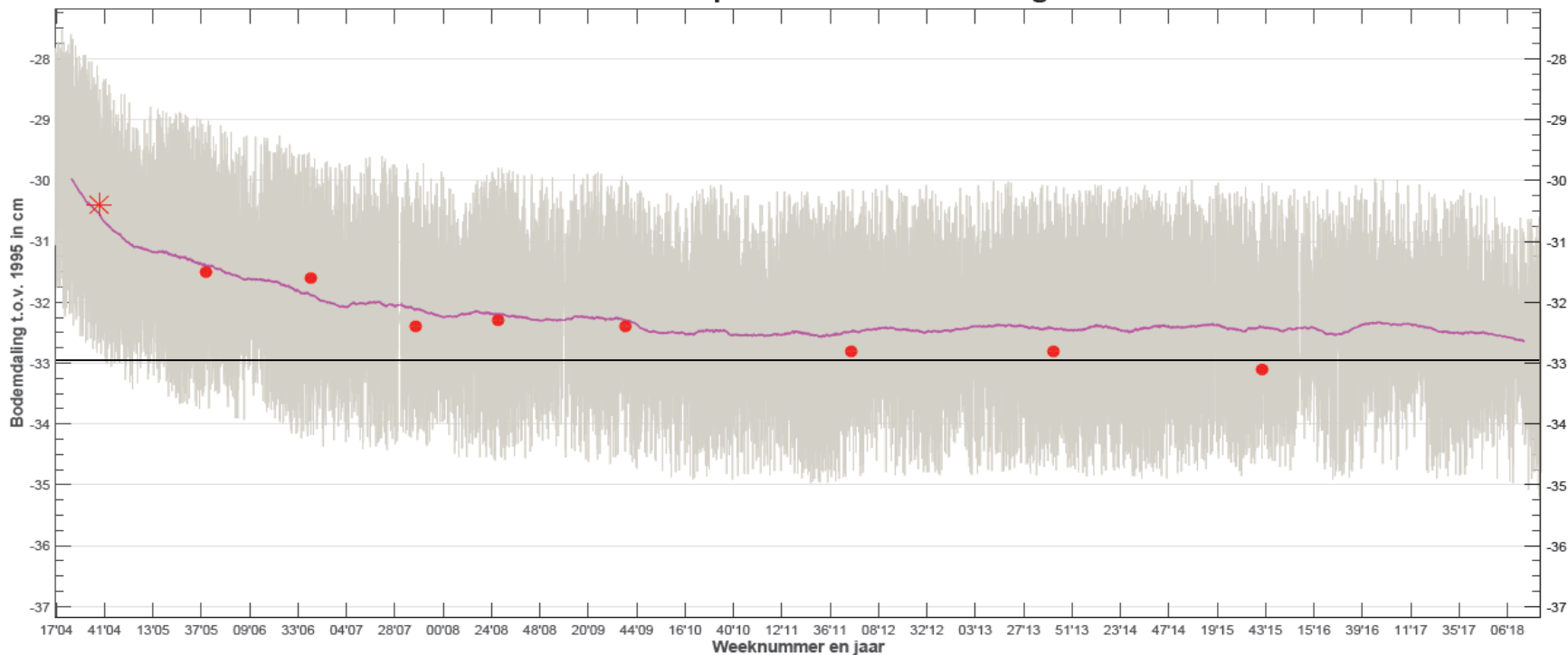
	BAS-3/30	BAS-4
➤ Winningsplan (Barradeel II):	300 mm	300 mm
➤ Current GPS (5-7-2018):	170 mm	278 mm
➤ Subsidence deepest point**:	189 mm	281 mm
➤ Subsidence / year current*:	16,1 mm/y	12,8 mm/y

* Based on full previous year

** Based on M&R 2015

GPS BAS 1/2

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



- Moving Average 16 weken
- Gemeten bodemdaling
- * Week 40 2004 = -30.4 cm**
- Week 40 2005 = -31.5 cm**
- Week 40 2006 = -31.6 cm**

- Week 40 2007 = -32.4 cm**
- Week 29 2008 = -32.3 cm**
- Week 40 2009 = -32.4 cm**
- Week 47 2011 = -32.8 cm**
- week 44 2013 = -32.8 cm**
- week 43 2015 = -33.1 cm**

