MAY 2022

OMV's Helius data ecosystem with the AVEVA PI System enabling scalable innovation in CBM

Aveva PI World, Amsterdam

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Introduction to OMV E&P's data ecosystem

OMV 2030: An integrated sustainable fuels, chemicals and materials company

GROUP

Chemicals & Materials

- Become a **global leader in specialty polyolefin** solutions, with a significantly strengthened position in Asia and North America
- **Scale up the circular business** and diversify into **new high-value chemicals and materials** for long-life applications

Refining & Marketing

- Reconfigure refining in the direction of **renewable fuels and chemical feedstock** production with deeper chemicals integration
- Provide **mobility solutions** by building a sustainable fuels business and **growing Retail** through non-fuel business and e-mobility

Exploration & Production

- Leverage existing capabilities to **provide sustainable energy solutions** (geothermal, CCS)
- **Reduce fossil production** gradually and shift to natural gas, as an energy transition fuel until 2030

Build a **sustainable growth business model**, with focus on increasing returns for shareholders

"Digitalization will change the way the E&P business is conducted. Digitalization will change the world of work. It will change what we do and how we do it. That's why we have to act immediately and be among the frontrunners."

Johann Pleininger – Executive Board Member OMV Exploration & Production, 2018

DigitUP in a Nutshell – the journey so far

2018 – DigitUP

"Becoming a Digital Frontrunner"

- Upstream integrated
- Value-focused
- Renovating the core

2020 Q1 – Program Refinement

"ShaPIng Our Expectations'

- Clear ambitions set for the future
- Prioritize portfolio to business outcome
- Accelerate innovation

2020 Q2 – Pandemic & Economic Crisis

"Proving the Concept"

- Digital backbone successfully delivers
- Doing more with less

2020 Q3 – UPFront

"Organizing to value"

- Uplifting our investments
- Upshifting our people
- Upscaling our innovation

2021 Q2 – DigitUP Petrom

"Bringing technology to the field"

- Scalable deployment in the field
- Portfolio of 23 projects

2021 Q4 – Changing Gears

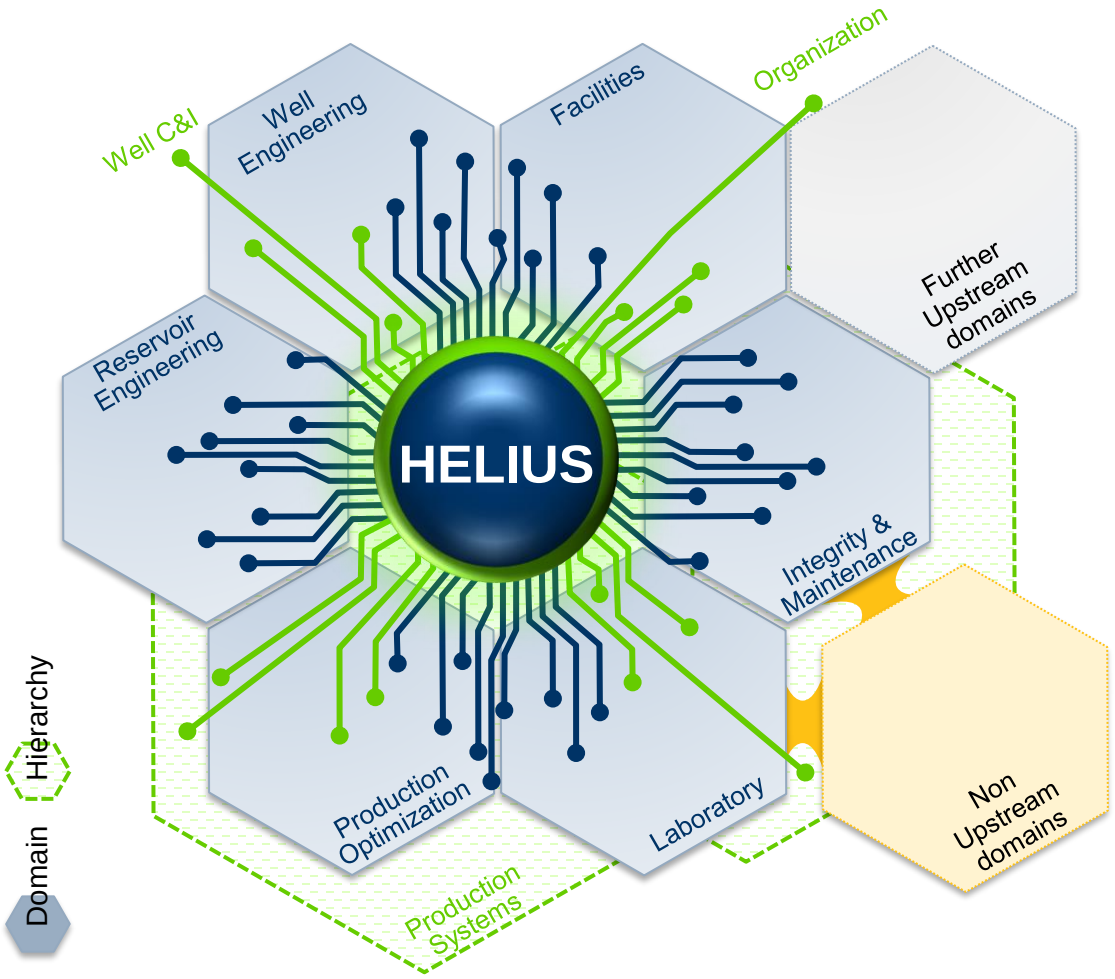
"Ready for acceleration"

- RamPIng up deployments
- Cloudification architecture set up
- Firm grasp on value

