RAG.TECHNOLOGY
SALES&SERVICES

MURAG

Listen to your Reservoir

ENGLISH

The Company

80 Years of History, Extensive Experience in Oil & Gas Exploration, Production, and Storage Operation Play a Key Role in Unlocking Significant Energy Resources.

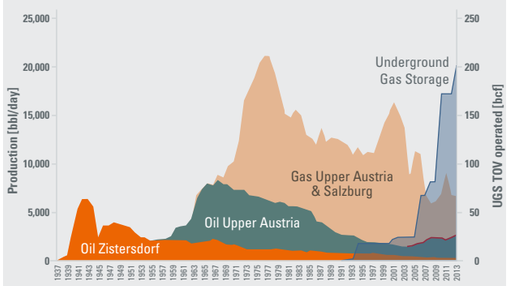
RAG is Austria's oldest established exploration, production and gas storage company, founded in 1935 as a Joint Venture between Shell and Mobil. In 2007, after 70 years of oil & gas production solely focused on Austria, the two Majors left RAG as an independent company. The core areas of business are crude oil and natural gas exploration and production, trading and gas storage. Integrated E&P Services (Drilling, Well Engineering, Completion and Testing, Wireline and Slickline Services) as well as production technology and mature field operation expertise support RAG business areas, joint venture partners and external customers.

RAG provides highest level of technical and economic performance and defends its competitive position based on innovation.

RAG is one of the leading Austrian companies with total assets of some 700 Mio EUR financed by roughly 30 % equity and around 400 employees. The company generates revenues of some 450 Mio EUR, a cash flow of some 150 Mio EUR, and achieves a profitability of more than 15 % (ROACE). Furthermore, RAG is the 4th largest Underground Gas Storage operator in Europe with a total storage volume of 5.8 billion cubic meters. RAG has discovered and developed 175 oil & gas fields and has produced over 15 million tons of crude oil and 25 billion cubic meters of natural gas during the past 80 years. With the background of long standing experience RAG offers highly specialized know-how, technologies and services in operating mature oil and gas fields.

Unlocking resources in tail-end oil production maximizing recovery in gas fields and turning depleted reservoirs into gas storages form part of this expertise.

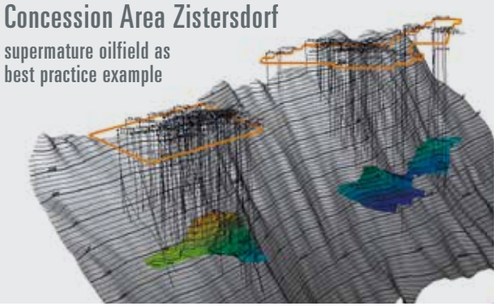
RAG Production & Storage History



In the oldest field Zistersdorf an economic tail end production with water cut up to 98 % underlines the expertise of RAG to handle mature field challenges successfully for more than 50 years.

Concession Area Zistersdorf

supermature oilfield as best practice example

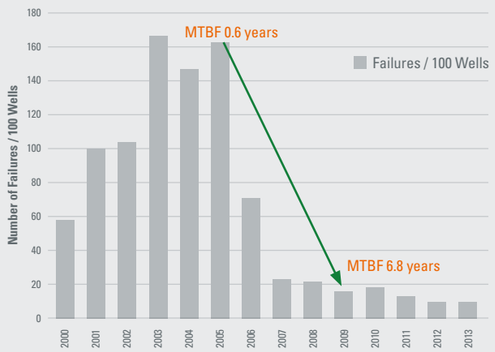


Unit operating cost-cutting technologies – UOC (fluid) 1 USD/bbl – with focus on corrosion control, automation and smart artificial lift solutions are the essentials to be successful in mature field operations.

How to Turn a Depleting Resource into a Business Opportunity

The new business unit **"RAG Technology Sales & Services"** offers upstream solutions leading to extraordinary meantime between failure (MTBF) increase from half a year up to 7 years without well intervention. Consequently a significant unit operating cost reduction (20 – 40 %) and production increase due to reduced downtime can be achieved.

