Society of Petroleum Engineers

SPE Romania

25th May 2023
Bucharest, Petrom City

SPE International
Romanian Section

OMV Petrom
Energia pentru o viață mai bună.

Well Integrity Management Implementation In Romania

Thursday, May 25th, 2023, 12:00 – 14:30
22 Coralilor, Bucharest, Romania
Tacit Room – Petrom City

speromania.org

SPE International
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Time	Speaker	Speaker Title	Activity
12:00	Felicia Cirstian	Sr. Expert Well Integrity Engineer OMV Petrom	**Welcome & Opening Speech**
12:10	Dumitru Gherghiceanu	Lecturer at the Petroleum-Gas University of Ploiesti	**History of Oil and Gas in Romania**
12:40	George Galloway	Advisor at Well Academy NL	**Well Integrity Risks Across the Well Lifecycle**
13:40		**Break**	
13:50	Felicia Cirstian	Sr. Expert Well Integrity Engineer OMV Petrom	**Well Integrity journey in OMV Petrom Romania**
14:20		**Closing & Networking**	

Well Integrity implementation in OMV Petrom

Presenter: Felicia Cirstian
Senior Expert Well Integrity Engineer
Well Completion and Integrity

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ABSTRACT

Presentation about the implementation of Well Integrity principles in OMV Petrom. Overview of the management system in place, organization, processes and data management.

Dumitru Gherghiceanu

Bio

Dumitru Gherghiceanu graduated from the Oil and Gas Institute of Ploiesti and Management at Open University.

Worked for 20 years at ICPT Campina, starting as a Drilling Engineer and becoming a Senior Researcher, obtaining a PhD in UPG Ploiesti.

Spent 15 years at OMV Petrom in various positions from Office Drilling Manager to Senior Drilling Department Manager and Skill Pool Manager for Well Engineering.

Currently retired, but still working part-time as a consultant and associate teaching staff at UPG Ploiesti.

Member of the Romanian SPE Section since its inception, holding different positions including Membership Chairman and Chairman.

Volunteered as Editor in Chief for the Romanian Petroleum Review during his time at ICPT Campina.

Published over 12 technical papers and delivered various presentations in SPE meetings and conferences, as well as acted as a lecturer for various training programs.

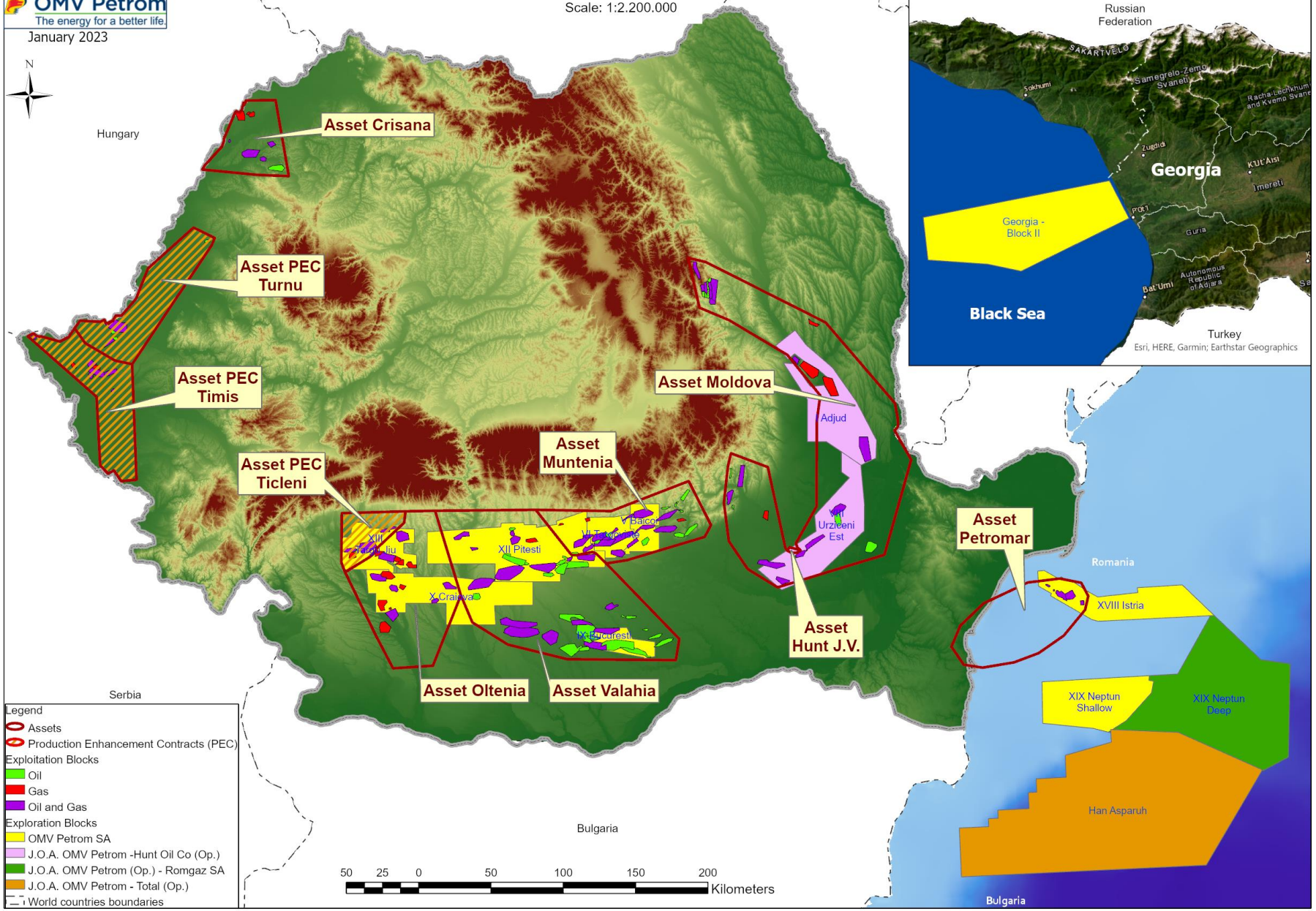
George Galloway

Bio

George Galloway is an Advisor with Well Academy and Technical Consultant with the International Well Control Forum (IWCF). In 2012 he co-founded The Well Academy and co-developed team-based scenario training integrating human factors. After establishing Well Academy in the Netherlands as a specialist wells training centre, he helped grow the business into a global training provider with centres added in USA and Australia. In 2021 George transitioned into his current advisory role and now provides independent consultancy services. George has led the IWCF Well Intervention Taskforce during which time significant improvements were made to the Well Intervention Pressure control curriculum.