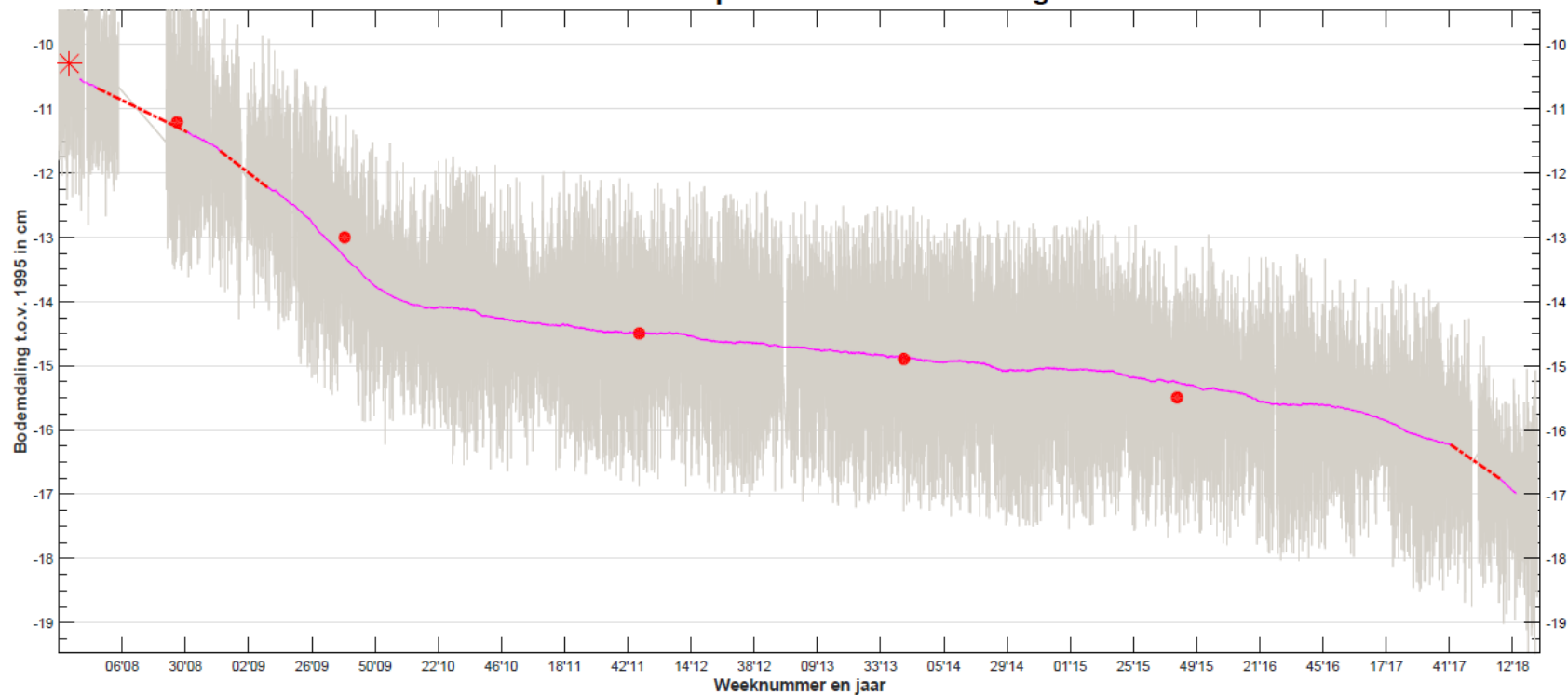
* Op basis van WEP Analyse WP 2015 bedraagt in 2015 daling van diepste punt in winningsvergunning Barradeel 1,65 cm meer dan daling van GPS-station Barradeel.