Meantime between Failure



- Reduce expensive workover
- Saving of operating costs: **~80.000 $/well/year**
- Increase of well test efficiency

Material Selection and Corrosion Management

Efficiency aspect by material science

In order to reduce corrosion rates RAG embarked on a concerted effort of metallurgy, chemistry and production technology and reduced in the course of a 3 years campaign the annual corrosion rate from 4 mm/year to less than 0.004 mm/year which is an improvement by a factor of 1000. Another success in increasing runtimes of artificial lift systems has been reached by selecting specific materials. The implementation of relined tubing systems within RAG increased the runtime of particular wells by the factor 20.

MURAG

Small Step with Huge Impact

A further in-house technology called MURAG, a small device mounted on the wellhead, is used for multiple fully automated measurement purposes based on acoustics. The system allows to set fluid levels by remote control to produce each well at its optimum drawdown. This provides a new way of digitalization of the pump device which can be applied to any type of pumping system like Electric Submersible Pumps (ESP) or Progressive Cavity Pumps (PCP). At the same time simple pressure buildup tests can give frequent well and reservoir performance information with very short interruption of the production process – just by stopping the well from your office desk, gathering the data and restart production.

Based on this experience and expertise RAG continuously develops its own production technologies. To better meet these future demands, RAG Technology Sales & Services offers the know-how of **50 years "TAIL END production"** to all customers worldwide with its technology and operation services built up in more than 80 years within RAG.

We offer the following services as an expert for mature fields

- ✓ Project Management
- ✓ Production Fluid Management (Corrosion, Paraffin, Scaling)
- ✓ Production Services
- ✓ Engineering Services
- ✓ Well Services
- ✓ Drilling Services

MURAG

Fully Automated Multi Measurement Tool – A Fit-for-Purpose Technology for optimizing Oil Production and Gas Well Dewatering Operations

The unique feature of the **MURAG** is its **fully automated** and **purely electronic functioning**. The measuring device is enclosed, mounted on the casing outlet, has a pressure rating of **5000 psi** and – contrary to conventional devices – works without the need of a gas gun.

Compared with conventional downhole sensors mounted on downhole pumps the device is **insensitive to high well fluid temperatures** and simple to maintain due to its easy access on the well head.