AGENDA

- Well Integrity application in OMV Petrom
- Organization and Work teams
- Well Integrity barrier testing process
- Annular pressure management
- Data management – digitalization of Well Integrity
- Risk Matrix used in OMV Petrom
- Well Life Extension process



OMV Petrom Well Integrity Management System boarding

Program initiation: team, procedures, equipment

WIMS Digitalization - 53% of the total active wells

2014 Program initiation

Tendering WIMS software

2015 MTP #1 CAPEX

Excel 300 wells

2016 SafeWells Acquisition and 400 wells; Asset WIMS teams

2017 First 700 wells in software, first WO WIMS crews for PT

2018 wells 1,500

Work instructions

2020 wells 3,100

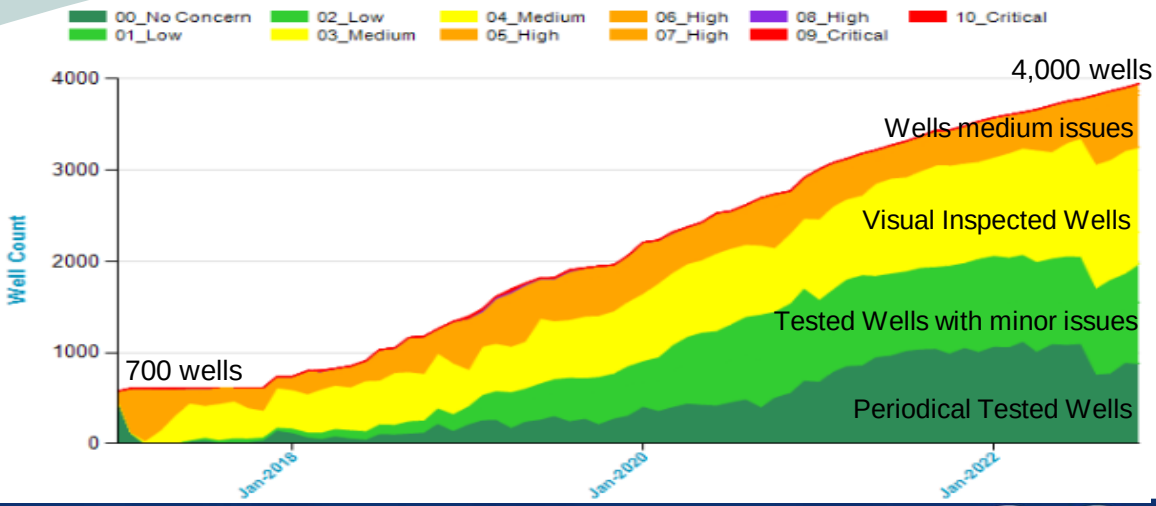
SSSV testing instructions

2021 wells 3,600

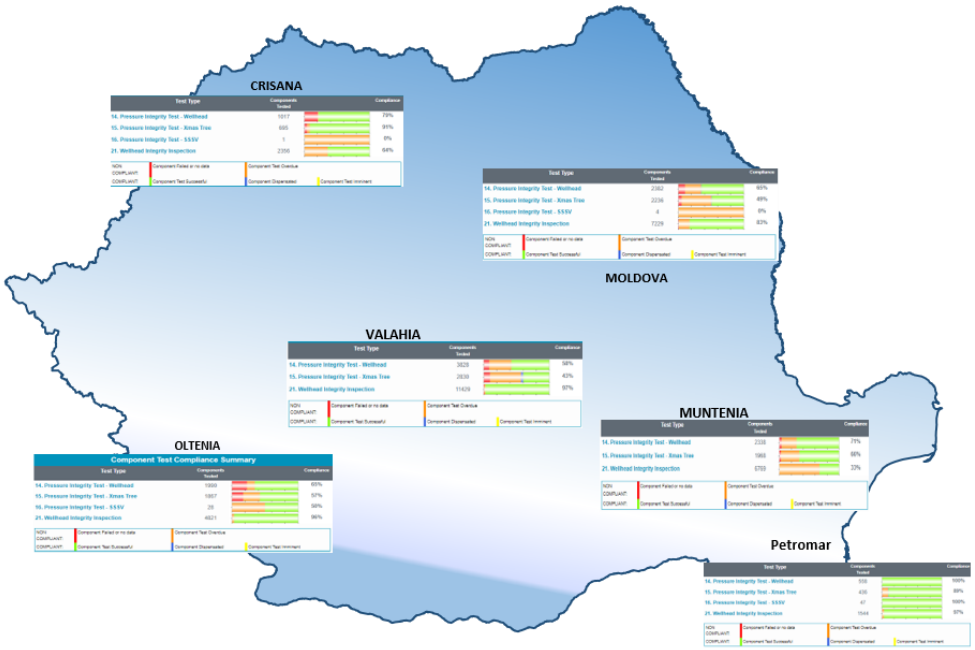
Well Life Extension

2022 wells 4,000

Corrosion model

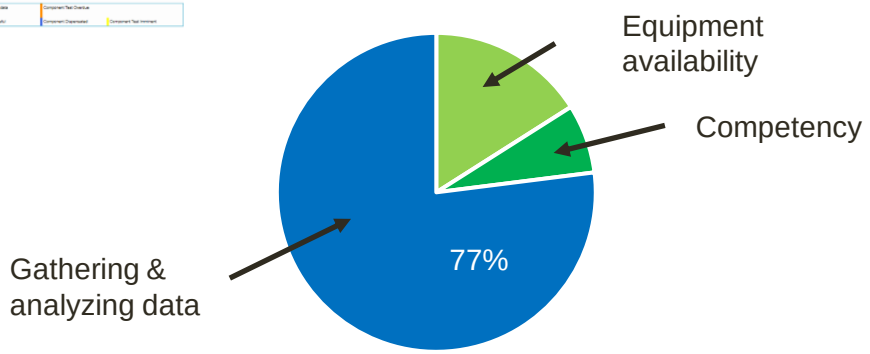


WIMS OMV Petrom Teams, processes, data management



Actual Well Integrity Management System OMV Petrom:

- Teams: HQ (2), Asset WIMS engineers (7), Sectors responsible, 5 WIMS WO crews
- Also for Well control during WO and Drilling, our colleagues are promoting the same Well Integrity principles
- Since 2015 - CAPEX MTP (Valves, Annuli Gauges, Logging)
- Software SafeWells 54% of active wells)
- Work Instructions in REAL (WIMS and SSSV Testing)
- Software Well Barrier Illustration



Well Integrity Management Challenges

XMT valves testing for barrier monitorization
Implementation of WO crews for WIMS pressure testing

WIMS WO crew set up in each Asset

- Created in WO-BU a new Special Operation crew for WIMS, in 2017
- Include 3 operators for XMT and WH pressure testing
- WO Procedures for Pressure testing and WIMS instructions

Equipment for WIMS WO crew

- Pressure test kit implemented in each Asset
- IVECO vehicles provided to each crew
- Set of hydraulic keys for each P/T kit delivered
- IT application on crew's laptops
- Asset Oltenia also has a SSSV testing kit

Annular pressure monitoring system installation – WIMS project

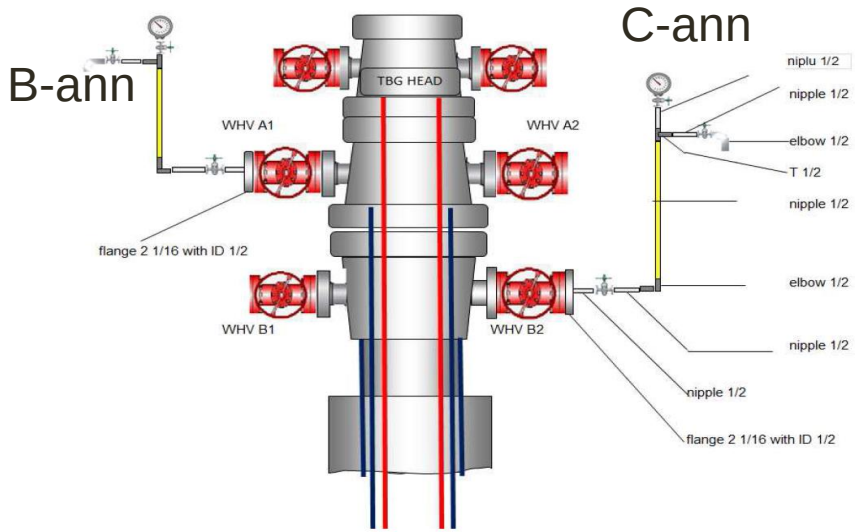


Figure 4. X-mass tree schematic with gauges system installation for annuli pressure