2022

HELIUS is a main Pillar of our Digitalization Journey

A fully integrated in the cross-domain data ecosystem

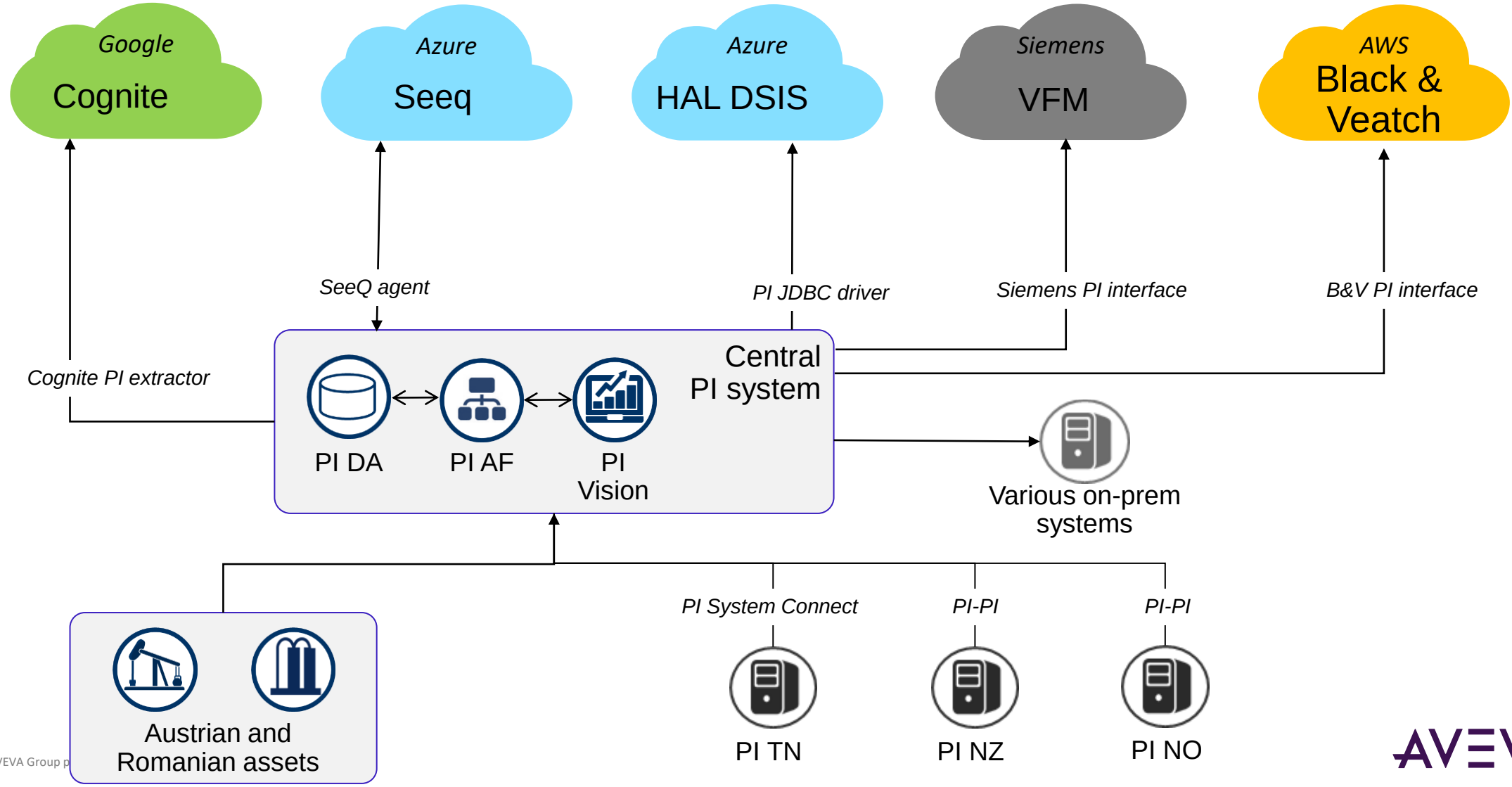


The **contextualizing** of all domain data unlocks the potential of large-scale automation and data-driven decision making.

HELIUS …

- is the **point of access for all E&P data** for application developers, citizen developers and all end users
- manages the **diversity of data types, documents, spatial and real-time Operational Technology** and sets them into a meaningful relation
- Based on a **tight integration of best of breed** industry platforms OSDU, Cognite Data Fusion, ESRi ArcGIS and Aveva PI System
- is governed and quality assured through the defined **Data Domain Framework** to increase confidence in our data,
- is safeguarded by a **common security and access framework**, and

The PI system plays a key role in HELIUS as gateway to the OT world



HELIUS uses PI Asset Framework as an engine to apply data governance in digital applications

Enable Digital Innovation at scale

- Transform digital innovation at a local level into products that can be rolled out across a global enterprise
- Allow a global community of experts to collaborate to solve common problems

