

Mud Logging

Experienced & Well Trained Personnel combine with the ALS to provide

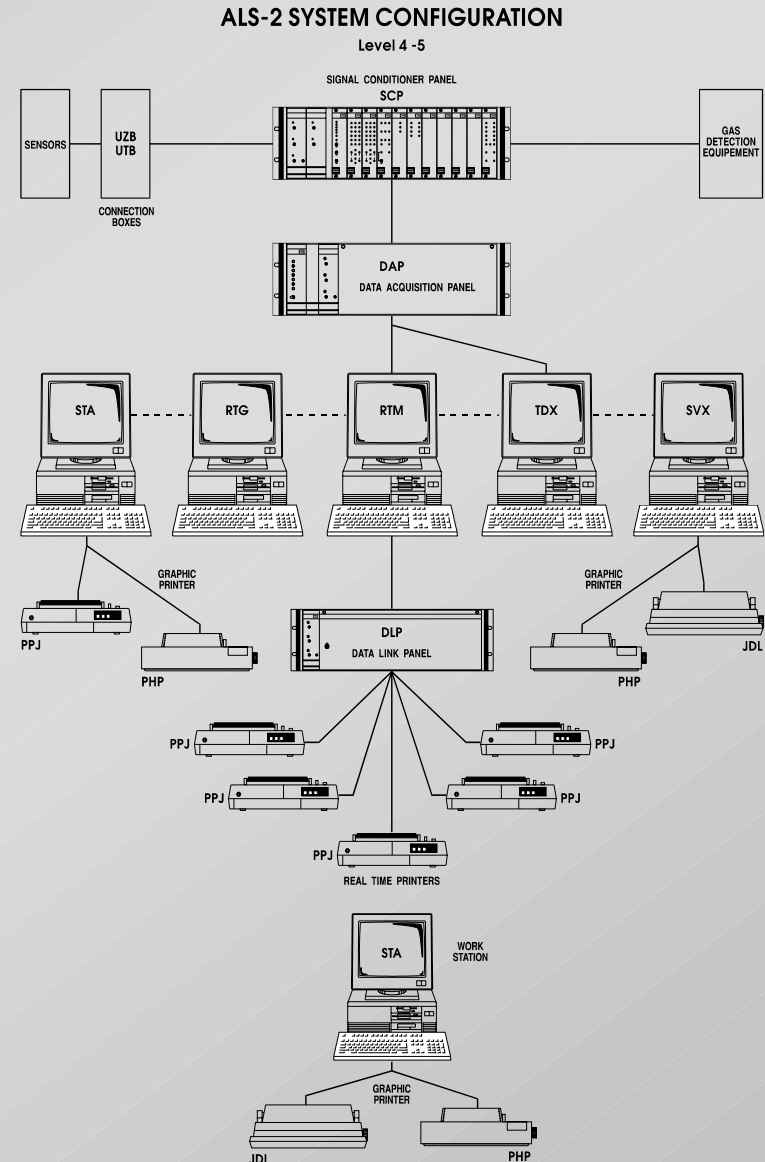
- **Real time Monitoring - On Site & Remote**
- **Drilling & Geological focus - Analyze & Advise**
- **Customized Graphic Displays & Logs**
- **Full integration & Display of 3rd party data LWD, e-logs**
- **Over 300 parameters are calculated and recorded for evaluation, interpretation & decision making**
- **Windows NT server for direct links to client networks**
- **Specialized services, Gas/Pore Pressure, ALSV, ALSK, CFM**

Reliability, Modularity & Redundancy

Mud Logging

ALS- Real Time Data

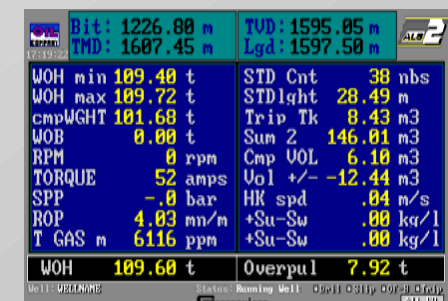
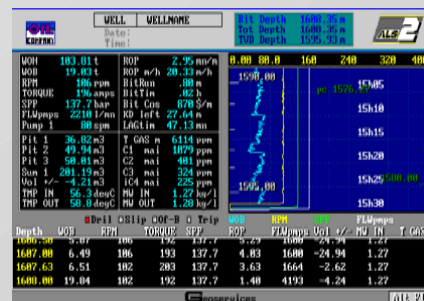
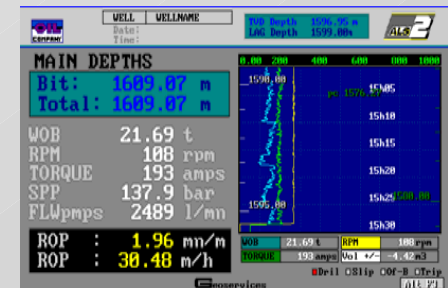
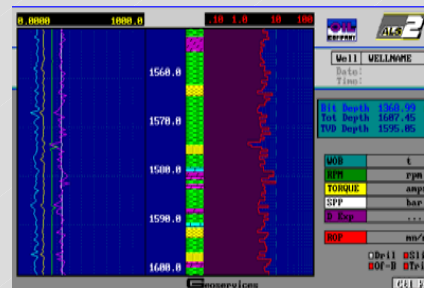
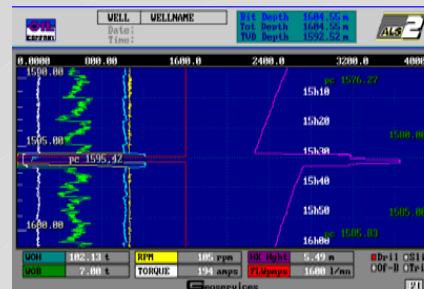
- **Geologic and hydrocarbon analysis**
- **Database vs. depth and vs. **time** (1/2 ft – 1 sec) all operations monitored**
- **Complete library of applications software**
Hydraulics, Surge & Swad, Pre Kick, Casing run, D'exponent & ECD in real time, Gas composition, Logs & Reporting.
- **Real time and play-back graphic displays**
- **Custom Log facilities**
- **Real time Data transmission**