- Annuli pressures are Well integrity key indicators.
- Wells monitored in SafeWells software need to be equipped with gauges systems for all annuli.
- Progress to automated annuli pressure measurement in collaboration with Gas Well Automation – wire sensors in XSPOC
- New Technology progression to wireless sensors – reading in OSIPI

Analog

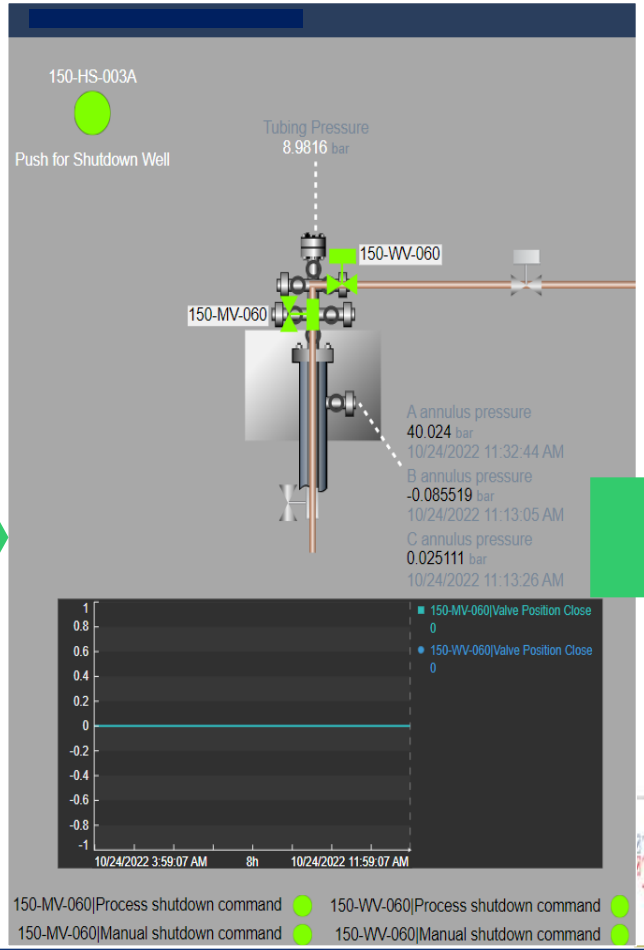
Wire sensors

Wireless sensors

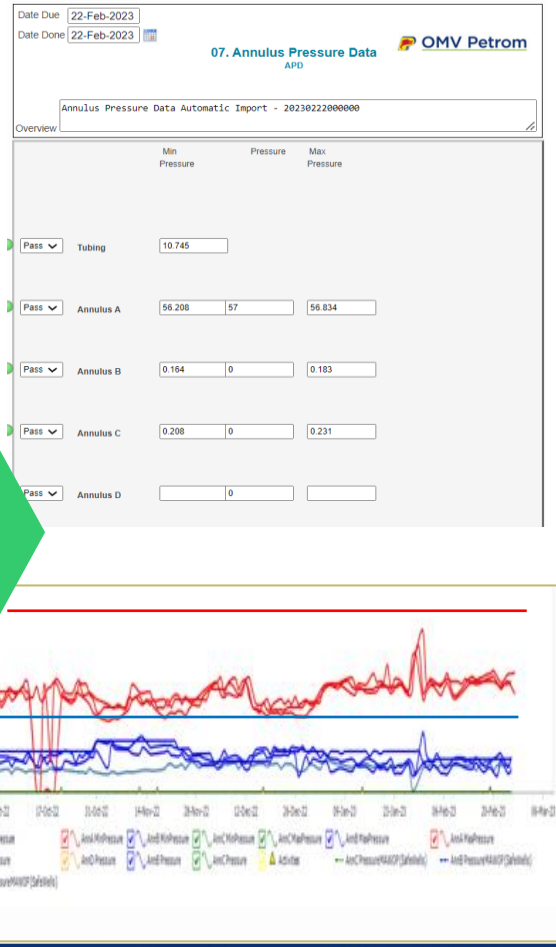
Annular Pressure Wireless sensors in OSI-Pi and SafeWells – New Technology