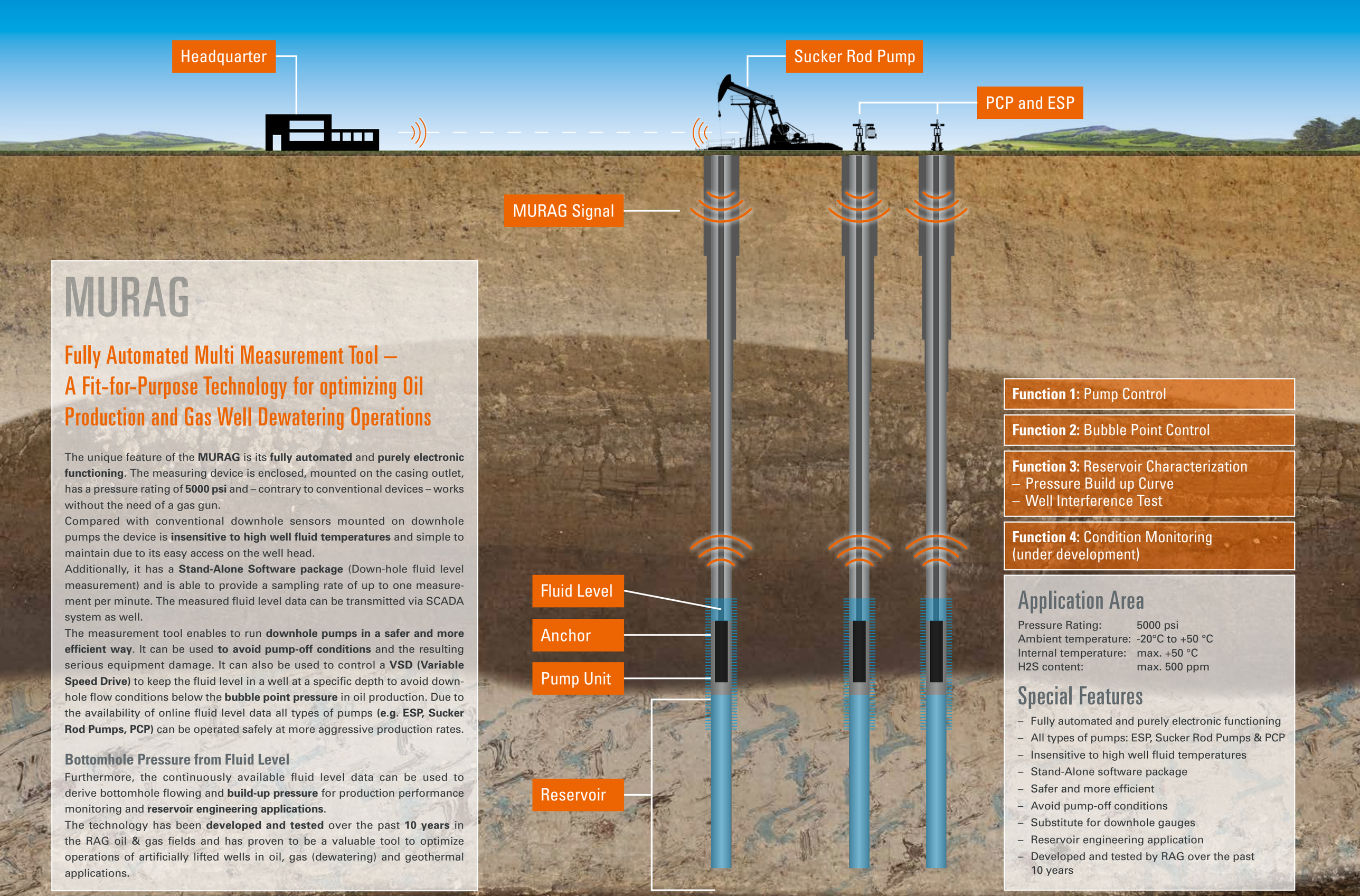
Additionally, it has a **Stand-Alone Software package** (Down-hole fluid level measurement) and is able to provide a sampling rate of up to one measurement per minute. The measured fluid level data can be transmitted via SCADA system as well.

The measurement tool enables to run **downhole pumps in a safer and more efficient way**. It can be used **to avoid pump-off conditions** and the resulting serious equipment damage. It can also be used to control a **VSD (Variable Speed Drive)** to keep the fluid level in a well at a specific depth to avoid downhole flow conditions below the **bubble point pressure** in oil production. Due to the availability of online fluid level data all types of pumps **(e.g. ESP, Sucker Rod Pumps, PCP)** can be operated safely at more aggressive production rates.

Bottomhole Pressure from Fluid Level

Furthermore, the continuously available fluid level data can be used to derive bottomhole flowing and **build-up pressure** for production performance monitoring and **reservoir engineering applications**.

The technology has been **developed and tested** over the past **10 years** in the RAG oil & gas fields and has proven to be a valuable tool to optimize operations of artificially lifted wells in oil, gas (dewatering) and geothermal applications.



Function 1: Pump Control

Function 2: Bubble Point Control

Function 3: Reservoir Characterization
– Pressure Build up Curve
– Well Interference Test

Function 4: Condition Monitoring (under development)