Geoservices Mud Logging

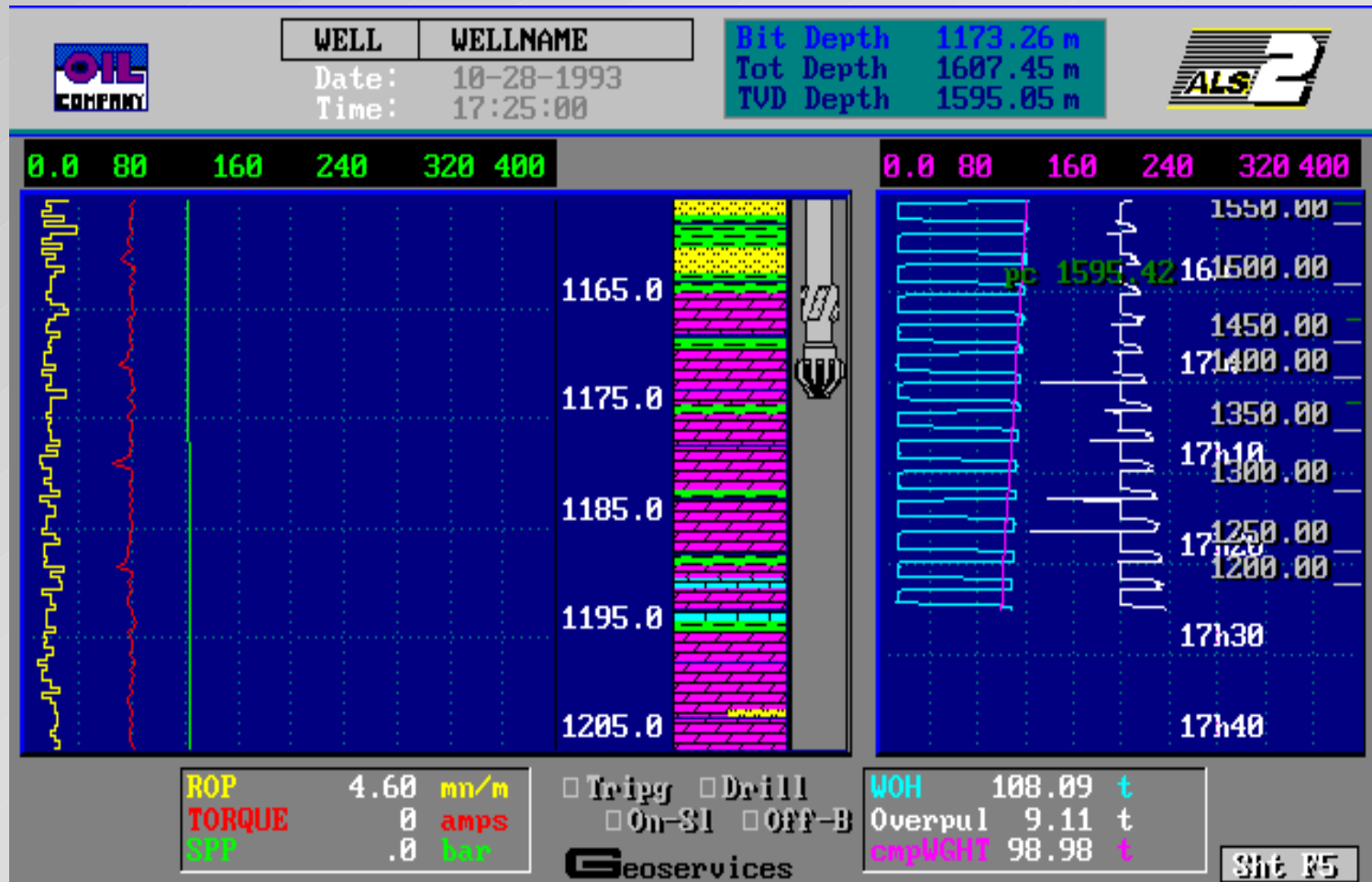
ALS-2 -- versatile graphics display

- ◆ Endless customised grid formats
- ◆ Mixed time and depth monitoring
- ◆ From the smallest to the largest scale
- ◆ Programmable zoom
- ◆ Fast hard copy for quick-look interpretation