Sensors and GateWay

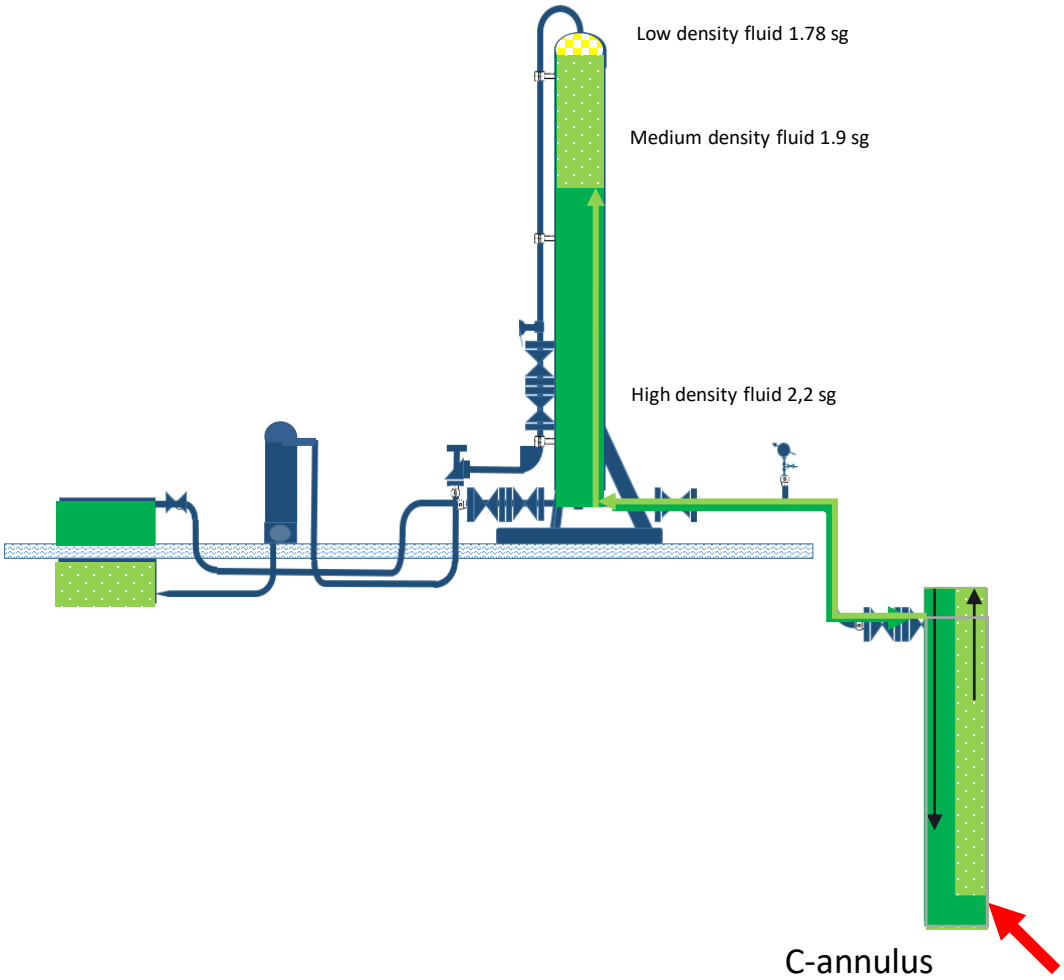
Via Satelit in OSI-PI



OSI-PI SafeWells integration

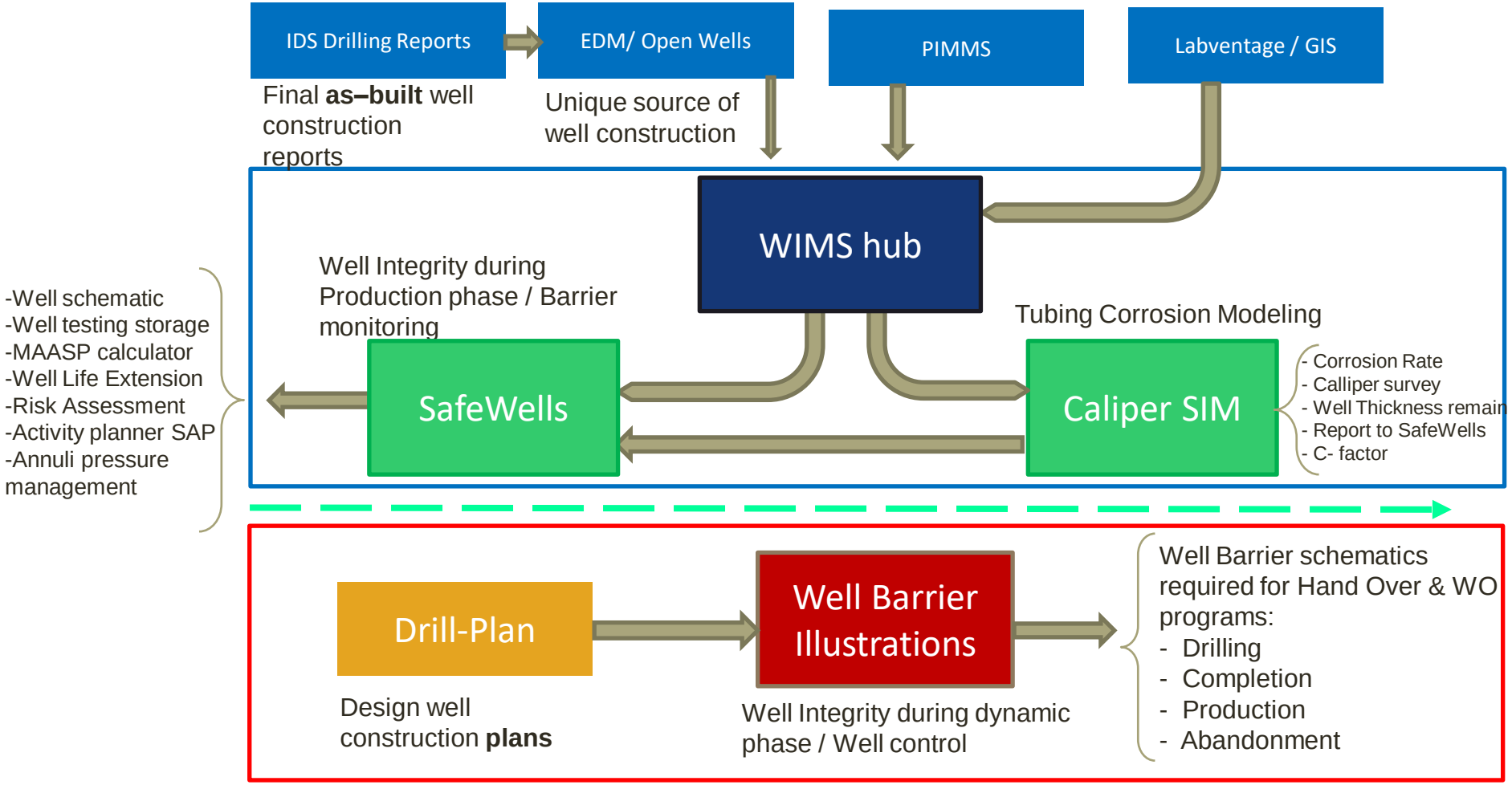


Management of the sustained Annular Pressure - Lubrication procedure

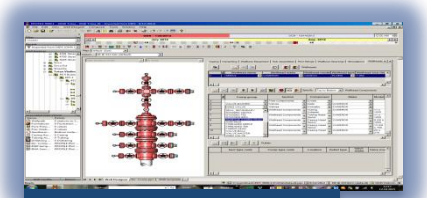


- The lubrication tower is connected to the annular space that presents sustained pressure
- The lubricator is filled with a heavier fluid, which ensures a gravitational advancement in the ring
- Fluid exchange occurs: the lighter fluid in the annulus replaces the heavier fluid in the lubricator
- Densities are measured to maintain a density difference between the lighter return mud and the heavier lube mud
- The lighter fluid collects on top of the lubricator and is periodically drained as the lubricator fills with heavier mud.
- The heavier lubricating fluid advances inside the annulus, displacing the older gasified mud and creating hydrostatic pressure to suppress leakage
- The next step is to drain the lubricator and start a new refill cycle with fresh, higher density mud