A governance framework to harmonize the data foundation

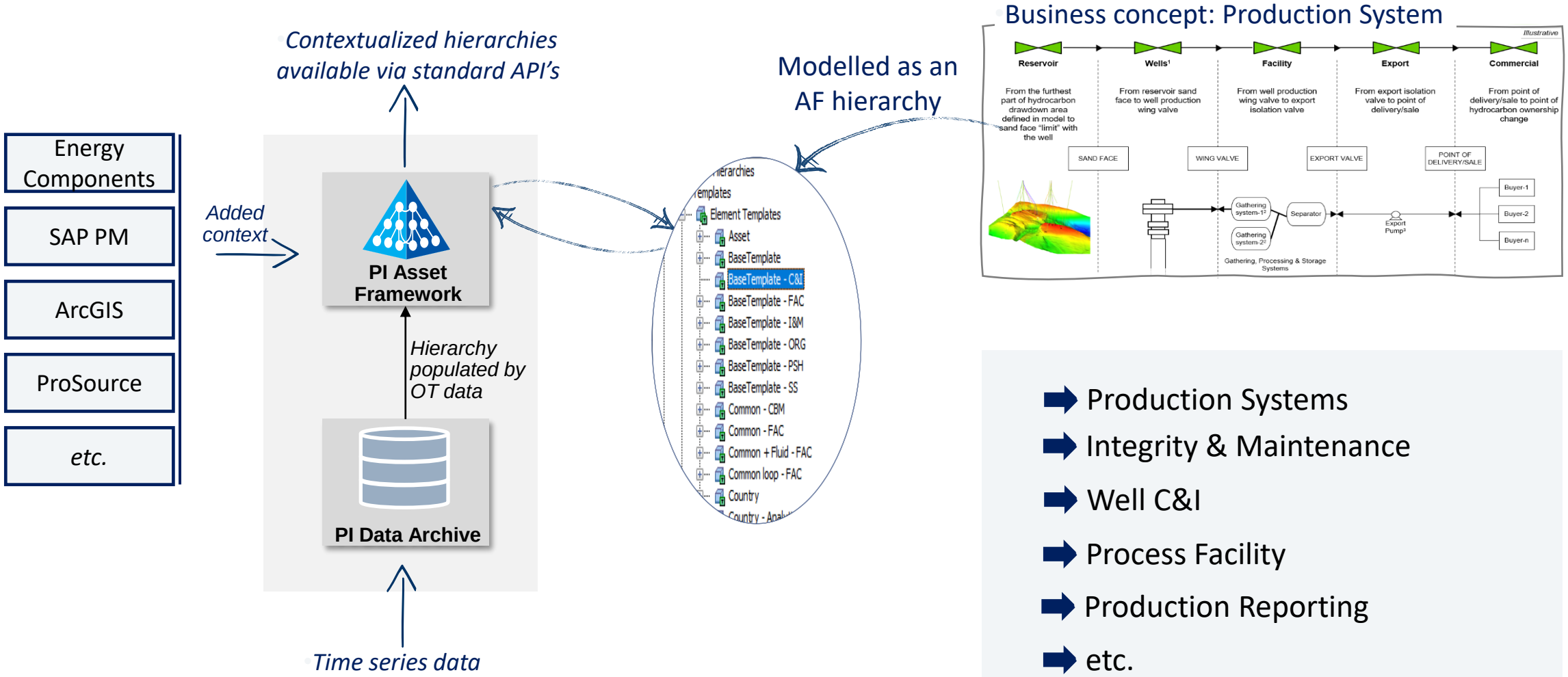
OMV E&P's **Data Domain Framework** establishes the principles and rules to overcome silos between the disciplines and between locations

- Standard definition of properties of significant business entities → **Data Dictionary**
- Standard definition of the relationships between significant business entities → **Upstream Hierarchies**

A technical platform to make governance rules accessible

- An API-layer that exposes data according to the standard definitions of the data dictionary
- Utilize PI AF's powerful modeling capabilities to establish a library of Upstream Hierarchies
- Utilize PI AF's integration capabilities to populate the Upstream Hierarchies and expose them to consumers via the API-layer

Upstream Hierarchies represent core concepts defined by Business SME's and managed as hierarchies in PI AF



- Production Systems
- Integrity & Maintenance
- Well C&I
- Process Facility
- Production Reporting
- etc.

Leveraging Helius to scale up a condition monitoring use case

Local innovation to address frequent compressor failure in the Austrian branch office shall be rolled out globally with almost no additional coding required

AT- OFF GAS Membrane Compressors Case

Type:	Diaphragm Compressor MKZ680-10
No. of rev.:	360 rpm
Stages:	2
Medium:	Hydrogen
Suction press.:	18 bar abs
Disch. press:	281 bar abs
Capacity:	580 m^3/h (VN)
Motor power:	135 kW
Execution:	ready for operation

Schönkirchen

Compressor	Type
ST32	MKZ-680/10
ST42	MKZ-560/10
ST62	MKZ-680/10

Off-gas compressors membrane failures

Purpose: To recycle gas to be flared and re-process it back to the production stream.

Issue:

Frequent failures (ruptures) of the compressor's membranes due to excessive stress, leading to gas flaring and production partial shutdown for membrane replacement.

Requirement:

Detect failure few days before to prevent unexpected production shutdown.

RGV Tage ohne Membranbruch bei den
H2S-Restgasverdichter ST32, ST42 ST62

Tage ohne Bruch		Datum	Stat	St	Membrane	Anmerkung	Bh	E1/ E2 korr./ pr	Membransatz	Ø Standzeit Membranen nach Bruch (Bh)	Ø Standzeit Membranen ges. (in Bh)
27	Tage	09-11-17	ST42	1A	gasseitig	Membranbruch nach	3,961	E1	*Kleibrink Satz*	3358*	3358*
5	Tage	14-11-17	ST42	1B	gasseitig	Membranbruch nach	4,058	E1	*Kleibrink Satz*		
36	Tage	23-07-18	ST42	2	ölseitig	Membranbruch nach	2,368	E1	*Membransatz Eigenfertigung*	1533	1533
	Tage	23-04-19	ST42	2	kein Bruch gefunden	kein Bruch nach	6,039	E1	*Membransatz Eigenfertigung*		
30	Tage	13-08-19	ST42	1B	gasseitig	Membranbruch nach	10,983	E1	*Membransatz Eigenfertigung*	2549	2558
13	Tage	25-11-19	ST42	1A	gasseitig	Membranbruch nach	261	E1	*Membransatz Eigenfertigung*		
46	Tage	10-01-20	ST42	1A	gasseitig	Membranbruch nach	971	E1	*Membransatz Eigenfertigung*		
13	Tage	23-01-20	ST42	1A	gasseitig	Membranbruch nach	971	E1	*Membransatz Eigenfertigung*		
117	Tage	17-08-20	ST42	1B	gasseitig / 11 Uhr	Membranbruch nach	6,329	E1	*Membransatz Eigenfertigung*		
	Tage	08-09-20	ST42	1A	kein Bruch	Wechsel bei Service nach	5,362	E2	*Membransatz Eigenfertigung*	2139	2522
	Tage	08-09-20	ST42	2	kein Bruch	Wechsel bei Service nach	6,805	E2	*Membransatz Eigenfertigung*		
1	Tage	08-10-20	ST42	1A	gasseitig	Membranbruch nach	506	E1	*Membransatz Eigenfertigung*		
50	Tage	27-11-20	ST42	1A	gasseitig	Membranbruch nach	1,170	E1	*Membransatz Eigenfertigung*		
57	Tage	23-01-21	ST42	1A	gasseitig	Membranbruch nach	1,315	E1	*Membransatz Eigenfertigung*	3180	3180
26	Tage	18-02-21	ST42	1A	gasseitig	Membranbruch nach	529	E1	*Membransatz Eigenfertigung*		

Case Study:

- Capsule failure symptoms using Seeq analytics.
- Capture a predominant signature and apply it for future failure prediction in order to extend membranes lifecycle.