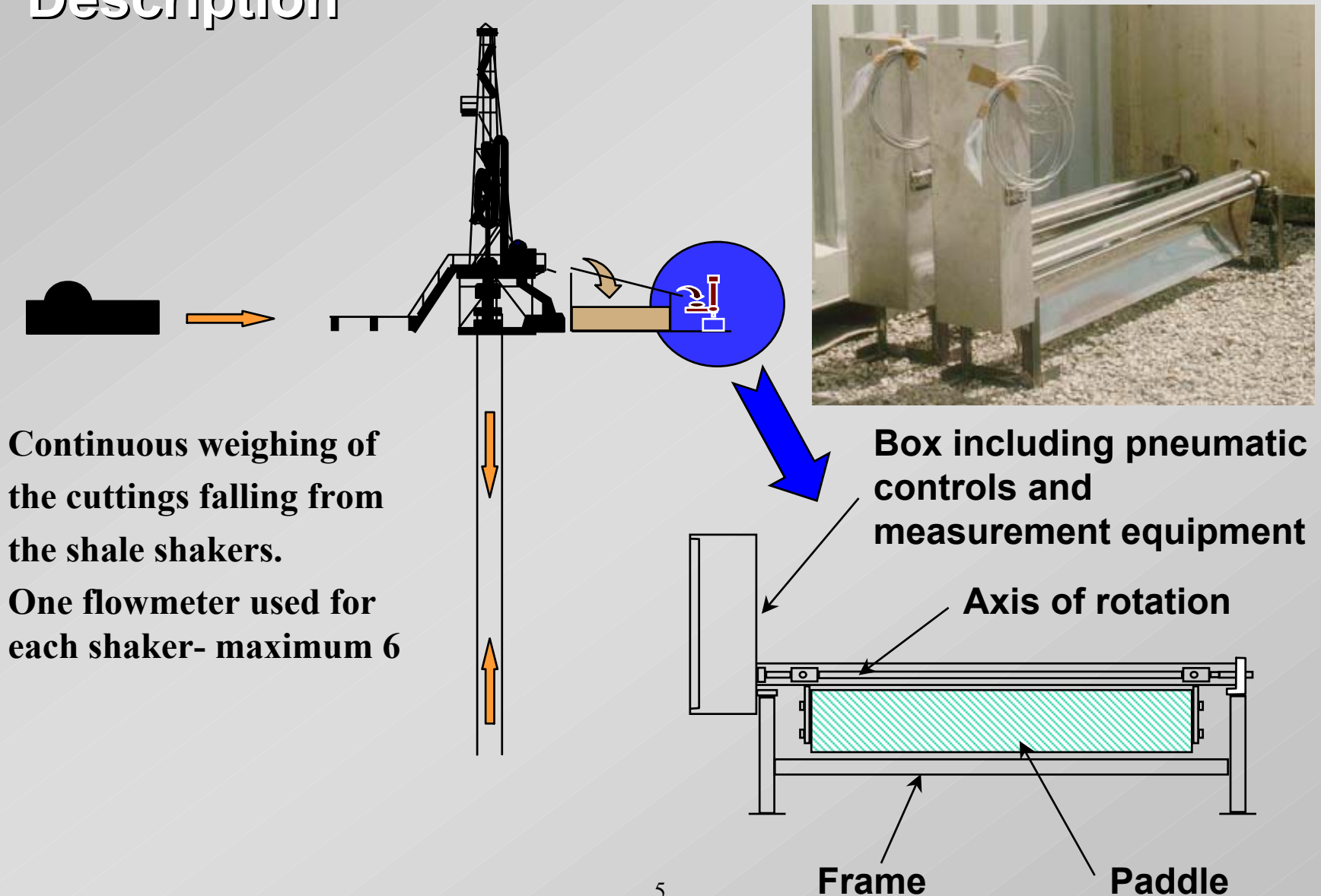


Geoservices Mud Logging

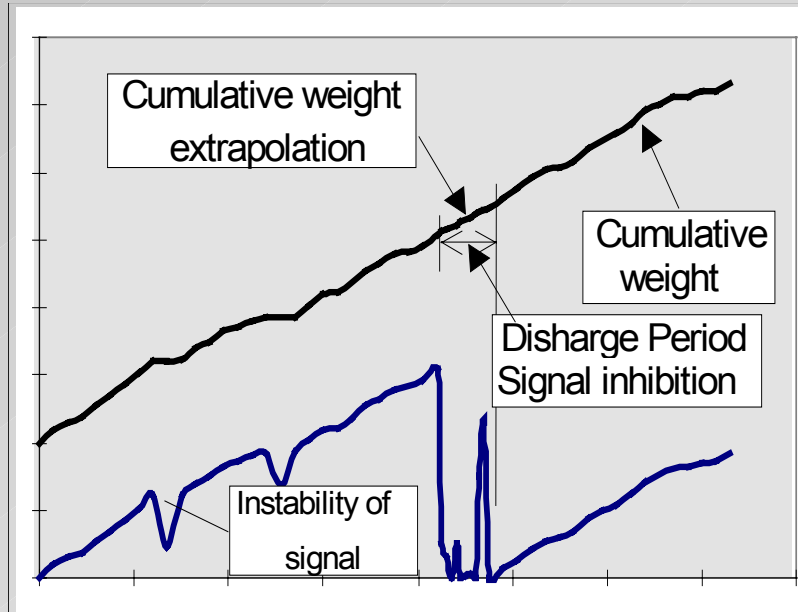
ALS-2 -- mixed time and depth graphics



CFM SERVICE - Principle & Description



Mass flow rate measurement principle

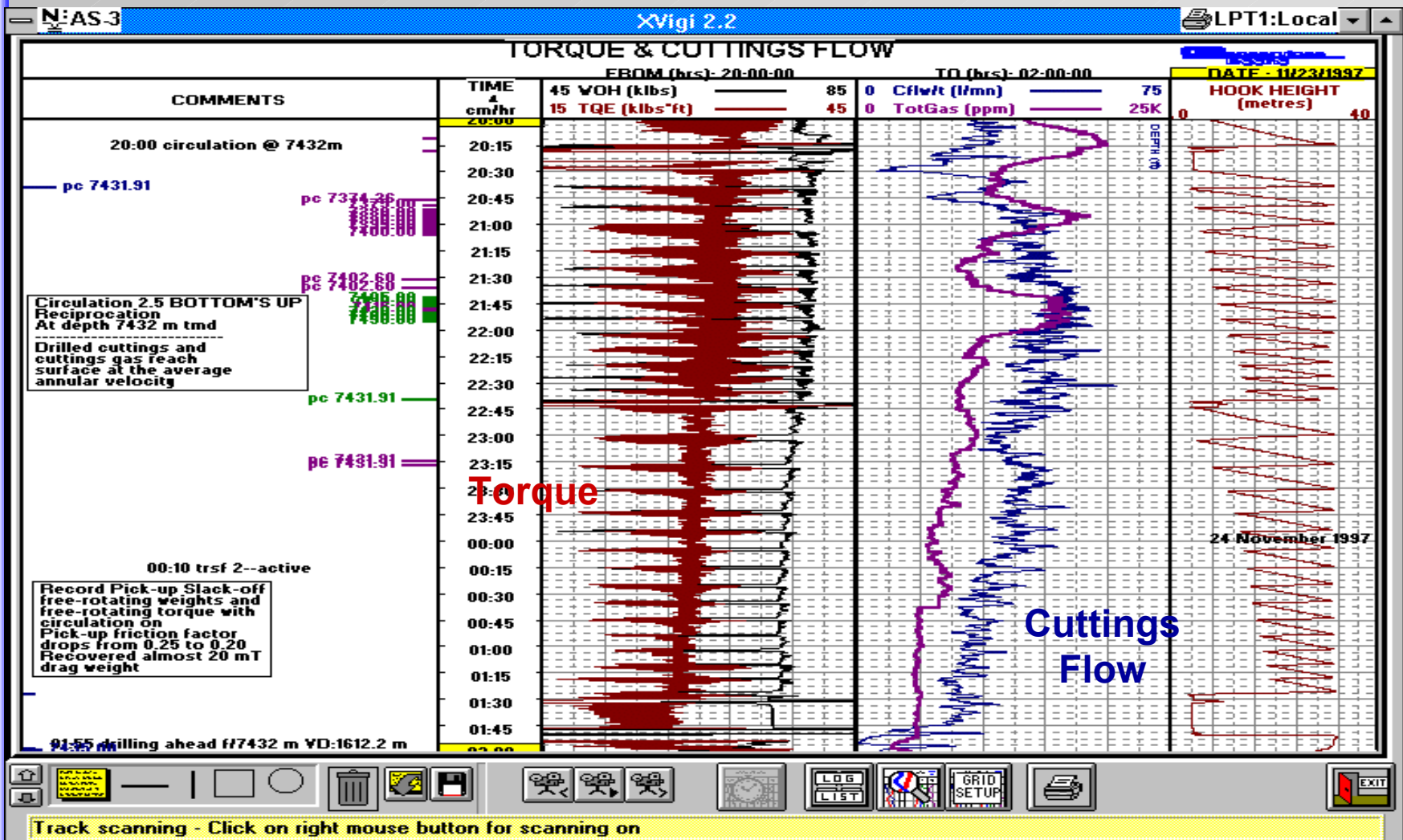


All Machines are tipping
Non-synchronised

- Instability caused by physical shocks are dampened.
- Weight is estimated by extrapolation while the paddle is discharging cuttings.
- The weight estimation period is triggered by a sudden change in the weight measured.
- Measurement time can be as long as 16 minutes. Normally 40-60 secs
- Discharge time generally 10-14sec.
- Not necessary for paddle to be clean when it returns to measurement position.