Well Integrity software in OMV Petrom

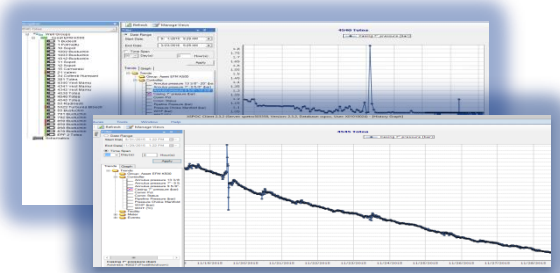


SafeWells is in connection with other OMV Petrom digital data bases



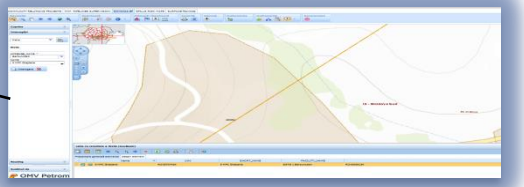
Open Wells/ IDS

MDS + PIMMS

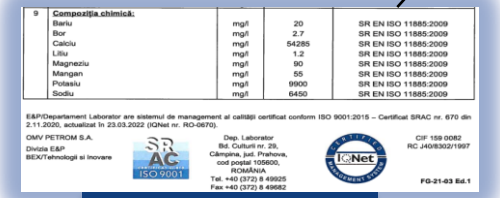


XSPOC / PI

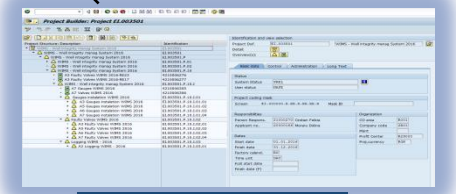
SafeWells



GIS

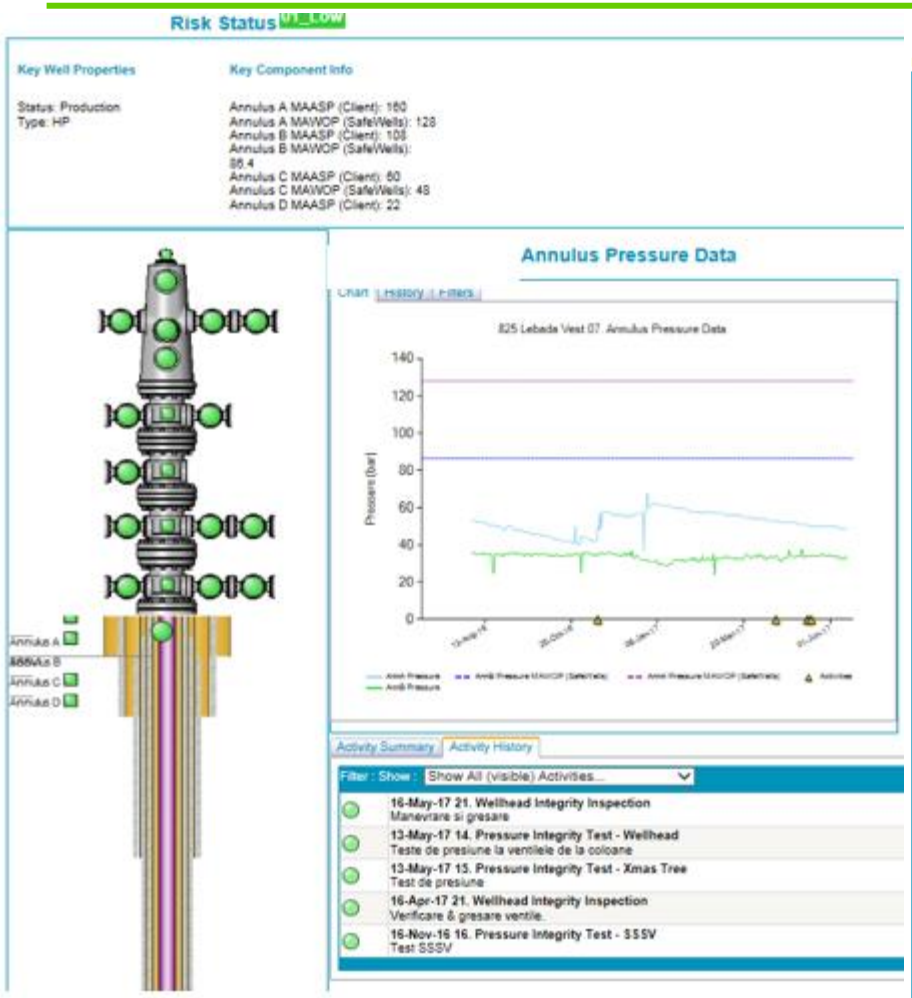


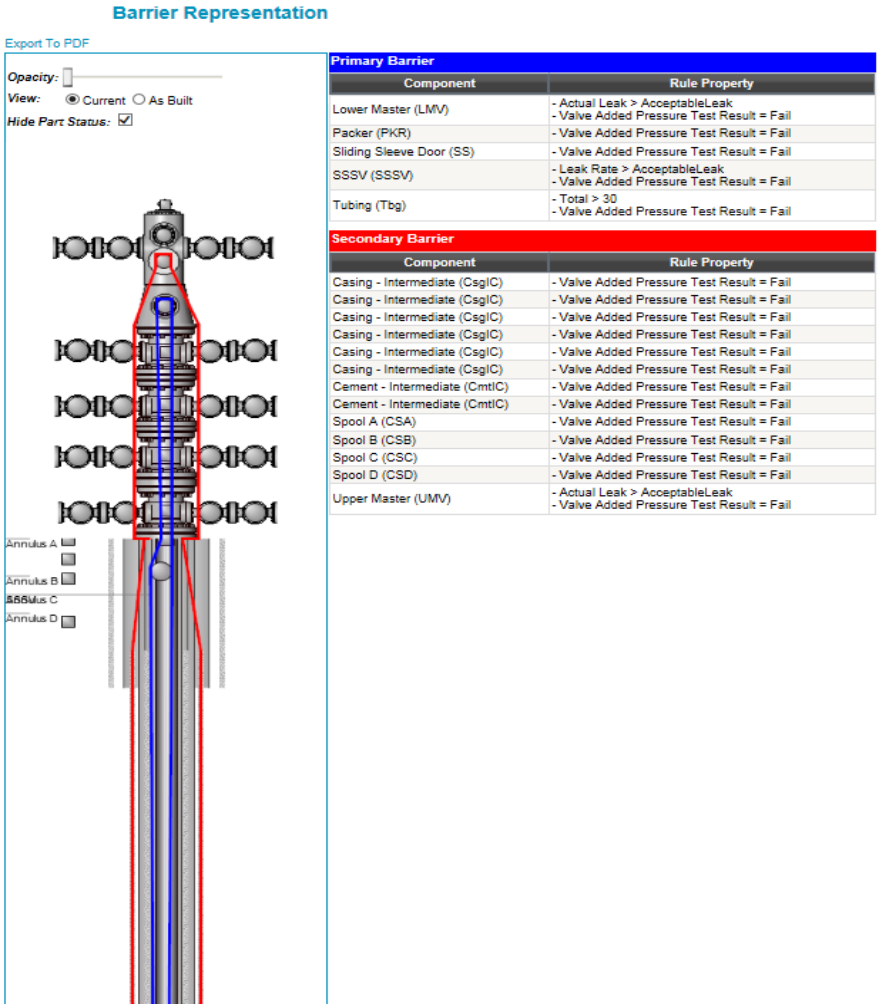
Labventage



SAP

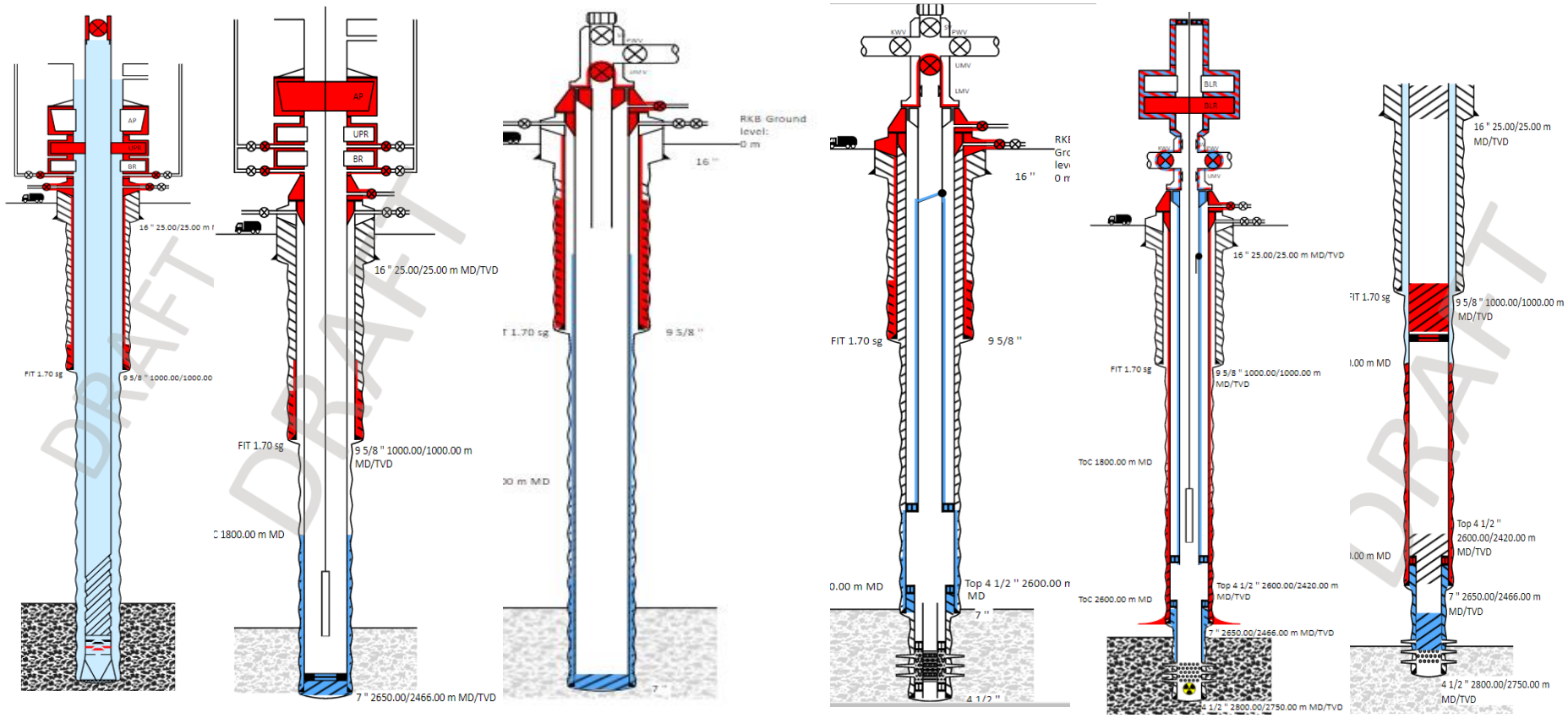
SafeWells – visualization of the well components status and well barriers





Well barriers Illustration capabilities: barrier planning during well life cycle

Drilling | Wireline before perf | Completion before perforation | Production | Wireline lubricator | P&A ABD



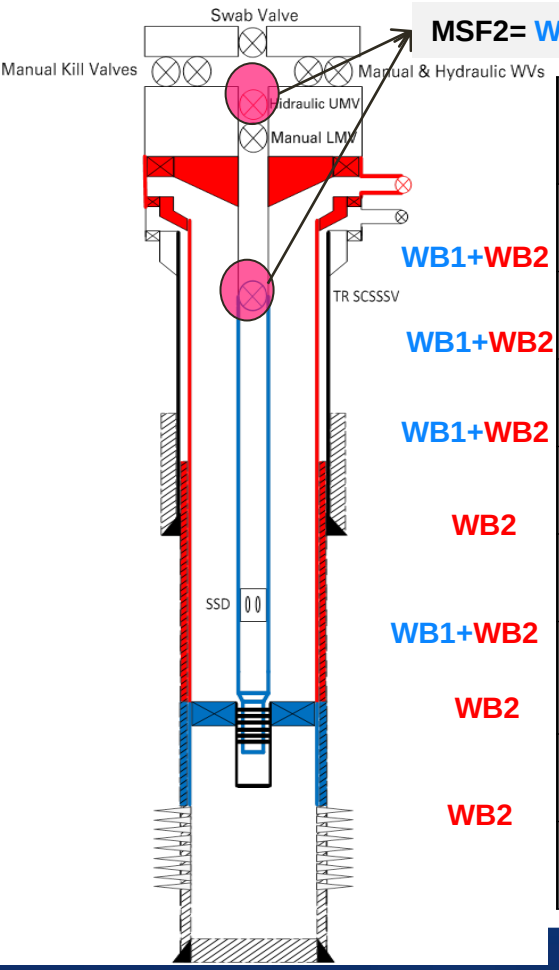
SafeWells Well integrity Risk Ranking

- SafeWells describes 11 Risk Categories, depending on Failure matrix and Resolution requirements in time;
- A well not evaluated has by default a score of 05-high (500 points), based on the following:
  - 100 point for not being inspected visual
  - 200 points for missing Pressure Test XMT
  - 200 points missing Pressure test Wellhead

	0	0	No faults found and no action required
	1	100	Repair at next planned maintenance / intervention
	2	200	Repair at the earliest opportunity but within 24 months - the well can be flowed during this period.
	3	300	Repair at the earliest opportunity but within 12 months - the well can be flowed during this period.
	4	400	Repair at the earliest opportunity but within 9 months - the well can be produced during this period.
	5	500	Repair at the earliest opportunity but within 6 months - the well can be flowed during this period.