** 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 te Zweins. De relatieve GPS meting is gekoppeld aan de absolute daling 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***



- * week 40 2007 = -10.3 cm**
- week 29 2008 = -11.2 cm**
- week 40 2009 = -13.0 cm**
- week 47 2011 = -14.5 cm**
- week 44 2013 = -14.9 cm**
- week 43 2015 = -15.5 cm**

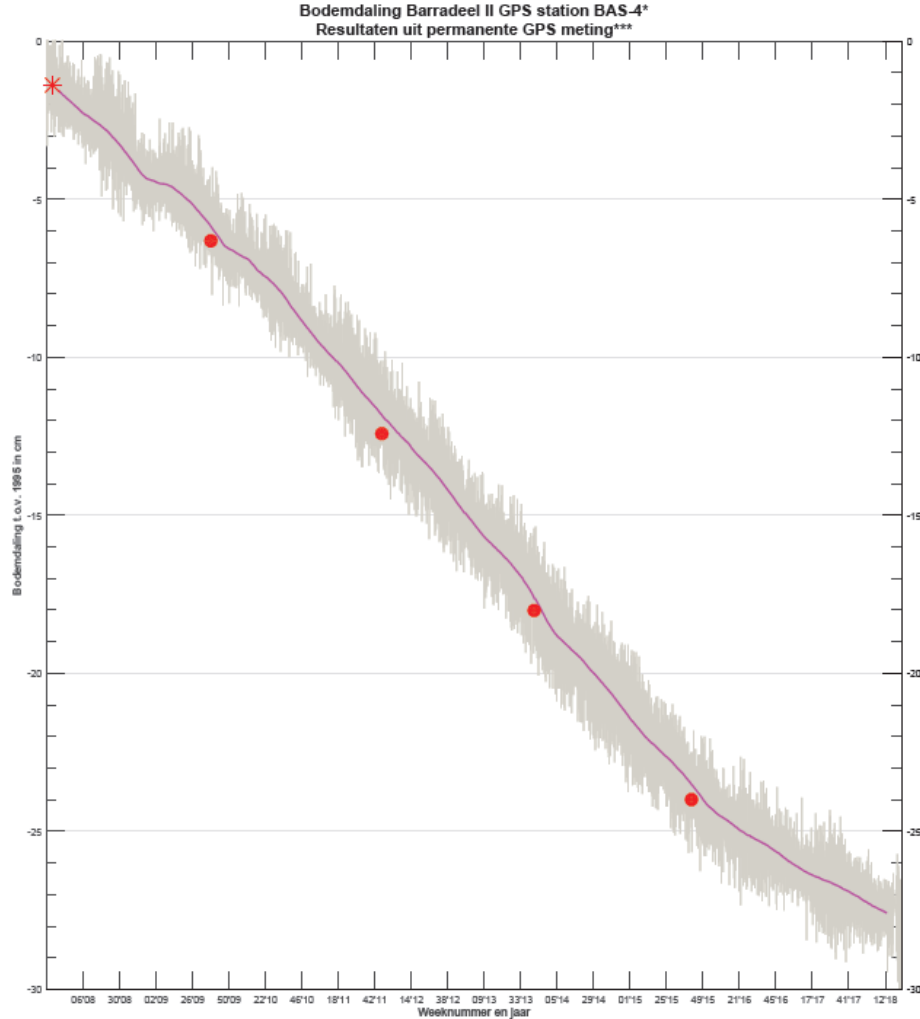
— Gemeten bodemdaling
— uitval verbinding
— Moving Average 16 weken

* Op basis van WEP Analyse WP 2015 bedraagt in 2015 bodemdaling boven caveïne BAS-3 1,95 cm meer dan 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 te Zweins. De relatieve GPS meting is gekoppeld aan de absolute daling vastgesteld in WP 2007 (rode ster)

GPS BAS-4



- * week 40 2007 = -1.4 cm^{**}
 - week 40 2009 = -6.3 cm^{**}
 - week 47 2011 = -12.4 cm^{**}
 - week 44 2013 = -18.0 cm^{**}
 - week 43 2015 = -24.0 cm^{**}
- Gemeten bodemdaling
— Moving Average 16 weken

^{*} Op basis van WEP Analyse WP 2015 bedraagt in 2015 bodemdaling boven caveerne BAS-4 0,3 cm meer dan daling van GPS-station BAS-4.