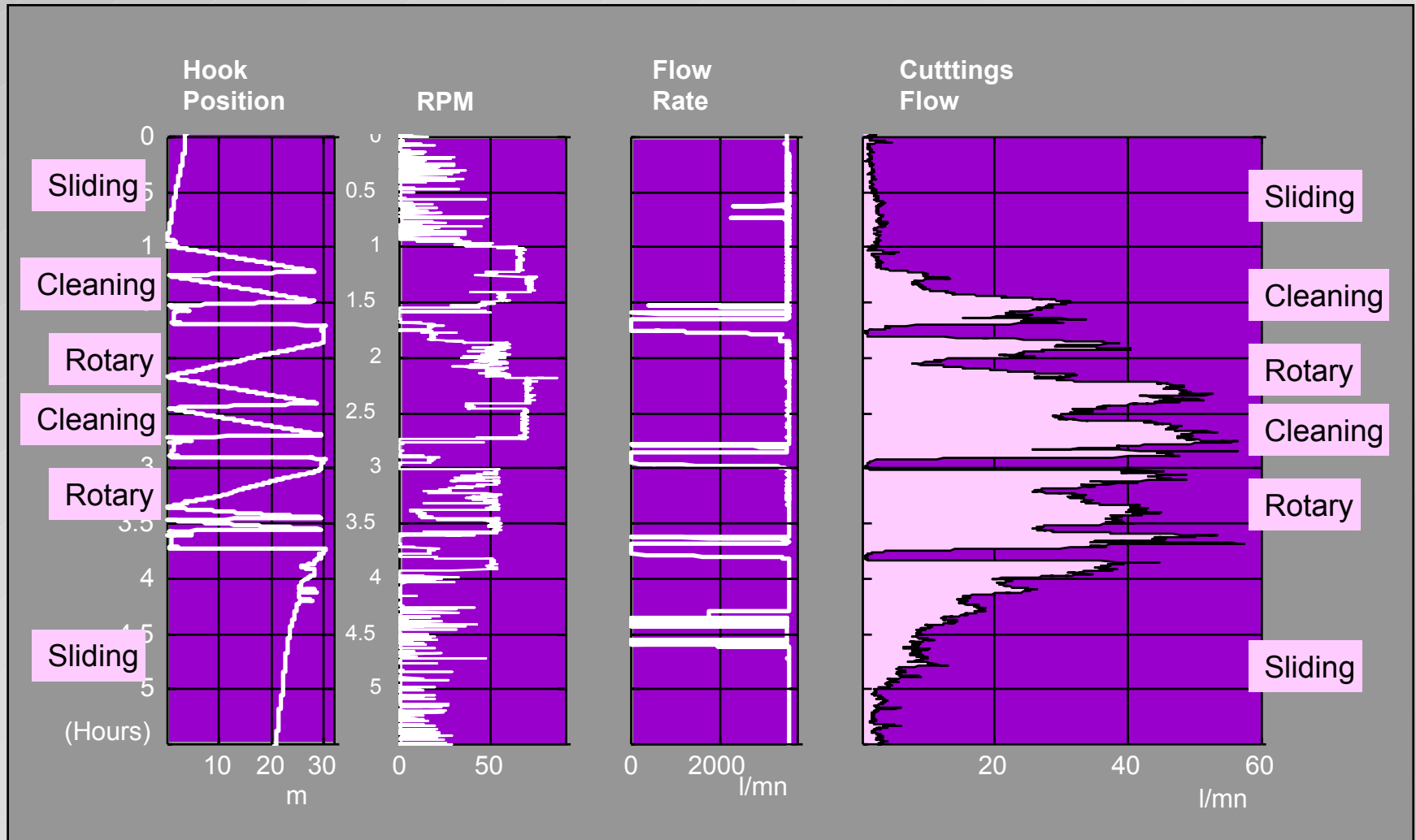
Multiple areas of benefit

- Find optimal string rotation for good cleaning and minimal string fatigue
- Evaluating relation between torque and drag and % cuttings left in hole
- Assessing risk situations (annulus packing off)
- Monitoring the recovered Volume of dry or wet cuttings
- Monitor volume of mud lose with cuttings (Coating effect)
- Know when at least 90% of what has been drilled has been recovered on surface
- Real time control on volume/weight of cuttings for environmental treatment
- Monitoring the Volume or weight of cuttings left in hole
- Determine the Critical angle of accumulation
- Assessing risk situations (annulus packing off)
- Evaluate optimal hook movement for efficient cleaning
- Quantify returns due to Lovis/Hivis pills
- Find optimal flow for good cleaning and minimal String/motor fatigue



Log versus time: Reciprocating pipe; log displaying a close relationship between torque and cuttings evacuation at surface

Effect Of Drilling Procedures



Formation Evaluation While Drilling

ReservalTM

Beginning with a Representative sample

Benefits of the Gastrap

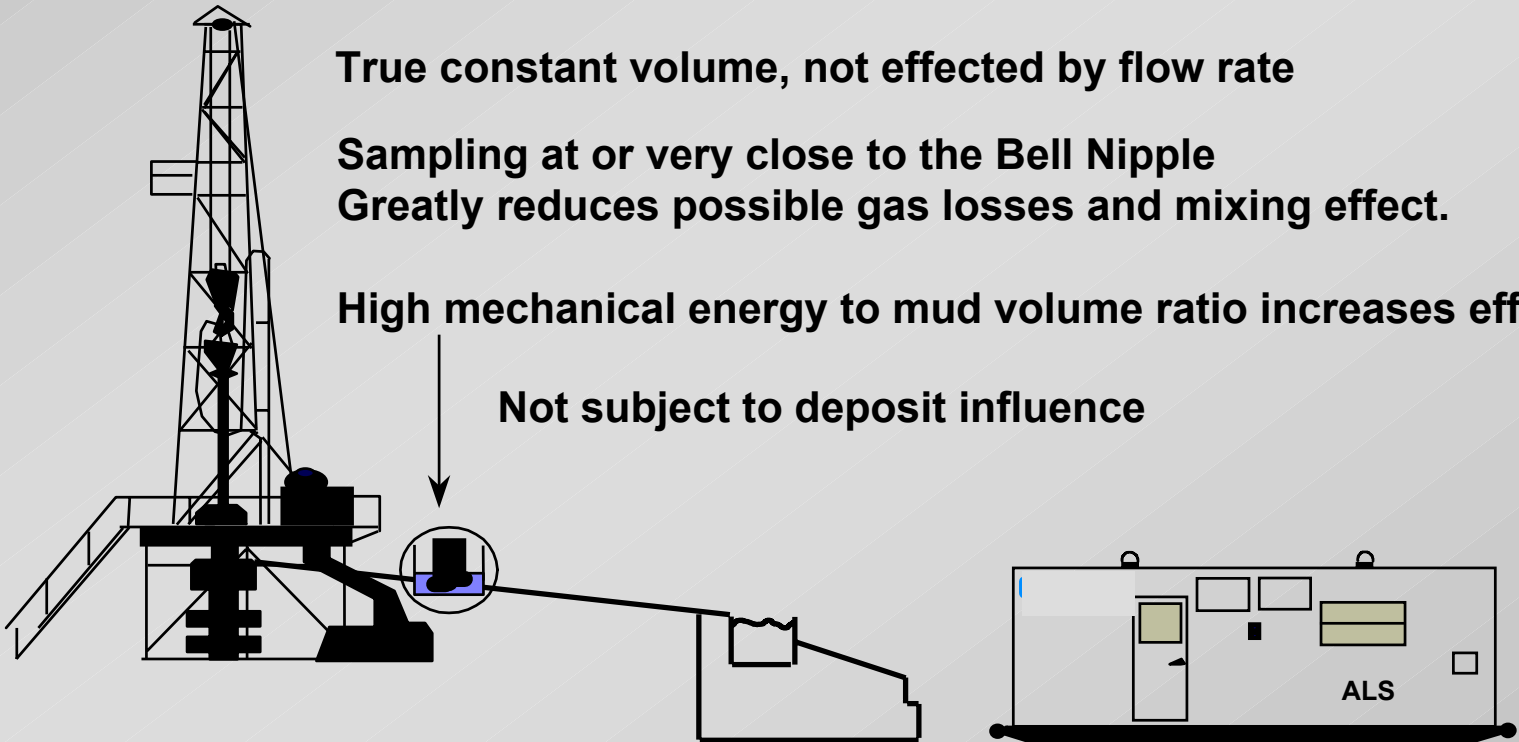
Highly efficient degassing of small constant volume