	6	600	Repair at the earliest opportunity but within 3 months - the well can be flowed during this period.
	7	700	Perform the overdue periodical test at the erliest oportunity
	8	3800	Carry out formal Technical Review within 7 days of known failure to determine mitigating actions and when/how to repair and / or continue operation - The minimum action is determination of another Action Code, i.e a repair is required.
	9	4600	Shut in immediately, make well safe at earliest opportunity and plan test / repair / suspension / abandonment
	10	5500	Implement installation/field Emergency Response Procedures immediately, make well safe at earliest opportunity and plan repair / suspension / abandonment.

SafeWells uses a Risk Engine based on Failure Matrix

- For each well type are described combination of failure models and their consequences
- Multidisciplinary team set up the Risk scores associated to each scenario
- Than the Risk scores are coded in the software program, running every day



International Failure model - presented by the WIMS Consultant Adapted for OMV Petrom

Cod	MSF-surface multiple failures Failure Mechanism	HP	NF	NFL	ESP	AL	SRP	GL	IN
MSF 1	SCSSV & FWV failure	8	8						
MSF 2	SCSSV & any MGV failure	9	5						
MSF 3	Swab or KWV or FWV + one master valve failure	5	5	5	5			5	5
MSF 4	Both master valves failure	9	6	6	5			5	5
MSF 5	Both master valves + (FWV failure or SCSSSV)	10	10	9	10			9	9
MSF 6	Multiple annulus (MA) valve failure (same side) on A annulus or lift annulus	5	5	8	9	1	1	8	8
MSF 7	KWV or FWV + one annuli valve failure	8	5	5	1	1	1	5	1
MSF 8	Multiple annulus valve failure (same side) on B or C annuli	8	1	1	5	1		1	1