Application Area

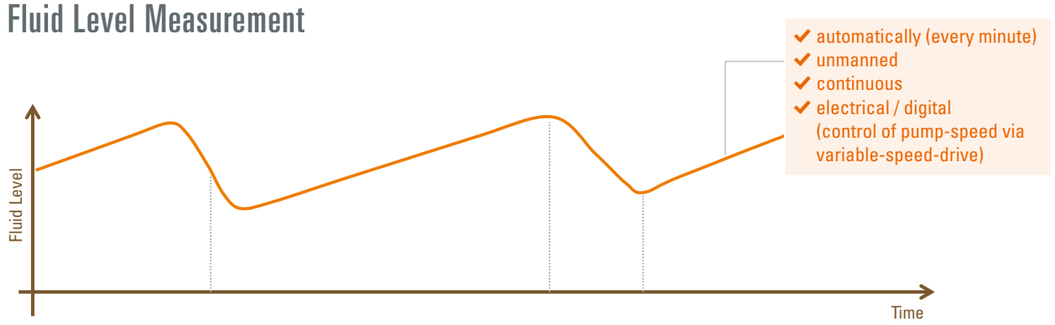
Pressure Rating:	5000 psi
Ambient temperature:	-20°C to +50 °C
Internal temperature:	max. +50 °C
H2S content:	max. 500 ppm

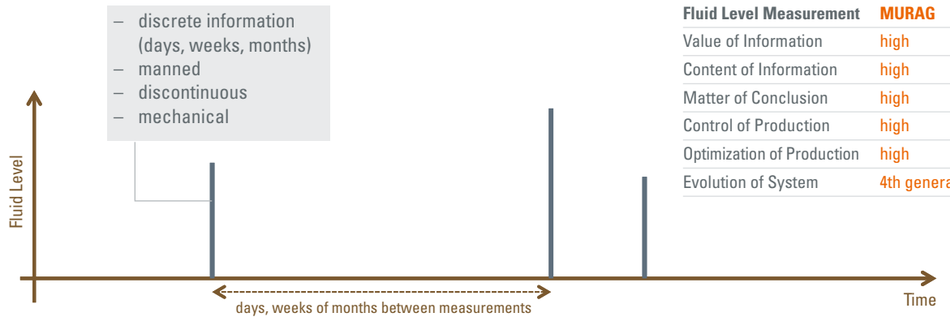
Special Features

- Fully automated and purely electronic functioning
- All types of pumps: ESP, Sucker Rod Pumps & PCP
- Insensitive to high well fluid temperatures
- Stand-Alone software package
- Safer and more efficient
- Avoid pump-off conditions
- Substitute for downhole gauges
- Reservoir engineering application
- Developed and tested by RAG over the past 10 years

MURAG versus Conventional Devices

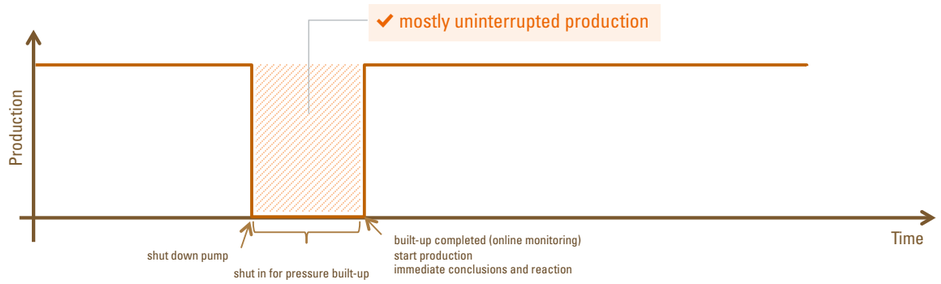
Fluid Level Measurement

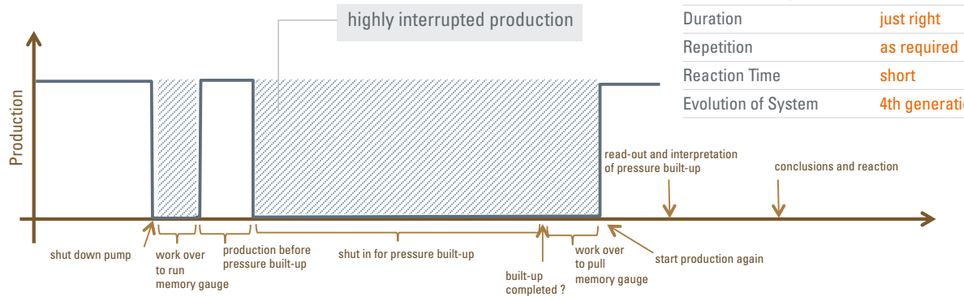




Fluid Level Measurement	MURAG	Conventional
Value of Information	high	low
Content of Information	high	low
Matter of Conclusion	high	low
Control of Production	high	low
Optimization of Production	high	low
Evolution of System	4th generation	parent