True constant volume, not effected by flow rate

**Sampling at or very close to the Bell Nipple
Greatly reduces possible gas losses and mixing effect.**

High mechanical energy to mud volume ratio increases efficiency

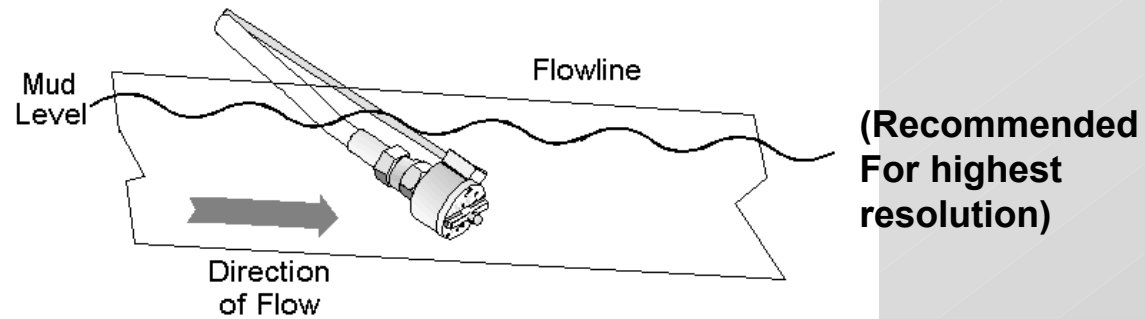
Not subject to deposit influence



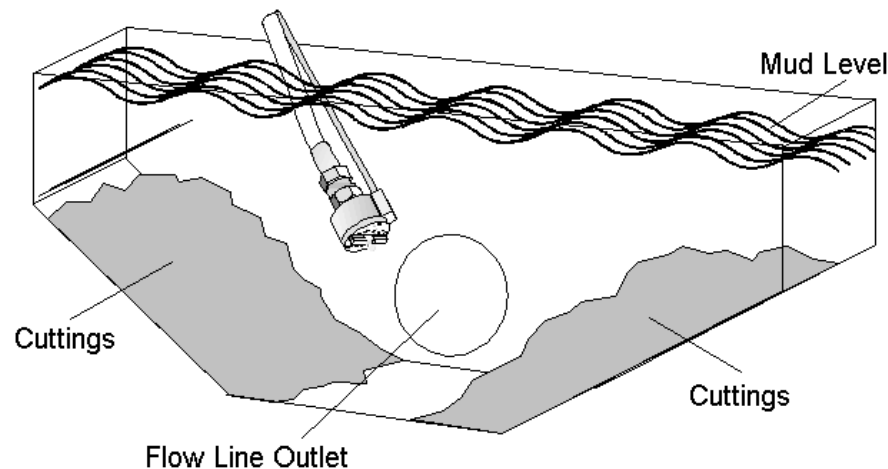
Beginning with a Representative sample

Degasser Intake Placement Options

E Installation in open flow line



C Installation in Header Box

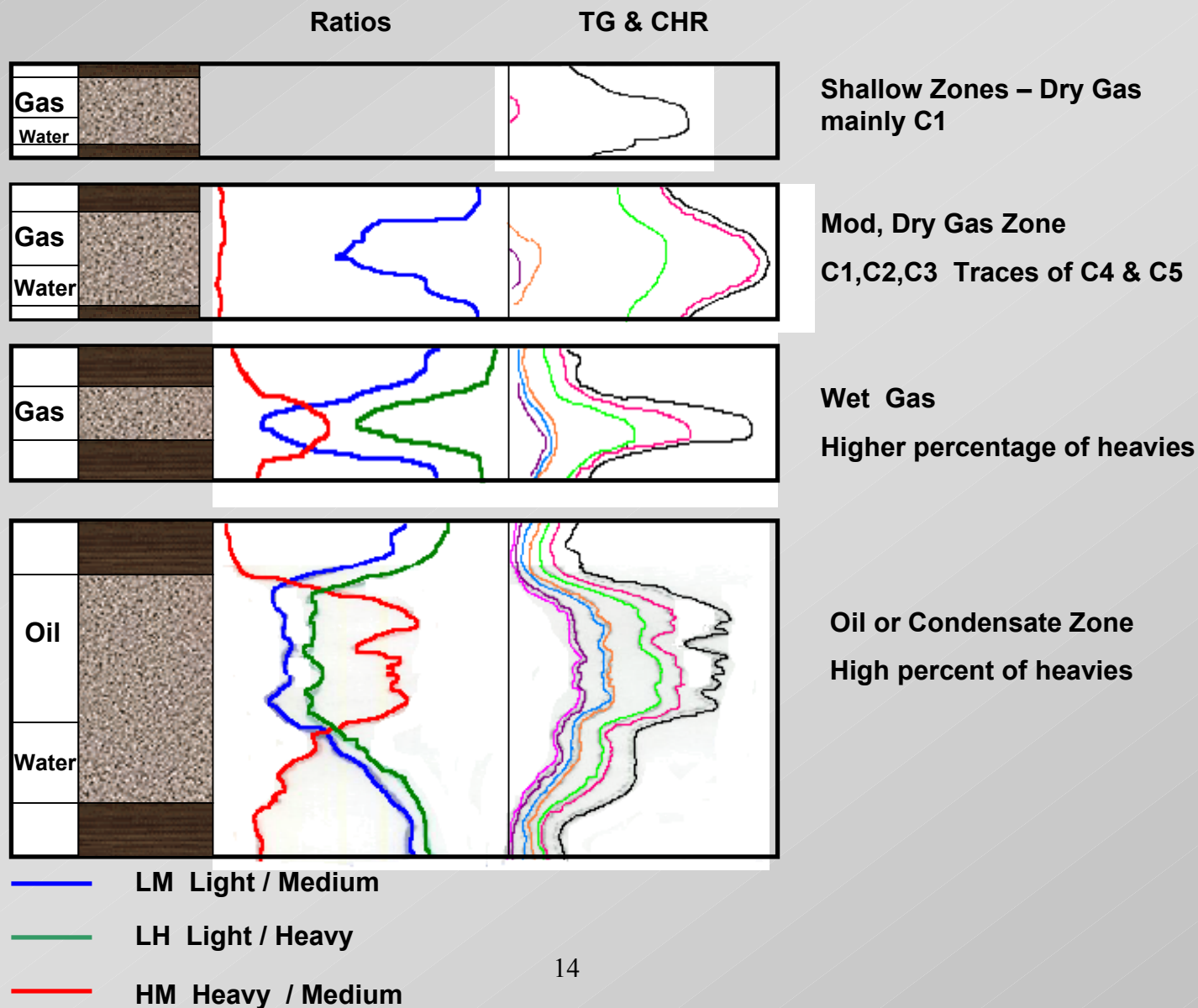


Formation Evaluation While Drilling

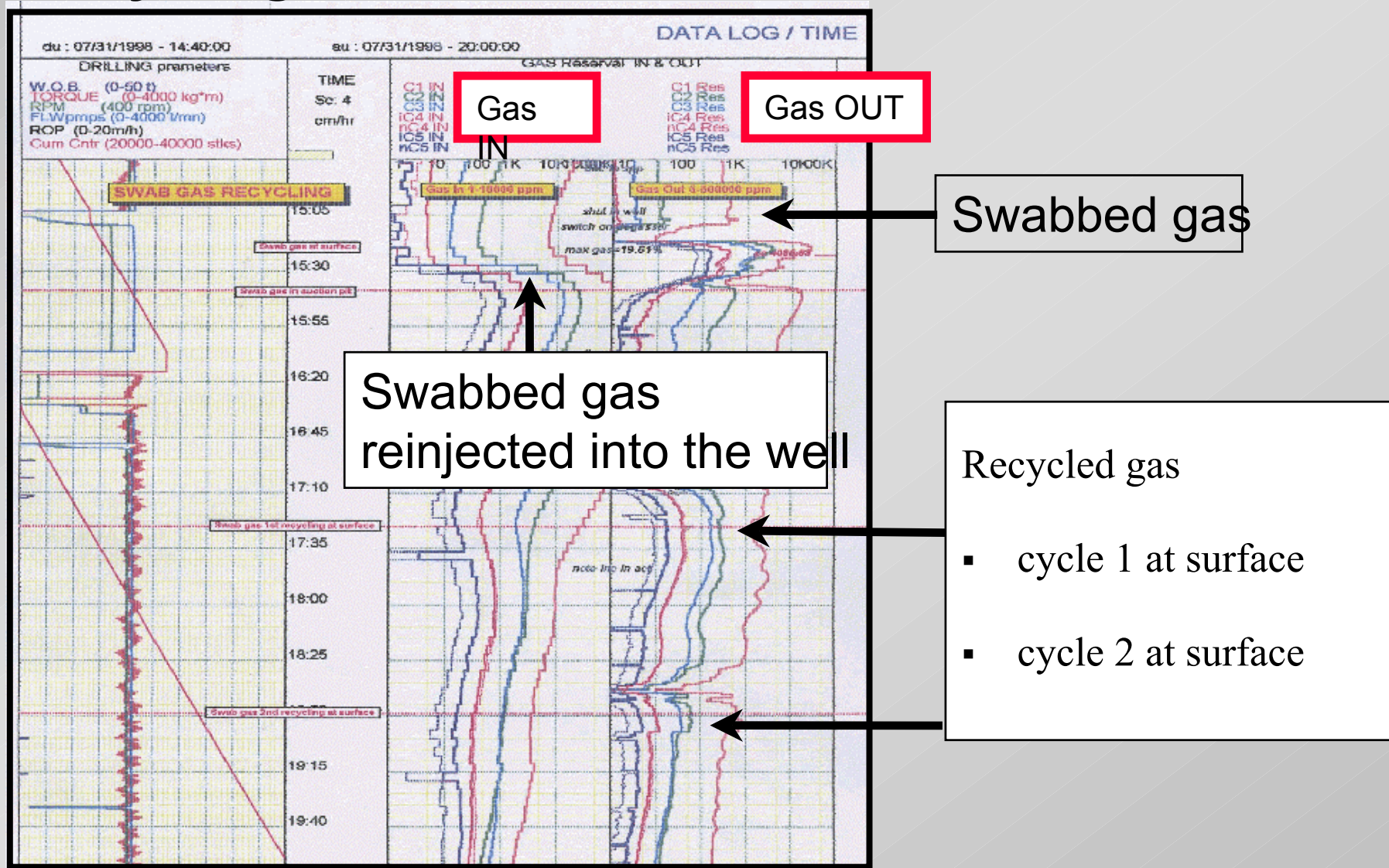
Value add features of the Reserval system