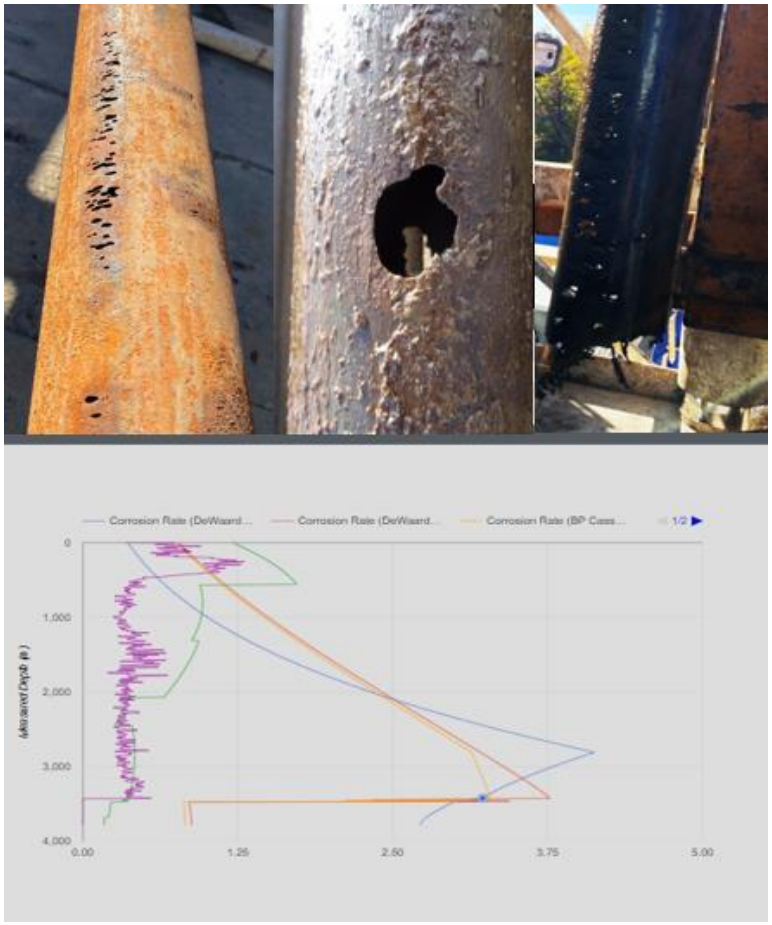
OMV Petrom current failure matrix

Petrom Well Failure Model

International Failure model - presented by the WIMS Consultant; Adapted for OMV Petrom

Failure Mode number	Failure Mechanism	Well Failure Type: High presure Natural flow oil or gas with PK / Off shore wells (HP)	Natural flow oil or gas, (NF)	Natural flow oil or gas, with older X-mass tree and low pressure (NFL)	ESP (55 wells) (ESP)	Artificila lift (including PCP with PK) (AL)	SRP (without PK-6000wells) (SRP)	GL (42 wells) (GL)	Injectors (IN)	Sonde abandonate (AB)	Sondesuspendate temporar (SU)
Single Surface Failure											
SSF 1	Surface Controlled Sub-Surface Valve (SCSSV) failure (if required)	8	8			3					
SSF 2	UMV or LMV failure	8	5	1	1	5	1	1	1		
SSF 3	FWV for Rod Pump Well					5	3				
SSF 4	Swab or KWV failure	8	5	3	1			1	2		
SSF 5	Single annulus valve failure (SA)	8	8	8	1	1	1	8	1		
SSF 6	Abandoned well - External leak or surface flow out	8	8	8	8	8	8	8	8		
SSF 7	External leak or surface flow out	10	10	10	10	10	10	10	10		
Multiple Surface Failures											
MSF 1	SCSSV & FWV failure	8	8								
MSF 2	SCSSV & any MGV failure	9	5								
MSF 3	Swab or KWV or FWV + one master valve failure	5	5	5	5			5	5		
MSF 4	Both master valves failure	9	6	6	5			5	5		
MSF 5	Both master valves + (FWV failure or SCSSSV)	10	10	9	10			9	9		
MSF 6	Multiple annulus (MA) valve failure (same side) on A annulus or lift annulus	5	5	8	8	1	1	8	8		
MSF 7	KWV or FWV + one annuli valve failure	8	5	5	1	1	1	5	1		
MSF 8	Multiple annulus valve failure (same side) on B or C annuli	8	5	5	1	1		5	1		
Single Sub-Surface Failure											
SSSF 0	A, B or C- annulus sustained pressure >50% MAASP	8	8	8	8	1	1	8	1	1	1
SSSF 1	Integrity failure - completion inc packer	8	8	1	5	1	1	4	1	1	1
SSSF 2	Integrity failure - A Annulus (production casing)	8	8	8	8	8	8	8	8	8	8
SSSF 3	Integrity failure - B Annulus	1	1	1	8	1	1	1	5	5	5
SSSF 4	Integrity failure - C Annulus	1	1	1	1	1	1	1	1	1	1
SSSF 5	Integrity failure - D Annulus	1	1		1	1					
SSSF 6	Casing leak in the last casing adjacent with formation	8	8	8	8	8	8	8	8	8	8
SSSF 7	Cross-flow outside surface casing & / or intermediate casing - see note F	8	8	8	8	8	8	8	8	8	8
Multiple Sub-Surface failures											
SSSF 0	A and B or C- annulus sustained pressure	8	8	1	8	1	1	8	8	8	8
MSSF 1	Integrity failure B + C annulus - see note F	1	1	1	8	1	1	1	1	1	1
MSSF 2	Integrity failure A + C annulus - see note F	8	8	8	9	8	8	8	8	8	8
MSSF 3	Integrity failure A + B annulus - see note F	8	8	8	9	8	8	8	8	8	8
MSSF 4	Integrity failure completion + B and / or C annulus - see note F	8	8	8	8	8	8	8			
MSSF 5	Integrity failure completion + A annulus (production casing)	10	10	8	9	8	8	9			
Sub-Surface plus related Surface Failure											
SS+SF 0	UMV or LMV failed plus A, B or C- annulus sustained pressure >50% MAASP	5	5	1	5	1	1	5			
SS+SF 1	Live annulus + only or both (same side) annulus valve failure on same annulus	10	10		10	10		9			

Tubing failure – primary barrier failure
Corrosion model implemented in SafeWells



Tubing failure

- Tubing is primary barrier element for wells with Packer
- Failure of tubing is indicated by casing pressure, when communication is already established
- At this stage the fluid entered the production casing causing corrosion of the casing;
- Wells highly deviated tends to have higher erosion/corrosion
- Consequences cans by casing corrosion and failure and complicated tubing retrieval (parting the tubing, fishing)