Reservoir Characterization through Pressure Built-Up Measurement

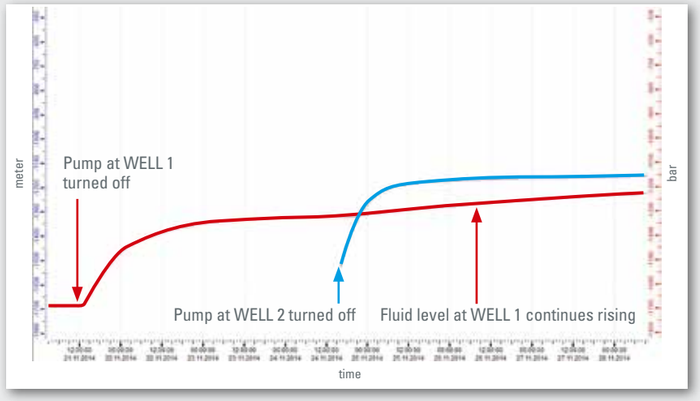




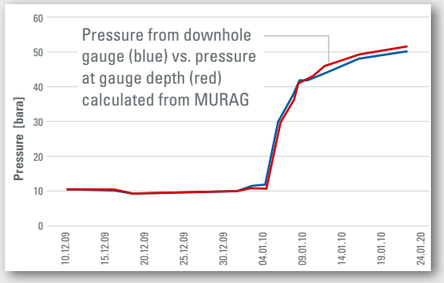
Pressure Built-up	MURAG	Conventional
Costs	low €	high € € € €
Data Availability	on line	off line
Duration	just right	maybe too long/short
Repetition	as required	low
Reaction Time	short	long
Evolution of System	4th generation	parent

MURAG Software

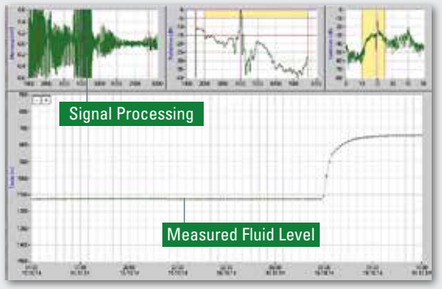
Well Interference Test



Pressure Build Up Curve – Downhole Gauges vs. MURAG



Oil Level Software



MURAG Productline

MURAG System – Basic Package:

- ✔ MURAG HDJD 5000 High Pressure Sensor Unit
- ✔ MURAG Front End Processor (Signal Generation, Analysis & Transmission)
- ✔ MURAG Oil Level Software

MURAG System – Extension Packages:

- ✔ MURAG BPfFL Module
- ✔ MURAG Hook Up Kit
- ✔ MURAG Control Cabinet (Indoor & Outdoor)
- ✔ MURAG Service Support

Legal notice
Published by: RAG Rohöl-Aufsuchungs Aktiengesellschaft
Schwarzenbergplatz 16, 1015 Vienna
Editorial content: RAG
Graphic design: Marianne Prutsch Werbeagentur
Pictures: RAG archives, steve.haider.com
Printed by: druck.at Druck- und Handelsgesellschaft mbH, 2544 Leobersdorf
Status February 2016

RAG.TECHNOLOGY.SALES&SERVICES
RAG Rohöl-Aufsuchungs Aktiengesellschaft · Schwarzenbergplatz 16 · 1015 Vienna · Austria
www.rag-technology.at · technology@rag-austria.at