- **High vertical resolution for thin bed detection C1 - nC5 in 40 seconds (1ft resolution for 100ft/hr ROP)**
- **Efficient degassing coupled with high sensitivity allows detection of the slightest trace of C1-nC5 (1PPM).**
- **Removal of recycled gases (Double circuit allows Analysis of Gas IN & OUT)**
- **Excellent correlation tool – the repeatability of measurements (Design features which include backflush and new capillary technology assures the stability of the analysis)**
- **Reverse calibration possible for stored Chromatograms, also has an auto-tracking feature**

Gas Ratios with Oil Base Mud



Importance and evolution of gas recycling



Formation Evaluation While Drilling

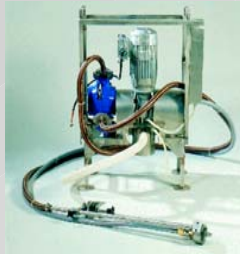
Interpretation of Results

- Eliminate as much interference as possible, Correct for Drilling Parameters ROP, MW, Flow. Analyse recycled gas, work with ratios
 - Better imaging of transition zones
 - Real Time correlation with LWD data
 - More accurate correlation with Electric logs (possible due to accuracy, sensitivity and stability of measurement)
 - **Clear signatures with precise ratios allows**
 - **Reservoir fluid characterization.**
 - **Correlation with the help of the multi-well software**
 - **Geo-steering of Horizontal wells**

Formation Evaluation While Drilling

System Schematic

Degasser



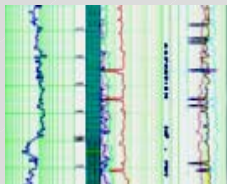
Analyser



ALS-2



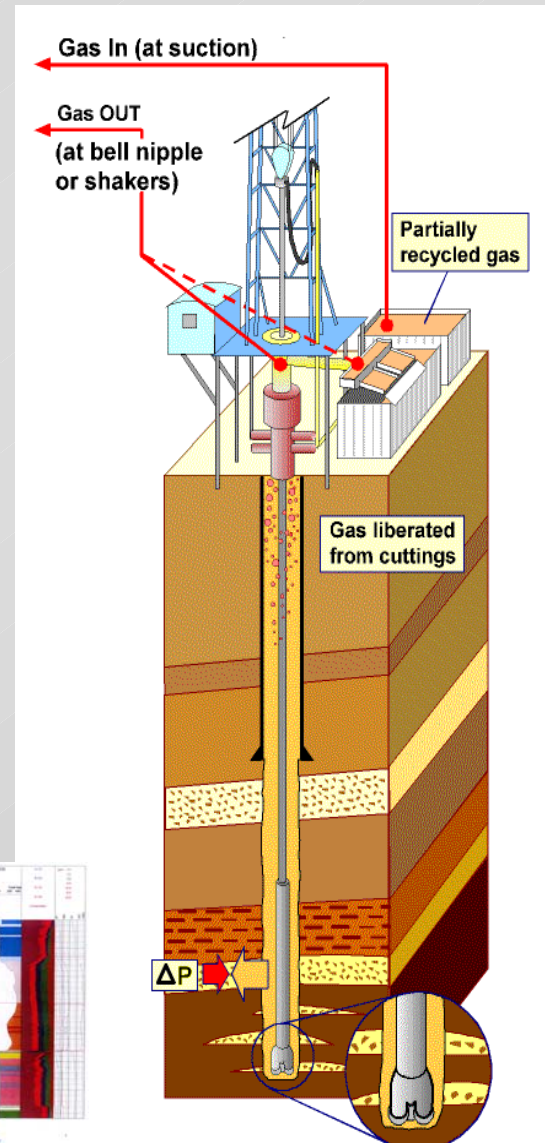
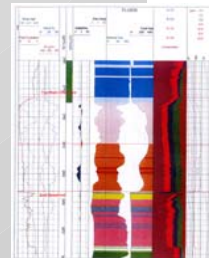
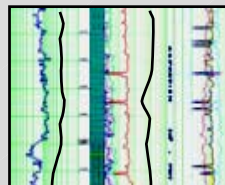
Gas Log



Cross Plot



Composite Logs



Formation Evaluation While Drilling

What this means

- The Quality of our surface gas data allows it to be used in real time and post drilling for important decision making
 - Pick coring points
 - Optimization of future Reservoir data collection, logs, MDT, well tests etc.
- **By correlation with other available data you can rely on the on site**

analysis with the Rreserval system to:

- Detect thin beds
- Identify low resistivity pay zones
- Detection light hydrocarbon bearing zones
- Detect Low porosity reservoirs
- Pick gas/oil & oil/water contacts

You can be comforted in the fact that you have at least one set of valuable formation evaluation data from your well.