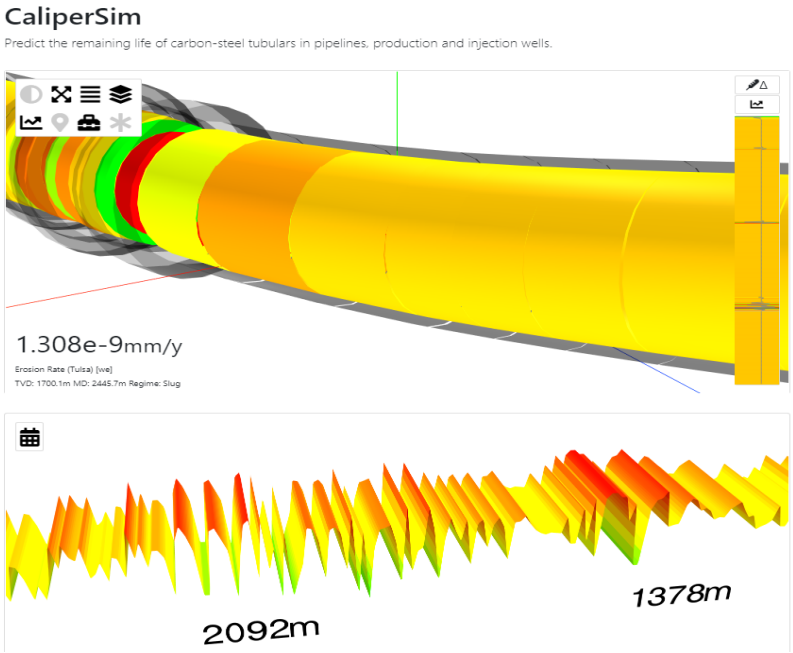
Corrosion model - Caliper sim tool

- Well Vertical lift performance, nodal pressure profile input for corrosion/erosion models
- Determination of Erosion/Corrosion rates
- Predictions of the remaining tubular life and report connected in SafeWells
- Wall thick-ness forecast based on corrosion rate calculated
- Well reports to SafeWells, highlighting main corrosion focus

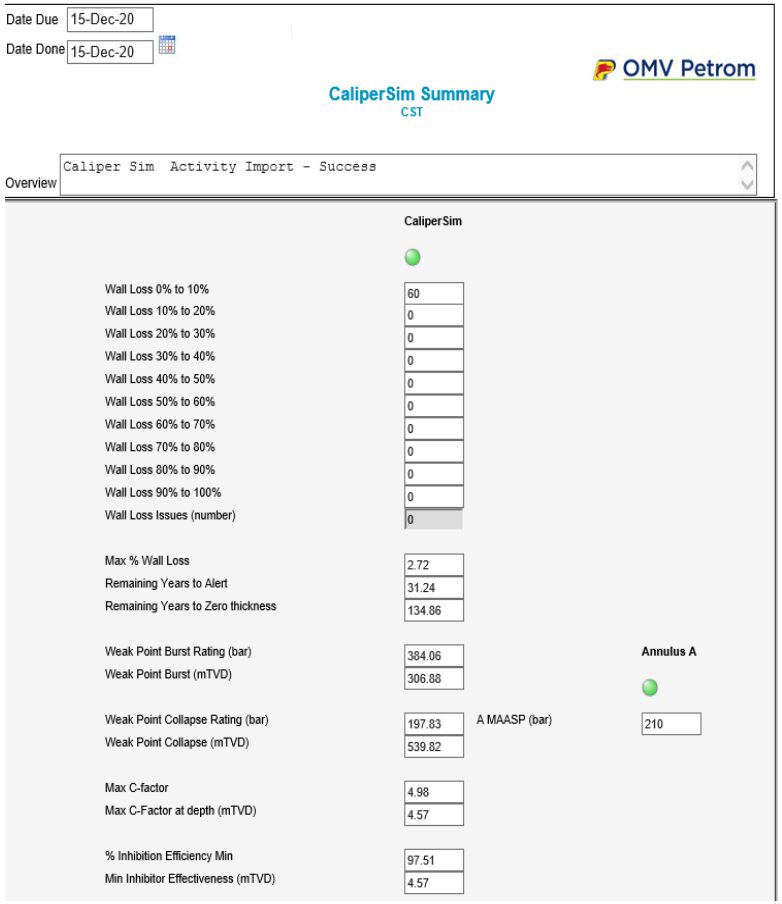
Corrosion Model – “CaliperSim” application associated with SafeWells

- Corrosion Model – “CaliperSim” uses same data base as SafeWells
- Additional uses fluid analysis form Labventage
- Performs corrosion analysis and send Activity Reports in SafeWells representing CaliperSIM results for each well

- Based on Corrosion reports SafeWells perform summary reports prioritizing the wells for tubing replacement



Visualization of Reports in SafeWells



Summary of Well Barrier testing - Well Life Extension

- All testing reports are summarized by the software and each well receive a risk score based on testing status
- These results are documented for evaluation of well life extension

SONDA	UWI	Durata de via	Masuri remedia	RISK_P ANKI	CONCERN LEVEL	RF_H2S	RF_CO2	TEST_DATE	Lower Mas	Swab Valv	Upper Mas	WHV A1	WHV A2	WHV A3	WHV A4	WHV B1	WHV B2	WV 1	WV 2	WV 3	WV 4	LH Gaug	LH Gaug	LH Gaug	RH Gaug	RH Gaug
		1		0	00_No Concern	0	3	07.07.2022		OK		OK	OK			OK		OK				OK				OK
		1		2	02_Low			14.04.2022				OK	OK			OK		OK				OK	OK			
		1	Inlocuire WHV B1	1	01_Low			11.06.2022	OK				OK			Failed		OK					OK		OK	
		1		4	04_Medium			16.05.2022		OK	OK	OK	OK			OK		OK								
		1		2	02_Low			20.05.2022	Dispensated			OK	OK			OK	OK		OK						OK	OK
		1	Inlocuire WHV	5	05_High			12.05.2022				Failed	Failed				OK	OK				OK	OK			
		1		0	00_No Concern			08.05.2022				OK	OK			OK		OK							OK	
		1		0	00_No Concern			15.06.2022					OK				OK	OK								
		1	Inlocuire WHV	1	01_Low			12.05.2022				Failed	OK			OK	OK		OK					OK	OK	OK
		1		5	05_High			28.04.2022				OK	OK			OK		OK								
		1	Echipare cu packer	4	04_Medium			10.05.2022	OK			OK				OK						OK	OK			
		1		2	02_Low			20.05.2022				OK					OK	OK				OK				OK
		1	Inlocuire WHV	5	05_High	0	2	18.05.2022				Failed	OK			OK	OK		Failed						OK	OK
		1	Inlocuire WHV B2	1	01_Low			09.05.2022	Dispensated				OK			OK	Failed	OK				OK	OK			
		1		4	04_Medium			07.07.2022				OK				Dispens	Dispens	OK				OK				OK
		1	Echipare cu packer	4	04_Medium			13.05.2022	OK			OK				OK							OK		OK	
		1		2	02_Low			21.04.2022				OK	OK			OK		OK								
		1		0	00_No Concern			19.05.2022				OK	OK			OK		OK								
		1	Echipare cu packer	4	04_Medium			15.05.2022	OK			OK				OK						OK	OK			
		1	Echipare cu packer	5	05_High			13.04.2022	OK	OK		OK				OK		OK				OK	OK			
		1	Echipare cu packer	4	04_Medium			27.04.2022	OK				OK				OK	OK							OK	OK
		1	Echipare cu packer	4	04_Medium			14.05.2022	OK			OK				OK						OK	OK			
		1	Echipare cu packer	4	04_Medium			13.04.2022	OK				OK			OK							OK		OK	

Pics from this event 25 May 2023

ACKNOWLEDGEMENTS / THANK YOU / QUESTIONS