Average period without Failure (2017-2020)		Max	min
ST32	33.2 Days	136	0
ST42	35.1 Days	117	1
ST62	34.6 Days	102	0

Off-Gas Compressor Failures costs

Off-Gas Compressor Failure

Shut down for repair to avoid fairing

Partial production shutdown (10 hrs)

GST-0259, Environmental Management

Prod. deferral/failure
(50% of 12kNm3/hr gas)
~ 9,320 €

Maint. cost/failure
(Material+manhours)
~ 3,000 €

Total Cost/ failure
~ 12,320 €

Yearly Cost/ Compr.
~ 148 k€

Repair without shutdown but with fairing

No production shutdown

Production loss/failure
(600Nm3 gas to flare)
~ 930 €

Maint. cost/failure
(Material+manhours)
~ 3,000 €

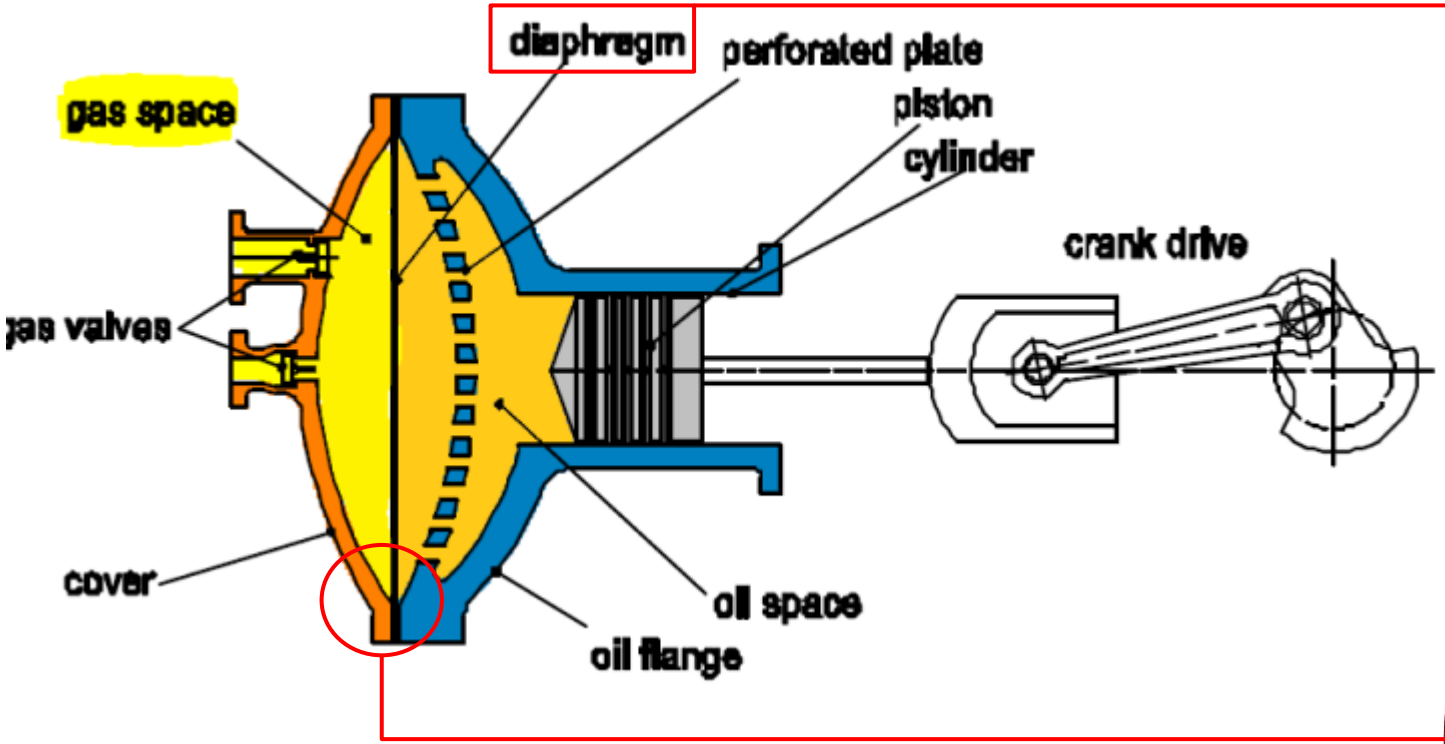
Total Cost/ failure
~ 3,930 €

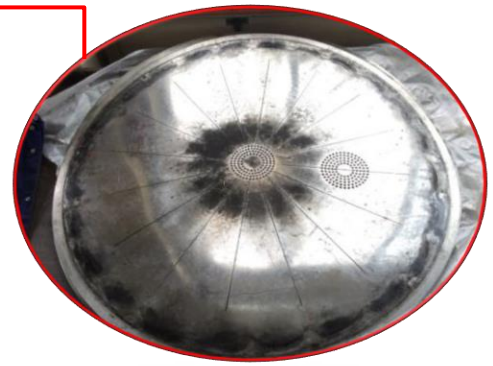
1 m3 ≈ 0.0353 MMBTU