Variety of Phenomena to be detected

Slip-stick

Torsional vibrations of drill string

Bit bouncing

Axial vibrations due to jumping of the bit

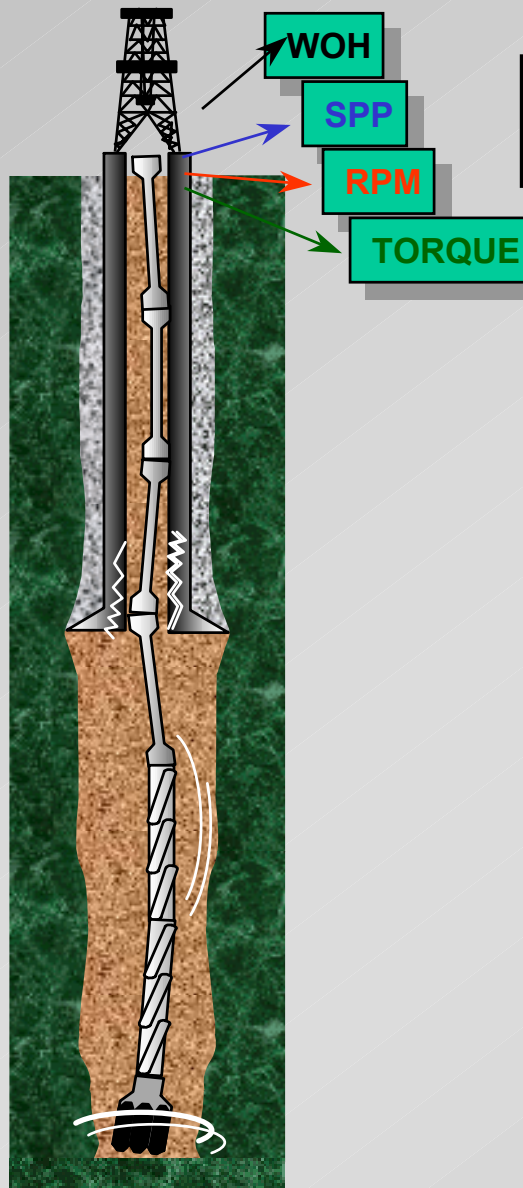
Whirling

Rotation of rotational center of BHA or Drill Bit around borehole

Or a complex combination of the above processes

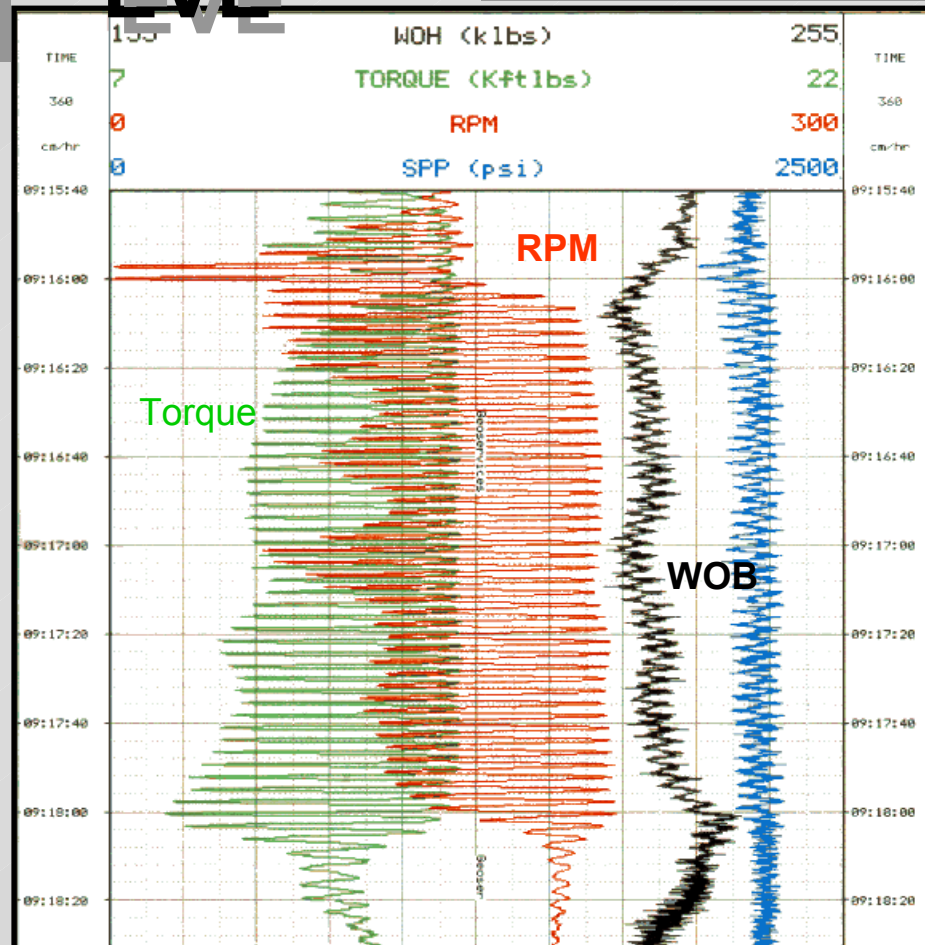
Drilling Optimisation

ALS-EVE



**ALS-
EVE**

Low cost vibration analysis.
Acquisition thru existing
sensors.
High speed data rate 10HZ.



Min and max bounds for WOH, RPM,TRQ and SPP.

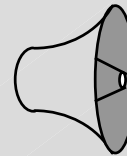
Min and max bounds on standard deviation of these parameters.

Seek specific torque patterns.

activates



A horn

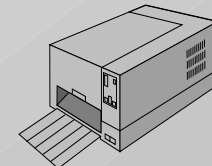


The traffic light



**A graphic chart on
a printer**

***+ New rig
floor
computer***

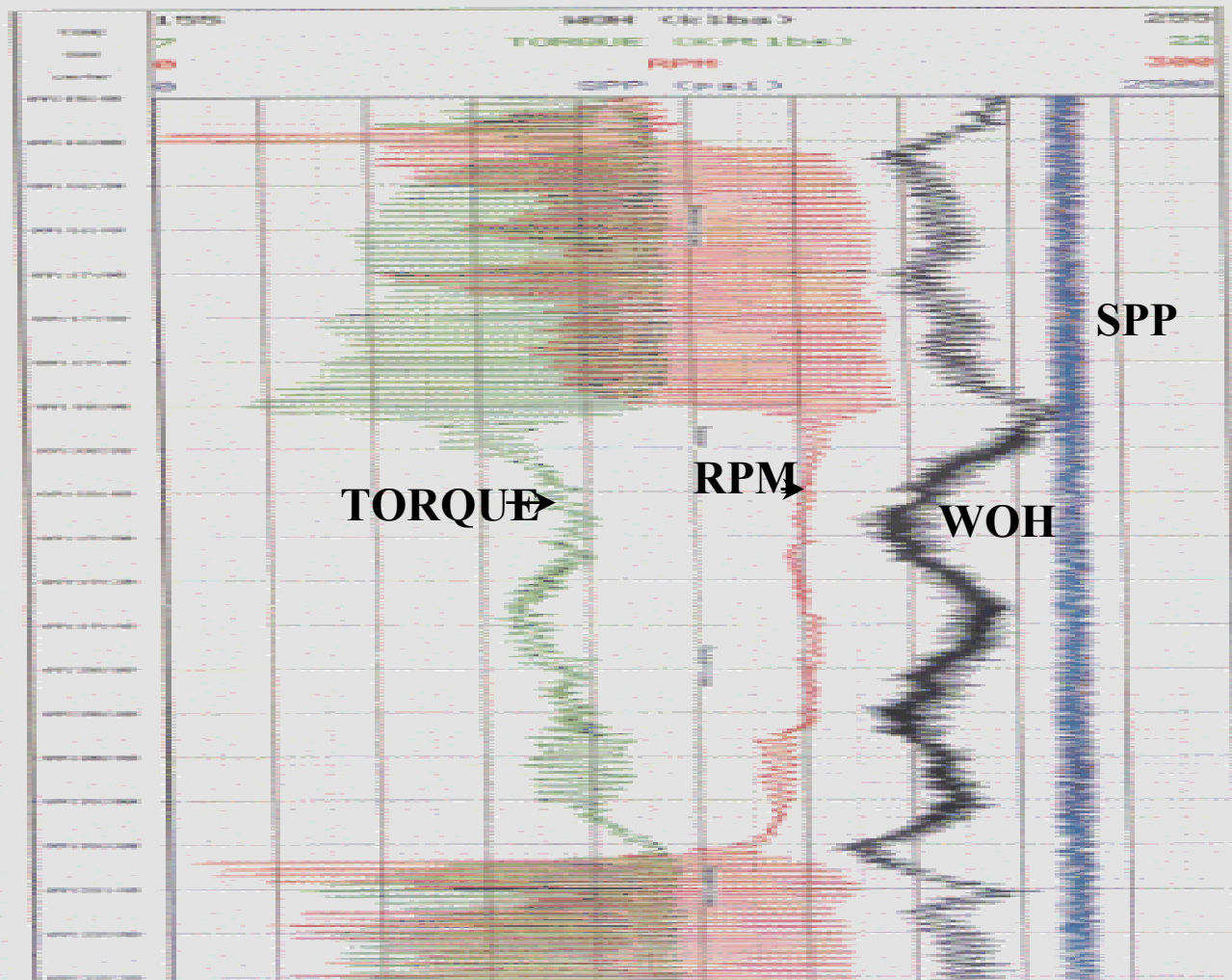


STICK SLIP

- **Increase of torque and decrease RPM**
- **Slow increase of SPP**
- **Cycle is dependant on the longitude of the drilling string**