^{**} Daling GPS station berekend uit "best fit" dalingskrommen. (ref. WP 2015 Zwiens, glijdende PM, 3 krommen v1.2- Dikrft 13 mm, gamma 4,3)

^{***} GPS is een relatieve meting tussen station BAS-4 en het station te Zwiens. De relatieve GPS meting is gekoppeld aan de absolute daling vastgesteld in WP 2007 (rode ster)

GPS logbook

GPS monitorings Logboek

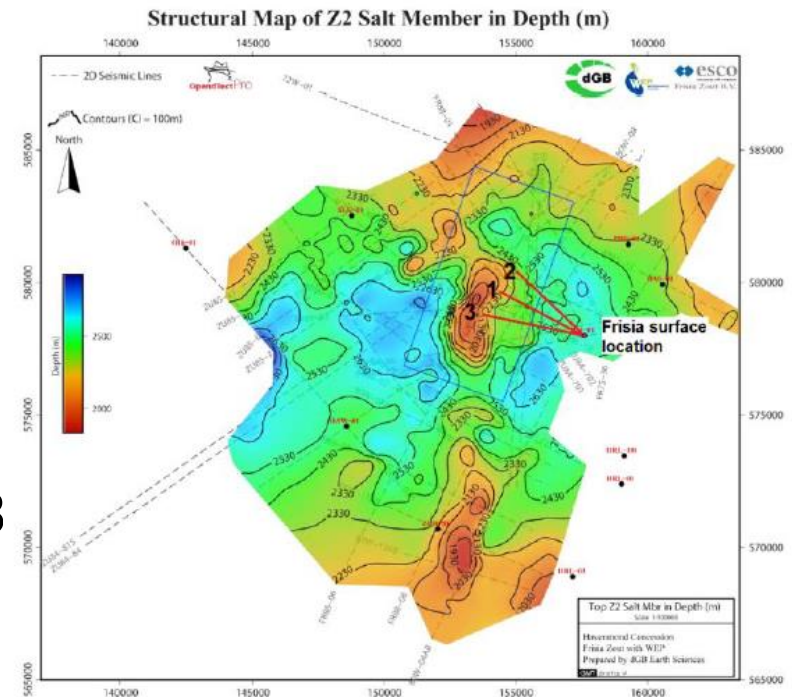
BAS12, BAS3, BAS4, Zweins

versie: 27-jun-18

Datum	Station	Omschrijving melding
24-04-2018 t/m 25-04-2018	Zweins	Onderbreking data ontvangst Zweins van 24-04-2018 21:59 t/m 25-04-2018 10:59, waardoor berekening van BAS12, BAS3 en BAS4 niet mogelijk is.
9-05-2018 t/m 15-05-2018	BAS4	Onderbreking data ontvangst van BAS4 van 9-05-2018 10:59 t/m 15-05-2018 23:59.
9-06-2018 t/m 13-06-2018	BAS12	Onderbreking data ontvangst van BAS12 van 9-06-2018 11:59 t/m 13-06-2018 12:59.
18-05-2018 t/m 19-05-2018	BAS3	Onderbreking data ontvangst van BAS3 van 18-05-2018 7:59 t/m 19-05-2018 10:59
6-06-2018 t/m 15-06-2018	BAS3	Onderbreking data ontvangst van BAS3 van 6-06-2018 10:59 t/m 15-06-2018 23:59.
15-05-2018 t/m 23-05-2018	BAS4	Onderbreking data ontvangst van BAS4 van 15-05-2018 0:59 t/m 23-05-2018 13:59.
7-06-2018 t/m 8-06-2018	BAS4	Onderbreking data ontvangst van BAS4 van 7-06-2018 8:59 t/m 8-06-2018 6:59.

Havenmond

- Update M&R, ready end October18
 - Zero measurements can start, installation of poles planned for Q3/Q4 2018.
- Submitted “Aanmeldnotitie MER” 1jul18
- Alternative blanket fluid study
- Finalize detailed design July/August 2018
- Omgevingsvergunning mid august18
- Start drilling summer 2019
- Winningsplan requirements:
 - Volume balance report
 - Review BAS-3 abandonment
 - Sluitingsplan before start production



WVTTK

- Next quarterly meeting 10th of October 2018, 10:00-15:00 SODM
- Risk ID, state of the sector
- Well integrity measurements performed in week 23