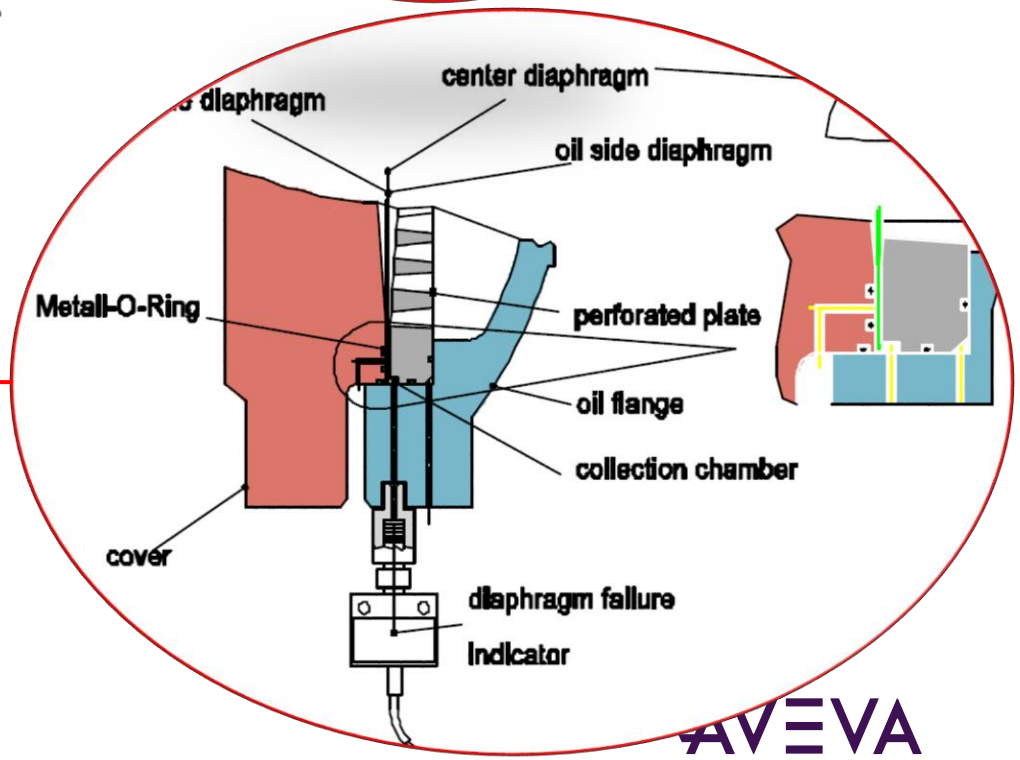
1MMBTU ≈ 4.4€ (Nov-2021)

(50%*12000m3)*0.0353MMBTU*4.4 € *10h≈ 9,320 €

Membrane failure detection







A pressure switch is connected to the chamber, and a contact pressure gauge will stop the compressor. This ensures, that gas and oil will never come into contact with each other, or that gas escapes to the atmosphere through the open hydraulic system downstream the overflow valve.

Membrane problem

PI-6004: Membrane internal pressure 1A

Provides information about membrane stress and rupture.

PT6004 value shall be negative pressure.

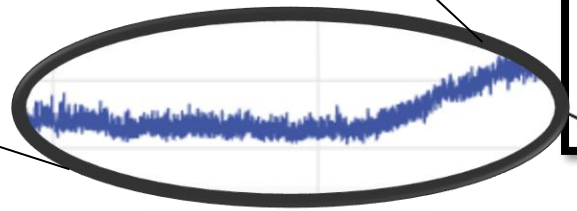
PT6004 Alarm high 0.8 bar.

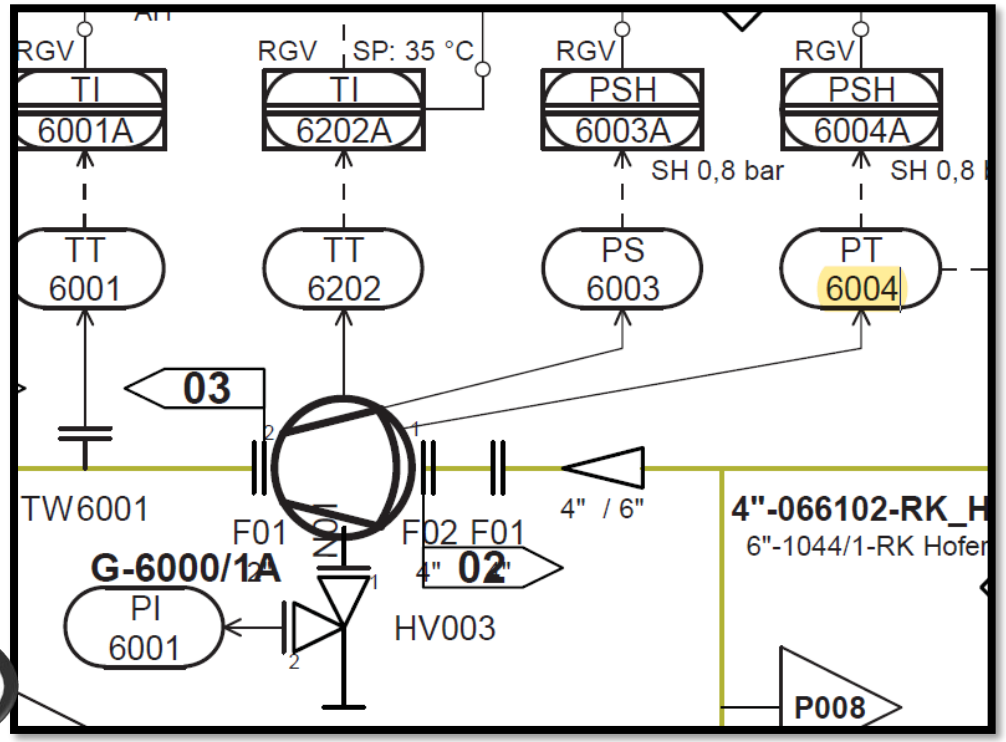
Any changes in the value will inform about the membrane status.