▪ **ACTIONS**

- **Increase the RPM and/or decrease WOB**



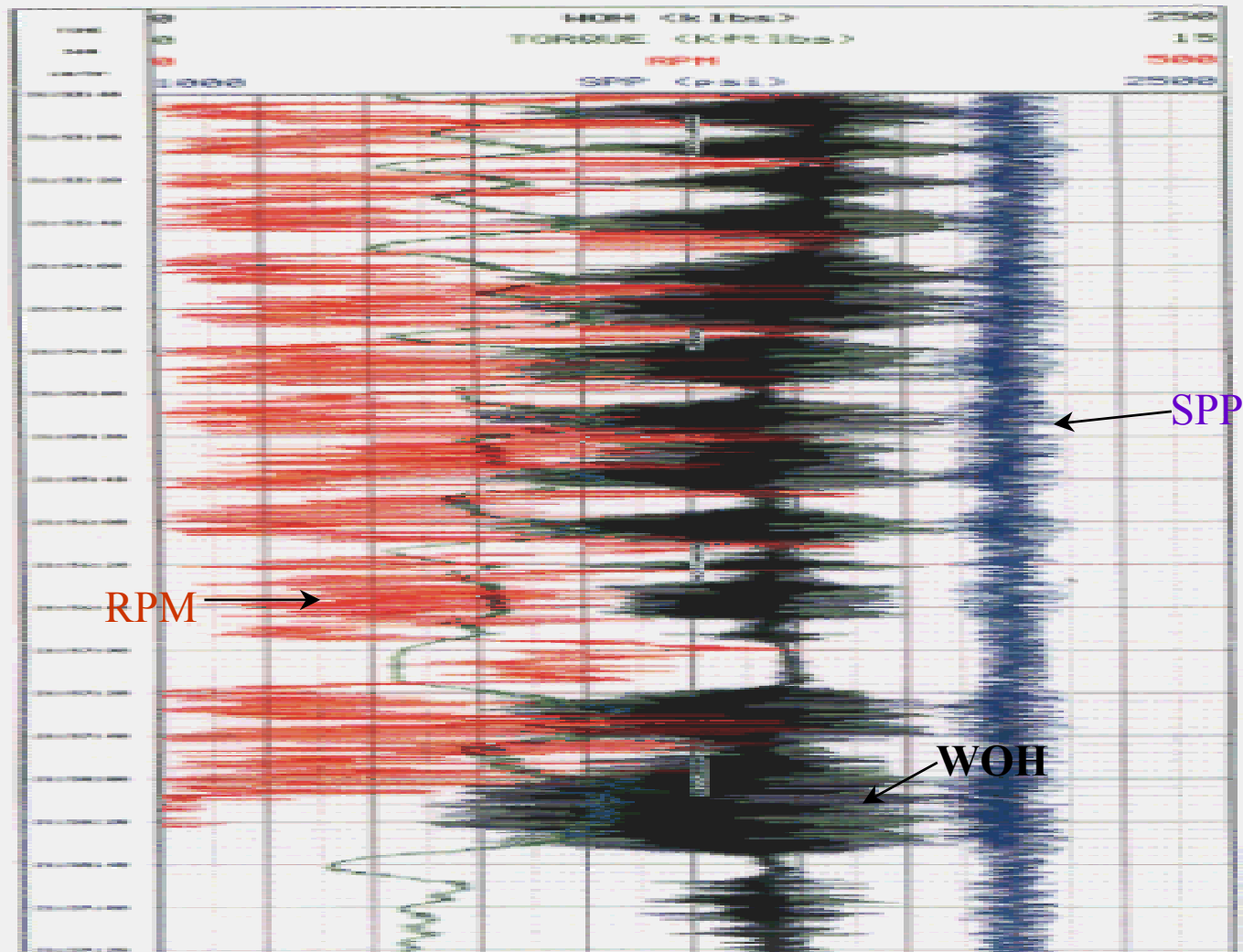
WHIRL

- **Increase of torque**
- **RPM oscillations**
- **There is no cycle**

ACTIONS

- **Lift up 5 foot, stop rotating**
- **Change the drilling parameters**
 - **increase WOB and decrease RPM**

whirl



TORQUE →

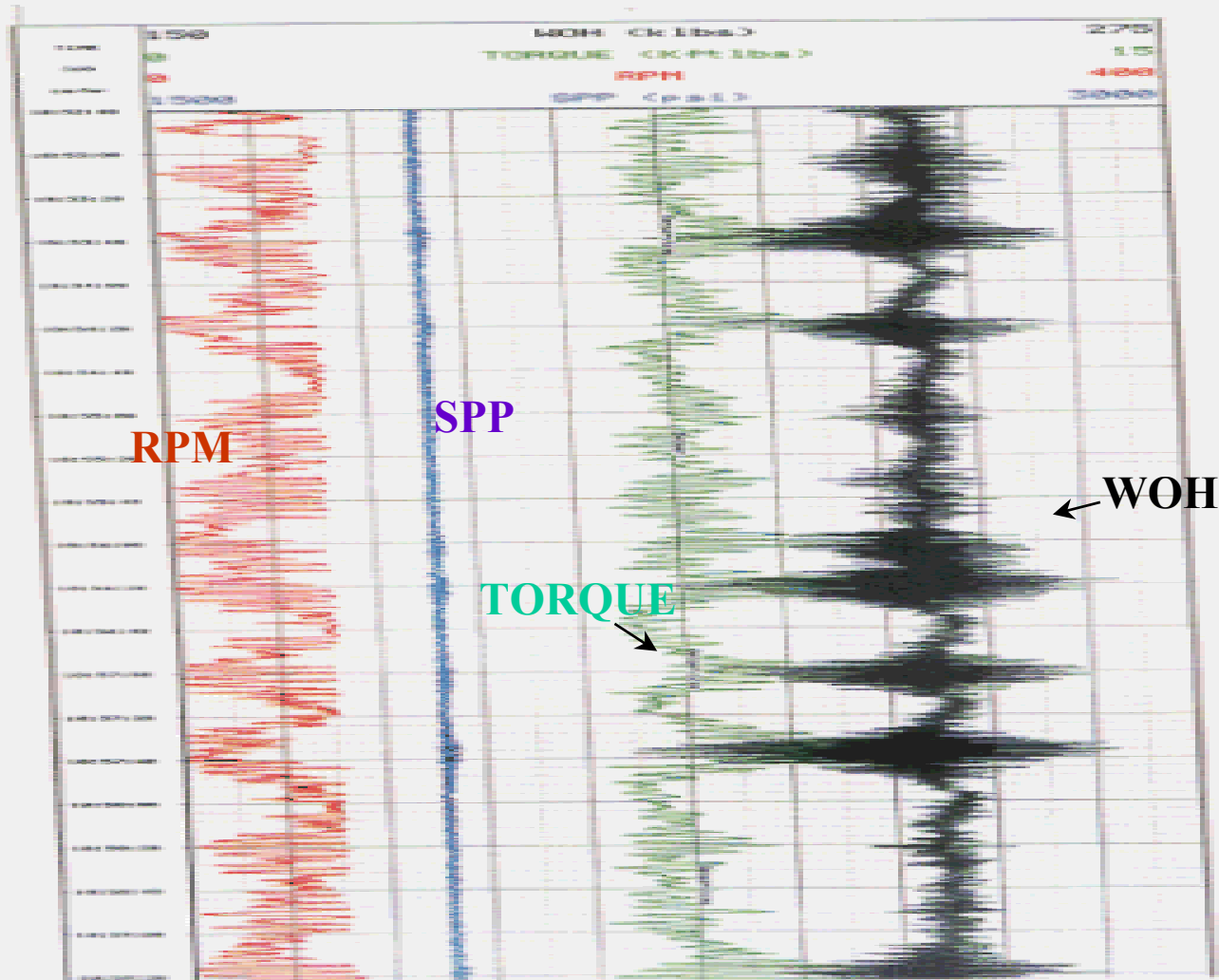
BOUNCING

- **Increasing vibration in the travelling block**
- **Vibrations in the top drive and/or kelly**
- **Change in oscillations of the WOH**

ACTIONS

- **Drop the RPM by 10 or 20 RPM**
- **Use a Shock sub in the BHA**

Slip - Stick and Bouncing



Pore Pressure Modelling

Engineers Armed With the Latest Pore Pressure Modelling Software Gives You the Critical Pore Pressure Information To:

- Optimise Casing Programs
- Avoid Well Control Situations
- Optimise Mud Weight
- Avoid Stuck Pipe Incidents
- Prevent Formation Damage
- Minimize Your Drilling Risks



Drilling Optimization