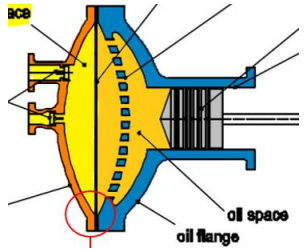
Normal operation

Abnormal Operation

<u>Pressure increase, and higher signal instability</u>



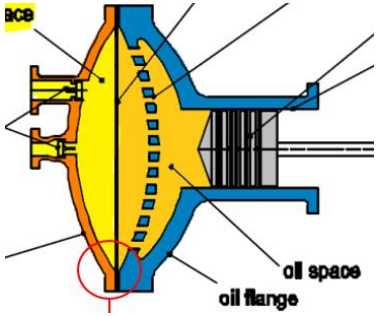




Signature identification using Seeq

Similar symptoms appeared before the membrane failure happens:

- Membrane stress pressure reaches 0.15 bar
- Higher signal instability reaching 0.1 bar P2P.



New threshold set at 0.15 bar

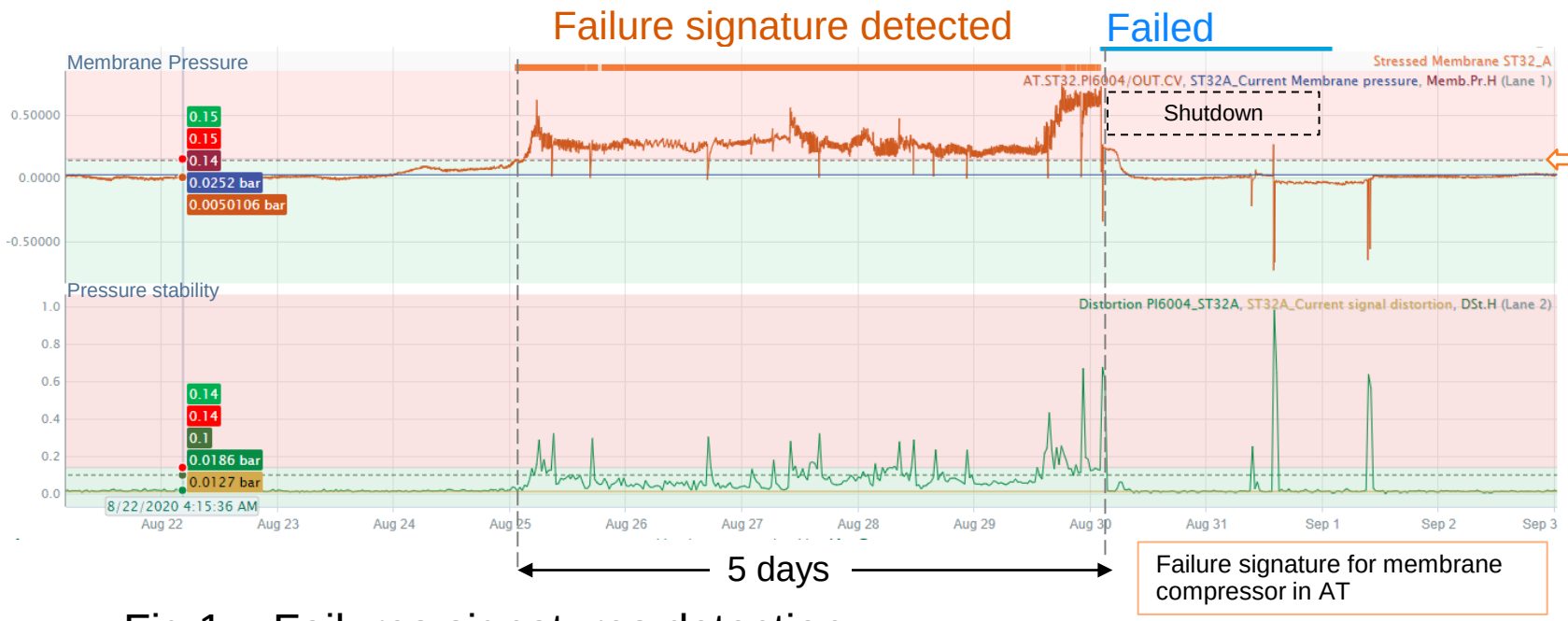
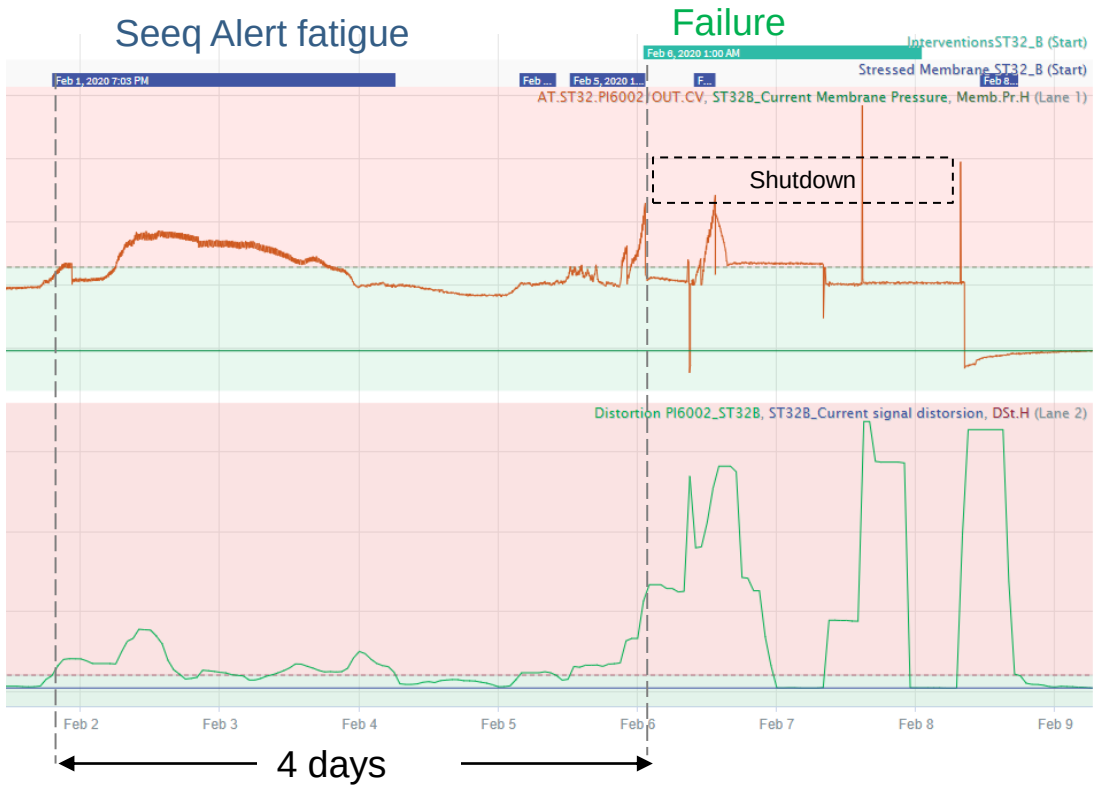
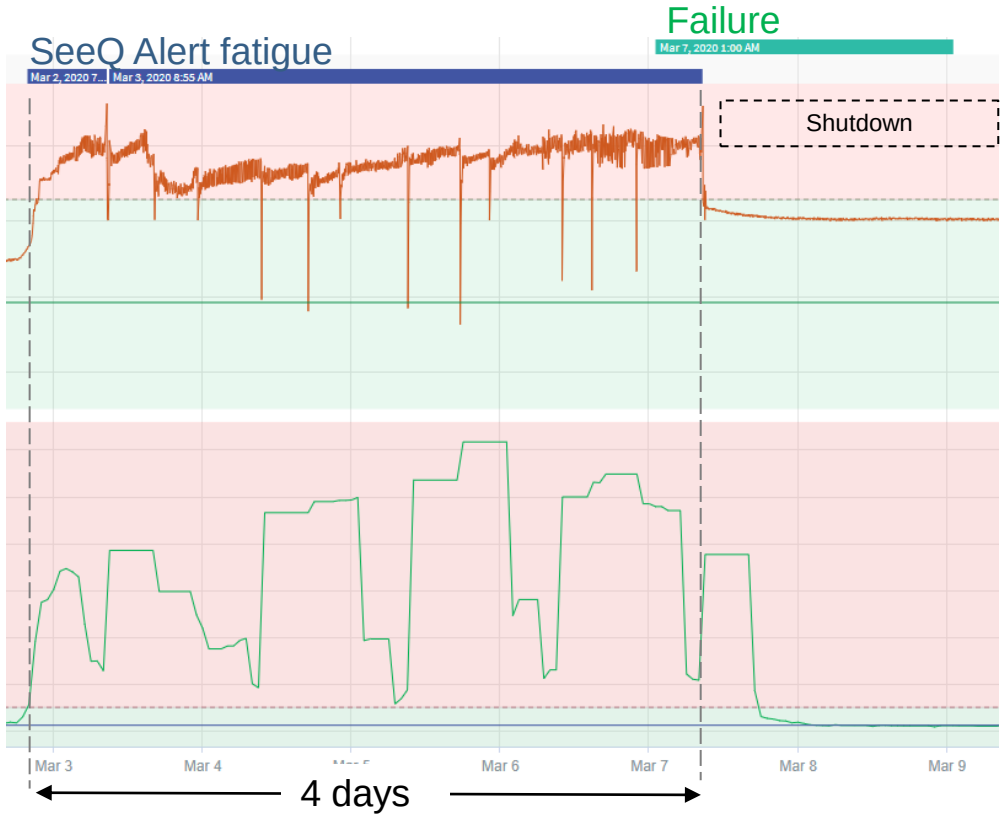
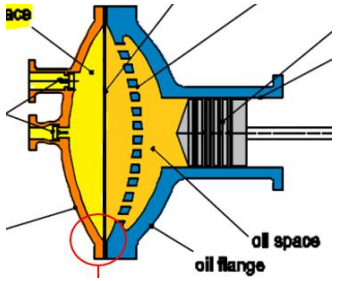


Fig 1 – Failures signatures detection

Signature tested on other compressors

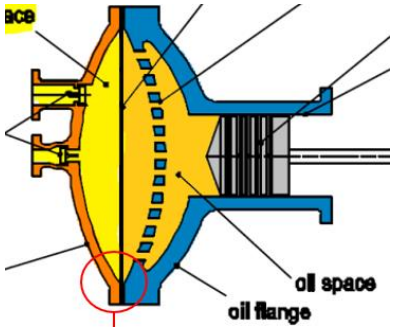


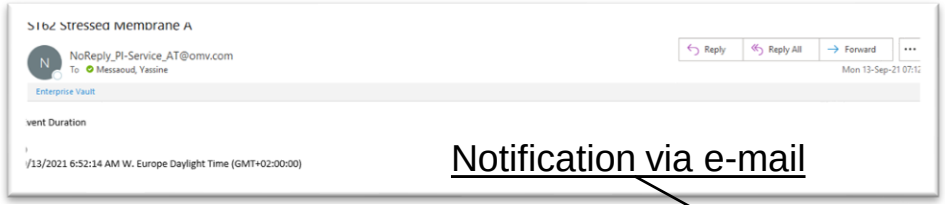




Proposed solution

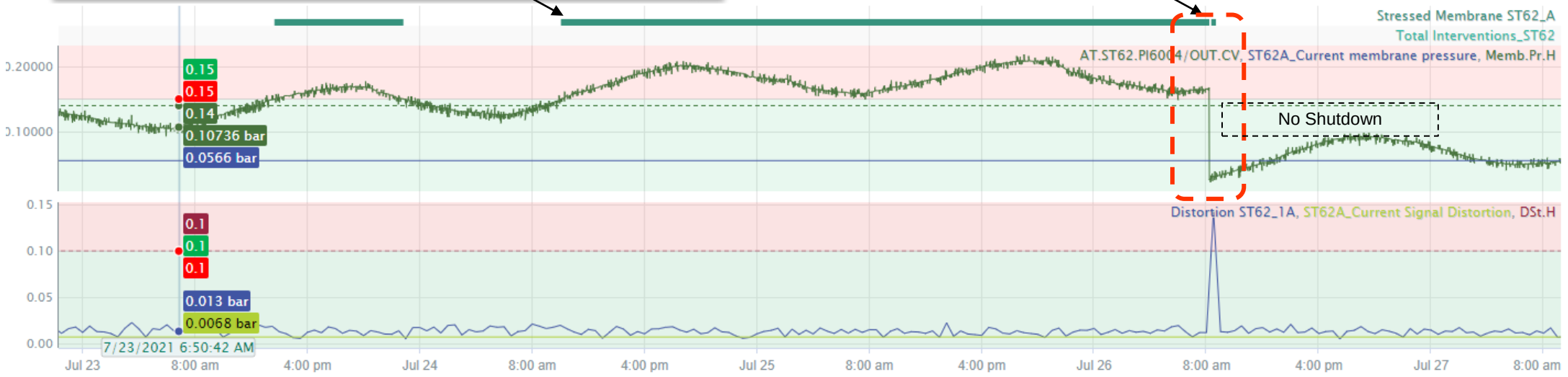
- Continuously Monitor membranes for all the compressors using Seeq
- Seeq creates an e-mail notification to alert if any symptom appear on the trend
- Inform operation team to drain the built-up pressure in the chamber





Notification via e-mail

Pressure released inside the chamber



Results

Since implemented (June-2021):

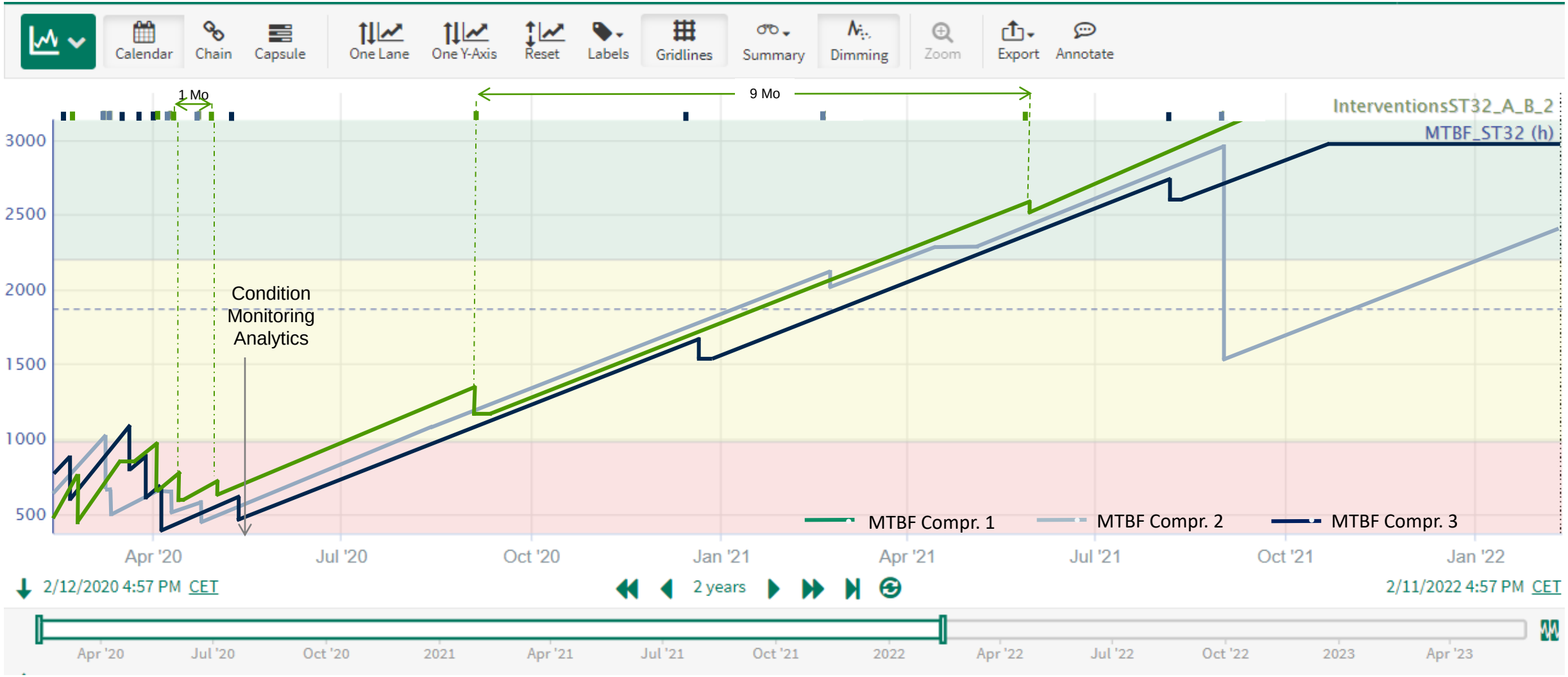
- 3 alerts were raised on ST32 and ST62
- No shutdown caused by the monitored membranes
- Cost avoidance for 6 months= 12.320 x 3= 36.960 **€**

Future steps:

- Apply the model on 6 similar compressors located in Tunisia
- Expand the solution to more complex reciprocating compressor

Note: the purpose of membranes monitoring with Seeq is not to eliminate the membranes failures root cause it, but to predict the next failure and extend its lifecycle

Increased MTBF



World-class upstream operations

Challenge

- Reduce high Off-Gas failure costs associated with compressor membrane rupture by identifying signs of stress and initiating corrective action.

Solution

- Deployed Seeq in combination with data gathered by the AVEVA PI System to derive an analytical model to predict compressor membrane failures
- Ensured the solution is scalable by applying our Standard Upstream Hierarchies as implemented in PI AF.

Benefits

- Increased MTBF from 1 month to 9 months
- No shutdowns caused by monitored membranes, avoiding costs of around 40K€ over the past 6 months; expecting around 120K€ per year.
- Ready to expand the solution footprint from Austria to similar compressors in Tunisia with no additional coding

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